Vestnik Zoologii, **53**(2): 149–154, 2019
DOI: 10.2478/vzoo-2019-0015

UDC 598.2: 504.122 (477.82)

THE EFFECT OF PYROGENIC SUCCESSIONON BREEDING BIRDS OF SHELTER BELTS IN THE NORTH-WESTERN PART OF THE AZOV SEA REGION

E. M. Ayubova[1], V. A. Koshelev[2]

[1]*Tavria State Agrotechnological University, Bohdan Khmelnytsky Ave., 18, Melitopol, Zaporizhzhia Region, 72310 Ukraine*
E-mail: tsatu.edu.ua
[2]*Bohdan Khmelnytskyi Melitopol State Pedagogical University, Hetmanska st., 20, Melitopol, Zaporizhzhia Region, 72312 Ukraine*
E-mail: nauka@mpu.melitopol.net

The Effect of Pyrogenic Succession on Breeding Birds of Shelter Belts in the North-Western Part of the Azov Sea Region. Ayubova, E. M., Koshelev, V. A. — The effect of the pyrogenic factor on the avifauna of shelter belts in the north-western part of the Azov Sea region, Ukraine is considered basing on results of the research carried out in 2001–2018. The breeding bird community of shelter belts is composed of 50 species, of them different types of shelter belts support 14–46 species. Changes in the species composition of breeding birds are analysed in subsequent years after the fires. The recovery of bird communities is progressing at a slow pace following the regeneration of tree-shrub vegetation and development of consortial relations of birds with dominating tree-shrub species and rook (*Corvus frugilegus*) colonies. It is established that the vegetation pyrogenic succession is accompanied by deep qualitative and quantitative changes in the structure of breeding avian communities in shelter belts of different type.
Key words: pyrogenic factor, pyrogenic succession, shelter belts, birds, bird communities, consortial relations.

Introduction

The relevance of the topic. Over the last century steppe landscapes of southern regions of Ukraine have been converted into anthropogenic and anthropogenically transformed areas (technogenic, agricultural, residential, urbanized, etc). The continuous ploughing has replaced the steppes with agrolandscapes which typical elements became planted forests and shelter belts of different type, size and purpose (field, roadside, riparian, erosion-prevention shelter belts, etc.) (Filonov, 1972; Koshelev et al., 2005). There have been formed bird communities consisting of 10–50 breeding species (Belik, 2009; Filonov, 1972; Kuzmenko & Kuzmenko, 2010; Orlov, 1955; Volchanetsky, 1940). The shelter belts planted along the fields, railways and highways are highly susceptible to fire, usually provoked by men's careless attitude (throwing away cigarette ends along the roads, leaving a campfire burning, etc.) or by burning stubble field after harvesting when the fire spreads over adjacent windbreaks (95 % of cases; n = 120). A less common cause of fires is an intentional arson of shelter belts with subsequent tree felling. The pyrogenic factor has a direct impact on the shelter belt plants

completely burning grass vegetation and partially, less often completely, destructing tree-shrub species. Over time, the burned areas develop vegetation associations with other species composition and structure (Bumar & Germanchuk, 2006; Furyaev & Kireev, 1979; Matveev & Matveeva, 2013). This directly or indirectly affects birds and determines the structure of breeding avian communities in shelter belts.

Material and methods

The research was carried out by us during 2001–2018 in the south of Zaporizhzhia Region, Ukraine in shelter belts of different types that had experienced the fires. Eight plots, each 500–1,000 m long, were selected in control shelter belts where the pyrogenic factor had been observed. Transect counts of birds were made in control plots 2–3 times during the breeding season before or after the fires over the period 5–25 years. The data for 1990–2000 were kindly given by A. I. Koshelev. Singing males and revealed nests were recorded, and pictures were taken. The transect length equalled to 1 km, the width of the counting strip — 50 m. For the shelter belts, the species and age structure of trees and shrubs, their condition, type of grass cover, structure of a shelter belt, extent of damage from fire and the type of fire were recorded. All the control plots are briefly characterized below.

