



SPECIES COMPOSITION AND BREEDING DENSITY OF FOREST BIRDS IN KÕPU NATURE RESERVE (WESTERN HIIUMAA)

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Abstract: Kõpu nature reserve is situated in Western Estonia, in the westernmost part on the island Hiiumaa. In 2005 the species composition and number of birds inhabiting the nature reserve was estimated by using different methods. Line transect method was used to study the overall population density of the bird fauna and the numbers of common species. To achieve better estimations on the numbers of raptors, woodpeckers, owls and several late-breeding nocturnal birds, specific mapping methods on different taxons were applied. Additional records data of rarer species were complemented the data set. Altogether 56 bird species were registered in the nature reserve; the average population density being 365 ± 53 breeding pairs per km². Population density within forest types protected by habitats directive did not significantly differ from the overall mean population density. However, breeding density was higher in western taiga and somewhat lower in deciduous paludificated and swamp woods. Species diversity was higher in deciduous and in mixed stands compared to coniferous forests with pine as the dominant tree species. The most numerous bird species was chaffinch *Fringilla coelebs*, followed by siskin *Carduelis spinus*, chiffchaff *Phylloscopus collybita* and willow warbler *P. trochilus*. Greenish warbler *Phylloscopus trochiloides* and red-breasted flycatcher *Ficedula parva* were recorded only in old-growth forests. Galliformes and several species of owls and woodpeckers that are common habitants of inland areas where completely absent in the nature reserve.

Introduction

Kõpu peninsula is located in the western part of Hiiumaa and is rich in old-growth woodland. Preservation of forests that have high conservation value was one of the priority objectives when establishing the Kõpu nature reserve. However, birds in this area have been studied only casually and even though an overview of the forest birds in Kõpu exists (Leito & Leito 1995; Leito 2000) the knowledge and data of the distribution within different areas and biotopes is still rather poor. The only results of counts and estimations on population density in the eastern part of the peninsula in 1978 are published by J. Kallas (1988).

Although the forest bird fauna of Estonia is considered to be studied quite poorly (Kumari 1970; Renno 1974; Ellermaa 2005), several articles about the density of forest birds in nature reserves as well as in 'average' forested areas have been published in the past few years. In these studies bird fauna has mostly been described by mapping during the early hours of a day and covering small areas (Ellermaa 2005; Lõhmus & Rosenväld 2005) or by line transect method (Ellermaa 2003b; Lõhmus 2003, 2004). However, in order to estimate the population concentration of bird species that are not numerous yet valuable in terms of nature conservation, these methods are not sufficient. Completely different approaches have been recommended for counting raptors on large study plots (Randla 1976; Lõhmus 1994), registering territories of woodpeckers by play-back method (Lõhmus *et al.* 2000a) and counting nocturnal birds at nights (Ellermaa 2003a) etc.

The aim of the current study was to estimate the breeding density of different bird species inhabiting Kõpu nature reserve. In order to obtain results as precise as possible different methods were applied for counting different bird groups. Line transect method was used for estimating population concentration of common and numerous species. The population concentration of woodpeckers and nocturnal birds was estimated by using specially modified transect counts while the distribution and abundance of raptors was estimated by applying specific observation methods and also by searching for nests. Additional

observations were carried out in order to specify the distribution of species and the numbers of rare birds.

Material and methods

Study area

Kõpu nature reserve was established in 2005 by joining the areas selected by the Estonian Forest Conservation Area Network project (Viilma *et al.* 2001) and *Natura 2000* inventory of species and habitat types to the former nature reserve (1109 ha). Present nature reserve covers 3022 ha and consists of a main area and 10 smaller areas (Fig. 1.). According to the conservation regime, there are 20 special management zones (2974 ha) and 3 limited management zones.

