

CHANGES IN BIRD SPECIES COMPOSITION AND ABUNDANCE
IN DRAGONJA VALLEY (SW SLOVENIA)

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ABSTRACT

*In 2015, breeding bird census was carried out in the Dragonja River Valley and its results compared with the census implemented there in 1996/97. In contrast to numerous other natural environments that have been thoroughly transformed and fragmented in the last few decades, a significant increase of the total number of breeding pairs with regard to the initial situation has been noted in the area under consideration. The species that reached the greatest degree of dominance remained the same throughout the observation period (Blackbird (*Turdus merula*), Blackcap (*Sylvia atricapilla*), Nightingale (*Luscinia megarhynchos*), Chaffinch (*Fringilla coelebs*)). Several new species were recorded as well, predominantly those characteristic of mature forests. Numbers of pairs are rising also in the great majority of cultural landscape species, forest species and generalists. The obtained results show that the Dragonja Valley plays an exceptionally significant role in the preservation of the endangered bird species' populations.*

Key words: Dragonja, sub-Mediterranean, bird census, conservation guidelines, land-use changes, secondary succession

CAMBIAMENTI IN COMPOSIZIONE ED ABBONDANZA DELLE SPECIE DI UCCELLI
NELLA VALLE DEL DRAGOGNA (SLOVENIA SUD-OCCIDENTALE)

SINTESI

*Nel 2015 è stato eseguito un censimento delle specie nidificanti nella valle del fiume Dragogna e i risultati sono stati confrontati con quelli del censimento effettuato nel periodo 1996/97. In confronto a numerosi altri ambienti naturali che sono stati trasformati e frammentati negli ultimi decenni, è stato osservato nella zona in esame un aumento significativo del numero totale di coppie nidificanti. Le specie che hanno raggiunto il massimo grado di dominanza sono rimaste le stesse durante tutto il periodo di osservazione: il merlo (*Turdus merula*), la capinera (*Sylvia atricapilla*), l'usignolo (*Luscinia megarhynchos*), ed il fringuello (*Fringilla coelebs*). Diverse nuove specie sono state registrate nell'area, prevalentemente quelle caratteristiche delle foreste mature. Il numero di coppie è in aumento anche nella maggioranza delle specie del paesaggio culturale, di quelle forestali e dei generalisti. I risultati ottenuti dimostrano che la valle del Dragogna svolge un ruolo particolarmente significativo nella conservazione delle popolazioni di specie di uccelli in via di estinzione.*

Parole chiave: Dragogna, area sub-mediterranea, censimento di uccelli, linee guida di conservazione, cambiamenti nell'uso del suolo, successione secondaria

INTRODUCTION

With the undreamed-of development of mass tourism as well as construction of residential buildings and infrastructure closely associated with these activities in most Mediterranean countries after World War II, natural and landscape-worthy areas have been rapidly disappearing in their coastal zones. In this respect, the Dragonja Valley in Slovenian Istria is something very special indeed, considering that it has managed to avoid agricultural intensification and watercourse regulation as well as great infrastructural and construction projects (Križan, 2002).

Until the first few decades of the 20th century, the Dragonja Valley had the characteristic image of the mosaic cultural landscape, which was in fact prevalent all over Istria. People inhabited villages and hamlets, making a living out of agriculture and livestock farming, as well as grain grinding in the characteristic mills on the Dragonja River. At the bottom of the valley, small fields, vineyards, plantations, orchards and pastures prevailed, whereas slopes were overgrown by mixed forests. After World War I, and especially World War II, people gradually abandoned agricultural production owing to its unprofitability and began to emigrate. Former arable plots, including the characteristic terraces with stone supporting walls, began to be overgrown with vegetation. Globevnik *et al.* (1995, 1999) ascertained that in 1971 22% of the Dragonja catchment was overgrown by forests, and no less than 62% in 1994; the surface area of meadows and pastures was reduced by 30% between 1971 and 1994. Arable land was reduced by one fifth. More rain water in the Dragonja River catchment than in old times is used for the growth of tree and shrub vegetation, which means that the water flow into the river is smaller as well (Globevnik, 1999). In turn, this causes lower annual flow rates on average in the Dragonja River (Globevnik *et al.*, 1995).

In the valley, birds have been systematically surveyed from the mid-1980s (Gregori, 1987). There followed the surveys in 1996/97 (Sovinc, 1998), 2012 (Gregorič, 2013) and 2015 (this work). The results are highly significant if we wish to understand the importance of conservation of the last few natural or nature-like areas in the coastal strip and to designate appropriate conservation regime needed to retain favourable conservation status for species and habitats in these sanctuaries.

The key characteristics of composition and abundance of birds in the area under consideration along the Dragonja River during the survey conducted by Gregori in 1986 (Gregori, 1987) and results of the census implemented in 1996/97 by Sovinc (1998) can be summarised in the following:

- The total number of registered species did not change, although there is a slight difference in composition of the registered species; Gregori, for example, registered some bird species that have not been confirmed as breeding species in 1996/97 or at a later date (Little

Bittern (*Ixobrychus minutus*), Tree Pipit (*Anthus trivialis*), Stonechat (*Saxicola rubicola*), Wren (*Troglodytes troglodytes*) and Jackdaw (*Corvus monedula*)).

- The surveys in 1996 and 1997 confirmed the newly established species in the survey area, *i.e.*: Sparrowhawk (*Accipiter nisus*), Collared Dove (*Streptopelia decaocto*), Hoopoe (*Upupa epops*), Mistle Thrush (*Turdus viscivorus*), Sardinian Warbler (*Sylvia melanocephala*), Starling (*Sturnus vulgaris*) and Corn Bunting (*Miliaria calandra*). Some species frequented the municipal waste landfill at Dragonja (but did not breed there), which is no longer functional, with Yellow-legged Gulls (*Larus michahellis*), Black-headed Gulls (*Chroicocephalus ridibundus*) and Hooded Crow (*Corvus cornix*) among them.

