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Breeding population dynamics of Common Tern *Sterna hirundo* and associated gull species with overview of conservation management in continental Slovenia

Dinamika gnezditvene populacije navadne čigre *Sterna hirundo* in pridruženih vrst galebov s pregledom naravovarstvenega upravljanja v celinskem delu Slovenije

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An overview of the long-term (1980–2019) population development of colonial Laridae species in continental part of Slovenia, their nest sites at anthropogenic water bodies, and various conservation measures with special focus on Common Tern *Sterna hirundo* along the Slovenian/border part of the Drava River is given. Breeding of these species occurs only on the westernmost fringes of the Pannonian plain, on lowland floodplains of the main rivers of the Danube Basin. Altogether, breeding of Common Tern and Black-headed Gull *Larus ridibundus* was recorded at 11 and 10 sites, respectively. Lake Ptuj is the single site with mixed-species colony residing there in all years of the study period, while at Ormož (two sites) it was established during the early 1990s in the Slovenian territory but moved completely to the Croatian side by the second half of the 2010s. At all other sites, a suitable breeding habitat became available or was provided by management in just a few years, or created only recently. The percentage of Common Tern national population breeding in continental Slovenia was usually well above 50% throughout the 1980s and 1990s (52–136 pairs), while in the last 16 years (77–258 pairs) it ranged between 40.8% and 69.0%. Breeding of Black-headed Gull remains largely limited to continental Slovenia. Overall, continental populations of both species in the last few years have been substantially higher compared to the most of the study period. Long-term trends were estimated as a moderate increase for Common Tern and a strong increase for Black-headed Gull. Since 2006, the Mediterranean Gull *L. melanocephalus* has been a regular breeder at Lake Ptuj (up to 28 pairs), the only such site in Slovenia. Three general types of conservation measures implemented at different nesting locations are described in detail: (1) measures to create/increase the total surface of breeding habitat – the construction of new breeding structures, such as artificial islands and nesting rafts, (2) measures to maintain and enhance breeding habitat through recurring management activities, and (3) measures aimed to increase chick/nest survival and improve breeding success.

Key words: Common Tern *Sterna hirundo*, breeding population, conservation management, continental Slovenia

Ključne besede: navadna čigra *Sterna hirundo*, gnezdeča populacija, naravovarstveno upravljanje, celinska Slovenija

1. Introduction

Common Tern *Sterna hirundo* has been strongly affected by habitat destruction (Becker & Ludwigs 2004). Loss of riverine freshwater breeding habitat was the major cause of inland population crashes in Europe during the 19th and 20th centuries (Glutz von Blotzheim & Bauer 1999). Canalization and regulation of rivers, constructions for shipping or power supply, and human recreational activities caused loss of gravel bars and islands for breeding. Consequently, the species now breeds in several countries mainly or exclusively at artificial sites such as gravel pits and, in particular, nesting rafts (Becker & Sudmann 1998, Boschert & Dronneau 1998, Raab 1998, Sudmann *et al.* 2003). The earliest confirmed breeding records for the Common Tern in Slovenia date to 1921 (Reiser 1925). In that year, the species was breeding in the furcation zone of the Drava River at the village of Loka. The next reported breeding was in the years 1977–1979 at a natural side arm of the Drava at Šturmovci (Geister 1995). No further breeding on natural riverbanks or islands has been confirmed in Slovenia. The main cause is the large-scale river canalisation and regulation for hydroelectric power stations. The absence of natural river dynamics resulted in dried river channels and disappearance of gravel habitats (Štumberger 1995). All recently reported nest sites were located on artificial, man-made structures like salt pans (Škornik 1983), artificial islets (Janžekovič & Štumberger 1984), gravel pits (Vogrin 1991a), concrete objects (Bračko 1999), a sandy reservoir islet (Šalamun 2001) and basins of the sugar factory (Štumberger 1982, Denac 2002b, Božič & Denac 2017). Due to often temporal character of such artificial structures, substantial efforts by DOPPS-BirdLife Slovenia were invested to preserve the breeding population of Common Tern in continental Slovenia (Denac 2002, Božič & Denac 2017, Denac & Božič 2018, Denac *et al.* 2019).

Common Tern usually nests colonially, often in association with other tern and gull species (Becker & Ludwigs 2004), which was the case at most Slovenian sites, too. Soon after the mixed Common Tern/Black-headed Gull *Larus ridibundus* colony was established on an artificial island at Lake Ptuj in 1978 (Geister 1995), its breeding became dependent on conservation measures that consider both species. In 2006, the Mediterranean Gull *Larus melanocephalus* started to breed in Slovenia for the first time in a mixed-species colony (Denac & Božič 2009). Its population development in later years profited by conservation measures mainly designed for the Common Tern (Božič & Denac 2019).

The aim of this paper is to give an overview of the long-term population development of colonial Laridae species in continental Slovenia and their nest sites at anthropogenic water bodies, with emphasis on the period since the introduction of more extensive conservation programme. Furthermore, we describe in detail and discuss various conservation measures carried out to preserve breeding populations of all three target species with special focus on Common Tern along the Slovenian/border part of the Drava River.

2. Methods

2.1. Study area

Geographical area of the study comprises landlocked regions of Slovenia with prevailing temperate continental climate. The latter is most pronounced in lowland regions of eastern Slovenia with average annual precipitation of 800–1000 mm. Only the Slovenian Coast with its hinterland in the extreme SW part of the country (the Slovene Istria region), which is largely characterized by coastal sub-Mediterranean climate (Ogrin 1996, Plut 1999), is excluded. In terms of the species studied, this means the colonies breeding at coastal wetlands (Mihelič *et al.* 2019) are beyond the scope of the study. Population figures of these are given only for comparison and overview of the national totals. When available, site toponyms were taken from the national Register of geographical names; otherwise, the established colloquial names are used. The name Ormož Area is used as a common name for two sites, Lake Ormož and Ormož Basins, combined. A detailed description of the colony sites is in Results.

2.2. Data collection

Data considered in this review span the period between 1980 and 2019, when natural nest sites in continental Slovenia no longer existed. In this

period, breeding records of the target species were collected by different means, substantially varying between sites and years in terms of the effort invested and accuracy. Data included in the review comprise confirmed breeding records (observations corresponding to a minimum EBCC Breeding Atlas code 10, Hagemeijer & Blair 1997) of individual species at different sites during the period studied, in most cases supplemented by number of breeding pairs. The Yellow-legged Gull *Larus michahellis*, which also breeds in continental Slovenia, was excluded from the overview, as it is here neither a colonial nor associated with other Laridae (Škornik 2018a). Data were obtained systematically using the following methods:

(1) Census of active nests was carried out annually during the two visits of breeding colony in the incubation period of the target species. This method was used at Lake Ptuj for Common Tern and Black-headed Gull in the 2009–2019 period, and Mediterranean Gull in the 2016–2019 period. Visits were planned in a way to coincide with estimated mid- or late phase of incubation period of individual target species, when the number of pairs is presumably the highest (Walsh *et al.* 2015): the first took place in the last 10-day period of April (median 22 Apr) and was aimed at counting Black-headed Gull nests, while during the second, conducted in the last 10-day of May (median 24 May), nests of Common Tern and Mediterranean Gull were counted. Most of the nests of the latter species before 2016 could not be located due to their scarcity and limited ability of observers to identify the clutches. In the 2005–2007 period, only late May-early June visit was carried out (only Common Tern nests counted). During the visits, each nest site was systematically walked and number of nests recorded. Most of the work was carried out by a permanent team of DOPPS ornithologists and the census effort remained fairly constant over the entire period. Due to the late start of the breeding season, two additional visits were made in June 2019. The island on Lake Ormož was visited for survey purpose by DOPPS/Biom team only once per year (late May, early June), as the island colony consisted exclusively or mainly of Common Terns.

(2) Counting of apparently incubating birds with a series of high resolution aerial images of nest sites, captured by drone during a low overflight (c. 20 m above the colony). This method alone was used at Brežice reservoir. As the number of pairs increased, this method was also implemented to supplement the census of active nests at Lake Ptuj in the 2018–2019 period. Drone photography was carried out on or near the same day as the breeding colonies were visited.

(3) Counting of incubating individuals and/or all adult birds present in or near the breeding colony and/or individuals during flush events, with the aid of binoculars and spotting scope from suitable vantage point (one or more) on the shore of the water body. This method was used routinely at Ormož Basins (except 2003), in some of the years between 1997 and 2008 at Lake Ptuj, Lake Ormož before 2015, Mediterranean Gull at Lake Ptuj before 2016, and at several sites with irregular and accidental breeding. Typically, it was implemented several times in the course of the breeding season at regularly occupied sites, and the highest registered number was considered as the number of breeding pairs in a given year (if not decided otherwise due to a specified reason).

(4) Multiple counts of active nests during evenly spaced consecutive visits of nesting location throughout the breeding season. Used as part of a dedicated study of mixed-species colony at Ormož Basins in 2003 (Denac 2006).

(5) Directly from correspondence with experts/local ornithologists (irrespective of the method used, in most cases best expert opinion).

(6) From ornithological literature.

2.3. Trends

Trends were calculated using rtrim-package (Bogaart *et al.* 2018), which is a specially developed program for analysing ecological data with missing values, specifically time-series of counts using Poisson regression (Pannekoek & van Strien 2005). Rtrim-package was used in R (R Core Team 2013). The multiplicative overall slope (trend) represents the mean growth or decline over a period of time and was determined over the whole time period for which the model

was fitted. Plots of the overall slope were created, its 95% confidence band, the total population per time and their 95% confidence intervals. Based on values and confidence intervals (slope ± se), trends were classified into one of the following categories: strong increase/decrease, moderate increase/decrease, and uncertain. Long-term trends were calculated over the entire period since the early breeding records (1980–2019 for Lake Ptuj and continental Slovenia, 1981–2019 for Ormož Area), and short term trends over the period since the creation of first artificial nest site aimed at target species (2005–2019 for Lake Ptuj and 1997–2019 for Ormož Area).

2.4. Conservation measures

In the overview of conservation measures implemented at sites included in the study, three general types of measures were differentiated according to their specific goal: (1) measures to create/increase the total surface of breeding habitat – the construction of new breeding structures, such as artificial islands and nesting rafts, (2) measures to maintain and enhance breeding habitat through recurring management activities, and (3) measures aimed to increase chick/nest survival and improve breeding success.

3. Results

3.1. Population dynamics

Continental populations of Laridae species breed in Slovenia only on the westernmost fringes of the Pannonian plain, specifically on lowland floodplains of the main rivers of the Danube Basin: Drava, Sava and Mura. After 1979, all nesting locations reported concern artificial structures on heavily altered or entirely man-made water bodies (Table 1, Appendix 1).

Altogether, breeding of Common Tern and Black-headed Gull was recorded at 11 and 10 sites, respectively (Table 2, Figure 1). However, regular breeding of both species over longer periods occurred only at three sites along the Drava River. Lake Ptuj is the single site with mixed-species colony residing in all years of the study period, while at Ormož (two sites) it was established during the early 1990s in the Slovenian territory but moved completely to the Croatian side by the second half of the 2010s (Table 2). At all other sites, suitable nesting habitat became available or provided by management in just a few years, or created only recently. Until 1983, the entire national population of Common Tern bred in the continental part of the country. In that year, the species started breeding at Sečovlje Salina on the Slovenian coast (Škornik 1983), and in 2007 another colony was formed at Škocjanski zatok Nature Reserve as a result of habitat restoration (Table 2). The percentage of national population breeding in continental Slovenia was usually well above 50% throughout the 1980s and 1990s (52–136 pairs), while in the last 16 years (77–258 pairs) it ranged between 40.8% (2015) and 69.0% (2005). Breeding of Black-headed Gull remains largely limited to continental Slovenia with only three breeding records of single pairs from Sečovlje Salina (Table 2). Since 2006, the Mediterranean Gull has been a regular breeder at Lake Ptuj, the only such site in Slovenia.

