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Spring migration of waterbirds and raptors at Medvedce reservoir (Dravsko polje, NE Slovenia)

Spomladanska selitev vodnih ptic in ujed na zadrževalniku Medvedce (Dravsko polje, SV Slovenija)

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Spring migration of birds, particularly waterbirds and raptors, was monitored from dawn till dusk from an observation point located on the levee on the northern side of the Medvedce reservoir (Dravsko polje, NE Slovenia) in three separate years (1–17 Mar 2009; 25 Mar–10 Apr 2011; 28 Feb–12 Apr 2012). In all three years, 42,045 individuals of 89 species (66 waterbirds, 23 raptors) migrated over the site. 38,238 of these were waterbirds. The most numerous species was Lapwing *Vanellus vanellus* (11,813 individuals), followed by Black-headed Gull *Chroicocephalus ridibundus* (10,515 individuals). In total, 3807 migratory storks, raptors and Cranes *Grus grus* were counted. Harriers (2303 individuals) were by far the most numerous group. The prevailing direction of migration was SW–NE. Half of all migrating birds were observed in the altitudinal belt between 10 and 100 m above ground level. Harriers were mostly observed up to 100 m above ground level, whereas storks, other raptors and Cranes were observed most often in the altitudinal belt between 100 and 500 m above ground level. The highest numbers of waterbirds were observed between 10 and 100 m above ground level. In the first five hours after sunrise, 61.3% of all waterbirds, 44.0% of all storks and raptors and only 20.5% of Cranes were observed. Although other parts of Dravsko polje have never been studied in such detail, it is possible that a significant portion of migrating birds from a larger area gathers at this site. This study confirms the importance of the area for migrating and staging birds, especially for Great Egret *Ardea alba*, Marsh *Circus aeruginosus* and Hen Harriers *C. cyaneus*, Osprey *Pandion haliaetus*, Crane, Ruff *Calidris pugnax* and Black-headed Gull that all reached at least 0.1% of their respective biogeographic populations. Internationally significant are particularly the numbers of migrating Marsh (1079 individuals in 2012) and Hen Harriers (408 individuals in 2012), as there are only few sites where these species migrate in such high numbers in spring.

Key words: waterbirds, raptors, spring migration, Medvedce, Marsh Harrier, *Circus aeruginosus*, Hen Harrier, *Circus cyaneus*
Ključne besede: vodne ptice, ujede, spomladanska selitev, Medvedce, rjavi lunj, *Circus aeruginosus*, pepelasti lunj, *Circus cyaneus*

1. Introduction

Many migratory bird species use well established migration routes (Newton 2008). Waterbirds generally follow one of the many flyways known around the world. Flyways are areas used by a number of species with similar geographical ranges and migration habits. However, the distribution and movements of many waterbird species are more continuous and complex, and do not allow ready division into populations (Delany & Scott 2006). Moreover, some species may even switch between well-established flyways during their lifetime (Guillemain *et al.* 2005). Finally, birds found at particular stop-over sites may

belong to several different flyways (Delany & Scott 2006). On the other hand, many raptors, specifically soaring ones, congregate at bottlenecks (Agostini & Loghozzo 1995, Jonzén & Pettersson 1999, Zalles & Bildstein 2000, Schneider-Jacoby 2001, Agostini *et al*. 2003, Newton 2008, Premuda *et al*. 2008, Probst 2009, Denac 2010, Michev *et al*. 2012) and thus take markedly different flight routes from those used by waterbirds or passerines (Newton 2008). This means that in Europe most waterbirds and many raptors using flapping flight migrate in E–W or NE–SW directions (Shydlovskyy 2000, Hake *et al*. 2001, Agostini *et al*. 2003, Leitão & Peris 2004, Davidson & Stroud 2006, Delany & Scott 2006, Limiñana *et al*. 2007, Premuda *et al*. 2008, Strandberg *et al*. 2008). Soaring birds, on the other hand, migrate towards the nearest bottleneck and then continue southwards (Meyburg *et al*. 1998, Berthold *et al*. 2002, Meyburg & Meyburg 2007).

Raptors were counted at several sites in western Slovenia both in spring and autumn, but there was only one study that utilized daily counts lasting the entire day, every day during migration (Denac 2010). This study confirmed assumptions of several previous incomplete counts that Breginjski Stol near Kobarid was a bottleneck for migrating raptors, the majority of which were Honey Buzzards *Pernis apivorus*. In eastern Slovenia, no such counts have been carried out, although Dravsko polje was listed as an important area for migrating raptors, especially Harriers *Circus* sp. and Ospreys *Pandion haliaetus* (Zalles & Bildstein 2000). No such study exists for waterbirds or passerines. This is at least partly due to their habit of nocturnal migration along a broad front (Newton 2008). Passerine migration is monitored at several more or less regular ringing sites (Vrezec *et al*. 2014), while waterbirds are counted at the national level during mid-winter counts (e.g. Božič 2014). Daily counts were performed in Sečovlje saltpans (Jančar 1995) and at reservoirs on the Drava River for monitoring migrating *Chlidonias* terns (L. Božič *pers. comm*.). Systematic, but not daily, counts were performed e.g. at the Medvedce reservoir

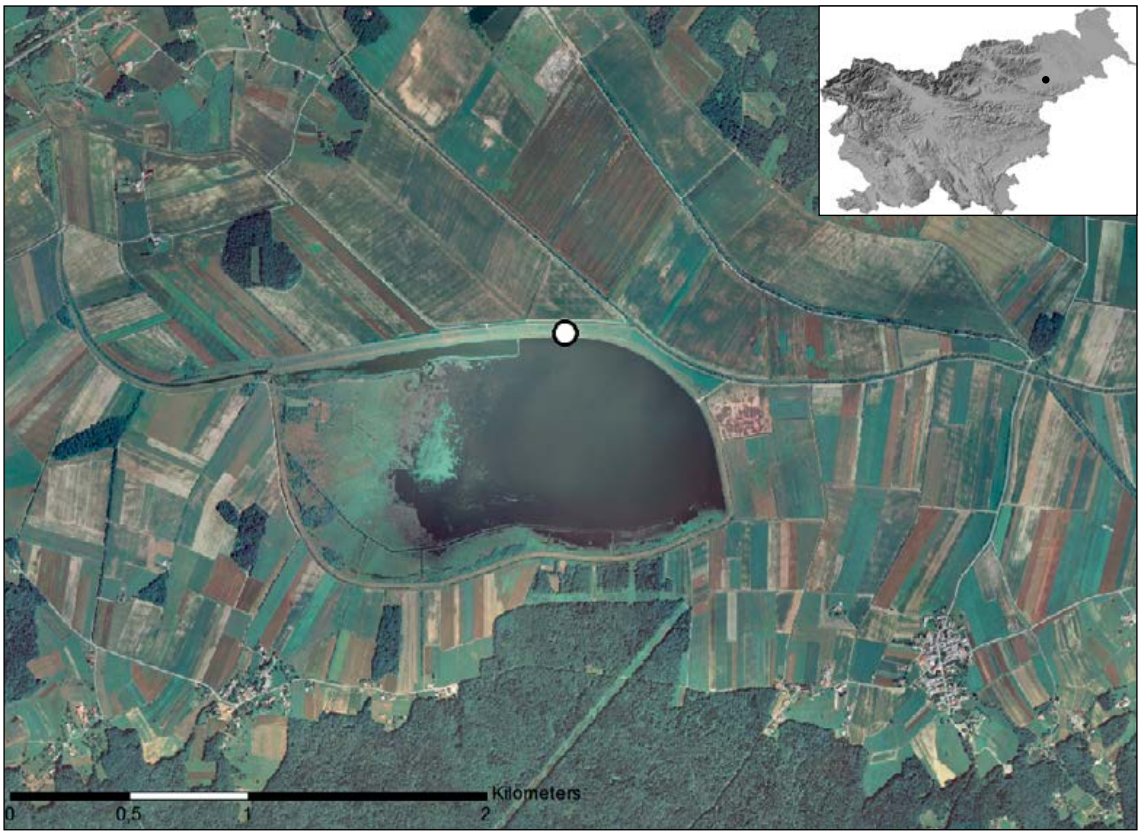

Figure 1: Study area with the observation point (scale 1:20,000)

Slika 1: Območje raziskave z opazovalno točko (merilo 1:20.000)

(Bordjan & Božič 2009), lakes in the Gorenjska region (Jančar *et al*. 2007), Drava River in Maribor (Logar & Božič 2014) and Lake Cerknica (Bordjan 2012). Birds moving to and from Lake Ptuj were monitored for two whole days along the Drava River and some migrants were also observed (Štumberger & Šorgo 1995). Several papers have been published on migration at Dravsko polje (Vogrin 1997, 1998a, b, c, 1999) but none with daily point counts.

The systematic counts of waterbirds and raptors in ten-day periods were implemented at the Medvedce reservoir in 2002 (Bordjan & Božič 2009) and are still being conducted. Although the counts were not designed to detect migration, observations were gathered that suggested substantial migration for some species. These data along with many observations at other parts of Dravsko polje (Božič 1992, Vogrin 1997, Bordjan 2007) were the actual reason for this study. Its aim was to evaluate size, spatial and temporal characteristics of spring migration of waterbirds and raptors at the Medvedce reservoir.

2. Study area and methods

2.1. Study area

Migration was monitored at the Medvedce water reservoir southeast of Pragersko in northeastern Slovenia (46°22'08" N; 15°40'04" E). The reservoir, which is utilized as a fishpond, is surrounded by intensively managed meadows and arable fields. It is situated at the southwestern corner of Dravsko polje approximately midway between Pohorje Mts (1543 m a.s.l.) and Mt Boč (978 m a.s.l.) at an altitude of 239 m a.s.l. The site is surrounded by low rolling hills to the west and south, and by flatlands to the north and east. Further characteristics of the study area were described in more detail by Bordjan & Božič (2009).

2.2. Methods

Spring migration was monitored in three separate years. Counting periods were as follows: 1–17 Mar 2009 (17 days); 25 Mar–10 Apr 2011 (17 days); 28 Feb–12 Apr 2012 (45 days). In 2009, the primary focus of monitoring was the migration of Lapwings *Vanellus vanellus*, thus the period was chosen accordingly. Periods in 2011 and 2012 were chosen based on previous experiences to cover the peak migration of Marsh Harriers *Circus aeruginosus*. The observation point was on the levee on the northern side of the reservoir (Figure 1). Daily monitoring lasted from dawn till dusk and was shortened only on days with prolonged rain and fog. Due to various reasons, monitoring was not conducted for one day in 2009 and 2011 respectively and for five days in 2012 (Table 1). Birds roosting in reed beds at the study site were counted separately.

Observers were constantly scanning the surrounding area in all directions with binoculars and spotting scopes (20–60x magnification). Apart from the weather conditions described in Denac (2010) we also noted the presence of fog and relative visibility. The latter was described as good, average or poor. In general, poor was used in case of fog, low clouds or drizzling rain. Each morning upon arrival at the site, weather was described and any significant change noted thereafter. Species were identified to the lowest possible taxonomic level. If possible, individuals were also sexed and aged. Data on their numbers, exact time of observation and direction of flight were recorded as by Denac (2010). Codes used for the height of individual flight were as follows: 0: < 10 m above ground, 1: 10–100 m above ground, 2: 100–500 m above ground, 3: birds visible with binoculars, but not with the naked eye, 4: birds visible only with spotting scopes. Although no exact measurements were made, 3 and 4 were taken as an estimate of > 500 and > 1000 m above ground respectively. To analyse the intensity of migration by time of day we used the time elapsed from the local sunrise, which was at 6.37 hrs on 28 Feb and 6.25 hrs on 10 Apr, with a transition to European Summer Time on 25 Mar. To compare migration characteristics among different groups of birds, the χ^2-test was used. Spearman's rank coefficient was used for correlations between variables. *P*-values lower than 0.05 were considered significant.