- The greatest rise in the number of breeding pairs in comparison with the previous survey by Gregori (1986) was recorded for Turtle Dove (*Streptopelia turtur*), Greenfinch (*Chloris chloris*), Goldfinch (*Carduelis carduelis*) and Woodlark (*Lullula arborea*), while Rock Bunting (*Emberiza cia*) was the only species for which a negative abundance trend was recorded between 1986 and 1996/97.

- Sovinc (1998) terminates the comparison with preliminary survey from 1986 with his conclusion that the abundance of most of the species of cultural landscape, forest-shrubland and populated areas in the area under consideration along the Dragonja River has increased.

The aim of this study is to discuss changes in the avifauna of the area as a result of changes in the land use patterns. Based on this analyses and evaluation of the conservation importance of the area, we would like to propose some management recommendations for the future land use, essential to safeguard favourable ecological conditions for the bird communities in the Dragonja valley.

MATERIALS AND METHODS

Study area

The Dragonja Valley covers 95 km² and is situated in the extreme south-western part of Slovenia along the border with Croatia. The Dragonja River has numerous tributaries and is 30 km long. It flows in east to west direction and drains into Piran Bay. Between the deep ravines which are cut in the flysch substratum, plateau-like hills are rising, on which hamlets and villages have developed in the past (Orožen-Adamič, 1979; Križan, 2002).

The entire area of Slovenian Istria, including the Dragonja Valley, is under the influence of sub-Mediterranean climate. Precipitation is evenly distributed all year round, with distinct dry and wet periods. The peak is reached in the autumn months and in early summer (May and June). The least rainfall is recorded during the transition season between winter and spring (from

January to April) and in peak summer months. Average January temperatures oscillate between 0°C and 4°C, while average July temperatures vary between 19°C and 22°C (Ogrin, 1995).

The Dragonja area belongs to the sub-Mediterranean phytogeographical region (Wraber, 1969). Owing to the cold flysch substratum, which is impermeable to water, no true evergreen Mediterranean plants thrive in the valley, but only thermophilous deciduous vegetation. Here, the association of Hop-Hornbeam and Downy Oak (*Ostrya-Quercetum pubescentis*) predominates (Kaligarič, 1997). A primary natural vegetation (*Seslerio-Quercetum*) is well preserved (Križan, 2002). Shady slopes of the valley are covered by Hornbeam stands (*Carpinus betulus*), while drier and thermophilous slopes are overgrown by Oriental Hornbeam (*Carpinus orientalis*). Quite common as far as trees are concerned, are Manna Ash (*Fraxinus ornus*) and Field Maple (*Acer campestre*) (Kaligarič, 1997). At the bottom of the valley and along the water we can find individual poplars (*Populus* sp.), black locust (*Robinia pseudoacacia*), willows (*Salix* sp.), maples (*Acer* sp.) and minor complexes of reed (*Phragmites* sp., *Arundo donax*), which are to a great extent overgrown by shrubs (Gregori, 2002). Shrub species are predominated by Blackthorn (*Prunus spinosa*) and English Hawthorn (*Crataegus oxyacantha*), which thrive especially in the Dragonja's hinterland. Some smaller areas are covered by grasslands (Kaligarič, 1997). Limestone islets (Sv. Štefan and Stena) are home to eu-Mediterranean plants, e.g. Holm Oak (*Quercus ilex*), Broad-leaved Phyllirea (*Phyllirea latifolia*), Yellow Germander (*Teucrium flavum*), etc. (Kaligarič, 1997; Wraber, 2002).

Amongst cultural plants, Common Grape Vine (*Vitis vinifera*), Common Olive (*Olea europea*) and various fruit trees prevail.

Field methods

The survey was carried out according to the point count method at transect length with 23 count points some 500 metres apart, as was in the years 1996/97 (Sovinc, 1998). The survey route was approximately 10.5 km long (Fig. 1). This method has been used at the time of the first census in 1986 (Gregori, 1987) and used all surveys that followed in order to enable best possible comparison of results obtained.

Owing to certain indistinctness's in the interpretation of some data and count points from 1986 (Gregori, 1987), we decided to take the 1996/97 survey (Sovinc, 1998) as the initial survey for the comparison of composition and abundance trends in the Dragonja Valley.

Birds were identified mainly through their singing and calls. At each point, listening time lasted five minutes (DOPPS, 2006). In 2015, three field days were conducted, each time in the months of May and June. Surveys lasted from early morning till mid-day, when birds are most active. Every singing male was treated as a breeding pair. At all times, the highest of the values at the same point of registered singing males or breeding pairs was taken into consideration. Surveys did not take place during the night which explains absence of some potential night species, like owls.