For most of the study period, the number of breeding Common Terns at Lake Ptuj did not exceed 100 pairs (range 32–91 pairs), and the population was presumably fairly stable from the second half of 1980s to the second half of the 1990s. Probable population low point in the late 1990s and early 2000s is obscured by a lack of data. It was only sometime after the construction of gravel islands in 2014, when the number of pairs increased substantially, reaching a maximum of 218 pairs in 2018 (Table 3). The multiplicative long-term trend of Common Tern at Lake Ptuj was estimated as a moderate increase (1.013 ± 0.002, $P<0.01$) and short-term as a strong increase (1.088 ± 0.008, $P<0.01$). The Black-headed Gull population more than doubled already in the first year after construction of the New Island, and further increased several-fold during the last decade, notably so after the expansion of the colony to gravel islands (Table 4). The latter also triggered a strong increase of the Mediterranean Gull population after a long period of stagnation at very low numbers (Table 5). The multiplicative long-term (1.080 ± 0.001, $P<0.01$) and short-term trend (1.114 ± 0.004, $P<0.01$) of Black-headed Gull at Lake Ptuj is strong increase. Mediterranean Gull trend in the 2006–2019 period was estimated as a strong increase (1.258 ± 0.055, $P<0.05$), too.

In the Ormož Area, the populations of Common Tern and Black-headed Gull reached the highest point during the early 2000s after the largest of the three nesting rafts was constructed at Ormož Basins. However, following the low water level in 2004 that completely prevented breeding and rapid drying of basins due to the cessation of sugar production during the late 2000s, the numbers of both species declined as they gradually moved to the nearby Lake Ormož. While a significant Common Tern population still breeds there, the Black-headed Gull recently became an irregular breeder in low numbers (Table 3 & 4). The multiplicative long-term trend of the Common Tern in the Ormož Area was estimated as a moderate increase (1.096 ± 0.046, $P<0.05$) and short-term as uncertain. For the Black-headed Gull, long-term trend was estimated as uncertain, and short-term trend as a moderate decrease (0.868 ± 0.046, $P<0.05$).

Overall, continental populations of both species in the last few years have been substantially higher compared to the most of the study period, and their long-term trends were estimated as a moderate increase (1.025 ± 0.002, $P<0.01$) for Common Tern and a strong increase (1.077 ± 0.001, $P<0.01$) for Black-headed Gull (Figure 2).

3.2. Conservation measures and their effects

Major threats to the Laridae colonies in our study area are similar as described from other colonies under management (Morris *et al.* 1992, Quinn *et al.* 1996, Cook-Haley & Millenbah 2002): encroachment of nesting habitat by vegetation, terns outcompeted for nest sites by breeding gulls, predation by mammalian and avian predators, erosion of nesting habitat and disturbance by people. Numerous conservation measures were implemented to address these threats.

Measures to create/increase the total surface of breeding habitat

Initially, three artificial nesting rafts were set in place in 1997, 1998 and 2001 in the wastewater basins of the Ormož Sugar Factory (now Ormož Basins Nature Reserve) with the aim to provide long-lasting and predictable Common Tern breeding habitat in the area (Denac 2002b, Božič & Denac 2017). Rafts were constructed and maintained by DOPPS. The size of the rafts was 12, 14 and 96 m^2, respectively. The first raft was functional until 2000, the second until 2002 and the third until 2010. Afterwards, they were all removed and dismantled (Table 1). The Common Tern and Black-headed Gull colonies existed for 12 and nine years on the rafts (1997–2009, except 2004), respectively (Tables 3, 4). The average number of Common Tern breeding pairs on the rafts was 36, and 14 of Black-headed Gull. However, in certain years, such as 2003, predation pressure was high on the rafts and despite the placement of chick shelters, 86% of Common Tern and 64% of Black-headed Gull chicks were predated by Goshawk *Accipiter gentilis* (Denac 2006). Another nesting raft installed at Vrbina gravel pit in 1999 lasted until 2002, when destroyed by anglers (Klenovšek 2003). Over this period, Common Tern bred there in three years (5 pairs on average). The construction of a small nesting platform (1 m^2) at Lake Pernica resulted in Common Tern breeding in 2013 (3 pairs) and 2015 (1 pair).

The first artificial island as a measure for Common Tern conservation was built in autumn 2004 at Lake Ptuj. We named it "New Island" (Table 1). Common Tern and Black-headed Gull started to breed here in 2005. The former bred on New Island between 2005 and 2015 (33 pairs on average), whereas the latter bred in the 2005–2019 period (390 pairs on average) (Tables 3, 4). Mediterranean Gull started to breed on New Island in 2006 (Denac & Božič 2009). Until 2016, only 1–3 pairs bred regularly, but the number increased to 27 pairs in 2019 (Table 5).

The second and the third artificial island were proposed by DOPPS in the "Ecological rehabilitation of Lake Ptuj" study (Božič & Denac 2012) and then constructed in autumn 2014 (Mišič *et al.* 2015). The islands, named "Gravel Island 1" and "Gravel Island 2" (Table 1) were designed to suit the nesting requirements of Common Tern in particular. Common Tern and Black-headed Gull started to breed on Gravel Island 1 in 2015, although the latter in significant numbers only in 2017. The average number of breeding pairs was 73 and 175, respectively. Black-headed Gull started to breed on Gravel Island 2 in 2017 (significantly in 2018) and Common Tern in 2018. The average number of Common Tern breeding pairs was 114, and 96 of Black-headed Gull (Tables 3, 4).

Table 1: Locations with breeding colonial Laridae species (1–3), recorded in continental Slovenia in the 1980–2019 period. Given herewith are the site name at which the location is situated, water body type and its total surface area (ha), nest site definition or location name (unofficial) and its surface area (m^2), year(s) or time period in which it existed together with eventual reason for disappearance, general/technical description, and an outline of vegetation development with indication of suitability for breeding of terns and colonial gull species in a specified period.

Tabela 1: Lokacije z ugotovljenim gnezdenjem kolonijskih vrst (1–3) iz družine Laridae v celinskem delu Slovenije v obdobju 1980–2019. Podani so ime območja, kjer leži lokacija, tip vodnega telesa in njegova celotna površina(ha), opredelitev gnezdišča ali ime lokacije (neuradno) in njegova površina (m^2), leto(-a) ali časovno obdobje, v katerem je obstajala, skupaj z morebitnim razlogom za izgin vrst, splošen/tehničen opis ter oris razvoja vegetacije z navedbo primernosti za gnezdenje čiger in kolonijskih vrst galebov v določenem obdobju.

Site / Območje	Type / Tip	Location (name), nest site / Lokacija (ime), gnezdišče	Surface area / Površina (m^2)	Availability / Razpoložljivost	Distance (m) from shore / Oddaljenost (m) od obale (min)
Lake Ptuj / Ptujsko jezero	Reservoir (Drava River) / akumulacijsko jezero (reka Drava); 450 ha	Small Island / Mali otok	210	1978-	190
		New Island / Novi otok	940	2005-	150
		Gravel Island 1 / Prodnati otok 1	1120	2015-	160
		Gravel Island 2 / Prodnati otok 2	1020	2015-	180
		Transmission line platform (left) / Daljnovodna ploščad levo	30 / 40	1978-	200
		Transmission line platform (right) / Daljnovodna ploščad desno	30 / 40	1978-	210

Description / Opis	Vegetation / Vegetacija
Created accidentally during the flooding of the reservoir basin. The basis is gravel mixed with sand, the central part round plateau c. 150 m^2, c. 1.5 m above average lake level.	Over the years, a layer of soil has formed on the plateau, resulting in the lush growth of herbaceous vegetation, especially *Fallopia japonica* and *Sambucus ebulus*. Until the early 2000s, up to a few meters high willows were growing along the edge of the plateau. Since early 2010s, the island has been unsuitable for breeding of terns and colonial gull species in most years.
The frame constructed of wooden piles interwoven with willows branches filled with silt from the lake bottom. The island is subject to considerable erosion, undermining deeply into the muddy interior.	Entire surface has been overgrowing intensively with various herbs since the first growing season; vegetation composition has changed slightly over the years; in most years *Urtica* sp. and *Phragmites australis* predominate. Along the eastern edge, c. 200 m^2 of reedbed developed in recent years. Due to encroaching of vegetation unsuitable for breeding of Common Tern since 2009.
Constructed of a continuous array of wooden piles along the perimeter, filled with silt from the lake bottom, above which a 50 cm thick, flatten layer of medium-grained gravel is deposited. The pilots are raised along the interior edge to form a c. 1 m high fence, while along the outer edge there is a c. 50 cm high chicken wire fence.	The island is gradually becoming overgrown with *Polygonum* sp. and other herbs in the direction from the outer edge towards the interior.
Constructed of a continuous array of wooden piles along the perimeter, filled with silt from the lake bottom, above which a 50 cm thick, flatten layer of medium-grained gravel is deposited. The pilots are raised along the interior edge to form a c. 1 m high fence. Along the outer edge, a silt-covered gently sloping ramp (length of 30 m) descends from line of the lowered piles, which is completely submerged at higher water levels. Behing a ramp a c. 1 m high, slightly raised plastic fence is installed.	The island is gradually becoming overgrown with *Polygonum* sp. and other herbs in the direction from the outer edge towards the interior.
As of 2015, square-shaped concrete platform with c. 1 m high metal fence around the perimeter to which the steel lattice tower of the transmission line is mounted; the platform is located c. 2 m above average lake level. Until 2014, the platform was round in shape.	None
As of 2015, square-shaped concrete platform with c. 1 m high metal fence around the perimeter to which the steel lattice tower of the transmission line is mounted; the platform is located c. 2 m above average lake level. Until 2014, the platform was round in shape.	None

Continuation of Table 1 / Nadaljevanje tabele 1

Site / Območje	Type / Tip	Location (name), nest site / Lokacija (ime), gnezdišče	Surface area / Površina (m^2)	Availability / Razpoložljivost	Distance (m) from shore / Oddaljenost (m) od obale (min)
Lake Ptuj / Ptujsko jezero	Reservoir (Drava River) / akumulacijsko jezero (reka Drava); 450 ha	Sewer shaft platform (left) / Ploščad kanalizacijskega jaška levo	15	1978-	200
		Debris / naplavine	-	-	30
Ormož basins / Ormoške lagune	Wastewater basins of the Ormož Sugar Factory / Bazeni za odpadne vode Tovarne sladkorja Ormož; 35 ha	Basin 3 / Bazen 3	65500	1980-	-
		Basin 4 / Bazen 4	64550	1980-	-
		Basin 5 / Bazen 5	64300	1980-	-
		Dyke / Nasip	1700	1980-	0
		Nesting raft 1 / Gnezdilni splav 1	12	1997–2000; removed from the basin after the breeding season of the latter year.	70
		Nesting raft 2 / Gnezdilni splav 2	14	1998–2002; removed from the basin after the breeding season of the latter year.	70
		Nesting raft 3 / Gnezdilni splav 3	96	2001–2013; removed from the basin after the breeding season of the latter year (ceased to function as suitable nest site in 2011).	50
Lake Ormož / Ormoško jezero	Reservoir (Drava River) / akumulacijsko jezero (reka Drava); 275 ha	Small artificial structures / Manjše umetne strukture (HR)	60	2006–2014; all structures were removed from the lake prior to the 2015 season.	150
		Large hunting hide / Velika lovska preža (SI)	20	2006–2014; removed from the lake prior to the 2015 season.	450

Description / Opis	Vegetation / Vegetacija
Concrete platform with a metal grate at the top of the sewer shaft (vent), surrounded by c. 1 m high metal fence along the perimeter.	None
Stranded trees, stranded large round hay bale (once).	None
Various structures in the TSO wastewater basin: (1) dry mudflats formed by sedimented industrial effluents at the shallow flooded bottom of the basin; (2) tussocks of tall sedges; (3) islets of floating branches, dry plant parts and similar material; (4) predominantly shingle surfaces exposed by decreasing water levels.	Mudflats and shingle surfaces sparsely overgrown with low herbaceous vegetation.
Islets of floating branches, dry plant parts and similar material in the TSO wastewater basin.	None
Not recorded.	-
Shingle surface of the embankment top between two TSO wastewater basins, c. 3 m wide, occasionally used as a road.	Sparsely overgrown with low herbaceous vegetation.
Anchored flat wooden platform 2 × 6 m with a 7 cm high edges and c. 1 m wide board sloping from raft to the water, mounted on eight (2 rows) floating metal barrels in the basin 4; covered with a thin layer of coarse-grained shingle.	None
Anchored flat wooden platform 2 × 7 m with 7 cm (1998–1999) and 20 cm (2000–2002) high edges, respectively and c. 1 m wide board sloping from raft to the water, mounted on ten (2 rows) floating metal barrels in the basin 4; covered with a thin layer of coarse-grained shingle.	None
Three anchored, firmly interconnected, flat 4 × 8 m wooden platforms with a 35 cm high chicken wire fence around the perimeter, mounted on floating polystyrene blocks in the basin 4; covered with a thin layer of coarse-grained shingle.	The raft became gradually sparsely overgrown with low herbaceous vegetation.
4–5 different small structures on the lake: 2 wooden fishing platforms on poles, c. 1 m above the average water level, and 2–3 hunting hides with a wooden frame low above the water level, masked by dry corn stalks or reed.	None
Similar construction as above but larger.	None