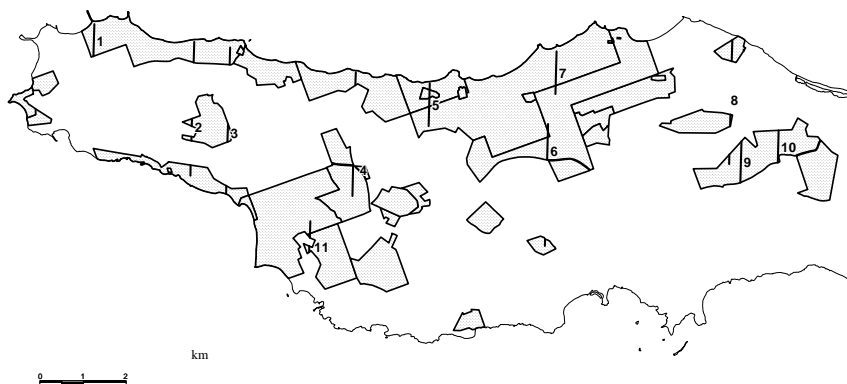


Figure 1. Location of transects on Kõpu peninsula. Shaded area represents the nature reserve.

Joonis 1. Linnustiku transektloenduse radade paiknemine Kõpu poolsaarel. Looduskaitseala on esitatud varjutatult.

More than 80% of the Kõpu peninsula is woodland of which 86% belongs to the state. Majority of forests in the nature reserve are hemiboreal pine forests, one could also find mixed forests of pine and spruce. A relatively large proportion is covered with old stands – more than one third of the forests belong to the ageclass 5 and 7 (determined by the age of the most common tree species). For example 39.5% of all pine forests are at least 100 years old, 18.8% at least 150 years old, and 5.7% at least 200 years old. 87.2% of all the spruce forests are at least 100 years old and 20% at least 200 years old. In 2001–2003, habitat types listed in *Natura 2000* were mapped and during the project 47% of all the forests in the reserve were registered as extremely valuable in terms of nature conservation. In addition to the 1417 ha of forest biotopes there is also 180 hectares of non-forested area protected by *Natura 2000*.

Fieldwork

Fieldwork was carried out during 27.03–23.06.2005 whereas the exact time and counting methods differed depending on bird group.

General distribution of the bird fauna and number estimates for common species were estimated in 28.05 – 01.06 by line transect method following commonly used methodology (e.g. Ellermäa 2003a). Mean temperature during these five mornings was measured as 10°C, wind was either weak or moderate and there was no rainfall except for a short shower on one day. Modifications improving the results in forests (Lõhmus 2003, 2004) were taken into account. For example, birds recorded in transects were divided into three groups (<25m, <50m and >50m). As a rule, 50+50m transects were used when making calculations, however, 25+25m transects were used for species that are difficult to detect. Comparatively, when estimating loudly singing and less numerous species further than 50m, we used the Finnish variant of the line transect method that uses correction coefficients in estimations: $\text{number of pairs} \times \text{correction coefficient} / \text{transect length}$ (Ellermäa 2003a). Coefficients, calculated by Estonian data (Ellermäa 2003a) were used. Even though these coefficients have not been developed especially

for woodland it should not have any great effect on our results since most of the observed birds are forest birds (except e.g. Raven and Hooded Crow). Therefore woodland counts were probably also the basis for developing these coefficients. Still reliable estimations can be obtained only for species that have been recorded at least three times. Yet or estimations by Finnish method have to be considered carefully as the total length of transects is far shorter than the necessary minimum of 40–50 km (see Ellermaa 2003a,b).

Initially, we selected 10 transects of 1 km length. Central point of each transect was put randomly onto the landscape and transects were drawn as 500 m in the direction of north and 500 m of south. If transect length exceeded the boundaries of the nature reserve the exceeding part was 1) continued on the neighbouring reserve area if this was closer than 500 m, or 2) extended on the other end. There were two transects where extension in the other direction was impossible thus, the first (752 m) and the tenth (754 m) transect remained shorter. Remaining parts of these two transects were added up and placed as a separate transect of 530 m in the area of thus far uncovered region of the nature reserve where it passed through deciduous stands that were poorly represented in the sample. All 11 transects together formed an area of 10050 m and represented well the distribution of the stands within the nature reserve (Table 1). In addition to forest biotopes that are valuable in terms of nature conservation, transects also covered 2.1 ha of non-forested habitats and 43.2 ha of non-*Natura* areas. Maps in a scale of 1:2000 were used in order to mark the observed birds. GPS and compass were used for a precise determination of observers' location on transects.