Plot 1. A roadside shelter belt, consisting of 6 rows, in the vicinity of Melitopol City. Loose-planted, tree species are represented by the black locust (*Robinia pseudoacacia* L.) and honey locust (*Gleditchia triacantha* L.), shrubs include the dog rose (*Rosa canina* L.) and wild privet (*Ligustrum vulgare* L.). Grass vegetation is well developed. The brushfire, widespread and strong, occurred in the summer of 2006. Five years after the fire the underbrush of the black and honey locusts was developed by self-seeding, after 10 years the shelter belt restored.

Plot 2. A shelter belt along the railway in the vicinity of Melitopol. Tree species are represented by the black locust, ash, box elder, honey locust, red cedar, silverberry. The plantation is dense, consisting of 4 rows. Fires occur annually in local parts of the shelter belt; untouched islets of tree-shrub vegetation still remain.

Plot 3. A roadside shelter belt, in the vicinity of Hyrsivka village, Pryazovske District. The plantation is wind-permeable, 4 rows, consisting of the black locust trees. The grass cover is dense. The shelter belt supported a rook colony of 200 nests. The brushfire happened in 2005.

Plot 4. A field shelter belt, in the vicinity of Hyrsivka Village, Pryazovske District. The plantation is wind-permeable, 8–10 rows, consisting of the black locust trees. The grass cover is of ornithogenic origin, very high and dense. The shelter belt supported a rook colony (350 pairs), and in it — the colonies of the little egret and red-footed falcon. The brushfire occurred in the summer of 2008.

Plot 5. A riparian shelter belt, at the eastern shore of Molochnyi Liman, in the vicinity of Mordvynivka Village, Melitopol District. Arboreal species are represented by young trees of the Chinese elm (*Ulmus parvifolia* L.), shrubs — by the Siberian peashrub (*Caragana arborescens* Lam.), and the yellow honeysuckle (*Lonicera flava* L.). The shelter belt is loose-planted, 4 rows. The brushfire occurred in the summer of 2007.

Plot 6. A riparian and erosion-prevention shelter belt on the terraced slope of the western shore of Molochnyi Liman, consisting of 4 rows, dense, not permeable by wind. Arboreal species are represented by middle-aged trees of the Crimean pine (*Pinus* sp.) and red cedar (*Juniperus virginiana* L.). The grass cover is high and dense. The widespread fire occurred in the summer of 2010 and completely destroyed coniferous trees, no restoration is recorded.

Plot 7. A riparian and erosion-prevention shelter belt at the western shore in the upper reaches of Molochnyi Liman, in the vicinity of Myrne village, Yakymivka District. The plantation consists of 10 rows, represented by middle-aged trees of the black locust, honey locust, and the European ash (*Fraxinus exctlsior* L.), shrubs include the desert false indigo (*Amorpha fruticosa* L.) and hawthorn (*Crataegus* sp.); the grass cover is dense. The shelter belt is dense, not permeable by wind. The brushfire occurred in June 2006.

Plot 8. A riparian and erosion-prevention shelter belt at the western high shore of Utliukskyi Liman, in the vicinity of Davydivka village, Yakymivka District. Arboreal species are represented by the black locust, shrubs — by the European smoketree (*Cotinus coggygria* Scop.). The shelterbelt is loose-planted, 6 rows. The grass vegetation is dense, of average height. The widespread brushfire occurred in the summer of 1996.