Continuation of Table 1 / Nadaljevanje tabele 1

Site / Območje	Type / Tip	Location (name), nest site / Lokacija (ime), gnezdišče	Surface area / Površina (m^2)	Availability / Razpoložljivost	Distance (m) from shore / Oddaljenost (m) od obale (min)
Lake Ormož / Ormoško jezero	Reservoir (Drava River) / akumulacijsko jezero (reka Drava); 275 ha	Fishing hut / Ribiška hišica (HR)	30	2010–2012; removed from the lake prior to the 2015 season.	430
		Fishing raft / Ribiški splav (HR)	20	2010–2012, 2014; removed from the lake prior to the 2015 breeding season.	450
		Double Island / Dvojni otok (HR)	1000	2012–2014; transformed into the basis of the Island, created in the latter year.	270
		Island / otok (HR)	310	2015-	270
		Debris / naplavine (SI/HR)	-	-	150
Hoče gravel pit / gramoznica Hoče	Gravel pit (active) / gramoznica (aktivna); 21 ha	Peninsula / polotok	150	1989?–1991; transformed in the following years.	0
Hotinja vas fishpond / ribnik Hotinja vas	Fishpond / ribnik; 4.1 ha	Island / otok	60	Until 1984; disappeared after construction of a culvert, resulting in a permanent water level increase.	60
Pragersko clay pit / glinokop Pragersko	Clay pit / glinokop; 2.2 ha	Debris / naplavine	-	-	50
Medvedce reservoir / zadrževalnik Medvedce	Reservoir (Devina stram) / akumulacija (potok Devina); 155 ha (water surface / vodna površina c. 100 ha)	Old tree stumps / Stari drevesni štori	-	1994-	100

Description / Opis	Vegetation / Vegetacija
Wooden fishing platform on poles, c. 1 m above the average lake level, atop of which a simple wooden hut with a flat roof is constructed at half the surface.	None
Anchored flat wooden platform, mounted on three arrays of connected floating metal barrels.	None
Low, gravel-silt mudflat, created accidentally during the machine removal of silt from the lake bottom, exposed at lower water levels.	None
Constructed on a basis of silt and rough stones covered with coarse-grained shingle, formed into a slightly undulating plateau of surface c. 200 m^2, c. 1.5 m above average lake level.	The island is gradually becoming overgrown with herbaceous vegetation and individual woody plants (poplars, willows), especially around the perimeter and lower outer edge.
Stranded trees	None
C. 50 m long end of the longer peninsula, which is the remnant of a former road for removal of gravel, partially flooded with water.	Sparsely overgrown with low herbaceous vegetation.
Elevated gravel surface, c. 1 m above the water during the period of lower water level.	None
Stranded tree	None
Dry stumps protruding low from the water in the flooded part of the reservoir.	None

Continuation of Table 1 / Nadaljevanje tabele 1

Site / Območje	Type / Tip	Location (name), nest site / Lokacija (ime), gnezdišče	Surface area / Površina (m^2)	Availability / Razpoložljivost	Distance (m) from shore / Oddaljenost (m) od obale (min)
Tržec gravel pit / gramoznica Tržec	Gravel pit / gramoznica; 17 ha	Island / otok	20	Occasionally until 1998; disappeared after permanent water level increase for angling purpose.	50
Lake Pernica / Perniško jezero	Reservoir (Pesnica River) / akumulacijsko jezero (reka Pesnica); 103 ha	Island / otok	1000	2003; accidental	10
		Nesting platform / Gnezdilna platforma	1	2013–2017; until collapsed.	130
		Old tree stumps / Stari drevesni štori	-	-	10
		Old tree stumps and reedbed / Stari drevesni štori in trstišče	-	-	150
Gajševci Lake / Gajševsko jezero	Reservoir (Ščavnica River); 67 ha	Island / otok	30	min. 1996-	30
Vrbina gravel pit / gramoznica Vrbina	Gravel pit / gramoznica; 18 ha	Nesting raft / gnezdilni splav	10	1999–2002; destroyed by anglers before the 2003 breeding season.	80
		Island / otok	400	2008–2013	50
Stari Grad gravel pit / gramoznica Stari Grad	Gravel pit (part) / gramoznica (del); 9 ha	Heap of gravel / nasutje proda	1350	2018-	15
Brežiško jezero / Lake Brežice	Reservoir (Sava River) / akumulacijsko jezero (reka Sava); 317 ha	Island / otok	1130	2018-	120

Description / Opis	Vegetation / Vegetacija
Elevated gravel surface, exposed during the period of lower water level.	None
Dry mudflat at the mouth of Pesnica River, exposed at exceptionally low water level in the lake.	Sparsely overgrown with c. 10 cm high herbaceous vegetation. Entire river mouth area significantly expanded and became largely overgrown with willow forest and reedbeds during the 2010s.
Wooden pallet on poles, coated and fenced (height c. 20 cm) around the perimeter with a fine-mesh raschel bag material, covered with a thin layer of gravel and three roof tiles intended as chick shelter.	None
Dry stumps protruding low from the water along the NE shore.	None
Dry stumps protruding low from the water within the reedbed in the marshland area at the mouth of Pesnica River.	None
Mudflat formed by sediment deposition at the mouth of Ščavnica River into the lake.	Partly overgrown by pioneer vegetation at first; since then the entire surface has been overgrowing intensively with woody vegetation to the stage of a willow forest (unsuitable for breeding of Common Tern since c. mid-2000s).
Anchored flat wooden platform 2 × 5 m with c. 20 cm high edges, mounted on eight (2 rows) interconnected floating metal barrels; covered with a thin layer of coarse-grained shingle.	None
Elevated gravel surface, created accidentally during the gravel excavation works in the active part of the gravel pit.	None
A few meters high heap of shingle material surrounded by water.	None
Constructed on a basis of rough stones covered with coarse-grained shingle, formed into a flat plateau of surface c. 780 m^2, on which the individual stone blocks are evenly spaced.	The island is gradually becoming moderately overgrown with woody plants (poplars, willows) and sparse herbaceous vegetation.

Table 2: Number of Common Tern *Sterna hirundo* (left number) and Black-headed Gull *Larus ridibundus* (right number) breeding pairs at all known sites in Slovenia in the 1980–2019 period; x denotes confirmed breeding, but without number recorded.

Tabela 2: Število gnezdečih parov navadne čigre *Sterna hirundo* (leva številka) in rečnega galeba *Larus ridibundus* (desna številka) na vseh znanih območjih v Sloveniji v obdobju 1980–2019; x označuje potrjeno gnezdenje brez zabeleženega števila.

Year / Leto	1	2	3	4	5	6	7	8
1980	x / x							
1981	x / x	27 / 17						
1982	x / x	10 / 10						
1983	x / x				5 / 10			
1984	89 / 112				9 / 0			
1985	x / x							
1986	52 / 85							
1987	57 / 90							
1988	60 / 99							
1989	58 / 100							
1990	69 / 95			24 / 38				
1991	75 / x	1 / 16		59 / 61				1 / 1
1992	50 / 100	10 / 26						4 / 2
1993	45 / 92	22 / 25						26 / 0
1994	42 / 105	15 / 35						
1995	x / x					1 / 0		
1996	x / x							
1997	41 / 150	12 / 6						
1998	x / x	38 / 35						20 / 0
1999	x / x	44 / 55						
2000	x / x	65 / 28						
2001	x / x	64 / 108						
2002	x / x	80 / 140						
2003	32 / x	110 / 112						
2004	91 / 112							
2005	59 / 238	50 / 11						
2006	48 / 355	31 / 21						
2007	47 / 265	49 / 21	3 / 0					
2008	35 / 155	59 / 26	0 / 2					
2009	45 / 435	53 / 7	10 / 19					
2010	56 / 444	35 / 0	37 / 18				0 / 4	
2011	61 / 408	14 / 0	40 / 18				0 / 3	

Year / Leto	9	10	11	12	13	14	15	Total / Skupaj
1980								- / -
1981								- / -
1982								- / -
1983						9 / 0		- / -
1984						15 / 0		113 / -
1985						12 / 0		- / -
1986						18 / 0		70 / 85
1987						15 / 0		72 / 90
1988						19 / 0		79 / 99
1989						20 / 0		78 / 100
1990						22 / 0		115 / 133
1991						41 / 0		177 / -
1992						43 / 0		107 / 128
1993	0 / 5					48 / 0		141 / 122
1994						50 / 0		107 / 140
1995						60 / 0		- / -
1996						53 / 0		- / -
1997						50 / 0		103 / 156
1998						48 / 0		- / -
1999			12 / 0			44 / 0		- / -
2000		15 / 0	1 / 0			51 / 0		- / -
2001		5 / 0				48 / 0		- / -
2002		12 / 0	1 / 0			41 / 0		- / -
2003	2 / 0					62 / 0		206 / -
2004						53 / 0		144 / 112
2005						49 / 0		158 / 249
2006						49 / 0		128 / 376
2007						72 / 0	3 / 0	174 / 286
2008						46 / 0	7 / 0	147 / 183
2009						52 / 0	13 / 0	173 / 461
2010			1 / 0			47 / 1	19 / 0	195 / 467
2011						57 / 0	26 / 0	198 / 429

Continuation of Table 2 / Nadaljevanje tabele 2

Year / Leto	1	2	3	4	5	6	7	8
2012	41 / 521		36 / 10				0 / 2	
2013	78 / 657		9 / 4					
2014	72 / 595		30 / 0					
2015	59 / 526		48 / 18					
2016	85 / 877		82 / 7					
2017	118 / 853		58 / 0					
2018	218 / 988							
2019	117 / 965		30 / 2					

Site names and data sources / Imena območij in viri podatkov:

1 Lake Ptuj / Ptujsko jezero (Janžekovič & Štumberger 1984, Geister 1995)
2 Ormož Basins / Ormoške lagune (Geister 1995)
3 Lake Ormož (border area SI/HR) / Ormoško jezero (mejno območje SI/HR)
4 Hoče gravel pit / gramoznica Hoče (Vogrin 1991a, 1991b)
5 Hotinja vas fishpond / ribnik Hotinja vas (M. Vogrin *pers. comm.*)
6 Pragersko clay pit / glinokop Pragersko (M. Vogrin *pers. comm.*)
7 Medvedce reservoir / zadrževalnik Medvedce (D. Bordjan *pers. comm*)
8 Tržec gravel pit / gramoznica Tržec (Geister 1995, Denac 2003a)
9 Lake Pernica / Perniško jezero (Denac 2002a, Denac 2003b, A. Tomažič *pers. comm.*, M. Gamser *pers. comm.*)
10 Gajševci Lake / Gajševsko jezero (Šalamun 2001, Ž. Šalamun *pers. comm.*)
11 Vrbina gravel pit / gramoznica Vrbina (Denac *et al.* 2010, D. Klenovšek *pers. comm.*)
12 Stari Grad gravel pit / gramoznica Stari Grad (D. Klenovšek *pers. comm.*, *own data*)
13 Brežiško jezero / Lake Brežice (*own data*)
14 Sečovlje Salina / Sečoveljske soline (Škornik 2012, 2019b, I. Škornik *pers. comm.*)
15 Škocjanski zatok (B. Mozetič *pers. comm.*)

Remark / Opomba: Shaded area denotes the sites and time period during which field records were systematically collected by the authors. / Osenčen del označuje območja in časovno obdobje, v katerem sta terenske podatke sistematično zbirala avtorja.