Determination of the extent of habitat types is based on the estimate of phytogeographical and vegetation

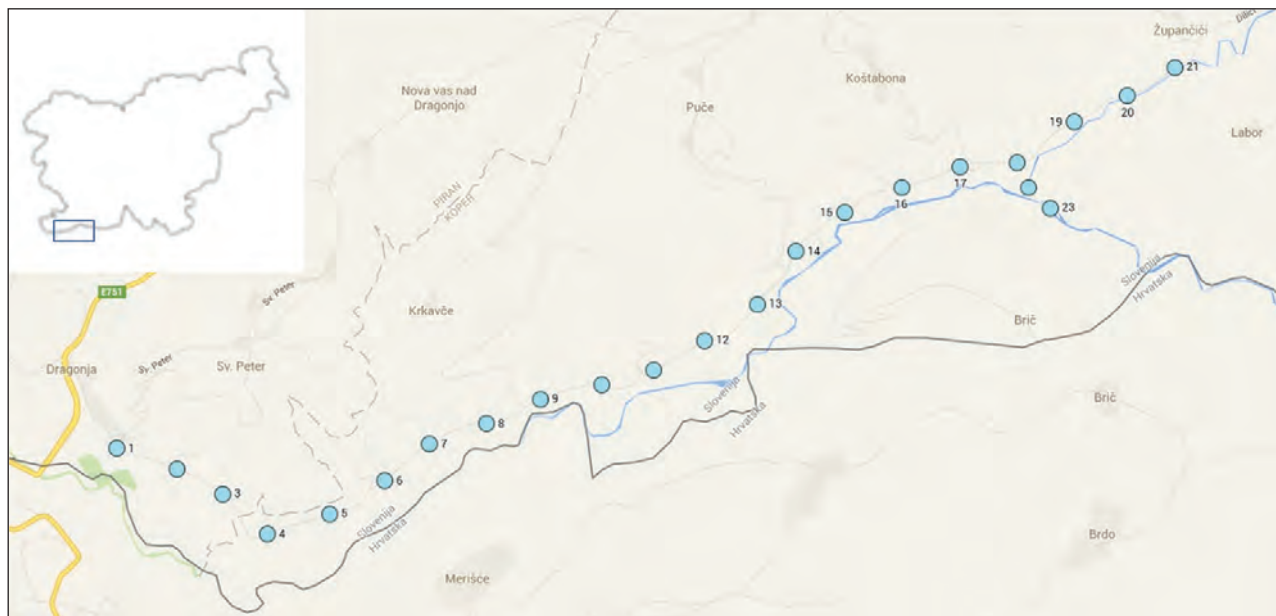


Fig. 1: Transect of the survey with count points (Source: adapted from Google maps: <https://www.google.si/maps>).
Sl.1: Transekt popisa s števnimi mesti (Vir: prirejeno po Google maps: <https://www.google.si/maps>).

characteristics, rate of overgrowth and land use; it was already Gregori (1987) who surveyed habitat types along the Dragonja River in the same manner, merging them into four groups: urban (residential buildings and other built up areas), vineyards, open areas (meadows, fields with trees, bushes and plantations in between, and overgrown areas (forest and scrubland). At each count point, the share of separate habitat type was estimated. Shares of habitat presence are given in %.

Data analysis

From collected data, the species dominance index (DOM) was calculated, which indicated relative frequency of the species in association (Tome, 2006). The dominance index was calculated according to the formula:

$$D = \frac{a}{S} \times 100 (\%)$$

where a is the number of territorial males of species recorded along the entire transect, and S is a total number of all bird species records on the census spot (transect). A species is dominant when its index is at least 5%, and subdominant when its index oscillates between 2 and 5% (Tarman, 1992).

Index for separate species (POV index) was calculated in the survey covering the years 1996/97 (Sovinc, 1998) and calculated again for the year of 2015 to enable accurate comparison of results. The index smaller than 100 indicates a reduction of pair numbers in the area under consideration with regard to the initial year, whereas index greater than 100 indicates an increase of pairs.

Indicator bird species for groups were also stipulated: generalists, cultural landscape species, forest species, shrubland and grassland species. The indicator species were designated on the basis of report entitled *Monitoring of generally distributed bird species to determine Slovenian index of agricultural landscape bird species* (Kmecl et al., 2014a).

For the evaluation of changes in number of breeding pairs of recorded bird species between 1996/97 and 2015, a Chi-square test was used. Test was not applied for the recorded species, which do not breed in the studied area.

RESULTS AND DISCUSSION

Numbers of probable and certain breeders

During the census carried out in the breeding season in the Dragonja Valley in 2015, 63 species were recorded, 57 of which are probable and certain breeders (Appendix 1). By 2015, the number of breeding bird species increased from the initial situation in the 1996/97 by 14 (Nuthatch (*Sitta europaea*), Song Thrush (*Turdus philomelos*), Black Woodpecker (*Dryocopus*

martius), Woodpigeon (*Columba palumbus*), Raven (*Corvus corax*), Tawny Owl (*Strix aluco*), Lesser Spotted Woodpecker (*Dendrocopos minor*), Nightjar (*Caprimulgus europaeus*), Marsh Tit (*Poecile palustris*), Short-toed Treecreeper (*Certhia brachydactyla*), Fan-tailed Warbler (*Cisticola juncidis*), Great Reed Warbler (*Acrocephalus arundinaceus*), Grey-headed woodpecker (*Picus canus*) and Spanish Sparrow (*Passer hispaniolensis*)). Regarding the latter this is, to the best of our knowledge, the first confirmed breeding in Slovenian Istria (DOPPS, 2016). The majority of newly established breeders belong to the group of forest species, especially species of mature forest. In the last few decades, the areas overgrown with shrubs and young trees along the Dragonja River have gradually transformed into mature forests, where the share of undergrowth has been noted, which in fact explains the arrival of the already mentioned forest specialists. In the last three years, especially cultural landscape species reappeared in the area under consideration, while Great Reed Warbler and Kingfisher (*Alcedo atthis*) are closely associated with water habitats. The Kingfisher's breeding in the dug burrow in the Dragonja's bank has not been confirmed, as the river ran dry in the summer at that section, which could indicate that the breeding attempt ended unsuccessfully. Breeding of both species was confirmed in this area before (Geister, 1995).