Results and discussion

The avifauna of planted forests of the north-western part of the Azov Sea region is composed of 120 species, including 80 breeding species. It is determined by the size, age and structure of the planted forests as well as availability of fresh bodies of water (Filonov, 1972; Koshelev, 2005; Kuzmenko & Kuzmenko, 2010). The breeding avifauna of shelter belts is much poorer, its species richness and diversity is also determined by the age and species composition of tree-shrub vegetation, proximity to water bodies, structure and condition of neighbouring fields, and proximity to settlements (Kopylova et al, 2011; Koshelev, 2005). We recorded a total of 50 bird species in shelter belts of different type and size, of them 25 species in field shelter belts, 30 — in shelter belts along railways, 20 — in

Table 1. Bird species composition in shelter belts of the north-western part of the Azov Sea region in 2001–2018 under the effect of the pyrogenic factor

Bird species	Species occurrence		
	Condition and age of a shelter belt after fire		
	After fire		Without fire
	3–5 years	6–10 years	
Night heron (*Nycticorax nycticorax* L.)	–	-	+
Little egret (*Egretta garzetta* L.)	–	-	+
Long-legged buzzard (*Buteo rufinus* Cretz.)	–	-	+
Common buzzard (*Buteo buteo* L.)	–	-	+
Hobby falcon (*Falco subbuteo* L.)	–	-	+
Red-footed falcon (*F. vespertinus* L.)	–	+	+
Kestrel (*Falco tinnunculus* L.)	–	+	+
Partridge (*Perdix perdix* L.)	+	-	+
Pheasant (*Phasianus colchicus* L.)	+	+	+
Wood pigeon (*Columba palumbus* L.)	–	-	+
Turtle dove (*Streptopelia turtur* L.)	–	-	+
Collared dove (*S. decaocto* Friv.)	–	+	+
Long-eared owl (*Asio otus* L.)	-	+	+
Short-eared owl *(Asio flammeus* L.)	+	+	+
Scops owl (*Otus scops* L.)	–	-	+
Roller (*Coracias garrulus* L.)	–	-	+
Hoopoe (*Upupa epops* L.)	–	-	+
Great Spotted Woodpecker (*D. major* L.)	-	-	+
Syrian Woodpecker (*Dendrocopos syriacus* L.)	–	–	+
Tree pipit (*Anthus trivialis* L.)	–	–	+
Red-backed Shrike (*Lanius collurio* L.)	+	+	+
Lesser grey shrike (*Lanius minor* Gm.)	–	+	+
Starling (*Sturnus vulgaris* L.)	–	–	+
Golden Oriole (*Oriolus oriolus* L.)	–	–	+
Blackbird (*Turdus merula* L.)	–-		+
Song thrush (*Turdus philomelos* C. L. Brehm)	–	+	+
Thrush nightingale (*Luscinia luscinia* L.)	–	+	+
Garden warbler (*Sylvia borin* Bodd.)	–	+	+
Whitethroat (*Sylvia communis* Lath.)	+	+	+
Blackcap (*Sylvia atricapilla* L.)	–	+	+
Barred warbler (*S. nisoria* Bechst.)	+	+	+
Willow warbler (*Phylloscopus trochilus* L.)	–	+	+
Spotted flycather (*Muscicapa striata* Pall.)	–	+	+
Collared flycatcher (*Ficedula albicollis* M.)	–	+	+
Great tit (*Parus major* L.)	–	–	+
Blue tit (*Parus caeruleus* L.)	–	–	+
Corn Bunting (*Emberiza calandra* L.)	+	+	+
Yellowhammer (*Emberiza citrinella* L.)	–	+	+
Ortolan Bunting (*Emberiza hortulana* L.)	+	+	+
Chaffinch (*Fringilla coelebs* L.)	–	–	+
Goldfinch (*Carduelis carduelis* L.)	–	–	+
Linnet (*Cannabina cannabina* L.)	+	+	+
Greenfinch (*Chloris chloris* L.)	–	+	+
House sparrow (*Passer domesticus* L.)	–	–	+
Tree sparrow (*Passer montanus* L.)	–	+	+
Raven (*Corvus corax* L.)	–	–	+
Hooded crow (*C. cornix* L.)	–	-	+
Rook (*Corvus frugilegus* L.)	–	–	+
Jackdaw (*Corvus monedula* L.)	–	–	+
Magpie (*Pica pica* L.)	–	+	+
Total of species	9	24	50
%	18.0	48.0	100.0