In order to detect rare species, additional observations were conducted within the entire nature reserve and all records of those birds were marked on maps.

Breeding territories of **raptors** were mapped on the entire nature reserve area, but we also used observations from outside the nature reserve. Nevertheless, it was reasonable to estimate the numbers of some raptor species for the entire Kõpu peninsula (ca 90 km²) and later calculate the relative proportion of numbers breeding in the nature reserve whereas also the characteristics of the landscape were taken into

account. Field work was mostly carried out before midday and was concentrated on the period of display flights and feeding of nestlings. Mapping of diurnal birds of prey requires observations from high sites. There was a 36 m high lighthouse, providing a good view over the entire nature reserve, in the middle of the peninsula, on Tornimägi (63 m above the sea level). Here we mapped breeding territories on the 19th of April and on the 30th of May. However, it was not always possible to determine the exact location of the nesting territory from the lighthouse since the nature reserve consists of several detached areas. Therefore, additionally nests were searched for during the period from March to June. To ease the mapping, we used also data from past years (1996–2004; Ü. Väli unpublished).

In order to map breeding territories of **owls**, four special listening trips were carried out in the second half of March. We were searching for owls also during the night-trips on the second half of May and particularly in the middle of June during transect counts of nocturnal birds. Playback method was used only occasionally, we mainly aimed to perform simple listenings in suitable weather conditions. Additionally, potential nest sites (old nest cavities of woodpeckers, old stumps with open top, old raptor nests, etc.) were checked. Transect counts of **nocturnal species breeding later in the season** were performed on the 17th, 18th and 21st of June during the dark hours (from 23:30 to 02:30). Altogether 39 km (inside and outside the reserve area) were passed through by bicycle whereas several stops were made in order to determine the occurrence and location of birds more accurately.

Playback method was used for counting **woodpeckers** (*Piciformes*) since it has been proved to be a best counting strategy of this particular bird taxon (Lõhmus *et al.* 2000a). The drumming of White-backed Woodpeckers was broadcasted for five minutes in every 300-500 m and both woodpeckers that were in or came to the vicinity were counted during some ten subsequent minutes. Woodpeckers respond to the drumming of the White-backed Woodpecker and applying this method enables to compare our data with this obtained during former counts (e.g. Lõhmus *et al.* 2000b). In order to avoid multiple counting of individuals, movement of birds were followed carefully. Counts were

carried out on the 27.03 (in the morning and in the evening) and on the 29.03, 30.03, 20.04 (only mornings). There also were counts on 19.04 and 21.04, when, however, weather conditions were poor and no woodpeckers were registered. Since at least one individual of the commonest woodpecker species – the Great Spotted Woodpecker - was registered during the rest of the counts, those two days were excluded from analyses. Data used in the analyses of population density was obtained from an distance of 30.5 km where drumming was played in 78 different sites. Radius covered by playbacking was 200 m. This was the estimated limit for woodpeckers to respond to the playback and for observing them, as well as approximately half of the distance between the two neighbouring playback locations. Thus, the total counting area was estimated as 829 ha. Since woodpeckers were counted in spring where there is still a lot of snow, observations were made from trails that usually were either boundaries of the nature reserve or boundaries of different zones within the reserve. Therefore, population density of woodpeckers was estimated for the total forested area (both nature reserve and adjacent areas included).