As already established by Gregorič (2013), Hooded Crow has disappeared from the list of Dragonja Valley breeders in the last few decades. In contrast, its population has increased significantly in urban areas as well as settlements in the vicinity of the area observed (Senič, 2015). Among the local breeders, no Collared Dove pair was registered in 2015 in the village of Dragonja, the same as Rock Bunting, which was no longer registered during the last censuses along the Dragonja River, we can once more write that this species most probably does not breed here anymore.

In 2015, at least four bird species were registered, for which no confirmation of their potential breeding could be established although they were observed in the time of the breeding period and in suitable breeding habitats; so these four species were not added to the list of Dragonja Valley breeders. These are Bee-eater (*Merops apiaster*), Calandra Lark (*Melanocorypha calandra*), Whinchat (*Saxicola rubetra*) and Yellow Wagtail (*Motacilla flava*). Yellow-legged Gulls and Swifts (*Apus apus*) observed along the Dragonja River only feed here and breed outside the area discussed so they are not included on the list of breeding species.

At the time when we are daily faced with alarming data on decline in abundance and local disappearance of bird species, a glimpse at the number of the birds' breeding pairs along the Dragonja River is very pleasing indeed. Such a result is no doubt the consequence of various factors: in the last few decades, no great environmentally harmful and destructive encroachments

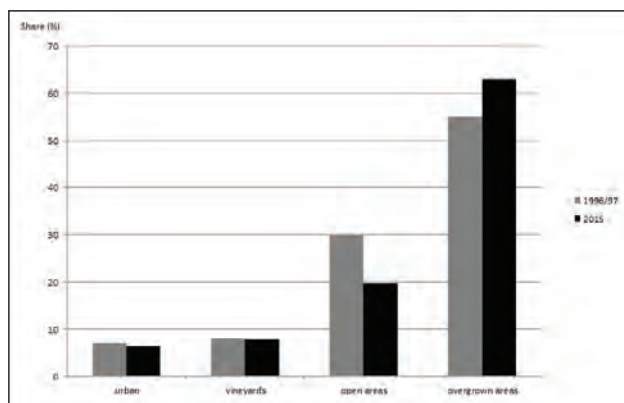


Fig. 2: Shares of habitat types (in %) between 1996/97 and 2015 - urban area, vineyards, open and overgrown areas.

Sl. 2: Deleži habitatnih tipov: urbano okolje, vinogradi, odprta in zaraščena območja (v %) v letih 1996/97 in leta 2015.

upon space have taken place in the Dragonja Valley. Predominantly tarmac road still leads through the valley, which limits the density of motor traffic. Along the survey route no new constructions or large infrastructural investments can be seen. No areas where exploitation of natural resources in industrial manner (e.g. major felling of woods) would be carried out have been designated and no ambitious changes in land use made. Our own observations show relatively small estimates in land use change (Fig. 2).

Changes in degree of dominance

The details regarding the degree of dominance for separate species are shown in Appendix 1. During all three surveys along the Dragonja River four species were among the dominant ones, i.e. Blackbird (*Turdus merula*), Nightingale (*Luscinia megarhynchos*), Chaffinch (*Fringilla coelebs*) and Blackcap (*Sylvia atricapilla*). From the initial census in 1996/97, however, the degree of the birds' dominance – with the exception of Blackbird – has been reduced till this day. Increase in the share of subdominant species from the initial census is evident as well; in 1996/97, 9 species were subdominant, while in 2015 their number reached 13 species. Among subdominant and even dominant species in a separate census were always the following species: Serin (*Serinus serinus*), Melodious Warbler (*Hippolais polyglotta*), Golden oriole (*Oriolus oriolus*), Cirl Bunting (*Emberiza cirlus*), Blue Tit (*Cyanistes caeruleus*), Great Tit (*Parus major*) and Turtle Dove. Song Thrush, as a newly established breeder in 2012 (Gregorič, 2013), immediately appeared as a subdominant species.

The rise in dominance degree has been lately registered particularly in the species characteristic of open

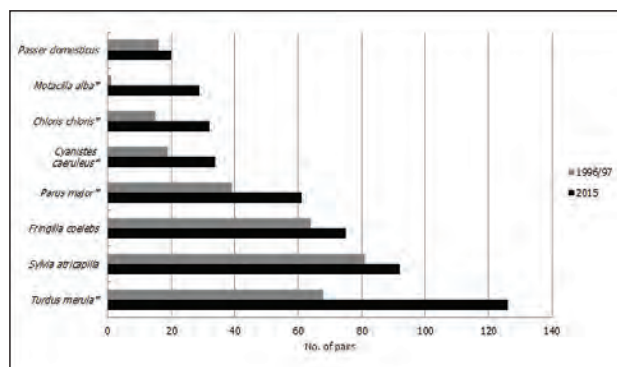


Fig. 3: Number of generalist pairs in 1996/97 (grey column) and 2015 (black column). Significance of χ^2 test on the differences between 1996/97 and 2015 is marked with *: $p = 0.02$.

Sl. 3: Število parov generalistov v letih 1996/97 (sivi stolpci) in 2015 (črni stolpci). Statistično značilne razlike med leti 1996/97 in 2015 so bile izračunane s testom hi-kvadrat in so označene z *: $p = 0,02$.

cultural landscape with trees and bushes (e.g. Red-backed Shrike (*Lanius collurio*), Pheasant (*Phasianus colchicus*)) and the species inhabiting wooded areas bordering on open landscape with rarer trees and bushes (e.g. Blue Tit, Greenfinch, Turtle Dove, Jay (*Garrulus glandarius*), Cuckoo (*Cuculus canorus*)).