The main foci of the study were waterbirds and raptors. Other species observed during the study are presented in Appendix 1. Due to some similarities in migration (e.g. using thermals, diurnal migration), Cranes *Grus grus* and storks were analysed together with raptors. Movements of known local breeding pairs and local movements to and from feeding sites such as flooded fields were excluded from the analysis. The distinction between true migration and local movements was made by observers on-site. For estimating the migration of waterbirds, which migrate mostly during the night, the daily difference in their numbers was used. Only days with positive (higher number on the following day) were counted. For example, if the daily numbers for a particular species were 100, 95, 36, 50, 12, 112, only the first, the fourth and the sixth days were counted. In that case the estimate was calculated as follows: 100 (*the number on the first day*) + (50 – 36 (*the difference between the fourth and third days*)) + (112 – 12 (*the difference between the sixth and fifth days*)) = 214.

Table 1: The number of observers and weather conditions for all three monitoring periods

Tabela 1: Število opazovalcev in vremenske razmere v vseh treh obdobjih monitoringa

	Date/ Datum	No. of observers/ Št. opazovalcev	No survey/ Brez popisa	Cloud cover/ Oblačnost (%)	Precipitation/ Padavine	Fog/ Megla	Visibility/ Vidljivost	Wind (intensity, direction)/ Veter (jakost, smer)
2009	1. 3.	1		0		Yes	Average / Povprečna	0–2, SW
	2. 3.	1		100			Good / Dobra	0
	3. 3.	1		100		Yes	Average / Povprečna	0
	4. 3.	1	*	0	Rain / Dež		Bad / Slaba	1, W
	5. 3.	1		100	Rain / Dež		Average / Povprečna	0
	6. 3.	2		10			Good / Dobra	2, changing direction/ spremenljiva smer
	7. 3.	1		60			Good / Dobra	2, SW
	8. 3.	3		10			Good / Dobra	1, SE
	9. 3.	1		100	Rain / Dež		Good / Dobra	2, NW
	10. 3.	1		20			Good / Dobra	1, SE
	11. 3.	1		10			Good / Dobra	2
	12. 3.	1		93			Good / Dobra	1
	13. 3.	1		60			Good / Dobra	1
	14. 3.	1		33			Good / Dobra	1
	15. 3.	2		80			Good / Dobra	
	16. 3.	1		100			Good / Dobra	2, SW
	17. 3.	1		40			Good / Dobra	1, SW
2011	25. 3.	2		0–70			Good / Dobra	0–4, SW
	26. 3.	3		20–80			Good / Dobra	3–4, NE
	27. 3.	2		50–100			Good / Dobra	0–1, SE
	28. 3.	1	*	100	Rain / Dež	Yes	Average to Bad/ Povprečna do slaba	1–2, SE
	29. 3.	1		10–70		Yes	Average to Bad/ Povprečna do slaba	0–1, changing direction/ spremenljiva smer
	30. 3.	2		0		Yes	In the morning Bad, later Good / Slaba zjutraj, dobra pozneje	1–3, SW
	31. 3.	2		0–10			Good / Dobra	0–2, changing direction/ spremenljiva smer
	1. 4.	2		50–100	Occasional rain/ Občasen dež		Good / Dobra	0–1, changing direction/ spremenljiva smer
	2. 4.	2		0			Good / Dobra	0
	3. 4.	1		0–15			Good / Dobra	0–1, SW
	4. 4.	1		5–80			Good / Dobra	0–4, changing direction/ spremenljiva smer
	5. 4.	1		20–70	Occasional rain/ Občasen dež		Good / Dobra	1–3, NW, NE

Continuation of Table 1 / Nadaljevanje tabele 1

	Date/ Datum	No. of observers/ Št. opazovalcev	No survey/ Brez popisa	Cloud cover/ Oblačnost (%)	Precipitation/ Padavine	Fog/ Megla	Visibility/ Vidljivost	Wind (intensity, direction)/ Veter (jakost, smer)
	6. 4.	1		10–60			Good / Dobra	0–1, NW
	7. 4.	2		10–85			Good / Dobra	0–2, SW
	8. 4.	1		30–100			Good / Dobra	0–3, NE, SW
	9. 4.	3		10			Good / Dobra	1–3, SW
	10. 4.	4		0			Good / Dobra	1, changing direction/ spremenljiva smer
	28. 2.	1		0			Average / Povprečna	1, SW
	29. 2.	1	*	0			Average / Povprečna	1, SW
	1. 3.	3		40–50			Good / Dobra	1–2, NE, SE
	2. 3.	2		0			Good / Dobra	0–1, E
	3. 3.	2		0–100			In the morning Bad, later Good / Slaba zjutraj, dobra pozneje	0–1, NE
	4. 3.	2		60			Good / Dobra	1–2, E
	5. 3.	1		60–100			Average / Povprečna	0–2, E, NE
	6. 3.	0	*	50			Good / Dobra	1
	7. 3.	1		0			Good / Dobra	1
	8. 3.	1		30			Good / Dobra	1
	9. 3.	1		50			Good / Dobra	1
2012	10. 3.	2		0			Good / Dobra	2, NE
	11. 3.	2		30–100			Good / Dobra	0–2, changing direction/ spremenljiva smer
	12. 3.	1		90			Good / Dobra	1
	13. 3.	1		20–100			In the morning Bad, later Good / Slaba zjutraj, dobra pozneje	0–2, changing direction/ spremenljiva smer
	14. 3.	1		5			Good / Dobra	1
	15. 3.	1		30			Good / Dobra	1
	16. 3.	5		0		Yes	In the morning Bad, later Good / Slaba zjutraj, dobra pozneje	1–3, changing direction/ spremenljiva smer
	17. 3.	2		0			Good / Dobra	4, SW
	18. 3.	1		75–100			Good / Dobra	4–6, SW
	19. 3.	1		0–60		Yes	In the morning Bad, later Good / Slaba zjutraj, dobra pozneje	1, changing direction/ spremenljiva smer
	20. 3.	0	*	60			Good / Dobra	2
	21. 3.	1		0		Yes	In the morning Bad, later Good / Slaba zjutraj, dobra pozneje	1, changing direction

Continuation of Table 1 / Nadaljevanje tabele 1

Date/ Datum	No. of observers/ Št. opazovalcev	No survey/ Brez popisa	Cloud cover/ Oblačnost (%)	Precipitation/ Padavine	Fog/ Megla	Visibility/ Vidljivost	Wind (intensity, direction)/ Veter (jakost, smer)
22. 3.	3		0			In the morning Average, later Good/ Povprečna zjutraj, dobra pozneje	1, changing direction/ spremenljiva smer
23. 3.	1		10–30			Average / Povprečna	1–3, SW
24. 3.	2		10–70			Good / Dobra	0–2, N
25. 3.	4		10–90			Good / Dobra	0
26. 3.	1		10			Good / Dobra	0–2, NW, NE
27. 3.	2		0–30			Good / Dobra	0
28. 3.	2		0			Good / Dobra	0
29. 3.	2		100			Good / Dobra	0–1, SE, NE
30. 3.	1		77			Good / Dobra	1–2, SW, NE
31. 3.	1		0–80			Good / Dobra	0–3, changing direction/ spremenljiva smer
1. 4.	1		0–40			Good / Dobra	0–2, SE, NE
2. 4.	1		10			Good / Dobra	2, SW
3. 4.	1		10			Average / Povprečna	4, SW
4. 4.	1		10–90			Good / Dobra	0–3, SW
5. 4.	1		70			Average / Povprečna	1
6. 4.	0	*	100	Rain / Dež		Average / Povprečna	2
7. 4.	2		50–100	Rain / Dež		Bad / Slaba	1, changing direction/ spremenljiva smer
8. 4.	1		100	Snow / Sneg		Average / Povprečna	2, NE
9. 4.	1		0–30			Good / Dobra	0–1, changing direction/ spremenljiva smer
10. 4.	0	*	40			Average / Povprečna	2
11. 4.	1		50–100			Average / Povprečna	0–1, SW
12. 4.	1		70			Average / Povprečna	0–1, changing direction/ spremenljiva smer

Mallard *Anas platyrhynchos* and Cormorant *Phalacrocorax carbo* were excluded from this, since the former regularly winters at the site and breeds in significant numbers (Bordjan & Božič 2009). Moreover, its peak migration occurs earlier in the year (Cramp 1998). Finally, Mallards regularly fly between the study site and other water bodies at Dravsko polje. Cormorants roost along the Drava River and fly to the study site every morning, returning in the evening. Different numbers could therefore simply reflect the change in feeding areas between days. For the Great White Egret *Ardea alba*, numbers from roost counts were used.

3. Results

3.1. Migration totals

In all three years, 42,045 individuals of 89 species (66 waterbirds, 23 raptors) were counted. The highest

number for both groups was counted in 2012 and the lowest in 2009 (Table 2). In total, four species had more than 1000 individuals (Tables 3 and 4), two of which had more than 10,000 (Lapwing; Black-Headed Gull *Chroicocephalus ridibundus*). 25 (28.1%) species were encountered in only one year, while 38 (42.7%) were observed in all three years (Tables 3 and 4).

3.2. Waterbirds

In total, 38,238 migratory waterbirds were counted. The highest number was recorded in 2012 and the lowest in 2011 (Table 2). The most numerous species on migration was Lapwing with 11,813 individuals (31.0%) closely followed by Black-headed Gull with 10,515 (27.5%) individuals. Ten species each presented more than 1% of all migrating waterbirds but only Ruff *Calidris pugnax* reached more than 2% with 6078 individuals (15.7%; Table 3). Out of 66 observed species of waterbirds the highest number was observed in 2012 (58) and the lowest in 2009 (34). 29 species were seen in all three years, while 18 were seen in one year only (Table 3).

The migration of waterbirds peaked in mid-March (Figure 2). The strongest migration was observed on 12 Mar 2012 when 2326 individuals were counted. In all three years, more than 1000 migrating individuals were counted on eight days. On average, 520 individuals (SD 385) were observed per day (lowest in 2011: 323 individuals/day; SD 124 and highest in 2012: 661 individuals/day; SD 430). There was no obvious trend in the number of migrating waterbirds through the entire period (R_S = -0.14, P = 0.234, df = 64), but if the period was divided in two parts the number of migrating individuals rose till 13 Mar (R_S = 0.43, P = 0.026, df = 23) and declined subsequently (R_S = -0.43, P = 0.002, df = 39).

3.3. Storks, raptors and Cranes *Grus grus*

In total, 3807 migratory storks, raptors and Cranes were counted; the most in 2012 and the fewest in 2009 (Table 2). Of 23 registered species, nine were observed in all three counting periods, while five were observed both in 2011 and 2012 (Table 4). One species was observed only in 2011 and six only in 2012.

Harriers were by far the most numerous migrants in this group, accounting for 60.5% (Table 4). They accounted for more than half birds in this group in all observation periods (from 55.0% in 2012 to 88.0% in 2009). Among harriers, Marsh Harriers were the most numerous. The 5% threshold for migrating storks, raptors and Cranes in any given year was attained by four other species (Table 4): Hen Harrier (2009: 52.6%; 2012: 15.0%), Buzzard *Buteo buteo* (2012: 11.6%), Osprey *Pandion haliaetus* (2011: 8.2%) and Crane (2011: 8.0%; 2012: 24.1%).

Raptors were observed on migration from the first day of monitoring onwards (Figure 3). The highest number was counted on 7 Apr 2012 with 173 individuals. More than a hundred individuals were counted on ten days during the survey. On average in all three years, 51 individuals (SD 42) were observed per day. Considering separate years 20 (2009; SD 15), 45 (2011; SD 29) and 66 (2012; SD 46), individuals were counted on an average day. The number of migrating storks, raptors and Cranes increased towards the beginning of April (R_S = 0.29, P = 0.012, df = 73).