Results and discussion

General description of the bird fauna

In 2005, altogether 56 bird species were registered in Kõpu nature reserve whereas 43 species were registered during transect counts (Table 2). A total of 473 pairs were counted; 211 were recorded within the 25x25 m zone, 153 pairs in 25-50 m distance and 109 pairs were even further away. The mean population density in Kõpu nature reserve was estimated to be 365 ± 53 breeding pairs per km². There was no difference in the population density of habitat types that have value in terms of nature conservation compared to other biotopes (363 pairs/km² and 366 pairs/km², respectively). However, breeding density was higher in western taiga biotope and somewhat lower in deciduous paludified and

Table 1. The number of breeding pairs in different forest and *Natura* habitat types. Areas presented in hectares. NR denotes –nature reserve

Table 1. Transektloendustel (50+50m) loendatud haudepaarid erinevates puistutes ning metsa-elupaigatiipides. Pindalad esitatud hektarites.

Age / Vanus	Dominant tree species / Peapuu liik										Habitat* / Elupaigatiip ^a				
	Mänd		Kuusk		Kask		Sanglepp								
	<i>Pinus sylvestris</i>		<i>Picea abies</i>		<i>Betula sp.</i>		<i>Alnus glutinosa</i>				2180	9010	9020	9050	9080
	<81	81-120	>120	<81	81-120	>120	<61	>61	<61	>60					
Area in NR	946	614	433	39	253	162	110	54	7	19	105	1035	16	28	231
<i>Pindala kaitsealal</i>															
Area in NR (%)	31,3	20,3	14,3	1,3	8,4	5,4	3,6	1,8	0,2	0,6	3,5	34,1	0,5	0,9	7,6
<i>Pindala kaitsealal (%)</i>															
Area in transects	27,6	25,6	17,3	2,6	3,0	8,8	8,2	4,7	0,3	0,4	3,1	29,3	1,5	0,4	6,7
<i>Pindala transektidel</i>															
Area in transects (%)	28,1	26,0	17,5	2,6	3,0	8,9	8,4	4,8	0,3	0,4	7,6	71,5	3,7	1,0	16,3
<i>Pindala transektidel (%)</i>															
<i>Columba palumbus</i>															1
<i>Strix aluco</i>						1									
<i>Anthus trivialis</i>	2				1	1	1	1				2			1
<i>Troglodytes troglodytes</i>															
<i>Prunella modularis</i>	1					1									
<i>Erithacus rubecula</i>	2	8	3	3	1	6		2			11				3
<i>Turdus merula</i>	2	1		1		1	2	1			1				
<i>T. philomelos</i>	4	1					2				1				1
<i>Sylvia borin</i>	2		2				2				2				
<i>S. atricapilla</i>	2		1	1	1			1		1		2			1
<i>S. curruca</i>	2	1	1			1		1			1	1			1
<i>S. communis</i>	3						1								
<i>Phylloscopus sibilatrix</i>															
<i>P. trochilus</i>	9	5		1		1	2	1	1		1	1			1
<i>P. collybita</i>	4	6	1	3	1	1	1	2			7			1	

<i>Regulus regulus</i>	5	3	3	3	2	6			
<i>Muscicapa striata</i>		1	1			1			1
<i>Ficedula parva</i>		1			2	1			
<i>F. hypoleuca</i>	1		1		2				1
<i>Parus palustris</i>		1		1					1
<i>P. montanus</i>	1	1							
<i>P. ater</i>		1							
<i>P. caeruleus</i>									1
<i>Parus major</i>	5		2	1	2	3			
<i>Certhia familiaris</i>			1			1			1
<i>Garrulus glandarius</i>	2								
<i>Nucifraga caryocatactes</i>				1					
<i>Corvus corone</i>	1								
<i>Fringilla coelebs</i>	32	32	32	4	5	10	14	7	1
								1	4
<i>Carduelis spinus</i>	6	2	6	1	1	4	1	1	10
<i>Loxia curvirostra</i>			1			1			
<i>Pyrrhula pyrrhula</i>	1		2			1	1		2
Pairs total / Kokku paare	85	68	57	16	10	33	32	24	5
Breeding tensities ^b									4
<i>Asustushädus</i> ^b	307	265	330	622	338	377	389	510	118
							(1149)	(955)	(161)
Total species / Kokku liike	19	16	14	9	6	14	11	13	403
									(267)
									(500)
									299
									2
									2
									12