Year / Leto	9	10	11	12	13	14	15	Total / Skupaj
2012						62 / 0	28 / 0	167 / 533
2013	3 / 0					54 / 0	56 / 0	200 / 661
2014						55 / 1	56 / 0	213 / 596
2015	1 / 10					53 / 0	102 / 0	262 / 554
2016	0 / 14					32 / 0	105 / 0	304 / 884
2017						57 / 0	140 / 0	373 / 853
2018				0 / 1	40 / 20	64 / 0	120 / 0	442 / 1010
2019					44 / 0	72 / 0	120 / 0	383 / 967

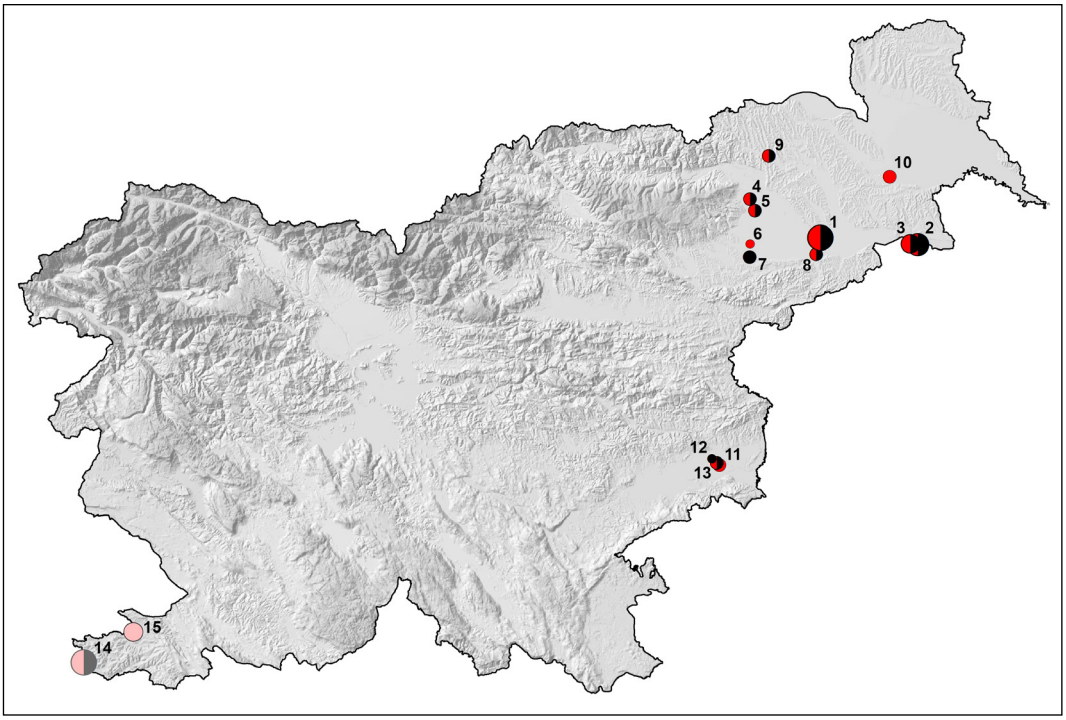

Figure 1: Sites with breeding Common Tern *Sterna hirundo* (red colour) and Black-headed Gull *Larus ridibundus* (black colour), recorded in Slovenia in in the 1980–2019 period and numbered according to Table 2. Dot size corresponds to the total number of years occupied (five size classes: 1, 2–5, 12–13, 20 and 37–40 years).

Slika 1: Območja z ugotovljenim gnezdenjem navadne čigre *Sterna hirundo* (rdeča barva) in rečnega galeba *Larus ridibundus* (črna barva) v Sloveniji v obdobju 1980–2019, oštevilčena glede na tabelo 2. Velikost pike ustreza skupnemu številu let, ko je bilo območje zasedeno (pet velikostnih razredov: 1, 2–5, 12–13, 20 in 37–40 let).

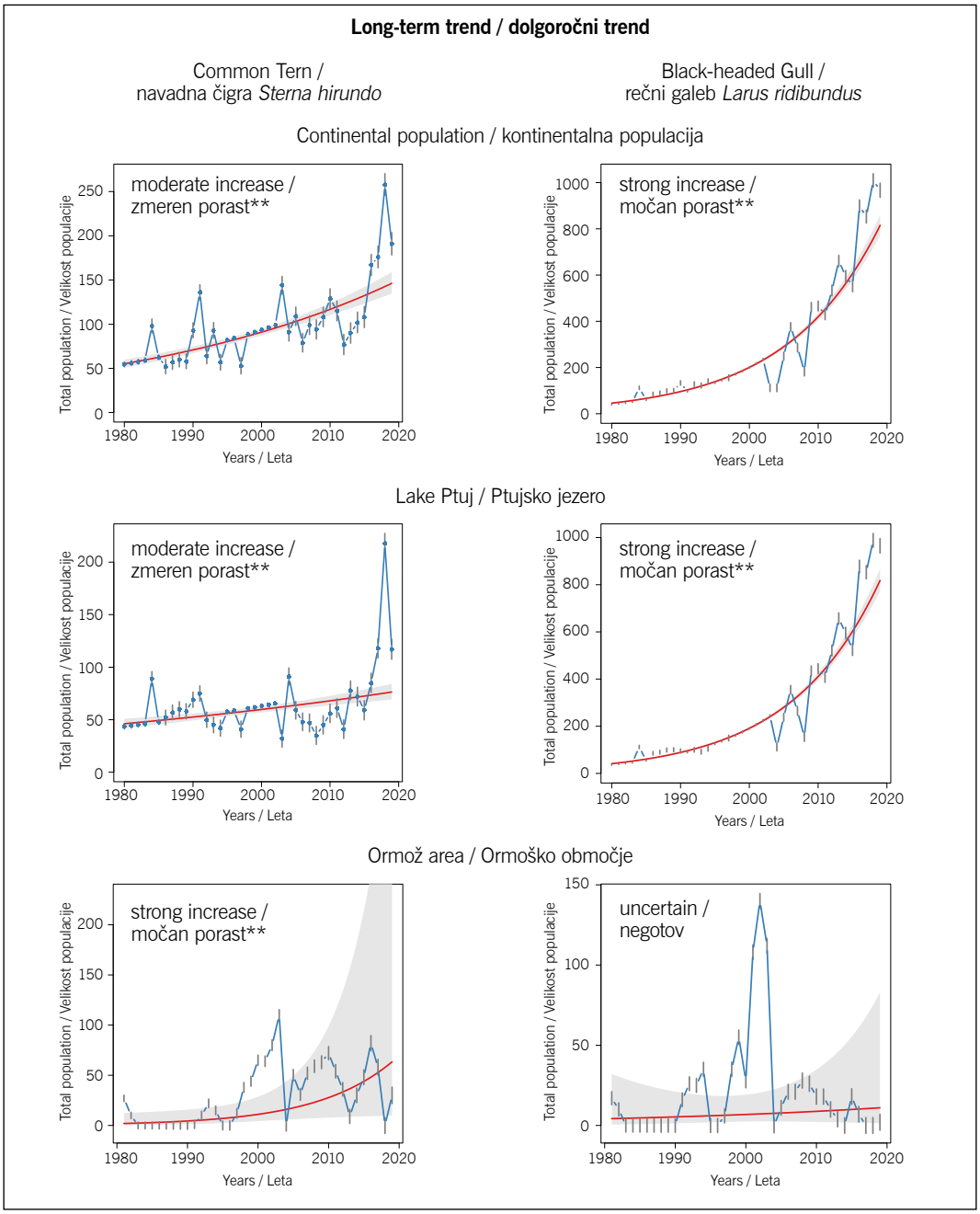

Figure 2: Multiplicative overall slope (long-term and short-term trend), its 95% confidence band, the total population (y axis) per time (x axis) and their 95% confidence intervals for Common Tern *Sterna hirundo* and Black-headed Gull *Larus ridibundus* populations (** $P<0.01$, * $P<0.05$).

Slika 2: Multiplikativni celotni naklon (dolgoročni in kratkoročni trend), njegov 95 % pas zaupanja, velikost populacije (y os) v času (x os) in njen 95% interval zaupanja za populacije navadne čigre *Sterna hirundo* in rečnega galeba *Larus ridibundus* (** $P<0.01$, * $P<0.05$).

Continuation of Figure 2 / Nadaljevanje Slike 2

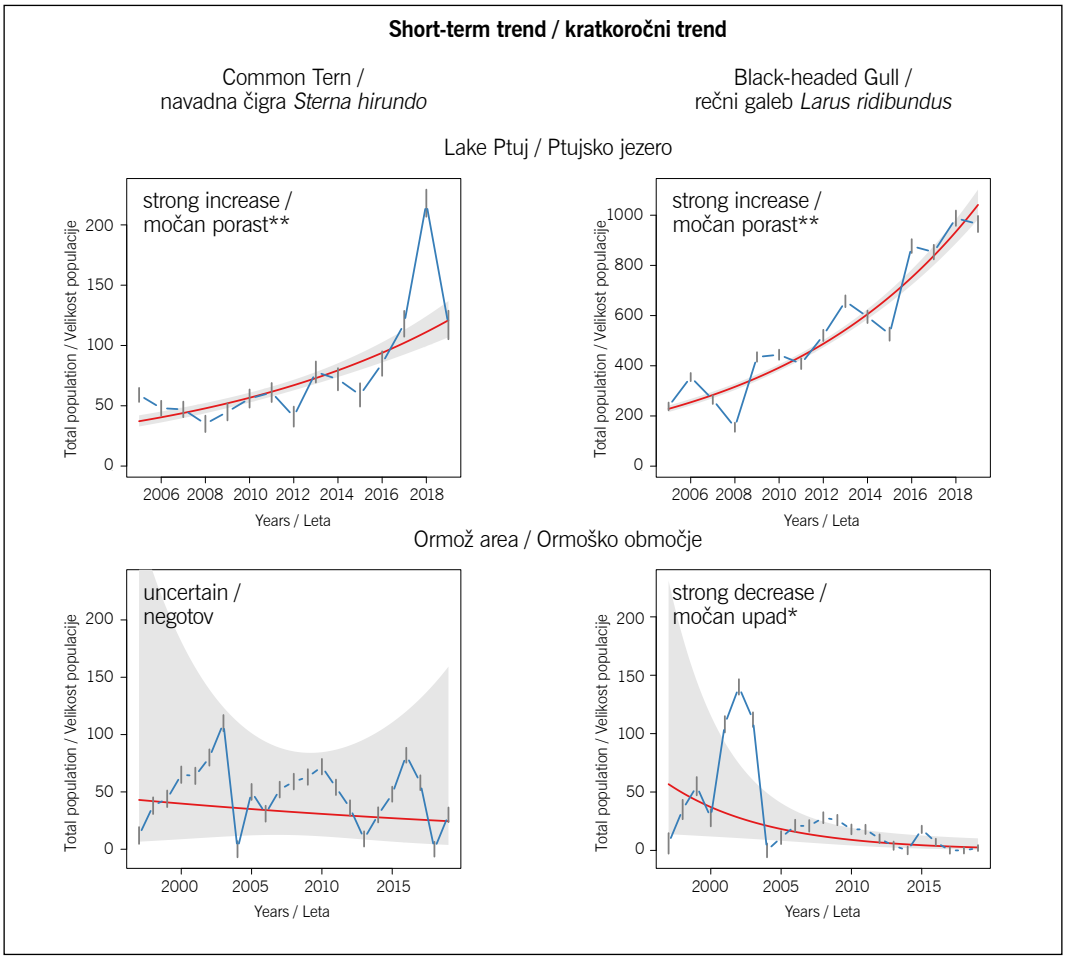

Table 3: Number of Common Tern *Sterna hirundo* breeding pairs on different locations at three sites along the Slovenian/border part of the Drava River in the 1980–2019 period; x denotes confirmed breeding, but without number recorded. Breeding of presumably the same pairs (replacement clutches) at different location in the same year is denoted in bold.

Tabela 3: Število gnezdečih parov navadne čigre *Sterna hirundo* na različnih lokacijah na treh območjih vzdolž slovenskega/mejnega dela reke Drave v obdobju 1980–2019; x označuje potrjeno gnezdenje brez zabeleženega števila. Gnezdenje domnevno istih parov (nadomestna legla) na različnih lokacijah v istem letu je označeno krepko.