Generalists

Among generalists in the area under consideration are, quite expectedly, the species that also predominate with degree of dominance, such as Blackbird, Blackcap, Chaffinch as well as Great Tit, Blue Tit and Greenfinch. Numbers of pairs of the above mentioned species statistically significantly increased (χ^2 , $p=0.02$), with the exception of Blackcap and Chaffinch (Fig. 3). Most conspicuous amongst generalists is the Pied Wagtail (*Motacilla alba*) owing to the great statistical significant increase (χ^2 , $p=0.02$) of its recorded pairs; from a single pair recorded in 1996/97, the number of this species' pairs rose to no less than 29 by 2015. In the Dragonja Valley, the Pied Wagtail is not closely linked only to the village of Dragonja and to the nearness of water, but it also breeds along fields and meadows in the entire valley. In Slovenia, a modest decline has been generally noted for this species (Kmecl *et al.*, 2014a).

Cultural landscape species

Among cultural landscape indicator species, increase of numbers of pairs is mostly noted (Fig. 4). During the 1996/97 surveys, only individual Hoopoes, Starlings and Wrynecks (*Jynx torquilla*) were recorded. The num-

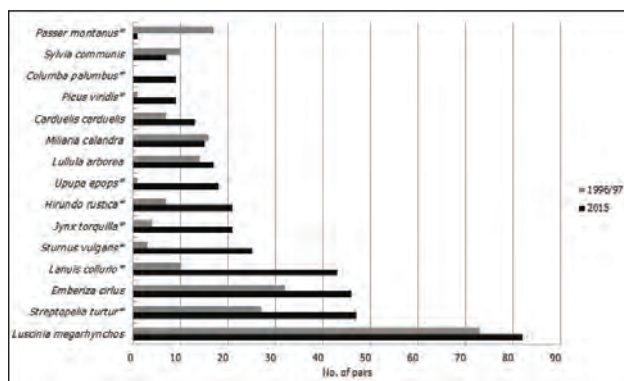


Fig. 4: Number of pairs of cultural landscape species in 1996/97 (grey column) and 2015 (black column). Significance of χ^2 test on the differences between 1996/97 and 2015 is marked with *: $p = 0.02$.

Sl. 4: Število parov vrst iz kulturne krajine v letih 1996/97 (sivi stolpci) in 2015 (črni stolpci). Statistično značilne razlike med leti 1996/97 in 2015 so bile izračunane s testom hi-kvadrat in so označene z *: $p = 0,02$.

bers of these species pairs have statistically significantly increased (χ^2 , $p=0.02$) along the Dragonja River in the last few years, which is very pleasing indeed, given that the above mentioned species, with the exception of Starling, are highly endangered in Slovenia, where their populations are rapidly declining (Kmecl *et al.*, 2014a).

In 1996/97, only a single pair of Green Woodpeckers (*Picus viridis*) was registered, while in 2015, 9 individuals were recorded. Very pleasing are the statistically significant rising numbers of pairs (χ^2 , $p=0.02$) and satisfactorily large breeding densities also in other elsewhere in Slovenia endangered species, such as Red-backed Shrike and Turtle Dove (Red List of Breeding Birds of the Republic of Slovenia, 2002), which are experiencing moderate or sharp decline (Kmecl *et al.*, 2014a). Also, number of Cirl Bunting pairs, in Slovenia endangered species (Red List of Breeding Birds of the Republic of Slovenia, 2002) have increased by 14.

The only indicator species of cultural landscape, the abundance of which has statistically significantly declined (χ^2 , $p=0.02$) in the last few years in the area along the Dragonja River, is Tree Sparrow (*Passer montanus*). In the valley, this bird is closely attached to the environs of individual secluded farms. Quite sensible for monitoring the trends of this species would be a survey on ridges of the slopes above Dragonja Valley with the characteristic densely packed settlements.

Grassland species

A look at the numbers of grassland species' pairs is encouraging, although some oscillations are noticeable. The number of Wryneck and Green Woodpecker statis-

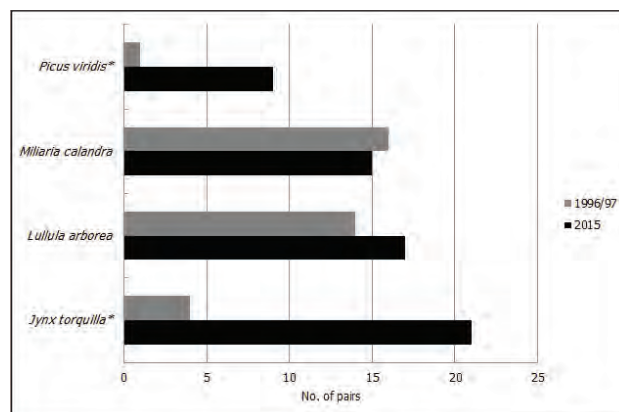


Fig. 5: Number of grassland species pairs in 1996/97 (grey column) and 2015 (black column). Significance of χ^2 test on the differences between 1996/97 and 2015 is marked with *: $p = 0.02$.

Sl. 5: Število parov travniških vrst v letih 1996/97 (sivi stolpci) in 2015 (črni stolpci). Statistično značilne razlike med leti 1996/97 in 2015 so bile izračunane s testom hi-kvadrat in so označene z *: $p = 0,02$.

tically significantly increased (χ^2 , $p=0.02$), while Corn Bunting decreased by one pair (from 16 to 15). Woodlarks numbers of pairs increased from 14 to 17 pairs (Fig. 5). Grassland species are otherwise considered one of the most endangered groups of birds in Slovenia (Kmecl *et al.*, 2014a, b).