^a Habitat types: 2180 – wooded dunes; 9010 – western taiga; 9020 – Fennoscandian hemiboreal natural old broad-leaved deciduous forests; 9050 – Fennoscandian herb-rich forests with spruce; 9080 – Fennoscandian deciduous swamp woods / *Elupaigatiübid*: 2180 – lüütemetsad; 9010 – lüümetaiiga; 9020 – looduslikud laialehised salumetsad; 9050 – hariliku kuusega rohunditerikkad metsad; 9080 – soostunud ja soo-lehtmetsad.

^b Breeding densities (pairs/km²) calculated on very small sample sizes and thus presented in parentages / Väga väikeste valimite põhjal arvutatud asustustihedused (paari/km²) võivad olla ebatäpsed ning on seetõttu esitatud sulgudes.

Table 2. Average breeding densities (pairs/km²) in Kõpu nature reserve according to transect counts. Breeding densities were usually calculated on 50 + 50 m wide transects; * - 25+25 m wide transects were used. For comparison, the breeding densities calculated with adjustment coefficients (when it was known) are presented. Breeding densities (based on observed data) are presented only for more numerous species.

Table 2. Haudelinnustiku^a keskmine asustustihedus (paari/km²) ning esinemine erinevates elupaigatüüpides Kõpu LKA-l transektloenduste põhjal. Asustustihedus loendusribade abil on määratud 50+50 m laiuse transekti põhjal, * - liikidel kasutati 25+25 m laiuse riba andmeid. Võrdluseks on liikidel, kellel vastav paranduskoeffitsient on teada, ka kõigi vaatluste põhjal koeffitsientide abil arvutatud asustustihedused. Tihedus elupaigatüüpides (üksnes loendusribade põhjal) on esitatud vaid arvukamatel liikidel.

Species / Liik	From transect counts only / Loendusribade põhjal				With adjustment coefficients Paranduskoeffitsientidega			
	Pairs counted Loendatud paare	Transects Radu	Density (± 95% confidence limits) Tihedus (±95% usalduspiirid)	Counted pairs Loendatud paare	Transects Radu	Density Tihedus		
Anas platyrhynchos	-	-		1	1			
Buteo buteo	-	-		1	1	0.2		
Grus grus	1	1	0.9 ± 5.9	4	4	0.3		
Columba palumbus	1	1	0.9 ± 5.9	8	7	1.6		
Strix aluco	1	1	0.9 ± 5.9	1	1			
Cuculus canorus	-	-		5	5	0.3		
Lynx torquilla	-	-		1	1			
Dryocopus martius	-	-		1	1	0.1		
Dendrocopos major	-	-		1	1	0.5		
Anthus trivialis	5	4	5.1 ± 8.3	11	6	3.9		
Troglodytes troglodytes	7	5	7.2 ± 8.7	8	5	3.4		