Site, location / Območje, lokacija	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Lake Ptuj / Ptujsko jezero																
Small Island / Mali otok	x[1,2]	x[1,2]	x[1,2]	x[1,2]	89[1]	x[2]	52[2]	57[2]	60[2]	58[2]	64[2]	75[2]	50[2]	45[2]	42[2]	x
New Island / Novi otok	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gravel Island 1 / Prodnati otok 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gravel Island 2 / Prodnati otok 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transmission line platform (left) / Daljnovodna ploščad levo											2[3]					
Transmission line platform (right) / Daljnovodna ploščad desno											3[3]					
Sewer shaft platform (left) / Ploščad kanalizacijskega jaška levo																
Lake Ormož / Ormoško jezero																
Small artificial structures / Manjše umetne strukture (HR)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Large hunting hide / Velika lovska preža (SI)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fishing hut / Ribiška hišica (HR)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fishing raft / Ribiški splav (HR)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Double Island / Dvojni otok (HR)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Island / otok (HR)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Debris / naplavine (SI/HR)																
Ormož Basins / Ormoške lagune																
Nesting raft 1 / Gnezdilni splav 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nesting raft 2 / Gnezdilni splav 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nesting raft 3 / Gnezdilni splav 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Basin 3 / Bazen 3		27[2]	10[2]									1	10[4]	22[4]	1[4]	
Basin 4 / Bazen 4																
Dyke / Nasip															14[4]	

1 Janžekovič & Štumberger (1984)
2 Geister (1995)
3 Bračko (1999)
4 Denac (2002b)
5 Denac (2006)
6 Denac (2004)
7 Rubinić *et al.* (2005)
8 Mihelič *et al.* (2006)
9 Rubinić *et al.* (2007)
10 Rubinić *et al.* (2008)
11 Rubinić *et al.* (2009)
12 Denac *et al.* (2010)
13 Denac *et al.* (2011)
14 Denac & Božič (2013)
15 Božič (2018)
16 Božič (2019)

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
x	1	?	?	?	?	?				3[8]	6[9]	15[10]	**25**[11]				24[15]						
-	-	-	-	-	-	-	-	-	37[7]	45[8]	21[9]	3[10]	**19**[11]	41[12]	34[13]	25[14]	42[15]	59[15]	**32**				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56[15]	85[15]	118[15]	70[15]	38[16]
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				148[15]	79[16]
							17	85[6]	20[7]		15[9]	12[10]	38[11]	1[12]	2[13]	2[14]	12[15]	11[15]					
	40	?	7	10	?	?	15	4[6]	2[7]		5[9]	5[10]	7[11]	14[12]	25[13]	14[14]		1[15]					
								2[6]										1[15]	3[15]				
-	-	-	-	-	-	-	-	-	-		3		10[11]	28[12]	22[13]		8[15]	10[15]	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-						6[13]		-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	9[12]	12[13]		-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-			**14**[14]	-	20[15]	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36[14]			-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48[15]	82[15]	58[15]		30[16]
																	1[15]						
-	5[4]	13[4]	19[4]	30[4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	20[4]	22[4]	35[4]	14[4]	5[4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	45[4]	59[4]	110[5]		50[7]	31[8]	45[9]	58[10]	53[11]						-	-	-	-	-
	7[4]		1[4]			16[4]					4[9]	1[10]		35[12]	14[13]								
		5[4]	2[4]		5[4]																		

Remark / Opomba: Unnumbered records are unpublished data of the authors. / Neoznačeni zapisi so neobjavljeni podatki avtorjev.

- Location did not exist in a given year. / Lokacija v tem letu ni obstajala.
? No data / Brez podatka
SI The location is situated on the Slovenian side of the lake. / Lokacija leži na slovenski strani jezera.
HR The location is situated on the Croatian side of the lake. / Lokacija leži na hrvaški strani jezera.

Table 4: Number of Black-headed Gull *Larus ridibundus* breeding pairs on different locations at three sites along the Slovenian/border part of the Drava River in the 1980–2019 period; x denotes confirmed breeding but without number recorded.

Tabela 4: Število gnezdečih parov rečnega galeba *Larus ridibundus* na različnih lokacijah na treh območjih vzdolž slovenskega/mejnega dela reke Drave v obdobju 1980–2019; x označuje potrjeno gnezdenje brez zabeleženega števila.

Site, location / Območje, lokacija	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Lake Ptuj / Ptujsko jezero																
Small Island / Mali otok	x[1,2]	x[1,2]	x[1,2]	x[1,2]	112[1]	x[2]	85[2]	90[2]	99[2]	100[2]	95[2]	x[2]	100[2]	92[2]	105[2]	x
New Island / Novi otok	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gravel Island 1 / Prodnati otok 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gravel Island 2 / Prodnati otok 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transmission line platform (left) / Daljnovodna ploščad levo																
Transmission line platform (right) / Daljnovodna ploščad desno																
Debris / naplavine																
Lake Ormož / Ormoško jezero																
Small artificial structures / Manjše umetne strukture (HR)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Large hunting hide / Velika lovska preža (SI)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fishing hut / Ribiška hišica (HR)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fishing raft / Ribiški splav (HR)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Island / otok (HR)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Debris / naplavine (SI/HR)																
Ormož Basins / Ormoške lagune																
Nesting raft 1 / Gnezdilni splav 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nesting raft 2 / Gnezdilni splav 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nesting raft 3 / Gnezdilni splav 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Basin 3 / Bazen 3		17[2]	10[2]									16	26[3]	25[3]	32[3]	
Basin 4 / Bazen 4																
Basin 5 / Bazen 5																
Dyke / Nasip															3[3]	

[1] Janžekovič & Štumberger (1984)
[2] Geister (1995)
[3] Denac (2002b)
[4] Denac (2006)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	x	150	?	x	?	?	?	?	70	150	80	75	32					21	2			31	13	
	-	-	-	-	-	-	-	-	-	14	160	100	70	353	340	339	471	575	514	516	843	631	495	435
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	33	162	292	389
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			6	164	117
									7	24	40	35	26	36	53	31	33	25	25	5		22	24	24
									35	50	75	55	27	46	51	38	17	36	54	3				
																				1	1	1		
	-	-	-	-	-	-	-	-	-	-				11	8	7	3	3		-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-				8	6	5	7	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4		-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-				-		-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	7			2
													2			2		1						
	-			3[3]	3[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-		3[3]	3[3]	4[3]	3[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	100[3]	110[3]	112[4]		11	21	18	26	5										
		6[3]					27[3]					3												
			35[3]	49[3]	22[3]	3[3]								2										
						1[3]																		

Remark / Opomba: Unnumbered records are unpublished data of the authors. / Neoznačeni zapisi so neobjavljeni podatki avtorjev.

- Location did not exist in a given year. / Lokacija v tem letu ni obstajala.
? No data / Brez podatka
SI The location is situated on the Slovenian side of the lake. / Lokacija leži na slovenski strani jezera.
HR The location is situated on the Croatian side of the lake. / Lokacija leži na hrvaški strani jezera.

Table 5: Number of Mediterranean Gull *Larus melanocephalus* pairs on different locations at Lake Ptuj since the first confirmed breeding in 2006

Tabela 5: Število parov črnoglavega galeba *Larus melanocephalus* na različnih lokacijah Ptujskega jezera od prvega potrjenega gnezdenja leta 2006

Site, location / Območje, lokacija	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Small Island / Mali otok								1	1					
New Island / Novi otok	1[1]	2[1]	1[1]	2[1]	2	2	1	2	1	1	2	1		27
Gravel Island 1 / Prodnati otok 1	-	-	-	-	-	-	-	-	-		13	11	6	1
Gravel Island 2 / Prodnati otok 2	-	-	-	-	-	-	-	-	-				20	
Transmission line platform (right) / Daljnovodna ploščad desno						1								
Total / Skupaj	1	2	1	2	2	3	1	3	2	1	15	12	26	28

[1] Denac & Božič (2009)

Remark / Opomba: Unnumbered records are unpublished data of the authors. / Neoznačeni zapisi so neobjavljeni podatki avtorjev.
- Location did not exist in a given year. / Lokacija v tem letu ni obstajala.

Mediterranean Gulls bred on both Gravel Islands as well, on the first one in all years since 2016 (majority of population there in 2016–2017) and on the second one only in 2018, but with a significant number. Average number of breeding pairs on both Gravel Islands was 10 (Table 5).

In Oct–Nov 2014, an island designed as a nest site for Common Tern was constructed in the Croatian part of Lake Ormož (Table 1), based on experience from Lake Ptuj and under supervision of the Association Biom (BirdLife in Croatia). In the years 2015–2019, 55 pairs of Common Tern and 9 pairs of Black-headed Gull bred on average on the island (Tables 3, 4), but there was no breeding in 2018, presumably due to predation by the Eurasian Otter *Lutra lutra* in previous years.

As part of mitigation measures, required to minimise negative impacts of HPP Brežice (Official Gazette of RS 2012, 2013), an island aimed as nest site for Common Tern was constructed in 2017, during the building of a reservoir. In two seasons available, 40 and 44 Common Tern pairs bred there, while Black-headed Gull bred only in 2018 (20 pairs).

Measures to maintain and enhance the breeding habitat – management techniques

Different types of recurring management techniques were applied at nest sites (Table 6). Measures 1–9 were aimed at vegetation control and prevention of habitat loss. Without regular implementation of these measures, the habitat would become unsuitable for breeding of target species in a year or two. Therefore, they form a crucial part of conservation efforts for the species. Since 2005, nesting locations subjected to conservation measures were mostly visited twice per year for management purposes, before the start of breeding season in spring (March) and afterwards in autumn (September, October). Management is mostly carried out by DOPPS staff and volunteers. Between 2003 and 2019, a total of 2,230 man-hours were invested in the management of nesting locations.

(1) Mowing with sickle bar mower

Since 2010, sickle bar mower has been used to cut the vegetation on New Island every autumn (Appendix 2a). Mowing with sickle bar mower replaced the brush cutters, as it

proved far more efficient and less strenuous on the workers. Blade height was set 10 cm above the ground and was fixed. This has been the only island where the amount of vegetation required this measure to be performed. To date, annual mowing of New Island has been the basic management technique to make the sparsely to moderately vegetated ground suitable for breeding of large proportion of the Black-headed Gull colony.

(2) Mowing with brush cutters

Brush cutters were used between 2005 and 2010 to control vegetation on New Island (Appendix 2a). Vegetation was cut either in autumn or/and in spring. Two or three brush cutters with iron blades were used simultaneously. Brush cutters were also used on Gravel Island 2 to remove vegetation from the silty outer edge. This method was used to provide sparsely vegetated ground as a breeding habitat for Common Tern and Black-headed Gull and it proved to be sufficient only for the first three consecutive years from the construction of the island (2005–2007). After 2008 a more efficient combination of covering ground with foil was necessary to retain suitable ground for the breeding Common Terns (see measure 3). Brush cutters were replaced by more effective sickle bar mower in 2010.

(3) Covering the ground by plastic foil

The number of Black-headed Gull breeding pairs on New Island increased many-fold during 2005–2008, occupying almost the entire available space before the arrival of Common Terns. Furthermore, upon return of terns to the breeding grounds, vegetation was already c. 20 cm high, causing rapid deterioration of their breeding habitat during the nest site selection period in the years 2006–2008. Consequently, after the first breeding of Common Tern on New Island (2005), its population increased next year, but decreased to 21 and 3 pairs in the following two years (Table 3). In order to tackle this issue, a piece of black plastic foil (sized c. 3 × 7 m), intended to delay vegetation growth, was placed on the ground in early March (Appendix 2b), prior to Black-headed Gulls settling on the island, for the first time in 2009. Stones, acting as weights, were put on the foil edges to prevent them from being lifted by wind, and a net of strings (see measure 9) with mesh size c. 1 × 1 m was installed c. 0.5 m above the foil. The latter was then removed during a short visit to the island in late April of the same year, aimed at counting the Black-headed Gull nests. This procedure was repeated annually on New Island for seven consecutive years between 2009 and 2015. The foil was always placed on the same place. This measure provided c. 20 m^2 of sparsely vegetated ground on New Island, enabling Common Tern to breed (Appendix 2c). By applying this measure, its population increased to 19 pairs in 2009 (all breeding on the surface where foil was placed; Denac *et al.* 2010) and to an average of 39 pairs in the following years until 2015. Afterwards, the measure was abandoned as Common Tern started breeding on Gravel island 1 (Table 3). Already in the following year, the species did not breed on New Island at all, highlighting the importance of the measure in maintaining the breeding population at Lake Ptuj during the first half of the 2010s.