Shrubland species

There are only two species in this group: Melodious Warbler and Sardinian Warbler (Fig. 6). We are dealing with them separately as shrubland species, given that they are distinctly attached to bush stands during the breeding season and do not look for food outside these stands (in contrast to, for example, Red-backed Shrike, which breeds in bushes from where it lurks for prey, after which it flies into more open landscape). The number of recorded singing Melodious Warbler males fell from the initial count in 1996/97 (50 pairs) to 38 pairs in 2015. Even greater statistically significant decline (χ^2 , $p=0.02$) was noted in Sardinian Warbler, which is here distinctly attached to breeding sites in the stands of Spanish Broom (*Spartium junceum*). The decline of Sardinian Warbler's abundance (11 pairs during the initial census, and only 3 pairs in 2015) can be associated with the increasingly smaller stands of this plant. In the past, people systematically grew Spanish Broom in Istria and used its stems for tying their products (M. Kaligarič, *pers. comm.*). Today, the plant is hardly still utilized for this purpose, and is not grown by farmers any longer. In the competition for space with other species, which are characteristic of the first phases of natural succession, the Spanish Broom is least successful. It seems, therefore, that the Sardinian

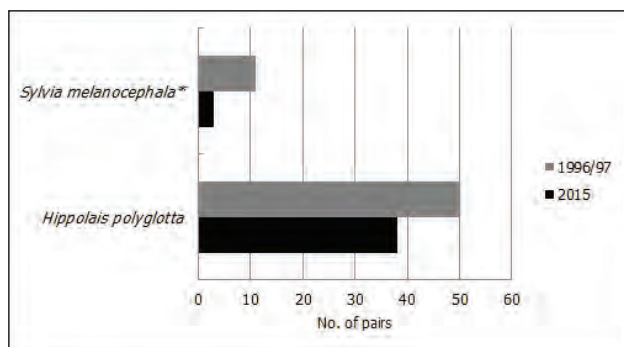


Fig. 6: Number of shrubland species pairs in 1996/97 (grey column) and 2015 (black column). Significance of χ^2 test on the differences between 1996/97 and 2015 is marked with *: $p = 0.02$.

Sl. 6: Število parov grmovnih vrst v letih 1996/97 (sivi stolpci) in 2015 (črni stolpci). Statistično značilne razlike med leti 1996/97 in 2015 so bile izračunane s testom hi-kvadrat in so označene z *: $p = 0,02$.

Warbler is becoming increasingly rare in the Dragonja Valley for these very reasons.

Forest species

During the analysis of the number of registered species we wrote that forest species have predominated among new species in Dragonja Valley in the last decade and a half, particularly those that favour mature forest and are not attached to thick undergrowth characteristic of the early succession phases. A statistically significant increase (χ^2 , $p=0.02$) of abundance of other forest species is noticeable as well, including Jay, Golden Oriole, Mistle Thrush and – particularly in the last three years – Hawfinch (*Coccothraustes coccothraustes*) (Fig. 7). A similar increase in the number of this species has also been noted in the last year by I. Škornik (*pers. comm.*) in the section where the river drains into the sea. Among forest indicator species, the number of Chiffchaff (*Phylloscopus collybita*) pairs has decreased from 22 to 15. As the bird is not characteristic of dry and hot areas, it is more abundant mainly along the upper and somewhat colder parts of the Dragonja River. It would certainly be interesting to establish how the species reacts, in the area under consideration, to influences associated with climate change. In Slovenia as a whole, a moderate decline of this species has been noted (Kmecl *et al.*, 2014a). In comparison to similar study in the Southern France, where increase of woodland species due to rural abandonment and secondary succession was detected (Preiss *et al.*, 1997) the extent of woodland areas in the Dragonja valley is not increasing dramatically in the last time (Fig. 2), which enables favourable ecological conditions for both woodland and open habitat species.

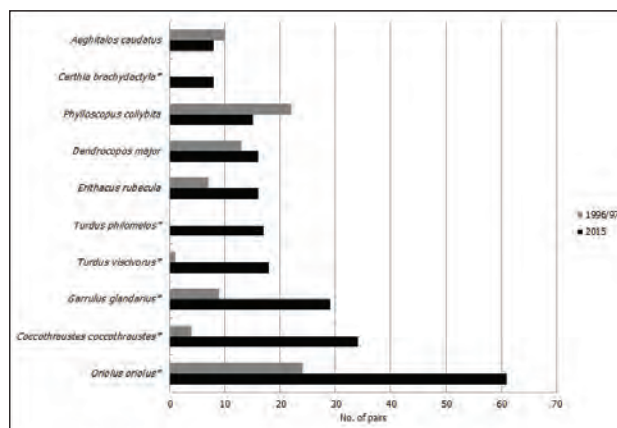


Fig. 7: Number of forest species pairs in 1996/97 (grey column) and 2015 (black column). Significance of χ^2 test on the differences between 1996/97 and 2015 is marked with *: $p = 0.02$.

Sl. 7: Število parov gozdnih vrst v letih 1996/97 (sivi stolpci) in 2015 (črni stolpci). Statistično značilne razlike med leti 1996/97 in 2015 so bile izračunane s testom hi-kvadrat in so označene z *: $p = 0,02$.

CONCLUSIONS

The systematic survey of composition and abundance of birds in the Dragonja Valley, carried out in accordance with the comparable and recognized method in 1996/97, serves as initial situation for comparisons and identification of changes in bird fauna. This paper presents the results of the breeding bird census implemented in 2015.