3.4. Migration characteristics

The majority of birds arrived to the area from the SW (30.5%) and W (28.3%) and departed towards the NE (44.7%) and E (28.9%) (Figure 4). Although this was generally true for both groups of birds, there was a

Table 2: Numbers of waterbirds and storks, raptors and Cranes *Grus grus* counted during spring migration in 2009, 2011 and 2012 at Medvedce reservoir

Tabela 2: Število vodnih ptic ter štorkelj, ujed in žerjavov *Grus grus*, preštetih med spomladansko selitvijo v letih 2009, 2011 in 2012 na zadrževalniku Medvedce

	Waterbirds / Vodne ptice		Storks, raptors, Cranes *Grus grus*/ Štorklje, ujede, žerjavi *Grus grus*	
	All / Vse	Migratory / Selivke	All / Vse	Migratory / Selivke
2009	15290	6303	561	325
2011	18646	5355	1031	765
2012	73694	26580	3610	2717
Total / Skupaj	107630	38238	5223	3807

Table 3: Number of migratory waterbirds counted during spring migration in 2009, 2011 and 2012 at Medvedce reservoir

Tabela 3: Število preštetih vodnih ptic med spomladansko selitvijo v letih 2009, 2011 in 2012 na zadrževalniku Medvedce

Species / Vrsta	2009	2011	2012	Species / Vrsta	2009	2011	2012
Cygnus olor	19	30	126	*Gallinula chloropus*	1	6	4
Anser albifrons			153	*Fulica atra*	103	16	634
Anser anser	35		68	*Himantopus himantopus*		47	13
Tadorna tadorna		6		*Charadrius dubius*		99	11
Anas penelope	54	9	133	*Charadrius hiaticula*			1
Anas strepera	17	7	49	*Charadrius morinellus*			1
Anas crecca	154	55	409	*Pluvialis apricaria*	13	5	94
Anas carolinensis		1		*Pluvialis squatarola*		1	
Anas platyrhynchos	688*	316*	1180*	*Vanellus vanellus*	3352	1665	6796
Anas acuta	115		84	*Calidris alpina*		6	8
Anas querquedula	112	155	421	*Calidris pugnax*	309	1248	4521
Anas clypeata	22	206	294	*Lymnocryptes minimus*			2
Netta rufina	3		12	*Gallinago gallinago*	69	86	369
Aythya nyroca	13	7	29	*Numenius phaeopus*		7	28
Aythya fuligula	31	52	136	*Numenius arquata*	2	12	19
Aythya fuligula x marila			1	*Actitis hypoleucos*		5	19
Bucephala clangula	3	1	1	*Tringa ochropus*	13	61	119
Mergellus albellus	3			*Tringa erythropus*		7	36
Mergus serrator			1	*Tringa nebularia*	2	46	94
Mergus merganser	14		77	*Tringa stagnatilis*		36	4
Phalacrocorax carbo	35	9	302	*Tringa glareola*		185	162
Botaurus stellaris		1	14	*Chroicocephalus ridibundus*	1155	520	8840
Nycticorax nycticorax			4	*Larus melanocephalus*		2	6
Egretta garzetta		2		*Larus canus*	126	13	501
Ardea alba	123	100	416	*Larus fuscus*		5	4
Ardea cinerea	23	204	310	*Larus michahellis*	91	17	264
Ardea purpurea			4	*Larus cachinnans*		11	101
Tachybaptus ruficollis	29	248	197	*Alcedo atthis*	2		4
Podiceps nigricollis		1	7	*Charadrius* sp.			4
Porzana porzana		1		Tringidae			6
Porzana parva		1		Laridae			1

* Only maximum counts are given and not added to total sum. / Podana so le najvišja števila, ki niso prišteta celotni vsoti.

significant difference in both arrival (χ^2 = 940.1; P < 0.001; df = 7) and departure directions (χ^2 = 567.6; P < 0.001; df = 7) between the two groups. Storks, raptors and Cranes arrived mostly from the SW and W (83.4%), whereas waterbirds arrived from other direction on almost half occasions (46.3%). Storks, raptors and Cranes departed mostly towards the NE (62.0%), whereas in waterbirds the direction of departure was more evenly distributed between the NE (42.0%) and E (29.9%).

50.7% of all migrating birds were observed at altitudes between 10 and 100 m above ground (Figure 5). Harriers were significantly more often observed at lower heights than storks, other raptors and Cranes (χ^2 = 567.1; P < 0.001; df = 4). Harriers

Table 4: Number of storks, raptors and Cranes *Grus grus* counted during spring migration in 2009, 2011 and 2012 at Medvedce reservoir

Tabela 4: Število štorkelj, ujed in žerjavov *Grus grus* preštetih med spomladansko selitvijo v letih 2009, 2011 in 2012 na zadrževalniku Medvedce

Species / Vrsta	2009	2011	2012	Species / Vrsta	2009	2011	2012
Ciconia ciconia		28	19	*Aquila heliaca*			1
Milvus migrans		12	6	*Pandion haliaetus*	9	63	100
Milvus milvus		2		*Falco tinnunculus*	*	5	13
Circus aeruginosus	115	496	1079	*Falco columbarius*			5
Circus cyaneus	171	24	408	*Falco subbuteo*			2
Circus macrourus		2	4	*Falco peregrinus*	3	5	19
Circus pygargus		1	3	*Asio flammeus*		1	1
Accipiter gentilis	10	2	24	*Grus grus*		61	656
Accipiter nisus	9	9	43	*Circus* sp.		8	1
Buteo buteo	5	32	316	*Falco* sp.		1	
Buteo lagopus			2	Raptor / Ujeda		2	

* The species was observed, but none of the individuals were counted as migratory. / Vrsta je bila opazovana, vendar noben osebek ni bil štet kot seleč.

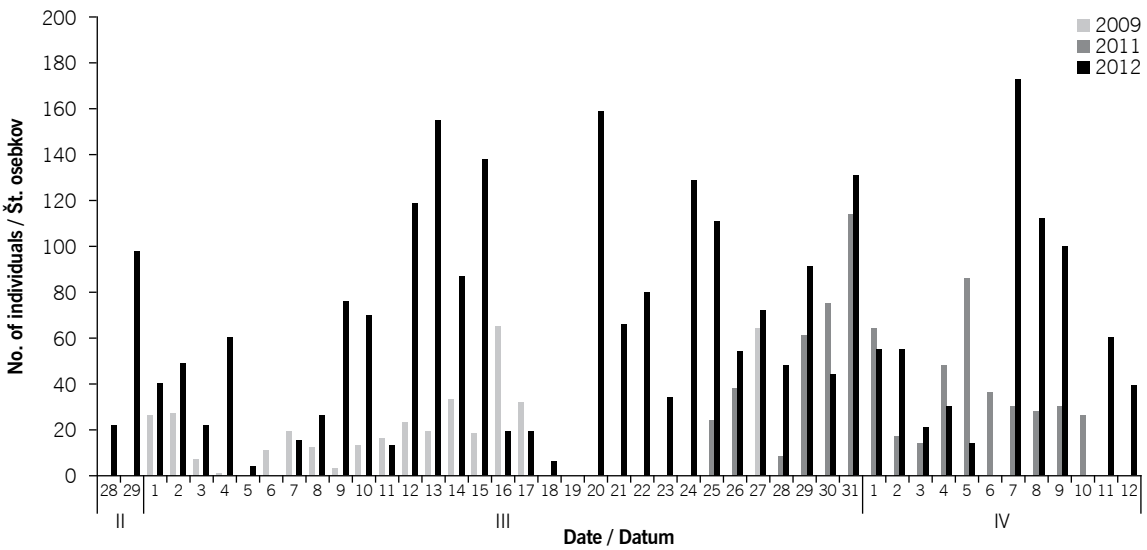

Figure 2: Phenology of migrating waterbirds counted in 2009, 2011 and 2012 between the end of February and the first half of April at Medvedce reservoir

Slika 2: Fenologija selečih se vodnih ptic, preštetih v letih 2009, 2011 in 2012 med koncem februarja in prvo polovico aprila na zadrževalniku Medvedce

were observed in the two lower belts (< 10 m: 40.4%; 10–100 m: 42.1%) in similar percentage, whereas storks and other raptors were observed most often (48.6%) at altitudes between 100 and 500 m (Figure 3). Cranes were observed at that altitude in an even higher percentage (66.5%) and their altitudinal distribution was significantly different from that of storks and raptors ($\chi^2 = 32.1$; $P < 0.001$; df = 4). Waterbirds also had a different altitudinal distribution from other groups, with the highest numbers observed between 10 and 100 m above ground (54.1%).

In the first five hours after sunrise, almost two thirds of all waterbirds (61.3%), fewer than half of all storks and raptors (44.0%) and only 20.5% of Cranes were observed.

The peak in migration of waterbirds was in the first two hours after sunrise (Figure 6). Thereupon, migration receded (R_S = -0.92, P < 0.001, df = 13). Most Cranes migrated over Medvedce in the late afternoon with 67.7% more than 9 hours after sunrise (Figure 6). Storks and raptors, which reached a peak in daily migration between the fourth and fifth hours after sunrise, had a significantly different hourly distribution from that of waterbirds (χ^2 = 1135.8, P < 0.001, df = 13). Waterbirds reached 50% of migrating individuals in the first four hours after sunrise, storks and raptors in the first six hours and Cranes in the first 11 hours after sunrise.

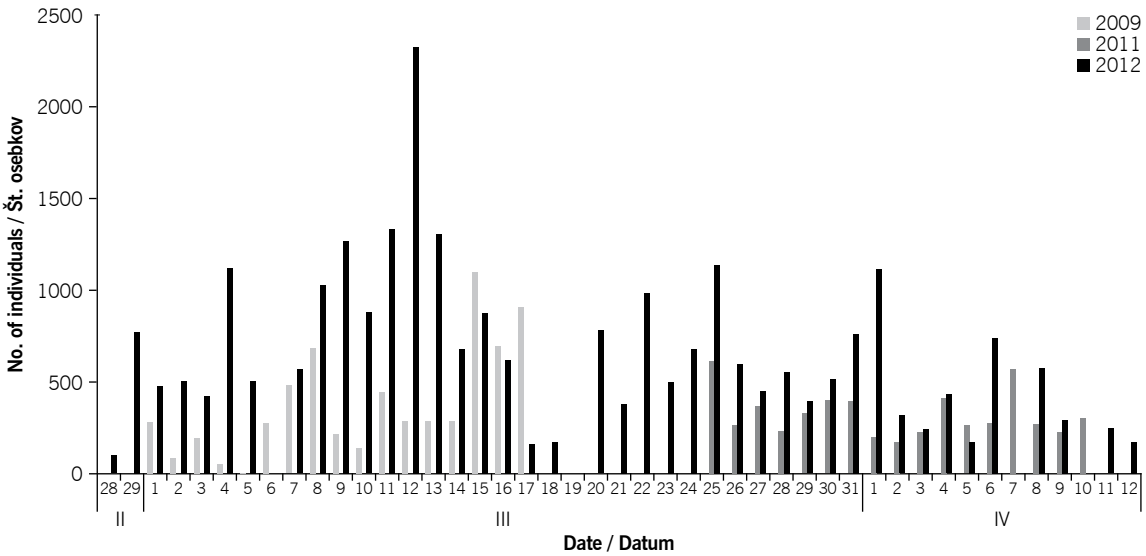

Figure 3: Phenology of migrating storks, raptors and Cranes *Grus grus* counted in three separate years between the end of February and the first half of April at Medvedce reservoir

Slika 3: Fenologija selečih se štorkelj, ujed in žerjavov *Grus grus*, preštetih v treh letih med koncem februarja in prvo polovico aprila na zadrževalniku Medvedce

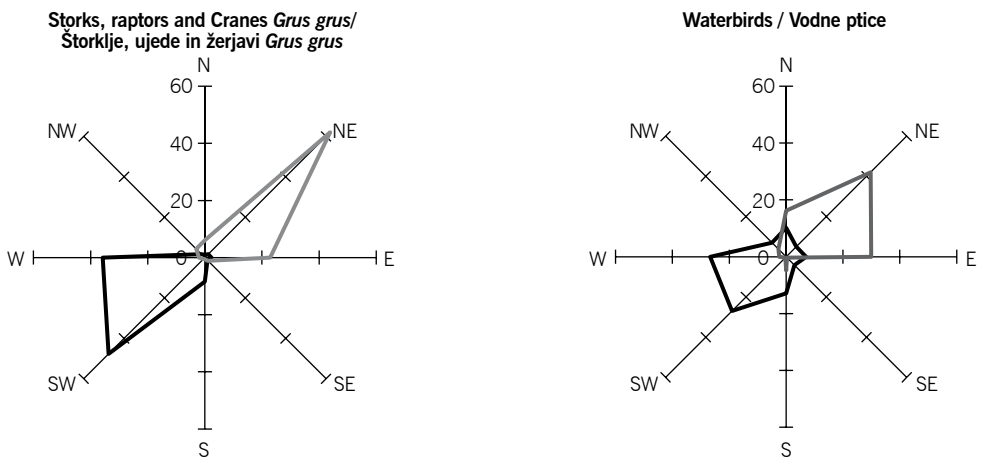

Figure 4: Percentage of waterbirds and storks, raptors and Cranes *Grus grus* using certain direction of migration to (black) and from (grey) the Medvedce reservoir in 2009, 2011 and 2012