shelter belts along highways, 46 — in riparian shelter belts along the banks of small rivers, and 12–20 species — on terraced slopes of high western shores of Molochnyi Liman and Utliukskyi Liman. Similar results were obtained for field shelter belts in steppes along the eastern bank of the Dnipro River, where 18 species breed in the permeable shelter belts, 39 — in loose-planted, and 41 — in dense shelter belts; in total, 51 species were recorded in them (Kuzmenko & Kuzmenko, 2010).

The breeding birds were monitored in 8 plots of control shelter belts that had experienced fires. A complete list of birds breeding in shelter belts at different stages of pyrogenic succession is given below (table 1).

The impact of the pyrogenic factor on shelter belts varies depending on the season and weather conditions. The types of fires can be distinguished as brushfire, crown fire, widespread fire; the most destructive is widespread fire in hot, dry and windy weather. The pyrogenic succession has the following stages: initial (burning out of vegetation), restoration of grass cover, restoration of shrubs, restoration of tree plants, and a completely restored shelter belt. These natural processes are accompanied by human factors which can accelerate (planting of trees and shrubs seedlings) or slow down (felling of the undergrowth, livestock grazing, repeated burning out, ploughing of burned areas, etc.) the succession process.

The breeding bird community in shelter belts is not uniform, dominated by the species nesting on trees and shrubs (fig. 1). After the fires happening in late May–June the birds

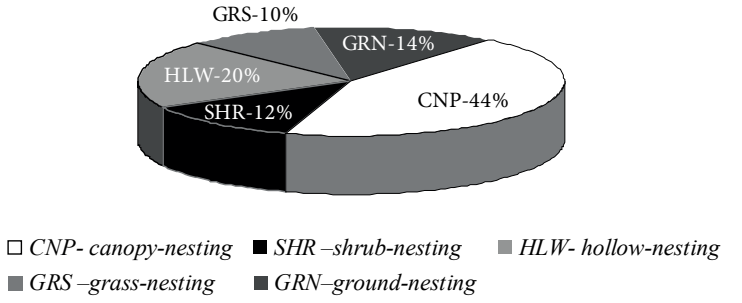

Fig. 1. Ecological bird groups nesting in shelter belts.

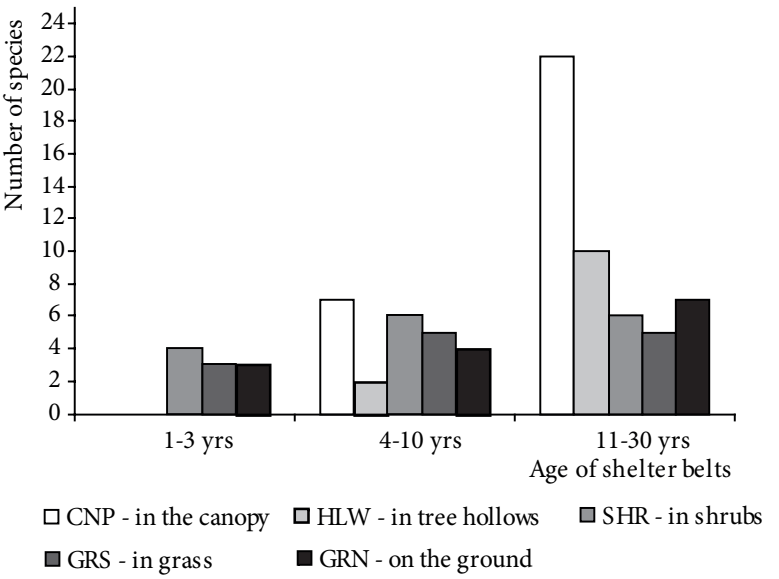

Fig. 2. Occurrence of birds of different ecological groups in shelter belts at different stages of pyrogenic succession.

breeding in the current season (rooks, magpies) leave their nests located on trees whereas the nests of ground-nesting birds and those on shrubs are simply destroyed. During 1–3 years after the fire Corvidae do not appear in the damaged shelter belt; other bird species usually occupying their old nests are absent as well (little egrets, kestrels, red-footed falcons, long-eared owls, house and tree sparrows).