<i>Prunella modularis</i> *	1	1	1	0.5 ± 2.9	2	2	1.0
<i>Erithacus rubecula</i> *	22	10	10	11.9 ± 5.0	31	11	17.9
<i>Phoenicurus phoenicurus</i>	-	-	-		1	1	0.5
<i>Turdus merula</i>	8	6	6	8.4 ± 7.0	17	8	6.6
<i>T. philomelos</i>	8	6	6	8.1 ± 6.9	16	7	5.3
<i>T. viscivorus</i>	1	1	1	0.9 ± 5.9	2	2	0.8
<i>Hippolais icterina</i>	1	1	1	0.9 ± 5.9	1	1	0.7
<i>Sylvia atricapilla</i>	8	8	8	8.7 ± 4.3	9	8	5.0
<i>S. borin</i>	7	7	7	6.6 ± 4.0	9	8	4.6
<i>S. curruca</i>	5	5	5	4.8 ± 4.9	5	5	2.7
<i>S. communis</i>	4	2	2	3.6 ± 12.8	4	2	2.4
<i>Phylloscopus sibilatrix</i>	9	4	4	9.1 ± 14.1	14	6	5.9
<i>P. collybita</i>	19	8	8	20.6 ± 13.2	22	10	9.0
<i>P. trochilus</i>	22	9	9	22.0 ± 12.9	24	9	9.5
<i>Regulus regulus</i> *	13	7	7	6.6 ± 4.3	17	8	13.5
<i>Muscicapa striata</i> *	3	2	2	1.4 ± 4.5	3	2	3.1
<i>Ficedula parva</i>	4	2	2	4.4 ± 14.1	4	3	1.6
<i>F. hypoleuca</i>	4	4	4	5.0 ± 7.1	4	3	1.9
<i>Parus palustris</i> *	2	2	2	1.1 ± 3.3	3	3	3.0
<i>P. montanus</i>	2	2	2	0.9 ± 2.8	2	2	1.3
<i>P. ater</i>	3	3	3	2.7 ± 5.3	4	3	2.5
<i>P. caeruleus</i> ^b	1	1	1	0.9 ± 5.9	1	1	0.8
<i>P. major</i>	10	5	5	10.7 ± 12.3	12	7	6.9

<i>Certhia familiaris</i> *	2	2	1.8 ± 5.6	2	2	1.3
<i>Garrulus glandarius</i>	2	2	1.8 ± 5.6	2	2	1.1
<i>Nucifraga caryocatactes</i>	1	1	1.2 ± 7.8	1	1	0.5
<i>Corvus corone</i>	1	1	0.9 ± 5.9	5	4	0.7
<i>Corvus corax</i>	-	-		1	1	0.1
<i>Fringilla coelebs</i>	143	11	139.8 ± 20.9	176	11	84.8
<i>Carduelis spinus</i>	24	9	23.5 ± 9.6	28	10	8.4
<i>Loxia curvirostra</i>	2	2	1.8 ± 5.6	4	3	
<i>Pyrrhula pyrrhula</i>	5	4	5.3 ± 7.8	5	4	2.9

^a Additionally to the species, mentioned in the table, following species were recorded from Kõpu nature reserve during the observation period: *Haliaeetus albicilla*, *Accipiter gentilis*, *A. Nisus*, *Tringa ochropus*, *Scolopax rusticola*, *Aegolius funereus*, *Dendrocopos minor*, *Caprimulgus europaeus*, *Lullula arborea*, *Alauda arvensis*, *Phylloscopus trochiloides*, *Aegithalos caudatus* and *Pica pica*. / *Lisaks tabelis nimetatutele täiendasil LKA liiginimestikku veel merikotkas, kanakull, raudkull, metskurvits, karvasjalg-kakk, väike-kirjurähn, öösor, nõmmelõoke, põldlõoke, rohelinehelind, sabatihane ja harakas.*

^b As no individuals were recorded in 25+25 m wide transects, the data from 50+50 m transects were used. *Kuna 25+25 m ribal ühtegi paari ei kohatud, kasutati 50+50 m riba andmeid.*

swamp woods (Table 1). On the other hand, species diversity^{*} appeared to be higher in swamp woods ($H'=2.22$) and lower in western taiga ($H'=1.97$). Too few data for making any conclusions was obtained from the other *Natura* habitat types. The population density was 298 pairs/km² (n=210 pairs) in pine stands, 419 pairs/km² (n=59) in spruce stands and 433 pairs/km² (n=56) in birch stands (Table 1). There were 372 pairs/km² (n=43) in stands that consisted mainly of trees belonging to ageclass 3, 325 pairs/km² (45) in stands in class 4, 300 pairs/km² (100) in class 5, 629 pairs/km² (13) in class 6 and 360 pairs/km² (128) in class 7. The number of observed species was higher in older stands (Table 1), however, this may just reflect the larger sample size (Fig 2).