Slika 4: Odstotek smeri prihodov (črno) in odhodov (sivo) vodnih ptic ter štorkelj, ujed in žerjavov *Grus grus* na zadrževalniku Medvedce v letih 2009, 2011 in 2012

3.5. Selected species

3.5.1. Marsh Harrier *Circus aeruginosus*

The earliest observations of Marsh Harrier during this study were on 1 Mar 2009 and 2 Mar 2012. Migration increased through the observation period and reached its peak at the end of March, when it receded slightly and reached a second peak in the first half of April (Figure 7). The highest number of individuals (94) in one day was recorded on 7 Apr 2012, while the second highest (88) was on 31 Mar

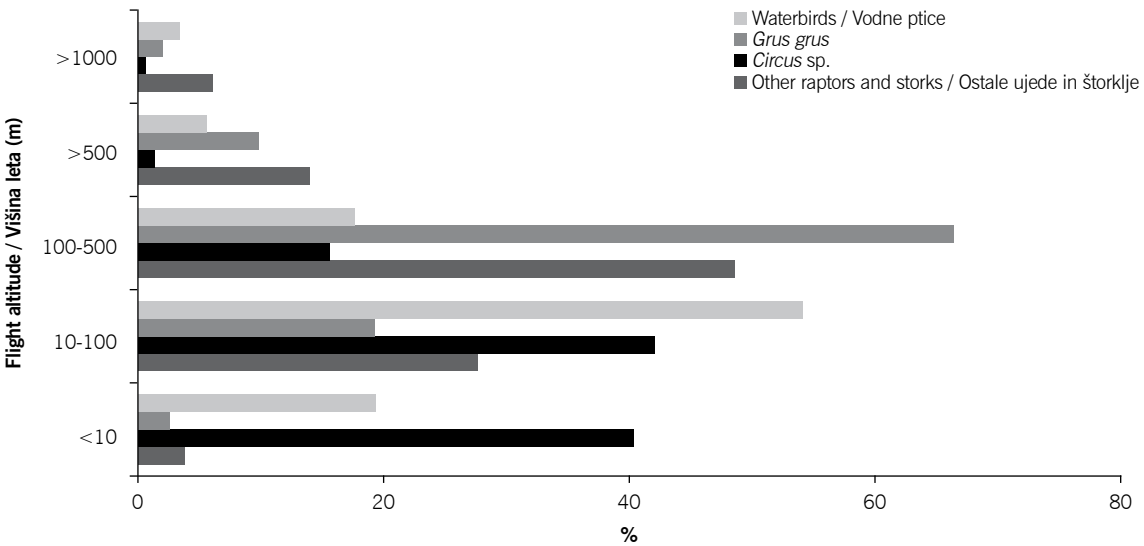

Figure 5: The altitudinal distribution of different groups of birds migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 5: Višinska porazdelitev ptic, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

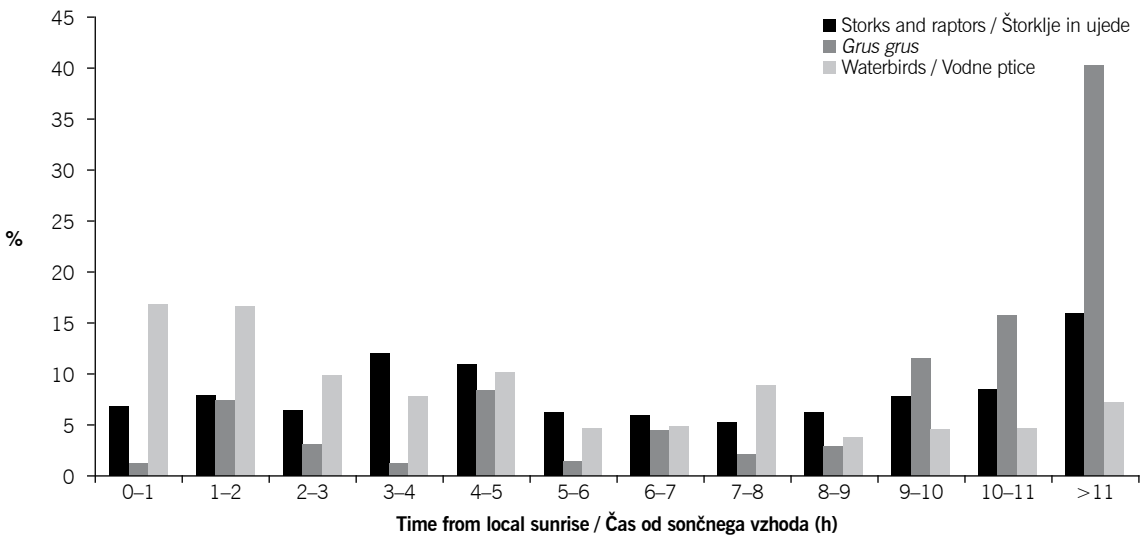

Figure 6: Hourly distribution of birds migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 6: Urna porazdelitev ptic, selečih se čez zadrževalnik Medvedce v letih 2009, 2011 in 2012

2011. In total, 1690 Marsh Harriers were observed. The observations were distributed among individual years as follows: 115 (2009), 496 (2011), 1079 (2012). Most observations were of single birds (85.4%), with five being the highest number in a single flock. Out of all Marsh Harriers observed during the count, 479 (28.4%) individuals also roosted in a reed bed within the reservoir.

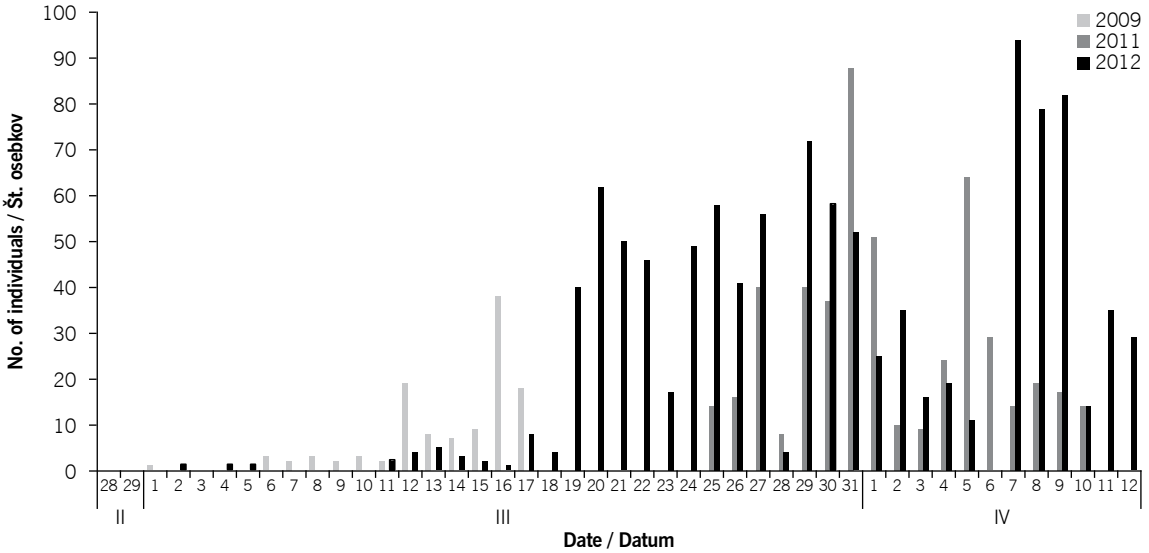

Figure 7: Phenology of Marsh Harriers *Circus aeruginosus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 7: Fenologija rjavih lunjev *Circus aeruginosus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

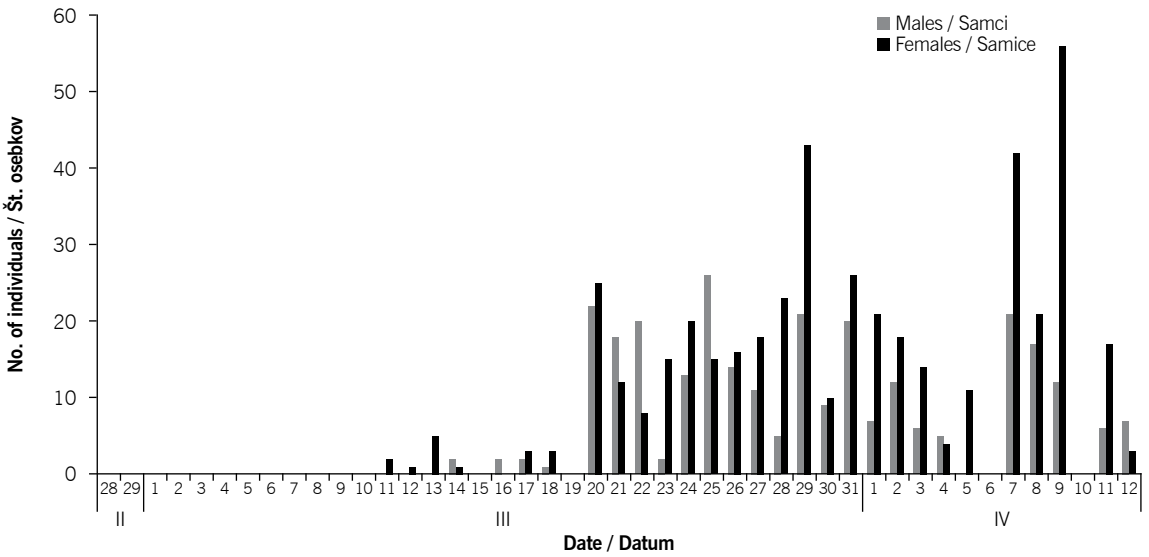

Figure 8: Phenology of Marsh Harriers *Circus aeruginosus* migrating over the Medvedce reservoir in 2012, separated by sex

Slika 8: Fenologija rjavih lunjev *Circus aeruginosus*, selečih se čez zadrževalnik Medvedce leta 2012, ločena po spolu

Out of 1522 individuals with a known age, 1061 (69.7%) were adults; among 1240 individuals with a known sex, 727 (58.6%) were females. In 2012, females reached the highest numbers in the first half of April, while males did so at the end of March (Figure 8). As with Harriers as a group (Figure 5), Marsh Harriers were observed at lower altitudes with 38.6% below 10 m and 44.7% between 10 and 100 m above ground. The highest percentage of individuals (13.4%) was observed between the third and fourth hours after sunrise (Figure 9). Some Marsh Harriers were observed hunting on the reservoir and in the surrounding fields, especially later in the counting season. Nevertheless, most just migrated over the site or used it as a roost.