(4) Removal of woody vegetation

The measure was carried out at Lake Ptuj (New Island and Small Island), islands at Lake Ormož and Lake Brežice, and nesting location at Gajševci Lake. On New Island, willows were planted along the edge during its construction, with the purpose to stabilize the perimeter and reduce the erosion effect. Tree roots have effectively protected and stabilized the island. However, tree crowns had to be cut every year with chainsaw to keep the island open and free of visual barriers for colonial breeders. This type of management has been done every autumn since the construction of New Island (2005). A similar measure was conducted on Small Island until the late 1990s, when willows were finally eliminated from the island by regular cutting. Starting in 2016, encroaching woody vegetation is being removed manually from the island at Lake Ormož on annual basis, before the start of the

Common Tern breeding season by members of the Association Biom. In March 2019, the first removal of pioneer woody vegetation (young willows and poplars) was carried out on the island at Lake Brežice by using gardening tools like hoe, hand saw, pick and garden shears (Appendix 2d). At Gajševci Lake, cutting of willows encroaching upon the mudflat was carried out by chainsaw in some years of the 2000s, before the management of the location was abandoned due to heavy predation on Common Tern nests and chicks (Ž. Šalamun *pers. comm.*).

(5) Removal of herbaceous vegetation
Gravel Islands 1 and 2, as well as Small Island are covered by gravel, which renders mowing of their surfaces practically impossible. Instead, manual pulling/rooting out (by hands or using digging tools) of herbaceous vegetation has been performed to provide for bare shingle surfaces each year before the start of the breeding season. This technique was also a basic management method for the concrete transmission line platforms, as the substrate was formed from the old Black-headed Gull nests and excrements of Cormorants *Phalacrocorax carbo* roosting on lattice towers, resulting in vegetation growth. As a rule, the vegetation was removed from the platforms together with the entire guano layer to keep them suitable for breeding of Common Tern (Appendix 2e). Throughout the 1980s and first half of the 1990s, Small Island was the most important (and in most years the only) breeding location for Common Tern, making such management crucial for the preservation of the colony. Common Tern colonized Small Island again in the years 2006–2009, when the number of Black-headed Gulls breeding there almost halved, albeit in smaller numbers (Table 3). Predation by Yellow-legged Gull that started breeding on Small Island in 2009 probably forced terns to abandon this breeding site. Finally, the excessive encroachment by invasive plants over the entire island surface prevented further breeding of Common Tern in the last few years of the study period, despite all efforts invested. Recently, the manual pulling management on Gravel Islands 1 and 2 (Appendix 2f) supports the largest Common Tern colony and significant proportion of Black-headed Gull population in the continental part of Slovenia. At a smaller scale, the method is also used to remove herbaceous vegetation from the island at Lake Ormož (carried out by the Association Biom).

(6) Covering the ground with wood chips
Wood chips were experimentally used on New Island to prevent rapid overgrowing and to secure suitable breeding place for Common Terns. An area of 24 m^2 (4 × 6 m^2) was covered with a 10 cm layer of wood chips with geotextile laid beneath in spring 2010 (Appendix 2b). The plot was adjacent to the one covered with plastic foil (see measure 3). In the same year, 17 pairs of Common Tern bred on wood chips (plus additional 24 on the surface where foil was placed), suggesting it was an appropriate breeding substrate for the species (Appendix 2g). The substrate was, however, short-lived. In the next year, it was mostly overgrown and in 2012 it more or less disappeared, with vegetation on the plot hardly differing from its surrounding. In spring 2019, a plot of c. 100 m^2 on New Island was covered with pine bark wood chips and geotextile laid beneath (Appendix 2h). The plot remained largely unvegetated throughout the breeding season with only a few single Reed *Phragmites australis* stems penetrating through. Almost the entire colony of Mediterranean Gull (27 pairs) moved there, together with a few Black-headed Gull pairs (Appendix 2i). Following these promising results, the area covered with pine chips was enlarged to c. 250 m^2 in autumn of the same year (preparation for breeding season 2020).

(7) Applying salt
Sea salt was experimentally used on Small and New Islands as a potential natural herbicide. On two small plots of the same size, 20 and 50 kg of salt was evenly dispersed and later compared to a control plot with no application. No effect was registered and the technique was not further implemented.

(8) Preventing the nesting habitat erosion
Since the erosion has reduced the surface area of Small Island significantly, it was restored and consolidated by wooden piles hammered along the plateau perimeter in the late 1990s. Gravel Islands 1 and 2 turned out to be highly prone to erosion as well. Along the interior edge exposed to the river current, the material became eroded and large holes appeared in some places (Appendix 2j), causing intrusion of water and partial flooding of the islands at high water levels of the reservoir. In addition, steep erosion holes were dangerous to chicks, for once they fell into they were unable to climb up again, which caused additional mortality. In autumn 2018, holes were covered by cloth and filled with gravel, eliminating the threat.

(9) Raising of nesting location by bringing silt and shingle material
Due to the high risk of flooding, the mudflat at Gajševci Lake on which Common Tern started to breed in 2000, was elevated by manually adding silty material from the surroundings to the central part of the nesting location, consolidated with wooden piles before the start of the ensuing season. Furthermore, 12 m^3 of shingle was brought to stabilise the location next year. With a combination of different measures, the breeding population of Common Tern there was maintained for further two years, but management efforts were abandoned shortly afterwards (Ž. Šalamun *pers. comm.*).

Measures aimed to increase chick/nest survival and to improve breeding success

Conservation measures summarized in this section include a diverse set of efforts, ranging from management practices conceived to prevent predation and to control occupancy of breeding locations by gulls, to measures aimed at reducing direct negative impacts of recreational activities, including general public awareness of conservation issues.

(10) Fencing
Protective fencing was set up on both transmission line platforms. The right one was fenced in 1999 and the left one in 2003. The fences prevented chicks from falling into the water and drowning (once a chick fell into the water, it was impossible for it to return due to the height of the platform) (Appendix 2k). They were 30 cm high and made of chicken wire with mesh size 1 × 1 cm. Both old platforms were removed and new ones constructed on exactly the same locations in 2014. They were fenced in the same manner in spring 2016. Gravel Island 1 was fenced with 50 cm high chicken wire along the vertical outer edge, where chicks could fall into the water and would no longer be able to return to the island (Appendix 2l). The outer edge of Gravel Island 2 is gently sloping. It was fenced to prevent access (and potential trampling of nests) to numerous Mute Swans *Cygnus olor* to the gravel surface of the island (Appendix 2m), as observed on regular basis before the measure was implemented. Also, their droppings significantly contribute to undesired vegetation growth by fertilizing the ground. The lower edge of the fence is 15 cm above the ground to enable Common Tern and gull chicks and ducklings to pass underneath. Both Gravel Islands were fenced in autumn 2015. In spring 2019, some sections along the interior edge of gravel islands were fenced with 30 cm high plastic mesh, protected with plastic foil along the lower part, to prevent chicks falling through the gaps in the array of wooden poles (Appendix 2n). The gaps appeared due to the pressure of the islands' building material on the perimeter and have probably been one of the major causes of mortality since at least 2017.

(11) Placing of plastic strings to prevent breeding of gulls
On New Island, a grid of plastic strings (max. spacing 1 m) supported by wooden poles, was placed c. 1 m above the ground over the plots covered with foil and wood chips (see measures 3 and 6) to prevent Black-headed Gull pairs from occupying the plots (Appendix 2b). They were placed in early spring between 2009 and 2015, prior to gulls settling at the breeding location. Strings were removed together with the foil in late April, when most Black-headed Gulls are usually already in mid- or late phase of incubation period, but Common Terns

just start breeding. Thus, the measure enabled terns to occupy the available plot free of gulls in the middle of the dense Black-headed Gull colony. Upon the removal of foil, the ground was sparsely vegetated and therefore suitable for Common Tern (Appendix 2c). Black-headed Gulls did not attempt to breed at the plots with strings. In 2011 and 2014, a grid of plastic strings was placed in the same manner over the entire plateau surface of Small Island, aimed to prevent breeding of Yellow-legged Gull (predator of Common Tern chicks). It proved unsuccessful as it bred among strings in both years (Appendix 2o). This method was adopted from the USA model, used to reduce aerial predation and gull occupancy in the Common Tern colony (Audubon Vermont 2009, 09:33).

(12) Placing chick shelters

Chick shelters (Burness & Morriss 1991) were placed for the first time on bare concrete transmission line platforms where Common Tern started to breed (Appendix 2p). They were placed in 1999 on the right platform and 2003 on the left one. After the platforms were replaced, new shelters were set in place in 2016. Before the start of the 2003 breeding season, Nesting raft 3 in Ormož Basins was also equipped with shelters (18), designed as an "open-ended tent", constructed from rectangular pieces of wooden plank (30 × 15 cm) nailed together (Appendix 2q). Nevertheless, severe predation by the Goshawk that managed to pull the chicks from underneath the shelters was observed in the same year (Denac 2006). Afterwards, the original unsuccessful shelters were replaced with a longer version (1 m) and breeding success probably improved somewhat in 2005 (cf. Rubinić *et al.* 2005). These remained functional for the entire life period of the rafts. About 10 ridge roof tiles aimed to serve as chick shelters were present on the plateau of Small Island in the 2010–2014 period, but remained largely

Table 6: Conservation measures carried out on locations with breeding colonial Laridae species at sites along the Slovenian/border part of the Drava River in the 2005–2019 period. Seasons when specific measures were implemented in individual years are given (S – spring, before the start of the breeding season; A – autumn, after the breeding season). Numbers correspond to the numbering in the section 3.2.

Tabela 6: Varstveni ukrepi, izpolnjeni na lokacijah z gnezdečimi kolonijskimi vrstami iz družine Laridae na treh območjih vzdolž slovenskega/mejnega dela reke Drave v letih 2005–2019. Naveden je letni čas, ko so bili izpeljani določeni ukrepi v posameznih letih (S – spomladi, pred začetkom gnezditvene sezone; A – jeseni, po gnezditveni sezoni). Številke ustrezajo oštevilčenju v podpoglavju 3.2.

	2005		2006		2007		2008		2009		2010	
Site, location / Območje, Lokacija	S	A	S	A	S	A	S	A	S	A	S	A
Lake Ptuj / Ptujsko jezero												
Small Island / Mali otok	4,5,7		4,5	5		5	7	5		4,5	12	4,5
New Island / Novi otok		2	2	2,4		2,4	2,7	2,4	2,3,4,11	2,4	3,6,11	1,2,4
Gravel Island 1 / Prodnati otok 1												
Gravel Island 2 / Prodnati otok 2												
Transmission line platform (left) / Daljnovodna ploščad levo			5	5		5		5		5		5,10
Transmission line platform (right) / Daljnovodna ploščad desno		5	5	5		5		5		5		5
Lake Ormož / Ormoško jezero												
Island / Otok (HR)												
Artificial structures / Umetne strukture (SI/HR)												

unused as the island was seldom occupied by breeding pairs during that period. In spring 2017, 48 chick shelters made of two plywood planks were placed on Gravel Island 1. Apparently, they were mostly used by Black-headed Gulls, as the majority of chick shelters had at least one gull nest next to it.

(13) Installation of electric fence

Heavy predation by Eurasian Otter resulted in extremely low breeding success of Common Terns nesting on the island at Lake Ormož in the years 2015–2017. To solve this problem, a portable battery-powered electric fence was installed around the plateau of the Island (action carried out by the Association Biom) (Appendix 2r). However, the system did not prevent the Otter entering the fenced area in 2019 during the late phase of incubation period. All nests were predated again, and most of the terns left the site soon thereafter, without attempting to replace the clutch.

(14) Reducing human disturbance

DOPPS - BirdLife Slovenia was actively involved in the preparation of Decree on navigation regime at Drava River and Lake Ptuj, adopted by the Municipality of Ptuj (Official Gazette of RS 2006). The Decree regulates navigation on the lake, including enforcement of temporal and spatial restrictions with 100 m "no-disturbance" zone around nesting locations. However, the Municipality did not provide for sufficient field control, and violations of the Decree provisions still occur fairly often, occasionally causing disturbance to the breeding colony. An observation tower with detailed information on Common Tern and other birds was opened for public in 2016, with telescope for observing the colony installed in the tower.