The number of the registered birds' breeding pairs increased by 64% in the period from 1996/97 to 2015. The majority of new species are the characteristic representatives of forest birds, particularly those inhabiting mature forests. This is not surprising at all, considering that the Dragonja Valley has been for almost a century subjected to overgrowing of arable land owing to people leaving the area and abandonment of traditional land use. The extent of woodland areas in the Dragonja valley is not increasing dramatically in the last time, which enables favourable ecological conditions for both woodland and open habitat species. The species that reached the greatest degree of dominance remained the same throughout the observation period (Blackbird, Blackcap, Chaffinch). However, the degree of their dominance – with the exception of Blackbird – has changed to a certain extent. At the same time, the number of subdominant species has risen. Number of pairs increased also in the great majority of cultural landscape species, forest species and generalists. Among the species with large increase in their populations are elsewhere in Slovenia highly endangered species, such as Red-backed Shrike, Hoopoe, Wryneck, Green Woodpecker, Turtle Dove and others (Red List of

Breeding Birds of the Republic of Slovenia, 2002). Only a few species suffered a decline in their numbers, such as Sardinian Warbler, Melodious Warbler (both shrubland species), Tree Sparrow and Rock Bunting.

The obtained results show that the Dragonja Valley, where no extensive fragmentation has taken place, plays an exceptionally significant role in the preservation of the endangered bird species' populations.

It should thus be necessary to suitably protect the valley and to manage it as a nature reserve, where more effort would be invested in the preservation of conditions for the survival of endangered species and creation of conditions for stable populations of these bird species than to looking for opportunities for sustainable use and exploitation of natural resources. In practice this means that reckless and ambitious changing of current landscape image into an area of industrial production of

crops, vegetables, vineyards and plantations with resulting changes in the manner of production (e.g. irrigation systems, fertilization, land consolidation, removal of hedgerows, early mowing, intensive grazing *etc.*) could have very similar negative consequences for the conservation of populations of most endangered bird species as would be imposed by industrial, infrastructural or urban land use in the valley.

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SPREMEMBE V SESTAVI IN ŠTEVILČNOSTI PTIČJIH VRST V DOLINI REKE DRAGONJE (JZ SLOVENIJA)

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POVZETEK

*V dolini reke Dragonje smo v letu 2015 opravili census ptic gnezdil in primerjali rezultate raziskave s censusom iz let 1996/97. V nasprotju z mnogimi drugimi naravnimi območji, ki so bila v zadnjih desetletjih fragmentirana ali povsem preoblikovana, beležimo na obravnavanem območju občutno povečanje skupnega števila gnezdečih parov glede na izhodiščno stanje. Vrste, ki dosegajo največjo stopnjo dominacije, so skozi vso opazovalno obdobje enake (kos (*Turdus merula*), črnoglavka (*Sylvia atricapilla*), slavec (*Luscinia megarhynchos*), ščinkavec (*Fringilla coelebs*)). Ugotovljeno je bilo tudi več novih vrst, predvsem tistih, ki so značilne za zrele gozdove. Tudi pri veliki večini vrst kulturne krajine, pri gozdnih vrstah in generalistih je število parov naraslo v primerjavi z izhodiščnim letom. Zbrani rezultati kažejo, da ima dolina Dragonje izredno pomembno vlogo pri ohranjanju populacij ogroženih vrst ptic.*

Ključne besede: Dragonja, sub-Mediteran, census ptic, varstvene usmeritve, spremembe rabe tal, sekundarna sukcesija

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Appendix 1: List of surveyed bird species and numbers of their pairs in 1996/97 and 2015, comparison of number of pairs between 1996/97 and 2015 by a χ^2 test ($p = 0.02$), Index POV and degree of dominance in 1996/97 and 2015.

Priloga 1: Seznam opaženih vrst ptic in število njihovih parov v letih 1996/97 in 2015, primerjava med pari v letih 1996/97 in 2015 z uporabo testa hi-kvadrat ($p = 0,02$) ter indeks POV in stopnja dominance v omenjenih letih.

Serial No.	English name	Latin name	No. of pairs		χ^2 test	Index POV		Degree of dominance (%)	
			1996/97	2015		1996/97	2015	1996/97	2015
1	Barn Swallow	<i>Hirundo rustica</i>	7	21	0.0082	100	300	0.9	1.7
2	Bee-eater	<i>Merops apiaster</i>	0	7*				0.0	0.6
3	Black Woodpecker	<i>Dryocopus martius</i>	0	2	0.1573			0.0	0.2
4	Blackbird	<i>Turdus merula</i>	68	126	0.0000	100	185	9.0	9.9
5	Blackcap	<i>Sylvia atricapilla</i>	81	92	0.4030	100	114	10.7	7.2
6	Blue Tit	<i>Cyanistes caeruleus</i>	19	34	0.0394	100	179	2.5	2.7
7	Calandra Lark	<i>Melanocorypha calandra</i>	0	2*				0.0	0.2
8	Cetti's Warbler	<i>Cettia cetti</i>	8	1	0.0196	100	12	1.1	0.1
9	Chaffinch	<i>Fringilla coelebs</i>	64	75	0.3508	100	117	8.5	5.9
10	Chiffchaff	<i>Phylloscopus collybita</i>	22	15	0.2498	100	68	2.9	1.2
11	Cirl Bunting	<i>Emberiza cirlus</i>	32	46	0.1129	100	144	4.2	3.6
12	Collared Dove	<i>Streptopelia decaocto</i>	1	0	0.3173	100	0	0.1	0.0
13	Common Buzzard	<i>Buteo buteo</i>	6	6	1.0000	100	100	0.8	0.5
14	Corn Bunting	<i>Miliaria calandra</i>	16	15	0.8575	100	94	2.1	1.2
15	Cuckoo	<i>Cuculus canorus</i>	13	41	0.0001	100	315	1.7	3.2
16	Fan-tailed Warbler	<i>Cisticola juncidis</i>	0	2	0.1573			0.0	0.2
17	Golden Oriole	<i>Oriolus oriolus</i>	24	61	0.0001	100	254	3.2	4.8
18	Goldfinch	<i>Carduelis carduelis</i>	7	12	0.2513	100	171	0.9	0.9
19	Goshawk	<i>Accipiter gentilis</i>	1	0	0.3173			0.1	0.0
20	Great Reed Warbler	<i>Acrocephalus arundinaceus</i>	0	1	0.3173			0.0	0.1
21	Great Spotted Woodpecker	<i>Dendrocopos major</i>	13	16	0.5775	100	123	1.7	1.3
22	Great Tit	<i>Parus major</i>	39	61	0.0278	100	156	5.2	4.8
23	Green Woodpecker	<i>Picus viridis</i>	1	9	0.0114	100	900	0.1	0.7
24	Greenfinch	<i>Chloris chloris</i>	15	32	0.0131	100	213	1.9	2.5
25	Grey Wagtail	<i>Motacilla cinerea</i>	2	5	0.2568	100	250	0.3	0.4
26	Grey-headed woodpecker	<i>Picus canus</i>	0	1	0.3173			0.0	0.1
27	Hawfinch	<i>Coccothraustes coccothraustes</i>	4	34	0.0000	100	850	0.5	2.7
28	Hobby	<i>Falco subbuteo</i>	0	1*				0.0	0.1
29	Hooded Crow	<i>Corvus cornix</i>	1*	0				0.1	0.0
30	Hoopoe	<i>Upupa epops</i>	1	18	0.0001	100	1800	0.1	1.4
31	House Sparrow	<i>Passer domesticus</i>	16	20	0.5050	100	125	2.1	1.6
32	Jay	<i>Garrulus glandarius</i>	9	29	0.0012	100	322	1.2	2.3