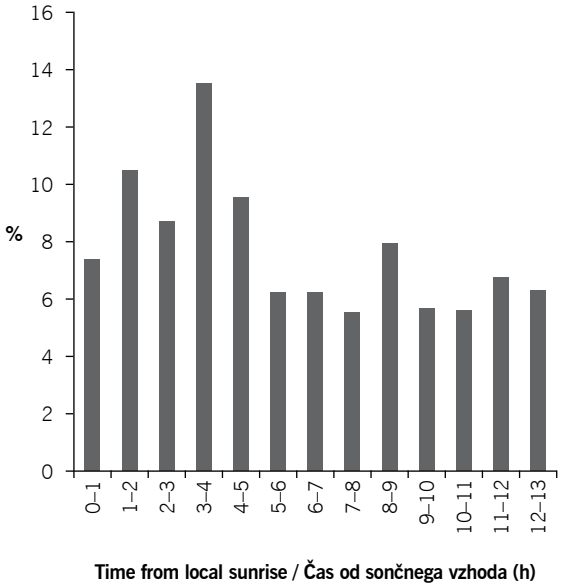

Figure 9: The hourly distribution of Marsh Harriers *Circus aeruginosus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 9: Urna porazdelitev rjavih lunjev *Circus aeruginosus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

3.5.2. Hen Harrier *Circus cyaneus*

Hen Harrier is known to winter at the site (Bordjan & Božič 2009), thus some individuals were already present prior to the beginning of counts. They were on migration during the first days of counting and migration was already strong at the beginning of March, with two highest numbers of migrating individuals on 2 Mar (2009: 26 individuals; 2011: 32). In the second half of March, migration had already receded, but some individuals were present also in April (Figure 10). The observations were distributed among individual years as follows: 177 (2009), 24 (2011) and 403 (2012). Out of all Hen Harriers observed during the study, 405 (67.0%) roosted in a reed bed within the reservoir. Among 618 observed Hen Harriers, including roosting birds, 194 (31.4%) were males, while the rest were "ringtails", which include females as well as immature individuals. The daily migration was strongest in

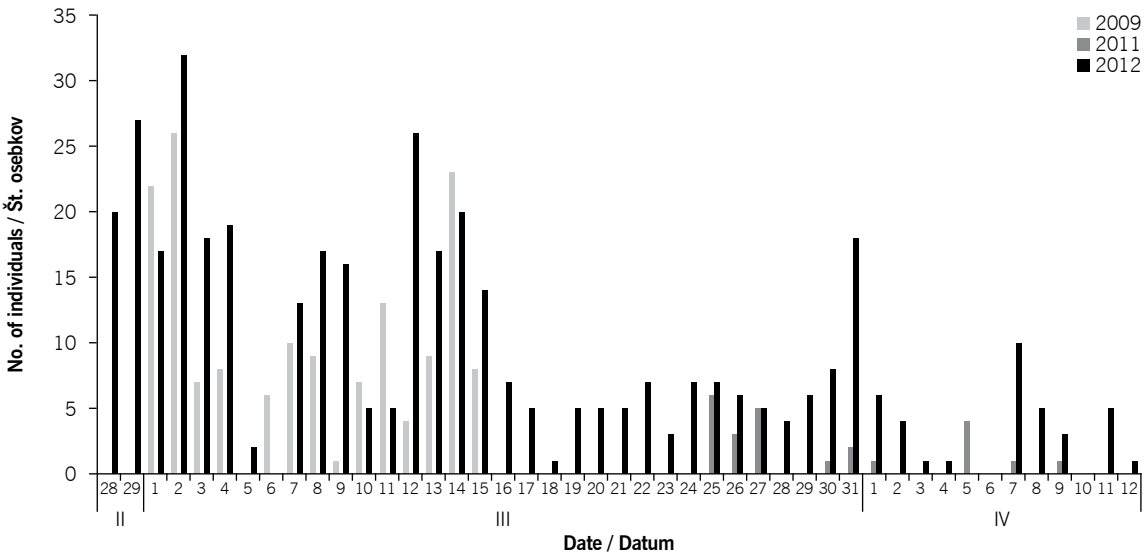

Figure 10: Phenology of Hen Harriers *Circus cyaneus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 10: Fenologija pepelastih lunjev *Circus cyaneus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

the morning hours and subsided afterwards with the smallest numbers in the evening (Figure 11). The majority of observed individuals migrated below 100 m (55.3% below 10 m, 25.7% 10–100 m). Only five individuals (3.3%) were observed flying higher than 500 m.

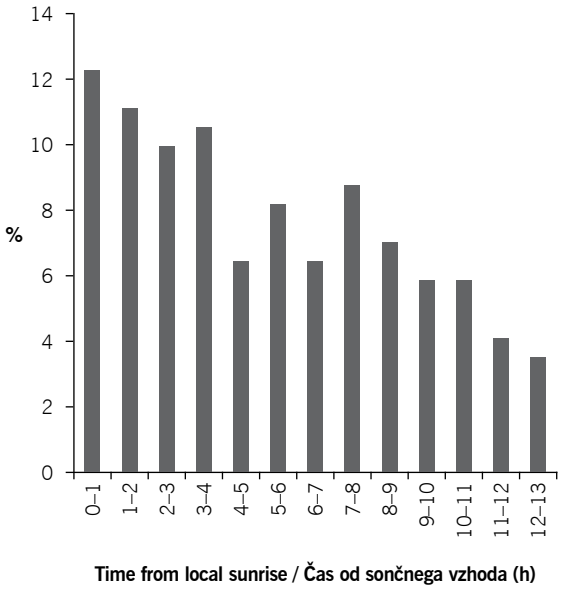

Figure 11: The hourly distribution of Hen Harriers *Circus cyaneus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 11: Urna porazdelitev pepelastih lunjev *Circus cyaneus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

3.5.3. Osprey *Pandion haliaetus*

The first Ospreys were observed on 7 Mar 2009 and 12 Mar 2012. The migration started noticeably later in 2012 than in 2009. While nine individuals were counted in 2009, only one was registered during the same period in 2012. The survey in 2011 started too late to include the start of migration. The numbers increased towards the beginning of April and decreased subsequently (Figure 12). The highest number of individuals (13) was recorded on 7 and 8 Apr 2012. The observations were distributed between years as follows: 9 (2009), 63 (2011) and 100 (2012). Observations of Ospreys were evenly distributed throughout the day ($R_S = 0.01$, $P = 0.977$, df = 10; Figure 13). The majority (61.4%) of migrating Ospreys were observed between 10 and 100 m above ground (Figure 14).

3.5.4. Crane *Grus grus*

In 2009, no Cranes were observed, while in the same period of 2012 85.1% of 644 Cranes had already passed (Figure 15). The peak migration was relatively short within seven days. In 2011, when the peak had occurred before the monitoring period, Cranes were present only in small numbers (57). In total, 47 flocks of Cranes were

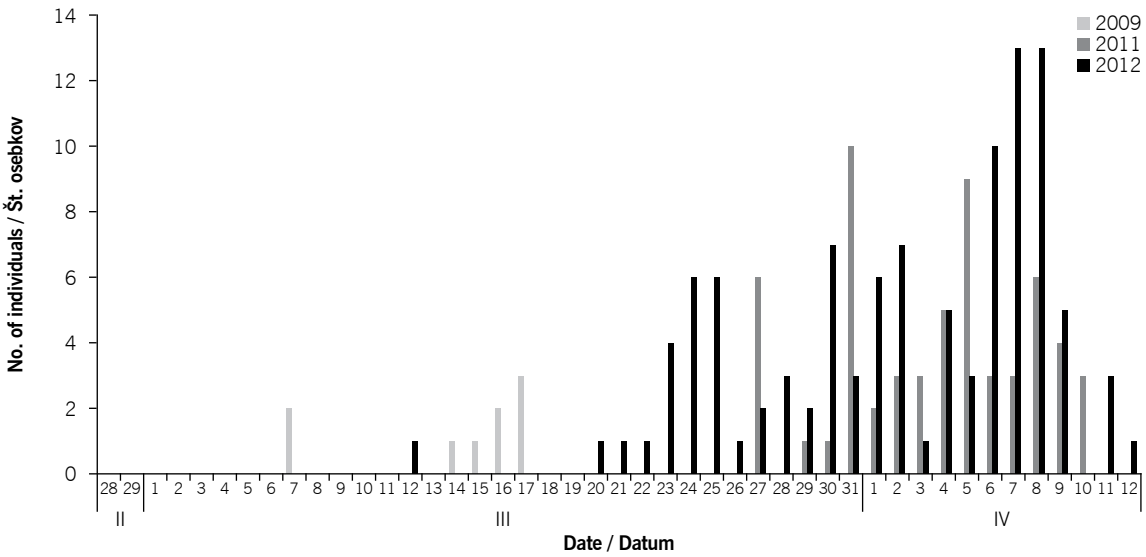

Figure 12: Phenology of Ospreys *Pandion haliaetus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 12: Fenologija ribjih orlov *Pandion haliaetus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

observed, 14 of which landed at or near the study site. The largest flock numbered 86 individuals, while most flocks (59.6%) had fewer than 10 individuals. Cranes migrated over the site later in the day (Figure 6) and higher (Figure 5) than storks and raptors.

3.5.5. Lapwing *Vanellus vanellus*

Lapwing was observed at the very beginning of the monitoring in both 2009 (1 Mar) and in 2012 (29 Feb). The peak migration was observed till the middle of March, but migrating individuals were observed well into the beginning of April (Figure 16). In 2012, 6816 Lapwings were counted, while in 2009, when only the first half of March was covered by monitoring, 3390

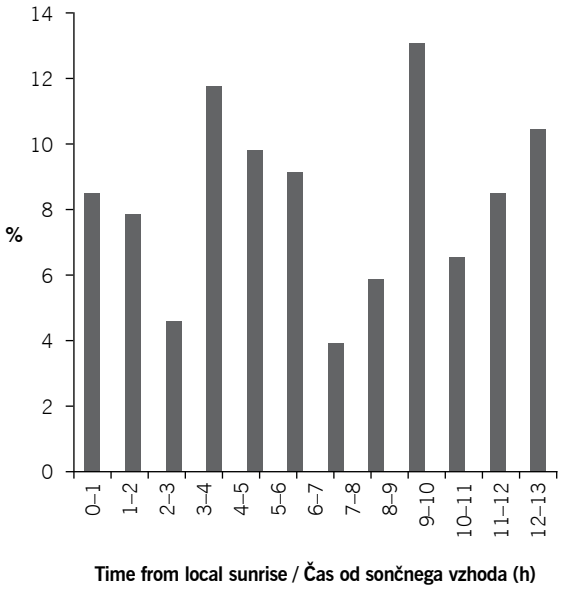

Figure 13: The hourly distribution of Ospreys *Pandion haliaetus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 13: Urna porazdelitev ribjih orlov *Pandion haliaetus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

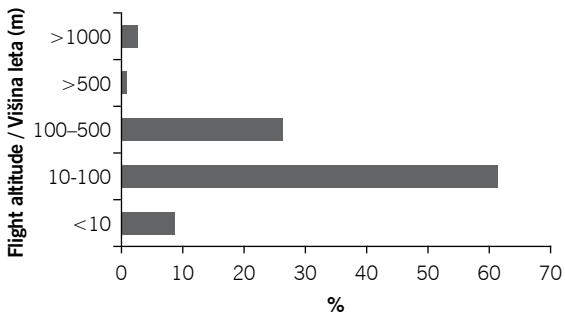

Figure 14: The altitudinal distribution of Ospreys *Pandion haliaetus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 14: Višinska porazdelitev ribjih orlov *Pandion haliaetus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

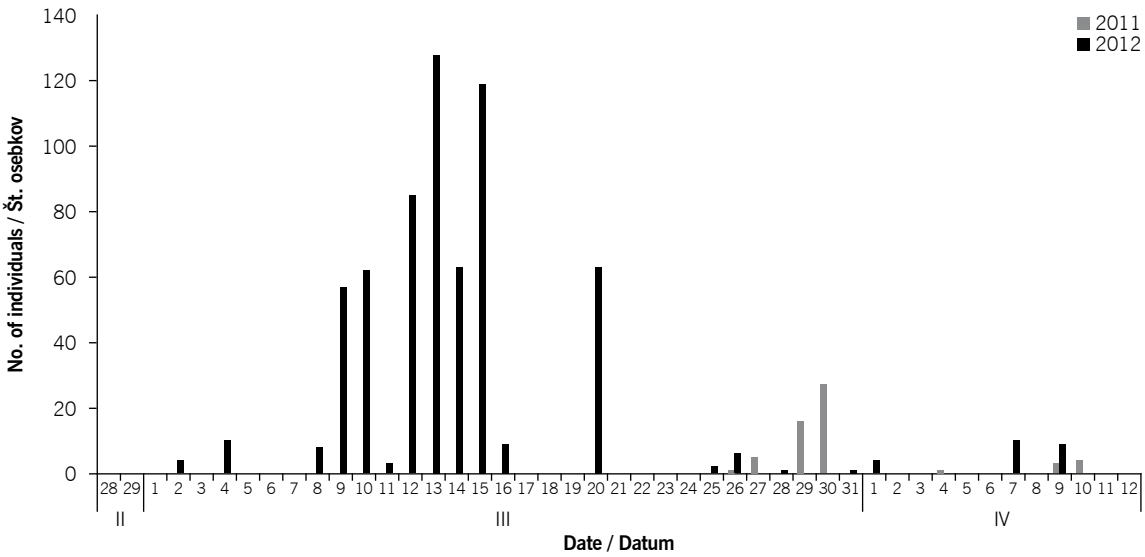

Figure 15: Phenology of Cranes *Grus grus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 15: Fenologija žerjavov *Grus grus*, selečih se čez zadrževalnik Medvedce v leta 2009, 2011 in 2012