(15) Removal of ecological traps

In the 2009–2014 period, Common Terns and Black-headed Gulls bred on several illegally built fishing and hunting platforms and

2011		2012		2013		2014		2015		2016		2017		2018		2019	
S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A
11	4,5		4	5	4	11	5		5		5		5		5		5
3,4,11	1,4	3,4,11	1,4	3,11	1,4	3,11	1,2,4	3,11	1,4		1,4		1,4		1,4	6	1,4,6
									5,10		5	12	5		5,8	10,12	5
									5,10		2,5		5		5,8	10	5
	5		5		5					10,12							
	5		5		5					10,12							
										4,5		4,5	4,5	4,5,13	4,5	4,5	

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similar structures at Lake Ormož (on average 14 and 6 pairs, respectively). The platforms functioned as ecological traps due to the fact that all nests were destroyed by visiting people in most of the years. In autumn 2014, all platforms were removed, thereby eliminating the ecological traps. Consequently, both species bred at Lake Ormož only on the artificial island in the following years.

4. Discussion

Common Tern occupies a wide range of nest sites and its breeding habitat was even described as "wherever they find a place, provided that conspecific breeders have settled there before", but the requirement for open ground, safe from terrestrial predators and flooding, with nests usually laid on bare substrate or very low vegetation, render its continental distribution rather local and closely connected with provision of artificial sites. Common Terns quickly exploit such sites, especially in areas where natural sites are scarce (Becker & Ludwigs 2004). Furthermore, the survival of Slovenian population was based on the availability of man-made water bodies since all known natural nest sites were lost through river regulation at the turn of the 1970s. However, suitable conditions there were mostly only temporary, resulting in short-lived or intermittent breeding. Due to the lack of suitable nest sites, Common Terns often bred at suboptimal locations with very low breeding success due to flooding of nest sites with low elevation (Double Island at Lake Ormož, Denac & Božič 2013), predation (Gajševci Lake, Ž. Šalamun *pers. comm.*), negative intra-specific interactions arising from very high nest densities (transmission line platform at Lake Ptuj, Božič & Denac 2012), or human-related mortality (Hoče gravel pit, Vogrin 1991b; artificial structures at Lake Ormož, Denac *et al.* 2011). Moreover, breeding attempts (copulation, nest building) were recorded on hardly suitable, freshly exposed small surfaces which were then flooded before the start of egg-laying (Vrbina and Stari Grad gravel pit; D. Klenovšek *pers. comm.*), further illustrating quick exploitation of potential nest sites when these are scarce. Similar holds true for Black-headed Gull, except for the fact that it did not occupy completely open locations, devoid of any kind of vegetation or structures, like featureless areas of bare substrate (shingle or mud) on newly created artificial islands, low mudflats and small rafts. As soon as some patches of vegetation appeared or structures like chick shelters were placed, gulls begun to colonize such sites as well (e.g. gravel islands at Lake Ptuj). Black-headed Gulls are known to occupy open, sparsely vegetated sites only after the arrival of Common Terns (Glutz von Blotzheim & Bauer 1999) and, indeed, such settlement pattern was observed on Gravel Islands at Lake Ptuj. Although Common Terns occasionally breed amidst taller vegetation and some shrubs, preferred sites can quickly become unsuitable due to rapid encroachment, caused by natural succession and/or competition with gulls, which settle at more vegetated areas (Glutz von Blotzheim & Bauer 1999, Becker & Ludwigs 2004, Cabot & Nisbet 2013) as was the case with several locations in continental Slovenia, including those constructed intentionally as nest sites for Common Tern.

In continental Slovenia, long-term preservation of regularly breeding significant populations of Common Tern and associated gulls is completely management dependent (Denac *et al.* 2019, Denac & Božič 2019, Božič & Denac 2019). The continental Common Tern population could be considered a metapopulation, consisting of a few subpopulations at different sites. The main purpose of the conservation programme has been therefore to preserve a viable continental Common Tern metapopulation. Taking into account all of its challenges over the years, it is one of the most intensive species conservation programmes of DOPPS-BirdLife Slovenia. In the 1980s and early 1990s, this required relatively moderate resources as only a single breeding location had to be maintained annually at that time. Furthermore, Common Tern started to breed at several other anthropogenic habitats, like gravel pits and wastewater basins of the Ormož Sugar Factory (now Ormož Basins Nature Reserve), or nest sites created accidentally on man-made water bodies. However, all such habitats turned out to be suitable for breeding for only a very short period (a year or two) due to their intermittent character and/or rapid encroachment of vegetation on freshly exposed surface, as documented by several sites where breeding occurred only in few years over the period of several decades.

In addition, for various reasons it was not feasible to implement conservation management at most of these sites. The only sites, where long-term management was possible, were wastewater basins of the Ormož Sugar Factory. There, an agreement with the company's management was achieved and artificial nesting rafts placed in 1997, 1998 and 2001 (Božič & Denac 2017). Thus, new breeding structures intended for Common Tern conservation were created for the first time. This was important, as in the late 1990s the species stopped breeding on Small Island due to the increased competition with Black-headed Gull (Božič & Denac 2012). Most likely, the pairs from Lake Ptuj moved to breed on artificial rafts in the wastewater basins. Strong predation on the rafts in 2003 (Denac 2006), combined with unfavourable water regulation regime in the basins, caused abandonment of the breeding location in the following year. In 2004, Common Terns bred in larger numbers at transmission line platforms, which clearly indicated a lack of suitable breeding habitats along the entire Drava River area. Despite the management efforts, neither the rafts nor the platforms turned out to be a long-term solution in the Common Tern conservation programme. High nest densities thereon resulted in negative intra- and interspecific interactions that negatively affected fecundity (Denac 2002b, 2004, 2006), which is a common consequence under such circumstances (Glasmacher 1987, Budde 1992, Sudmann 1998). Therefore, a new stable and optimal breeding habitat was required in order to preserve the most important Common Tern colony in continental Slovenia. New Island was built at the Lake Ptuj in 2004/2005 and Common Terns immediately started to breed there in 2005. New Island, on the other hand, was constructed without the final placement of gravel layer, and had to be mown annually to remove the high herbaceous vegetation. Specific habitat conditions favouring Black-headed Gull developed soon on New Island and its numbers increased significantly. Upon construction, both gravel islands offered an optimal Common Tern breeding habitat. However, the nesting ecological niche of the Common Tern partly overlaps with that of the Black-headed Gull (Fasola & Canova 1992), so every new nest site of the former is also a potential site for the latter. This is exactly what happened at both Gravel Islands – Black-headed Gull occupied them over time, resulting in increase of their population. Despite the fact that their surface is covered with a thick gravel layer, the encroaching of vegetation has intensified over years, to the point that in 2019 the islands were largely covered with continuous stand of dense herbaceous vegetation already by mid-June (most Common Tern pairs at chick stage). Terns avoid dense vegetation because it obscures visual contact and recognition between chicks and parents, making delivery of fish more difficult. Dense vegetation also prevents chicks from drying after heavy rain or dew (Kress 2000). Evidence exists that low Common Tern fledging success on Gravel Islands in 2019 is at least partly related to the moist conditions in the lush herb layer (*own data*). Consequently, more resources and introduction of new conservation measures will be needed to prepare suitable nest sites on Gravel Islands for the following breeding seasons.

The Common Tern conservation programme was launched and is being implemented by DOPPS-BirdLife Slovenia. In the 1980s and 1990s, management was organized and carried out by volunteers only. During the last two decades it has been organized by DOPPS' staff, but performed with extensive help of volunteers. Management equipment used is owned by DOPPS and volunteers. Common Tern is a qualifying Natura 2000 species for SPA Drava (SI5000011). The "Natura 2000 management programme for the period 2015–2020", adopted by the Government of Slovenia (Government of RS 2015), specifies "management of breeding islands" as a measure to protect the Common Tern at the SPA. DOPPS is listed as the responsible institution and volunteer work as "financial source". The amount of volunteer workload required to accomplish annual conservation measures has been steadily increasing: in the 2004–2008 period, 432 man-hours were needed for conservation management, in the 2009–2014 period a total of 712 man-hours, and in the 2015–2019 period 1086 man-hours were invested. These numbers do not include preparatory and monitoring activities. Altogether, 161 different volunteers have participated in the management since 2003. We conclude that with this dramatically increased workload and rising demands of tasks implemented, the current predominantly volunteer-based model is no longer sustainable in the

long term and a more supportive state mechanism is urgently required.

There are many further positive effects of the activities carried out within the frame of Common Tern conservation programme. Following the example of breeding islands at Lake Ptuj in Slovenia, a similar island was built by the Croatian power company "Hrvatska elektroprivreda d.d." in 2014 and Common Tern bred there in 2015 for the first time. Bird species that were new for Slovenia or the Podravje region started to breed on the islands, such as Red-crested Pochard *Netta rufina* and Yellow-legged Gull *Larus michahellis*. Breeding population of Tufted Duck *Aythya fuligula* increased substantially after the construction of islands at Lake Ptuj (*own data*).

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New Island and both Gravel Islands at Lake Ptuj were financed by Dravske elektrarne Maribor d.o.o., whereas the Island at Lake Ormož was financed by Hrvatska elektroprivreda d.d. In the late 1990s, Wetlands International enabled stabilisation of Small Island at Lake Ptuj that was carried out by VGP Drava Ptuj d.o.o. We thank ELES d.o.o. for the possibility to improve breeding conditions at the transmission line platforms at Lake Ptuj. Mr. Mesarič and Mr. Habjanič from »Brodarsko društvo Ranca Ptuj« often offered help in transportation of volunteers to the Islands at Lake Ptuj and Komunalno podjetje Ptuj d.d.

showed much understanding when using access to Ptuj Lake. The Association Biom (BirdLife in Croatia) succeeded in their efforts to remove all illegal structures that acted as ecological traps for Common Tern at Lake Ormož – a problem that has influenced birds for years. Under its umbrella, management of the island at Lake Ormož was also started, and carried on since 2016 by the following members: Sandra Hodić, Tomislav Hudina, Biljana Ječmenica, Ivan Katanović, Monika Korša, Iva Šoštarić, Florbella Torres, Josip Turkalj and Mate Zec.

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5. Povzetek

V članku je obravnavana dolgoročna populacijska dinamika (1980–2019) kolonijskih vrst iz družine Laridae v celinski Sloveniji z opisi njihovih gnezdišč na antropogenih vodnih telesih in naravovarstvenih ukrepov s poudarkom na varstvu navadne čigre *Sterna hirundo* vzdolž slovenskega/mejnega dela reke Drave. Obravnavane vrste tu gnezdijo na zahodnem obrobju Panonske nižine, na nižinskih poplavnih ravnicah velikih rek donavskega povodja. Gnezdenje navadne čigre je bilo potrjeno na 11, rečnega galeba *Larus ridibundus* pa na 10 območjih. Ptujsko jezero je edino območje, na katerem je mešana kolonija obeh vrst gnezdila v celotnem obravnavanem obdobju. Pri Ormožu (na dveh območjih) je kolonija nastala v zgodnjih 90. letih na območju Slovenije, po letu 2010 pa se je povsem preselila na hrvaško stran. Na vseh drugih območjih so bila ustrezna gnezdišča, nastala naključno ali z upravljanjem, na voljo le nekaj let oz. narejena šele nedavno. V 80. in 90. letih je v kontinentalni Sloveniji gnezdilo več kot 50 % nacionalne populacije navadne čigre (52–136 parov), v zadnjih 16 letih pa 40,8–69,0 % (77–258 parov). Rečni galeb gnezdi skoraj izključno v celinski Sloveniji. Celinski populaciji obeh vrst sta v zadnjih letih bistveno večji, kot sta bili večino obdobja raziskave; dolgoročni trend za navadno čigro je bil ocenjen kot zmeren porast, za rečnega galeba pa kot močan porast. Črnoglavi galeb *L. melanocephalus* je reden gnezdilec Ptujskega jezera od leta 2006 (do 28 parov), kar je edino gnezdišče te vrste v državi. Podrobno so predstavljene tri splošne skupine naravovarstvenih ukrepov, izpeljane na različnih lokacijah: (1) ukrepi za povečanje obsega gnezditvenega habitata – izdelava novih gnezdilnih struktur, kot so umetni otoki in gnezditveni splavi, (2) ukrepi za ohranjanje in izboljšanje gnezditvenega habitata z vsakoletnim upravljanjem, in (3) ukrepi za izboljšanje preživetja gnezd in mladičev ter povečanje gnezditvenega uspeha.