33	Kingfisher	<i>Alcedo atthis</i>	0	2*				0.0	0.2
34	Lesser Spotted Woodpecker	<i>Dendrocopos minor</i>	0	1	0.3173			0.0	0.1
35	Long-tailed Tit	<i>Aeghitalos caudatus</i>	10	8	0.6374	100	80	1.3	0.6
36	Magpie	<i>Pica pica</i>	1	1	1.0000	100	100	0.1	0.1
37	Mallard	<i>Anas platyrhynchos</i>	0	7	0.0082			0.0	0.6
38	Marsh Tit	<i>Poecile palustris</i>	0	1	0.3173			0.0	0.1
39	Melodious Warbler	<i>Hippolais polyglotta</i>	50	38	0.2008	100	76	6.6	3.0
40	Mistle Thrush	<i>Turdus viscivorus</i>	1	18	0.0001	100	1800	0.1	1.4
41	Nightingale	<i>Luscinia megarhynchos</i>	73	82	0.4697	100	112	9.7	6.5
42	Nightjar	<i>Caprimulgus europaeus</i>	0	1	0.3173			0.0	0.1
43	Nuthatch	<i>Sitta europaea</i>	0	2	0.1573			0.0	0.2
44	Pheasant	<i>Phasianus colchicus</i>	9	38	0.0000	100	422	1.2	3.0
45	Pied Wagtail	<i>Motacilla alba</i>	1	29	0.0000	100	2900	0.1	2.3
46	Raven	<i>Corvus corax</i>	0	1	0.3173			0.0	0.1
47	Red-backed Shrike	<i>Lanius collurio</i>	10	43	0.0000	100	430	1.3	3.4
48	Robin	<i>Erithacus rubecula</i>	7	16	0.0606	100	229	0.9	1.3
49	Rock Bunting	<i>Emberiza cia</i>	8	0	0.0047	100	0	1.1	0.0
50	Sardinian Warbler	<i>Sylvia melanocephala</i>	11	3	0.0325	100	27	1.5	0.2
51	Serin	<i>Serinus serinus</i>	20	22	0.7576	100	110	2.6	1.7
52	Short-toed Treecreeper	<i>Certhia brachydactyla</i>	0	8	0.0047			0.0	0.6
53	Song Thrush	<i>Turdus philomelos</i>	0	17	0.0000			0.0	1.3
54	Spanish Sparrow	<i>Passer hispaniolensis</i>	0	1	0.3173			0.0	0.1
55	Sparrowhawk	<i>Accipiter nisus</i>	1	1	1.0000	100	100	0.1	0.1
56	Spotted Flycatcher	<i>Muscicapa striata</i>	3	9	0.0833	100	300	0.4	0.7
57	Starling	<i>Sturnus vulgaris</i>	3	25	0.0000	100	833	0.4	1.9
58	Swift	<i>Apus apus</i>	7	7	1.0000	100	100	0.9	0.6
59	Tawny Owl	<i>Strix aluco</i>	0	1	0.3173			0.0	0.1
60	Tree Sparrow	<i>Passer montanus</i>	17	1	0.0002	100	6	2.2	0.1
61	Turtle Dove	<i>Streptopelia turtur</i>	27	47	0.0201	100	174	3.6	3.7
62	Whinchat	<i>Saxicola rubetra</i>	0	1*				0.0	0.1
63	Whitethroat	<i>Sylvia communis</i>	10	7	0.4669	100	70	1.3	0.6
64	Woodlark	<i>Lullula arborea</i>	14	17	0.5900	100	121	1.9	1.3
65	Woodpigeon	<i>Columba palumbus</i>	0	9	0.0027			0.0	0.7
66	Wryneck	<i>Jynx torquilla</i>	4	21	0.0007	100	525	0.5	1.7
67	Yellow Wagtail	<i>Motacilla flava</i>	0	1*				0.0	0.1
	No. of species		46	63					
	No. of breeders		45	57					
	No. of breeding pairs		755	1243					
	*Species does not breed								