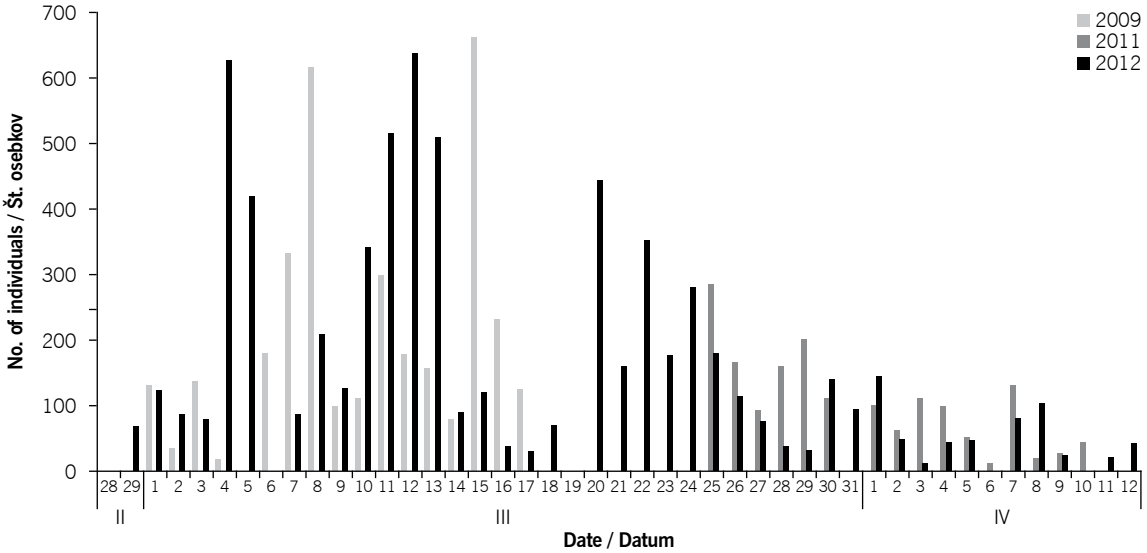

Figure 16: Phenology of Lapwings *Vanellus vanellus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 16: Fenologija prib *Vanellus vanellus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

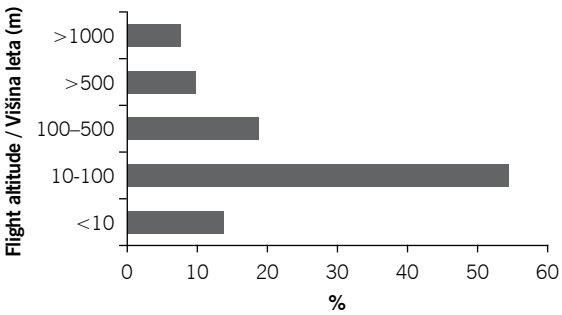

Figure 17: The altitudinal distribution of Lapwing *Vanellus vanellus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 17: Višinska porazdelitev prib *Vanellus vanellus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

were observed. In both years when monitoring was conducted in the first half of March, the number of migrating Lapwings exceeded 600 individuals on two separate days (2009: 8 Mar – 617, 15 Mar – 663; 2012: 4 Mar – 627, 12 Mar – 637). 49.4% of all observed flocks numbered 11–100 individuals and 46.8% had fewer than 10 individuals. The largest flock had 438 individuals and was observed on 12 Mar 2012. More than half (54.5%) of all migrating Lapwings were observed between 10 and 100 m above ground (Figure 17).

3.5.6. Black-headed Gull *Chroicocephalus ridibundus*

In 2009 and 2012, Black-headed Gulls were observed from the beginning of the count period. 1150 individuals were counted in 2009, more than half of which (590) on the last day. The number of Black-headed Gulls rose steadily from the start to the middle of March (Figure 18). In contrast, in 2012 the number of individuals was already high at the beginning of March (Figure 18), but nevertheless rose towards the middle of the month, with a peak on 12 Mar with 935 individuals. The number of individuals fell rapidly after 16 Mar and remained low until the end of the counting period. The migration was weak throughout the counting period in 2011, when the survey started after the migration peak of this species.

An equal percentage of flocks (43.8% each) contained fewer than 10 and 11–100 individuals, while the largest flock had 488 individuals and was observed on 12 Mar 2012. The majority of Black-headed Gulls (58.9%) migrated at altitudes between 10 and 100 m (Figure 19).

4. Discussion

This study showed that substantial numbers of waterbirds and raptors migrate over the Medvedce reservoir, some in conservationally important numbers.

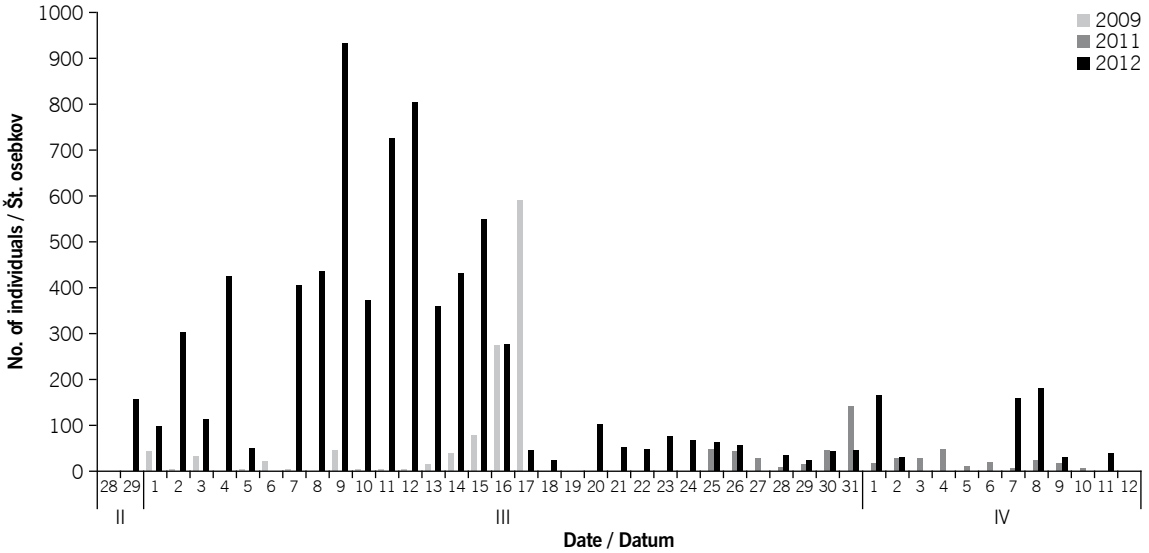

Figure 18: Phenology of Black-Headed Gulls *Chroicocephalus ridibundus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 18: Fenologija rečnih galebov *Chroicocephalus ridibundus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

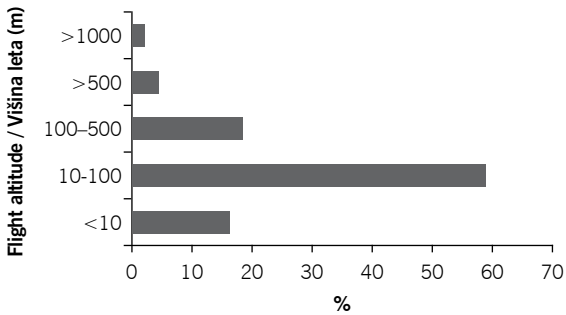

Figure 19: The altitudinal distribution of Black-headed Gull *Chroicocephalus ridibundus* migrating over the Medvedce reservoir in 2009, 2011 and 2012

Slika 19: Višinska porazdelitev rečnih galebov *Chroicocephalus ridibundus*, selečih se čez zadrževalnik Medvedce leta 2009, 2011 in 2012

The main direction of migration was SW–NE, with the flight altitude mainly below 100 m above ground. Taxonomic groups of birds differed in their phenology, migration direction, as well as hourly and altitudinal distribution.

The main migration direction SW–NE observed in this study is found in many avian taxa (Hake *et al.* 2001, Agostini *et al.* 2003, Leitão & Peris 2004, Davidson & Stroud 2006, Delany & Scott 2006, Limiñana *et al.* 2007, Meyburg & Meyburg 2007, Premuda *et al.* 2008, Strandberg *et al.* 2008, Mingozzi *et al.* 2013) across different flyways in Europe. Although species observed at the study site may belong to different flyways, all were flying in the same general direction, reflecting a local geographical constraint. The study site is surrounded by high hills in the northwest and in the south, but it is currently unknown whether birds congregate along those hills. Data from synchronized counts, done near Celje 30 km to the southwest from the study area, indicate that at least some, but not all, waterbirds, raptors and Cranes follow a direct route from Celje to Medvedce (M. Gamser *pers. comm.*).

Mt Boč and Pohorje Mts are both more than 5 km away, so the question arises, what percentage of migrating birds from a larger area converges at the site. Migrating raptors were also observed in the nearby Dravinja valley (Vrezec 1997) and on the edges of Pohorje Mts (*own data*). As mentioned above, not all birds migrating through the lowland area near Celje arrive at the study area (M. Gamser *pers. comm.*). Although individuals and even flocks on migration were observed at other sites on Dravsko polje (Vogrin 1997, L. Božič *pers. comm.*, *own data*), their numbers were considerably smaller. On the other hand, higher numbers of migrating Montagu's Harriers *Circus pygargus* and sometimes Red-Footed Falcons *Falco vespertinus* were observed a few kilometres to the northeast of the site (L. Božič *pers. comm.*). Although other parts of Dravsko polje have never been studied in as much detail, my assumption is that a

Table 5: Conservationally important species on spring migration at Medvedce reservoir that reach at least 0.1% of the biogeographical population. Populations of raptors were calculated from BirdLife International (2004), while populations of waterbirds were gathered from http://wpe.wetlands.org/.

Tabela 5: Varstveno pomembne vrste, ki na spomladanski selitvi čez zadrževalnik Medvedce dosegajo najmanj 0,1 % svoje biogeografske populacije. Populacije ujed so bile izračunane na podlagi BirdLife International (2004), populacije vodnih ptic pa na podlagi podatkov na strani http://wpe.wetlands.org/.

Species / Vrsta	No. of ind. counted in 2012/ Št. preštetih os. leta 2012	1% threshold/ 1 % prag	Percentage of biogeographic population / Odstotek biogeografske populacije	Biogeographic population/ Biogeografska populacija
Ardea alba	416	460	0.9	W C & SE Europe/ Black Sea & Mediterranean
Circus aeruginosus	1079	3423	0.3	Europe
Circus cyaneus	408	1340	0.2	Europe
Pandion haliaetus	100	274	0.4	Europe
Grus grus	656	900	0.6	North-east & Central Europe/ North Africa
Vanellus vanellus	6796	72300	0.1	Europe, W Asia/ Europe, N Africa & SW Asia
Philomachus pugnax	4521	12200	0.4	Northern Europe & Western Siberia / West Africa
Chroicocephalus ridibundus	8840	11800	0.8	East Europe/ Black Sea & East Mediterranean

significant portion of migrating birds from a larger area gathers at the study site.

Abundance and availability of food resources are the major factors determining distribution of migrants (Newton 2008). Thus, some waterbirds, e.g. herons, waders, gulls and at least Osprey among raptors congregate at the site to feed on migration. In contrast to the strategy of making a full stop to forage and deposit fuel, a fly-and-forage migration strategy is possible for species that fly extensively during foraging or rely on search flights to find their prey either on ground or on water (Strandberg & Alerstam 2007). The use of this strategy has been demonstrated for Ospreys both on their autumn and spring migration (Strandberg & Alerstam 2007), while conclusive evidence is still lacking for Marsh Harriers (Strandberg *et al*. 2008).