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DODATEK / APPENDIX 1

Locations with breeding colonial Laridae species in continental Slovenia: Small Island at Lake Ptuj in May 1997 (a), on 21 Apr 2010 (b) and on 7 May 2018 (c); New Island at Lake Ptuj in the first breeding season after construction (Common Tern *Sterna hirundo* nests visible), 4 Jun 2005 (d), on 20 Apr 2012 (e) and on 7 May 2018 (f); Gravel Island 1 at Lake Ptuj in the first breeding season after construction, 30 Jun 2015 (g), on 11 May 2019 (h) and on 22 Jun 2019 (i); Gravel Island 2 at Lake Ptuj on 11 May 2019 (j) and on 24 Jul 2019 (k); left transmission line platform at Lake Ptuj, 23 May 2006 (l) and platform detail, 24 Apr 2019 (m); right transmission line platform at Lake Ptuj, 15 Jun 2012 (n); left sewer shaft platform at Lake Ptuj, 13 Jun 2015 (o); nest of a Black-headed Gull *Larus ridibundus* on a stranded large round hay bale at Lake Ptuj, 21 Apr 2017 (p); shingle surface exposed by decreasing water levels at Ormož Basins (Basin 3), 1 Jun 2011 (q); dry mudflats formed by sedimented industrial effluents at Ormož Basins (Basin 3), 24 May 2007 (r); Common Tern breeding on floating branches at Ormož Basins (Basin 4), (s); Nesting raft 1 (t), Nesting raft 2 (u) and Nesting raft 3 (v) at Ormož Basins; nesting locations at Lake Ormož in the first half of the 2010s – small hunting hide, 24 May 2014 (w), wooden fishing platform, 8 Feb 2009 (x), large hunting hide, 14 Feb 2009 (y), fishing hut, 25 Jan 2011 (z), fishing raft, 26 May 2014 (aa) and Double Island, 15 Jun 2012 (ab); Island at Lake Ormož in the first breeding season after construction, 28 May 2015 (ac) and on 7 Jun 2019 (ad); peninsula at Hoče gravel pit in both years with breeding recorded – Jul 1990 (ae) and Mar 1991 (af); Black-headed Gull nest site at Medvedce reservoir (ag); nesting platform at Lake Pernica just after construction, 20 Apr 2013 (ah); Island at Gajševci Lake (ai); nesting raft at Vrbina gravel pit, May 1999 (aj); heap of gravel at Stari Grad gravel pit, 10 May 2018 (ak); Island at Lake Brežice in the first breeding season after construction, 22 May 2018 (al). Photos: T. Basle (c, f, h, j, ad, ah, al), L. Božič (a, b, e, g, i, k–n, p, v–ac), D. Denac (d, s–v, ai), D. Klenovšek (aj, ak), M. Vogrin (o, ae, af), R. Tekavčič (q), D. Tome (r)

Lokacije z ugotovljenim gnezdenjem kolonijskih vrst iz družine Laridae v celinskem delu Slovenije: Mali otok na Ptujskem jezeru maja 1997 (a), 21. 4. 2010 (b) in 7. 5. 2018 (c); Novi otok na Ptujskem jezeru v prvi gnezditveni sezoni po izgradnji (vidna so gnezda navadne čigre *Sterna hirundo*), 4. 6. 2005 (d), 20. 4. 2012 (e) in 7. 5. 2018 (f); Prodnati otok 1 na Ptujskem jezeru v prvi gnezditveni sezoni po izgradnji, 30. 6. 2015 (g), 11. 5. 2019 (h) in 22. 6. 2019 (i); Prodnati otok 2 na Ptujskem jezeru 11. 5. 2019 (j) in 24. 7. 2019 (k); leva daljnovodna ploščad na Ptujskem jezeru, 23. 5. 2006 (l) in detajl ploščadi, 24. 4. 2019 (m); desna daljnovodna ploščad na Ptujskem jezeru, 15. 6. 2012 (n); leva ploščad kanalizacijskega jaška na Ptujskem jezeru, 13. 6. 2015 (o); gnezdo rečnega galeba *Larus ridibundus* na naplavljeni veliki okrogli bali na Ptujskem jezeru, 21. 4. 2017 (p); prodnata površina, izpostavljena zaradi upadajoče vodne gladine v Ormoških lagunah (bazen 3), 1. 6. 2011 (q); suhi poloji, nastali s sedimentacijo industrijskih izpustov v Ormoških lagunah (bazen 3), 24. 5. 2007 (r); navadna čigra, gnezdeča na plavajočih vejah v Ormoških lagunah (bazen 4) (s); Gnezdilni splav 1 (t), Gnezdilni splav 2 (u) in Gnezdilni splav 1 (v) v Ormoških lagunah; gnezditvene lokacije na Ormoškem jezeru v prvi polovici 2010-ih let – majhna lovska preža, 24. 5. 2014 (w), lesena ribiška ploščad, 8. 2. 2009 (x), velika lovska preža, 14. 2. 2009 (y), ribiška hišica, 25. 1. 2011 (z), ribiški splav, 26. 5. 2014 (aa) in Dvojni otok, 15. 6. 2012 (ab); otok na Ormoškem jezeru v prvi gnezditveni sezoni po izgradnji, 28. 5. 2015 (ac) in 7. 6. 2019 (ad); polotok v gramoznici Hoče v obeh letih z ugotovljenim gnezdenjem – julij 1990 (ae) in marec 1991 (af); gnezdišče rečnega galeba na zadrževalniku Medvedce (ag); gnezdilna platforma na Perniškem jezeru takoj po postavitvi, 20. 4. 2013 (ah); otok na Gajševskem jezeru (ai); gnezdilni splav na gramoznici Vrbina, maj 1999 (aj); kup proda v gramoznici Stari Grad, 10. 5. 2018 (ak); otok na Brežiškem jezeru v prvi gnezditveni sezoni po izgradnji, 22. 5. 2018 (al). Foto: T. Basle (c, f, h, j, ad, ah, al), L. Božič (a, b, e, g, i, k–n, p, v–ac), D. Denac (d, s–v, ai), D. Klenovšek (aj, ak), M. Vogrin (o, ae, af), R. Tekavčič (q), D. Tome (r)

(a)

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Nadaljevanje dodatka 1 / Continuation of Appendix 1

(i)

(j)

(k)

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(q)

(r)

(s)

(t)

(u)

(v)

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(x)

Nadaljevanje dodatka 1 / Continuation of Appendix 1

(y)

(z)

(aa)

(ab)

(ac)

(ad)

(ae)

(af)

(ag)

(ah)

(ai)

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APPENDIX 2 / DODATEK 2

Conservation measures implemented at different nesting locations of colonial Laridae species in continental Slovenia: (a) mowing with sickle bar mower and brush cutter on New Island, (b) ground covered by plastic foil and wood chips on New Island, intended to delay vegetation growth, and grid of plastic strings supported by wooden poles placed above it to prevent Black-headed Gulls *Larus ridibundus* from occupying this area, (c) sparsely vegetated area on New Island after removal of plastic foil, with breeding Common Terns *Sterna hirundo*, (d) removal of pioneer woody vegetation from the island at Lake Brežice using gardening tools, (e) right transmission line platform after removal of vegetation and guano layer, (f) manual pulling of herbaceous vegetation on Gravel Island 1, (g) the plot with wood chips during the breeding of Common Terns, (h) area of c. 100 m^2 on New Island covered with pine bark wood chips, (i) aerial view of the latter area with colony of Mediterranean Gull *L. melanocephalus*, (j) erosion hole dangerous to chicks along the interior edge of Gravel Island 1, (k) protective chicken wire fence along the perimeter of transmission line platform, preventing chicks from falling into the water (Black-headed Gull chicks on the photo), (l) installation of chicken wire along the vertical outer edge of Gravel Island 1, (m) plastic fence along the outer edge of Gravel Island 2 aimed to prevent access of Mute Swans *Cygnus olor* to the gravel surface of the island, (n) section along the interior edge of the gravel island fenced with plastic mesh, protected with plastic foil on the lower part, to prevent chicks falling through gaps in the array of wooden poles, (o) grid of plastic strings placed over the plateau surface of Small Island, which did not prevent Yellow-legged Gull *L. michahellis* from breeding there (nest visible in the centre), (p) Wooden chick shelter placed on transmission line platform with Common Tern chicks, (q) chick shelters 30 × 15 cm on Nesting raft 3 which did not prevent severe predation of Common Tern and Black-headed Gull chicks by Goshawk *Accipiter gentilis*, (r) a portable, battery-powered electric fence installed around the plateau of the Island at Lake Ormož did not prevent the Eurasian Otter *Lutra lutra* entering the fenced area during the breeding of Common Terns. Photos: T. Basle (i), G. Bernard (d), L. Božič (b, g, m–o), D. Denac (a, e, f, h, j–l, p, q), T. Hudina (r)

Naravovarstveni ukrepi, izpeljani na različnih gnezditvenih lokacijah kolonijskih vrst iz družine Laridae v celinski Sloveniji: (a) košnja s samohodno in nahrbtno kosilnico na Novem otoku, (b) površina prekrita s plastično folijo in lesnimi sekanci, namenjenimi zaviranju rasti vegetacije, ter mreža iz plastičnih vrvic nad njo za preprečevanje naselitve rečnih galebov *Larus ridibundus*, (c) skromno poraščena površina na Novem otoku po odstranitvi plastične folije, z gnezdečimi navadnimi čigrami *Sterna hirundo*, (d) odstranjevanje pionirske lesnate vegetacije z otoka na Brežiškem jezeru z uporabo vrtnarskega orodja, (e) desna daljnovodna ploščad po odstranitvi vegetacije in plasti gvana, (f) ročno puljenje zelnate vegetacije na Prodnatem otoku 1, (g) ploskev z lesnimi sekanci v času gnezdenja navadne čigre, (h) površina na Novem otoku velikosti c. 100 m^2, prekrita s sekanci borovega lubja, (i) pogled iz zraka na slednjo površino s kolonijo črnoglavega galeba *L. melanocephalus*, (j) mladičem nevarna erozijska luknja vzdolž notranjega roba Prodnatega otoka 1, (k) zaščitna žična ograja vzdolž oboda daljnovodne ploščadi za preprečevanje padanja mladičev v vodo (na sliki so mladiči rečnega galeba), (l) nameščanje žične ograje vzdolž navpičnega zunanjega roba Prodnatega otoka 1, (m) plastična ograja vzdolž navpičnega zunanjega roba Prodnatega otoka 2, namenjena preprečevanju dostopa labodov grbcev *Cygnus olor* na prodnato površino otoka, (n) odsek na notranjem robu prodnatega otoka s plastično mrežo, zaščiteno s plastično folijo na spodnjem delu, za preprečevanje padanja mladičev v vodo skozi vrzeli v nizu lesenih pilotov, (o) mreža iz plastičnih vrvic, nameščena čez ravno površino Malega otoka, ki ni preprečila gnezdenja rumenonogega galeba *L. michahellis* (gnezdo vidno na sredini), (p) leseno zatočišče za mladiče na daljnovodnem podstavku z mladiči navadne čigre, (q) zatočišča za mladiče 30 × 15 cm na Gnezdilnem splavu 3, ki niso preprečila velikega plenjenja mladičev navadne čigre in rečnega galeba s strani kragulja *Accipiter gentilis*, (r) prenosna baterijska električna ograja, nameščena okoli ravne površine otoka na Ormoškem jezeru, ni preprečila vstopa vidre v ograjeno območje v času gnezdenja navadne čigre. Foto: T. Basle (i), G. Bernard (d), L. Božič (b, g, m–o), D. Denac (a, e, f, h, j–l, p, q), T. Hudina (r)

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Nadaljevanje dodatka 2 / Continuation of Appendix 2

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