The rate with which the birds occupy shelter belts after the fires varies for different ecological groups. The first are the species nesting on the ground in dense grass and in young shrubs (pheasants, partridges, whitethroats, red-backed shrikes, linnets, etc.), then appear the species nesting in the middle layer (lesser grey shrikes, turtle doves, wood pigeons, magpies, etc.), the last are hollow-nesting species (Syrian woodpeckers, hoopoes, great tits, spotted flycatchers, tree sparrows, etc.). Their proportion at the last stage of the pyrogenic succession is shown below (fig. 2). The birds occupy a shelter belt with a different rate depending on the shelter belt type, extent of vegetation damage from fire and the pace of restoration (table 2).

As the vegetation recovers, the restoration of bird communities in shelter belts after fires goes on the basis on ecological relations of birds with the biocoenosis (topic and fabric links), enrichment of forage resources (trophic links), use of building material (fabric links). We traced it by the example of individual consortia, which core in forest belts is represented by some species of trees: black locust (*Robinia pseudoacacia* L.), Chinese elm (*Ulmus parvifolia* L.), silverberry *(Elaeagnus commutate*) and shrub species (European smoketree, hawthorn. Black locusts and Chinese elms form a canopy layer in shelter belts and are used as nesting trees by the hooded crow, rook, raven, and the golden oriole. The undercanopy is formed by silverberries with nests of magpies, wood pigeons, turtle doves, lesser grey shrikes, red-backed shrikes, blackbirds and song thrushes. The old nests of corvids are occupied by birds of prey (buzzards, long-legged buzzards, kestrels, red-footed falcons), long-eared owls, scops owls, wood pigeons, little egrets, etc.), while multi-species bird colonies are formed around these nests (Kopylova et al., 2011; Numerov et al., 2017). The main suppliers of these nests in our region are the rook and magpie. Therefore the destruction of corvid nests due to fires leads to the disappearance of these species returning in the restored shelter belts only at the 3rd–4th succession stages. As woodpecker-made cavities and natural hollows appear in old trees (4th stage), the shelter belts are starting to be occupied by hollow-nesting species (hoopoes, starlings, house and tree sparrows, spotted flycatchers, etc.)

Table 2. Occupation of shelter belts by birds after fires

No of control plot	Structure of a breeding bird community prior to the fire	Number of species in plots according to phases of pyrogenic succession				
		1st year after fire	Initial stage, grass vegetation	Appearance and development of shrub vegetation	Appearance and development of tree vegetation	Completion of succession, mature trees
1	2	3	4	5	6	7
1	30	3	6	24	26	28
2	32	4	8	16	26	30
3	18	1	4	8	12	16
4	38	0	3	10	14	20
1	2	3	4	5	6	7
5	12	0	2	6	10	11
6	14	0	2	4	5	10
7	46	8	15	22	26	34
8	14	2	4	7	9	12
Average number of species	26	2	7	12	16	22