Numbers of migrating birds observed during the study were considerably higher than those from counts in ten-day periods (Bordjan & Božič 2009). While for most species the longer period of dedicated observation can explain the difference in abundance, the higher numbers of Cranes can also be attributed to the significant rise in the number of Cranes migrating through the new migration corridor over northern Italy (Mingozzi *et al*. 2013). Although Mingozzi *et al*. (2013) studied Cranes on autumn migration, birds from this flyway most likely include migrants from Slovenia both on autumn and spring migrations.

For some species, numbers were lower than expected. One such species is Lapwing. Considerably higher numbers were observed in 2006 (993 individuals in only a part of the day) (Bordjan & Božič 2009), and in flooded fields in 1995 (2000–3000) (Bračko 2009) and in 2014 (1882; *own data*). The estimate could be even higher for the study itself, since on 14 Mar 2012 only 90 individuals were counted due to fog, while 1,060 were counted at Lake Ormož at the same time (B. Štumberger *pers. comm*.), indicating strong migration possibly overlooked due to poor visibility. Lapwings are known to perform large-scale movements in response to adverse weather conditions, evacuating large regions in a short time (Vepsäläinen 1968, Wernham *et al*. 2002). Nevertheless, it is entirely possible that Lapwings did not migrate over the study area on that day, as they migrate along a broad geographic front (Gillings & Wilson 2009). Black-headed Gull is another such species, with daily maxima of 1055 and 2527 individuals on 15 Mar 2006 and on 13 Mar 2010 respectively (Bordjan & Božič 2009, *own data*).

The number of waders fluctuates at Medvedce in parallel with water levels and the extent of flooded arable land in the surroundings during migration.

They are considerably more numerous in years with low water levels (e.g. 2003, 2011, 2012) than in years with higher water levels (e.g. 2004 and 2008) (Bordjan & Božič 2009, *own data*). Thus the numbers of waders counted in 2012 probably represented the upper limit in numbers of wader migration, including Ruff.

Not only the number of individuals, also the number of species is higher for the study compared to the ten-day period counts (Bordjan & Božič 2009). Between 2002 and 2008, when one count was done per period, the number of observed species per ten-day period in March ranged from 18 to 42 (average 27). Between 2009 and 2014 (excluding periods covered by the study), when two counts per period were done, the number of species ranged from 29 to 60 (average 37), while during the study it ranged from 37 to 64 (average 48). Thus, with one count per ten-day period approximately half of all species present are detected, while with two counts more than two thirds are detected.

Marsh Harriers migrate along a broad front and concentrations at bottlenecks are not as pronounced as in other raptor species (Agostini & Panuccio 2010). The migration route across the Strait of Messina is the most frequently used flyway for this species in the Western Palearctic with 1621 to 3074 birds counted during spring between 1996 and 2000 (Corso 2001). Only few birds are counted in spring at the Strait of Gibraltar (usually fewer than 200) (Agostini 2001), Eilat (annual mean of 178) (Leshem & Yom-Tov 1998) and the Bosphorus (negligible numbers) (Collman & Croxall 1967). The numbers recorded at Medvedce in 2012, when the counting period was designed to coincide with peak migration of the species, therefore appear to be important at the continental level. The migration of Marsh Harriers at Medvedce had two peaks: one in late March and another in the first half of April. Mediterranean watchpoints have a single migration peak between 1 and 10 Apr (Agostini 2001, Corso 2001, Panuccio *et al.* 2004, Panuccio *et al.* 2013). Marsh Harriers migrate across the Strait of Messina until the end of May (Corso 2001). Birds are present at Medvedce and Dravsko polje throughout late spring and summer (Vogrin 1997, Bordjan & Božič 2009). Even though it is difficult to distinguish migrants from breeders and non-breeding summer visitors with certainty, spring migration of Marsh Harriers at Medvedce seems to continue well into May. In agreement with previous research (Agostini & Panuccio 2010), males at Medvedce reservoir migrated earlier than females, albeit with considerable overlap.

Hen Harriers are even less numerous at bottlenecks than Marsh Harriers: in spring, 3–84 were counted at the Strait of Messina (Corso 2001), negligible numbers at Eilat (Leshem & Yom-Tov 1998) and the Strait of Gibraltar (Bensusan *et al.* 2007) and up to 250 at Falsterbo in autumn (Kjellén & Roos 2000). Considering only spring migration, the number of Hen Harriers migrating over the Medvedce reservoir is internationally important.

Migration habits of harriers (Marsh, Montagu's and Pallid *Circus macrourus*) were studied using radar in southern Israel (Spaar & Bruderer 1997). Harriers as a group migrated at a lower average altitude than other raptors and soaring birds, which was also the case in our study. In Marsh Harrier, there was a trend towards increasing flight altitude later in the day. As in our study, Marsh Harriers in Israel started migrating soon after sunrise. By combining flapping (around sunrise and sunset) and soaring flight (around midday), harriers were able to use the entire day for migration. Although flight styles were not studied at Medvedce, the hourly distribution confirmed that harriers migrated throughout the day.

This study confirmed the importance of the area for migrating and staging birds. Apart from Marsh and Hen Harriers, other species counted in important numbers are Great Egret, Osprey, Crane, Lapwing, Ruff and Black-Headed Gull. For the three raptors, these numbers are also the highest counted so far in Slovenia (Tome *et al.* 2005, Bordjan & Božič 2009, Denac 2010, Denac *et al.* 2011, Bordjan 2012). The number of Black-Headed Gulls is higher only on Lakes Ptuj and Ormož (Denac *et al.* 2011). More Lapwings probably gather in some years at Ljubljansko barje (Tome *et al.* 2005) and the Drava River (Denac *et al.* 2011). While none of the above mentioned species reached more than 1% of the biogeographic population, all but Lapwing attained more than 0.1%. (Table 5). This also justifies the position of these species as qualifying species for IBA Črete (Denac *et al.* 2011).

In 2012, when the monitoring period lasted for 45 days, 2717 raptors and Cranes were counted. Taking into account reasons for overlooked or missed birds of prey listed by Denac (2010) and discussed below, the actual number of migrating raptors is probably even higher. Some species of raptors start migrating before and some after the monitoring period used in the study (Cramp 1998). The number migrating in April and May might be similar to the number migrating during the study period (Denac 2010). The migration of the most numerous species, Marsh Harrier, does not end till mid-May (Strandberg *et al.* 2008) and significant number may still pass by that time (Premuda *et al.* 2008), especially juveniles (Strandberg *et al.* 2008). On most, but not all, monitoring days two observers

were present. Moreover, on five days in 2012 no counts were made at all. At the same time, the percentage of overlooked individuals is higher with flapping flyers than soaring flyers. It is also higher with single individuals and small groups (majority of observation in this study) than with larger flocks (Sattler & Bart 1984). Raptors can migrate in unfavourable weather conditions, such as headwinds or rain (Denac 2010). On several days, the visibility was lowered due to rain or fog. More individuals were probably overlooked during days with fog, since it was usually present until 9.00 hrs, a time by which a significant number of individuals had already been registered on clear days. In some species, nocturnal migration is known (Russell 1991, DeCandido *et al*. 2006). This is especially true for falcons (33–34% of migration by night) and harriers (15–20%) (Meyer *et al*. 2003), the most numerous group observed at Medvedce.

These results warrant further migration studies at Medvedce, which should be designed to focus on the migration of key species, such as Marsh and Hen Harriers. A species-targeted count should be able to yield reliable estimates of annual migration totals and address some of the methodological limitations of this study.

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5. Povzetek

V treh ločenih letih (1. do 17. 3. 2009; 25. 3. do 10. 4. 2011; 28. 2. do 12. 4. 2012) je v organizaciji avtorja prispevka potekal spomladanski monitoring pretežno vodnih ptic in ujed. Pticam smo sledili vse od zore do mraka z opazovalnice, postavljene na nasipu na severni strani zadrževalnika Medvedce (Dravsko polje, SV Slovenija). Skupno je bilo v teh obdobjih preštetih 42.045 osebkov 89 različnih vrst (66 vodnih, 23 ujed), selečih se prek Medvedc. Od teh je bilo 38.238 vodnih ptic. Najštevilnejša je bila priba *Vanellus vanellus* (11.813 os.), njej pa je sledil rečni galeb *Chroicocephalus ridibundus* (10.515 os.). Preštetih je bilo tudi 3807 selečih se štorkelj, ujed in žerjavov *Grus grus*. Daleč najštevilnejši so bili lunji (2302 os.). Prevladujoča smer selitve je bila JZ–SV. Polovica vseh selečih se ptic je bila opazovana v višinskem pasu med 100 in 500 metri nad tlemi. Lunji so leteli večinoma v pasu do 100 metri nad tlemi, štorklje, druge ujede in žerjavi pa najpogosteje v višinskem pasu med 100 in 500 metri. Največje število vodnih ptic je bilo opazovano v pasu med 10 in 100 metri. V prvih petih urah po sončnem vzhodu je bilo zabeleženih 61,3 % vseh vodnih ptic, 44,0 % vseh štorkelj in ujed in samo 20,5 % žerjavov. Čeprav drugi deli Dravskega polja niso bili še nikoli preučevani tako podrobno, je povsem mogoče, da se pomemben delež selečih se ptic iz večjega območja zbira prav na preučevani lokaliteti. Sicer pa je raziskava potrdila velik pomen območja za seleče se in tu počivajoče ptice, še posebno za veliko belo čapljo *Ardea alba*, rjavega *Circus aeruginosus* in pepelastega lunja *C. cyaneus*, ribjega orla *Pandion haliaetus,* žerjava, togotnika *Calidris pugnax* in rečnega galeba, ki so tu vsi dosegli najmanj 0,1 % svojih biogeografskih populacij. Mednarodnega pomena je še posebno število tako selečih se rjavih *Circus aeruginosus* (1079 os. v letu 2012) kot pepelastih lunjev *C. cyaneus* (408 os. v letu 2012), saj je znanih le nekaj lokalitet, kjer se ti vrsti spomladi selita v tako velikem številu.

6. References

Agostini N. (2001): Spring migration in relation to sex and age of Marsh Harriers *Circus aeruginosus* over a central Mediterranean island. – Ardeola 48 (1): 71–73.

Agostini N., Coleiro C., Panuccio M. (2003): Autumn migration of Marsh Harriers (*Circus aeruginosus*) across the central Mediterranean in 2002. – The Ring 25 (1/2): 47–52.

Agostini N., Logozzo D. (1995): Autumn migration of Honey Buzzards in Southern Italy. – Journal of Raptor Research 29 (4): 275–277.

Agostini N., Panuccio M. (2010): Western Marsh Harrier (*Circus aeruginosus*) migration through the Mediterranean Sea: a review. – Journal of Raptor Research 44 (2): 136–142.

Bensusan K. J., Garcia E. R. J., Cortes J. E. (2007): Trends in abundance of migrating raptors at Gibraltar in spring. – Ardea 95 (1): 83–90.

Berthold P., Bossche W. V. D., Jakubiee Z., Kaatz C., Kaatz M., Querner U. (2002): Long-term satellite tracking sheds light upon variable migration strategies of White Storks (*Ciconia ciconia*). – Journal of Ornithology 143: 489–495.

BirdLife International (2004): Birds in Europe: population estimates, trends and conservation status. BirdLife Conservation Series No. 12. – BirdLife International, Cambridge.

Bordjan D. (2007): Črni škarnik *Milvus migrans*. – Acrocephalus 28 (134): 129.

Bordjan D. (2012): Vodne ptice in ujede Cerkniškega polja (južna Slovenija) v letih 2007 in 2008, s pregledom zanimivejših opazovanj do konca leta 2010. – Acrocephalus 33 (152/153): 25–148.

Bordjan D., Božič L. (2009): Pojavljanje vodnih ptic in ujed na območju vodnega zadrževalnika Medvedce (Dravsko polje, SV Slovenija) v obdobju 2002–2008. – Acrocephalus 30 (141/142/143): 55–163.