Conclusions

The pyrogenic factor causes significant damage to shelter belts, from the partial destruction of tree-shrub vegetation to total extermination of all vegetation that adversely affects the birds inhabiting the suffered area. Coniferous planted forests are especially susceptible to fire. Restoration of shelter belts is a slow process. Each stage of the pyrogenic succession is corresponded with a particular composition of the breeding bird community; the species diversity and numbers of birds in shelter belts increase with each stage. At the initial stage, birds do not nest in completely burnt shelter belts and are found only during feeding, at the second stage there are ground-nesting species, at the third — shrub species, at the fourth — tree-nesting and hollow-nesting species appear. The final restoration of the breeding bird community in shelter belts is completed between 18 and 30 years after the fire. It is associated with the improving forage resources, availability of areas suitable for nesting, and protective conditions of the area. Despite the economic damage, a positive ecological value of fires in shelter belts lies in renewal and changing of phytocoenoses and, accordingly, in changing of the species composition and numbers of breeding birds. Indicators of the species diversity and abundance of birds are important characteristics of the status of shelter belts and the natural environment as a whole.

References

Belik, V. P. 2009. *Birds of planted forests of the steppe Ciscaucasia*. Mineral, Krivoy Rog, 1–216 [In Russian].

Bumar, G. Y., Germanchuk, V. O. 2006. Wildfires in natural biocoenoses of Polissia Reserve. *Zapovidna Sprava v Ukraini,* **12** (1), 74–76 [In Ukrainian].

Filonov, K. P. 1972. The number of birds in various landscapes of the northern part of the Azov Sea region. *Vestnik Zoologii,* 4, 20–27 [In Russian].

Furyaev, V. V., Kireev, D. M. 1979. Studying post-fire dynamics of forests on a landscape basis. Nauka, Novosibirsk, 1–160 [In Russian].

Kopylova, T. V., Koshelev, A. I., Koshelev, V. A. 2011. Number dynamics of breeding Corvidae in control plots during 2000–2010 in the south of Zaporizhzhia Region (northern part of the Azov Sea region). *Branta: Transactions of the Azov-Black Sea Ornithological Station,* 14, 94–105 [In Russian].

Koshelev, A. I. 2005. Bird communities of planted forests of the northern part of the Azov Sea region: development, dynamics and contribution to the maintenance of regional diversity. *In*: *The biodiversity and role of zoocoenosis in natural and anthropogenic ecosystems*. Proceedings of the 3d International Scientific Conference. Dnipropetrovsk National University Press, Dnipropetrovsk, 422–425 [In Russian].

Koshelev, A. I., Peresadko, L. V., Koshelev, V. A., Pokusa, R. V., Kopylova, T. V. 2005. Anthropogenic transformation of landscapes of the northern part of the Azov Sea region, booms and recessions in the number of common vertebrate species and their impact on the zoocenoses structure *In*: *The biodiversity and role of zoocoenosis in natural and anthropogenic ecosystems*. Proceedings of the 3rd International Scientific Conference 123–125. Dnipropetrovsk National University Press, Dnipropetrovsk [In Russian].

Kuzmenko, T. M., Kuzmenko, Yu. V. 2010. Breeding avifauna of shelter belts of the forest-steppe zone of Left-bank Ukraine. *Branta: Transcations of the Azov-Black Sea Ornithological Station,* 13, 121–134 [In Ukrainian].

Matveev, A. M., Matveeva, T. A. 2013. The role of the pyrogenic factor in the forest development process. *Selskokhozyaystvennye Nauki*, 4, 914–918 [In Russian].

Numerov, A. D., Vengerov, P. D., Sapelnikov, S. F., Sokolov, A. Yu., Kupriyanov, A. A. 2017. A case study of the development of a multi-species bird colony as a result of Corvidae nesting activity. *Russian Journal of Ornithology,* **26**, 1395, 257–261 [In Russian].

Orlov, P. 1955. Materials on the avifauna of planted forests and shelter belts of Melitopol District. *Scientific Notes of Melitopol State Pedagogical Institute*, 2, 55–65 [In Ukrainian].

Volchanetsky, I. B. 1940. Main features of the fauna development in agromelioration planted forests of the steppe zone of Ukraine. *Transactions of Zoobiological Institute*, 8–9, 26–33 [In Russian].

Received 15 June 2018
Accepted 25 October 2018