Božič L. (1992): Spomladanski prelet sršenarja *Pernis apivorus* prek Maribora. – Acrocephalus 13 (54): 144–145.

Božič L. (2014): Rezultati januarskega štetja vodnih ptic leta 2014 v Sloveniji. – Acrocephalus 35 (160/161): 73–83.

Bračko F. (2009): Priba *Vanellus vanellus*. – Acrocephalus 30 (141/142/143): 175–176.

Collman J. R., Croxall J. P. (1967): Spring migration at the Bosphorus. – Ibis 109 (3): 359–372.

Corso A. (2001): Raptor migration across the Strait of Messina, southern Italy. – British Birds 94 (4): 196–202.

Cramp S. (ed.) (1998): The complete birds of the western Palearctic on CD-ROM. – Oxford University Press, Oxford.

Davidson N. C., Stroud D. A. (2006): African-Western Eurasian Flyways: current knowledge, population status and future challenges. pp. 63–73. In: Boere G. C., Galbraith C. A., Stroud D. A. (eds.): Waterbirds around the world. – The Stationery Office, Edinburgh.

DeCandido R., Bierregaard R. O., Martell M. S., Bildstein K. L. (2006): Evidence of nocturnal migration by Osprey (*Pandion haliaetus*) in North America and Western Europe. – Journal of Raptor Research 40 (2): 156–158.

Delany S. N., Scott D. A. (2006): Wetlands International's Flyway Atlas series: establishing the geographical limits of waterbird populations. pp. 574–581. In: Boere G. C., Galbraith C. A., Stroud D. A. (eds.): Waterbirds around the world. – The Stationery Office, Edinburgh, UK.

Denac K. (2010): Census of migrating raptors at Breginjski Stol (NW Slovenia) – the first confirmed bottleneck site in Slovenia. – Acrocephalus 31 (145/146): 77–92.

Denac K., Mihelič T., Božič L., Kmecl P., Jančar T., Figelj J., Rubinić B. (2011): Strokovni predlog za revizijo posebnih območij varstva (SPA) z uporabo najnovejših kriterijev za določitev mednarodno pomembnih območij za ptice (IBA). Končno poročilo (dopolnjena verzija). Naročnik: Ministrstvo za okolje in prostor. – DOPPS – BirdLife Slovenia, Ljubljana.

Hake M., Kjellén N., Alerstam T. (2001): Satellite tracking of Swedish Ospreys *Pandion haliaetus*: autumn migration routes and orientation. – Journal of Avian Biology 32: 47–56.

Gillings S., Wilson A. (2009): Northern Lapwing *Vanellus vanellus*. pp. 129–133. In: Delany S., Dodman T., Stroud D. (eds.): An atlas of wader populations in Africa and western Eurasia. – Wetlands International, Wageningen.

Guillemain M., Sadoul N., Simon G. (2005): European flyway permeability and abmigration in Teal *Anas crecca*, an analysis based on ringing recoveries. – Ibis 147: 688–696.

Jančar T. (1995): Spremljanje številčnosti vodnih ptičev v Sečoveljskih solinah. – Acrocephalus 16 (71): 108–112.

Jančar T., Kmecl P., Mihelič T., Kozinc B. (2007): Pregled vodnih ptic Blejskega in Bohinjskega jezera ter jezera HE Moste (Gorenjska, SZ Slovenija). – Acrocephalus 28 (135): 141–158.

Jonzén N., Pettersson J. (1999): Autumn migration of raptors on Capri. – Avocetta 23 (2): 65–72.

Kjellén N., Roos G. (2000): Population trends in Swedish raptors demonstrated by migration counts at Falsterbo, Sweden 1942–97. – Bird Study 47 (2): 195–211.

Leitão D., Peris S. (2004): The origin of Lapwings *Vanellus vanellus* and Golden Plovers *Pluvialis apricaria* wintering in Portugal. – Ornis Fennica 81 :49–64.

Leshem Y., Yom-Tov Y. (1998): Routes of migrating soaring birds. – Ibis 140: 41–52.

Limiñana R., Soutullo A., Urios V. (2007): Autumn migration of Montagu's harriers *Circus pygargus* tracked by satellite telemetry. – Journal of Ornithology 148: 517–523.

Logar K., Božič L. (2014): Letna dinamika pojavljanja vodnih ptic na reki Dravi med Mariborskim jezerom in jezom Melje (SV Slovenija). – Acrocephalus 35 (160/161): 5–24.

Meyburg B.-U., Meyburg C., Barbraud J.-C (1998): Migration strategies of an adult Short-toed Eagle *Circaetus gallicus* tracked by satellite. – Alauda 66 (1): 39–48.

Meyburg B.-U., Meyburg C. (2007): Quinze années de suivi de rapaces par satellite. Alauda 75: 265–286 (English translation).

Meyer S. K., Spaar R., Bruderer B. (2003): Sea crossing behaviour of falcons and harriers at the southern Mediterranean coast of Spain. – Avian Science 3 (2/3): 153–162.

Michev T. M., Profirov L. A., Karaivanov N. P., Michev B. T. (2012): Migration of Soaring birds over Bulgaria. – Acta Zoologica Bulgarica 64 (1): 33–41.

Mingozzi T., Storino P., Venuto G., Alessandria G., Arcamone E., Urso S., Ruggieri L., Massetti L., Massolo A. (2013): Autumn migration of Common Cranes *Grus grus* through the Italian Peninsula: new vs. historical flyways and their meteorological correlates. – Acta Ornithologica, 48 (2):165–177.

Newton I. (2008): The migration ecology of birds. – Academic Press, London.

Panuccio M., Agostini N., Barboutis C. (2013): Raptor migration in Greece: a review. – Avocetta 37: 1–7.

Panuccio M., Agostini N., Massa B. (2004): Spring migration at Ustica, southern Italy. – British Birds 97 (8): 400–414.

Panuccio M., Agostini N., Mellone U. (2005): Autumn migration strategies of honey buzzards, black kites, marsh and Montagu's harriers over land and over water in the Central Mediterranean. – Avocetta 29: 27–32.

Premuda G., Gustin M., Pandolfi M., Sonet L., Cento M. (2008): Spring raptor migration along the Adriatic coast (Italy): a comparative study over three sites. – Avocetta 32: 13–20.

Probst R. (2009): Der Greifvogelzug im Unteren Gailtal im Herbst 2009. Bericht von BirdLife Österreich, Landesgruppe Kärnten, an das Amt der Kärntner

Landesregierung, Abteilung 20 – Landesplannung, UAbt. Naturschutz, Feldkirchen.
Russell R. W. (1991): Nocturnal flight by migrant "diurnal" raptors. – Journal of Field Ornithology 62 (4): 505–508.
Sattler G., Bart J. (1984): Reliability of counts of migrating raptors: an experimental analysis. – Journal of Field Ornithology 55 (4): 415–423.
Schneider-Jacoby M. (2001): Lastovo – a new bottleneck site for the migratory Honey Buzzards *Pernis apivorus*? – Acrocephalus 22 (108): 163–165.
Shydlovskyy I. V. (2001): Peculiarities of Migrations of the Lapwing (*Vanellus vanellus*) in Western Ukraine. – Vestnik zoologii, 35(5): 61—67.
Spaar R., Bruderer B. (1997): Migration by flapping or soaring: flight strategies of Marsh, Montagu's and Pallid Harriers in southern Israel. – Condor 99: 458–469.
Strandberg R., Alerstam T. (2007): The strategy of fly-and-forage migration, illustrated for the osprey (*Pandion haliaetus*). – Behavioral Ecology and Sociobiology 61: 1865–1875.
Strandberg R., Klaassen R. H. G., Hake M., Olofsson P., Thorup K., Alerstam T. (2008): Complex timing of Marsh Harrier *Circus aeruginosus* migration due to pre- and post-migratory movements. – Ardea 96 (2): 159–171.
Šere D. (2009): Kratko poročilo o obročkanih ptičih v Sloveniji, 1983–2008. – Scopolia Suppl. 4: 111–174.
Štumberger B., Šorgo A. (1995): Dnevni prelet vodnih ptic v dravski loki pri Ptuju – prezimovanje ali selitev. – Acrocephalus 16 (68/69/70): 72–78.
Tome D., Sovinc A., Trontelj P. (2005): Ptice Ljubljanskega barja. Monografija DOPPS št. 3. – Društvo za opazovanje in proučevanje ptic Slovenije, Ljubljana.
Vepsäläinen K. (1968): The effect of the cold spring 1966 upon the Lapwing (*Vanellus vanellus*) in Finland. – Ornis Fennica 45 (2): 33–47.
Vogrin M. (1997): Occurrence and passage of Marsh Harrier *Circus aeruginosus*, Hen Harrier *Circus cyaneus* and Osprey *Pandion haliaetus* in northeastern Slovenia. – Ring 19 (1/2): 59–63.
Vogrin M. (1998a): Prelet in pojavljanje sivke *Aythya ferina* v Krajinskem parku Rački ribniki – Požeg v severovzhodni Sloveniji. – Acrocephalus 19 (89): 109–114.
Vogrin M. (1998b): Prelet in pojavljanje togotnika *Philomachus pugnax* na Dravskem polju. – Acrocephalus 19 (90/91): 155–158.
Vogrin M. (1998c): Occurrence and passage of Wood sandpiper *Tringa glareola* and Green sandpiper *Tringa ochropus* on the Dravsko polje, north–eastern Slovenia. – Wader Study Group Bulletin 87: 55–58.
Vogrin M. (1999): Migration of Garganey *Anas querquedula* and Teal *Anas crecca* in north-eastern Slovenia. – Ornis svecica 9: 19–22.
Vrezec A. (1997): Ujede in sove Dravinjske doline. – Falco 12: 17–20.
Vrezec A., Fekonja D., Šere D. (2014): Obročkovalska dejavnost in pregled najdb obročkanih ptic Slovenije v letu 2013. – Acrocephalus 35 (160/161): 25–58.
Wernham C. V., Toms M. P., Marchant J. H., Clark J. A., Siriwardena G. M., Baillie S. R. (2002): The migration atlas: movements of the birds of Britain and Ireland. – T & A D Poyser, London.
Zalles J. I., Bildstein K. L. (eds.) (2000): Raptor watch. A global directory of raptor migration sites. BirdLife Conservation Series No. 9. – BirdLife International, Cambridge.

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APPENDIX 1 / DODATEK 1:

The number of migrating birds at Medvedce reservoir in 2009, 2011 and 2012 not systematically analysed in the paper

Število osebkov selivk čez zadrževalnik Medvedce v letih 2009, 2011 in 2012, katerih selitev v članku ni sistematično analizirana

	2009	2011	2012	2009–2012
Species / Vrsta	1. 3. – 17. 3.	25. 3. – 10. 4.	28. 2. – 12. 4.	
Columba oenas	161	19	1018	**1198**
Columba palumbus	274	719	1447	**2440**
Streptopelia decaocto	1			**1**
Apus apus			8	**8**
Upupa epops		1		**1**
Corvus monedula		10		**10**
Corvus frugilegus			64	**64**
Remiz pendulinus			15	**15**
Parus major			8	**8**
Alauda arvensis	1		940	**941**
Riparia riparia			5	**5**
Hirundo rustica		8	1542	**1550**
Delichon urbica			167	**167**
Hirundine sp. / Vrsta lastovke			1000	**1000**
Phylloscopus collybita	1		1	**2**
Bombycilla garrulus	75			**75**
Sturnus vulgaris	8446		9611	**18057**
Turdus pilaris	1534	24	589	**2147**
Turdus iliacus	1			**1**
Turdus viscivorus	4		4	**8**
Phoenicurus phoenicurus			1	**1**
Oenanthe oenanthe			2	**2**
Motacilla flava			479	**479**
Motacilla alba			151	**151**
Anthus pratensis	7		28	**35**
Anthus cervinus			1	**1**
Anthus spinoletta	1		3	**4**
Anthus sp.			514	**514**
Fringilla coelebs			233	**233**
Chloris chloris	4		6	**10**
Carduelis carduelis			12	**12**
Linaria cannabina			106	**106**
Emberiza schoeniclus	15		1183	**1198**
Miliaria calandra			1	**1**
Total / Skupaj	10525	781	19139	**30445**