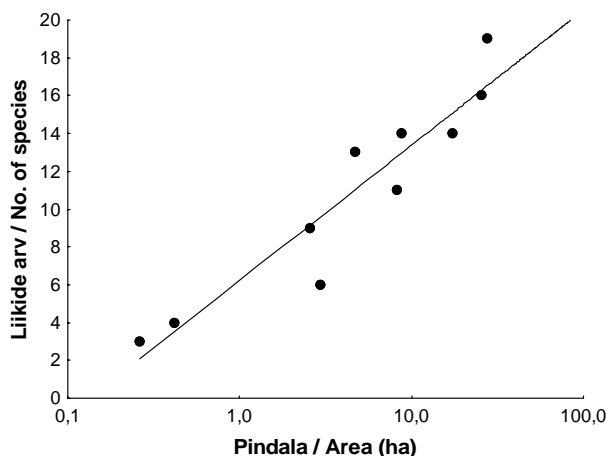


Figure 2. Relationship between number of observed species and study area ($R^2=0.75$; $F_{1,8}=25.5$; $P<0.001$). X-axis is log-transformed.

Joonis 2. Transektloendustel kohatud liikide ja uuritud ala pindala suhe ($R^2=0.75$; $F_{1,8}=25.5$; $P<0.001$). NB - X-teljel logaritmskaala.

^{*} Estimated as Shannon-Wiener index $H' = -\sum p_i \ln p_i$, where p_i is relative importance of species i in the habitat.

The total length of transects studied in 1978 (Kallas 1988), 9.1 km, is well comparable with those of the current study. However, the previous results were rather variable since five transects of 1–3 km length were located in different forest types. Transects of undetermined width contained 3–76 (151 in total) pairs of birds and 2–28 (33) species whereas the population density varied between 1.9–25.3 pairs per km. Both in 1978 and 2005, transects were passed once at the end of May or in the beginning of June. As single counts may underestimate the actual population density (e.g. Lõhmus & Rosenvald 2005), both results from Hiiumaa are probably lower than real densities. However, the density of birds in Kõpu forests is probably rather low since the majority of the forest consists of pine stands that have relatively low population density compared to other forest types (Kallas 1988, Lõhmus 2004, current study). Even though species diversity in Kõpu forests resembled the one recorded in Tartumaa (see Lõhmus 2004), population density in pine stands here is higher than this in Tartumaa (Lõhmus 2003), probably due to higher age, and rather similar to mature pine stands in Pärnumaa (Vilbaste 1965).

Chaffinch (*Fringilla coelebs*) was the most common species within the forests in 1978 as well as in 2005; the density estimated by us reached to 140 pairs per km². These results are in concordance with the data collected from other areas in Estonia (Leibak *et al.* 1994). Therefore it was rather surprising to see four times smaller numbers (35.4 ± 8.9 pairs/km²; n=72) in the 25+25 m transect. Probably such a huge decline in bird numbers on a narrower transect could be explained by the moving of birds away from the counter (Lõhmus 2003). However, estimations made for Tartumaa (77 pairs/km²; Lõhmus 2003) resemble more our estimations obtained by Finnish line transect method. There was no such drastic discordance in the numbers of other species registered in transects of various width. The second common species was Siskin (*Carduelis spinus*). We cannot exclude the possibility of increasing the numbers only by numerous non-breeding individuals even though no obviously vagrating birds were detected. The number of Siskins fluctuates annually (Leibak *et al.* 1994) and, in 2005 there was probably a strong invasion of this species into the current study area.

Siskin was encountered during the entire spring whereas relatively many individuals might have also bred. In the very same year a high number of Siskins was also registered among other areas (e.g. in eastern Estonia; Lõhmus & Rosenvald 2005).

The population density of several early-breeders (tits *Paridae*, the Treecreeper *Certhia familiaris*, the Nutcracker *Nucifraga caryocatactes* and others) may have been underestimated since second clutches are laid only by a small part of the population (Edula 1999) while the rest of the population has a rather hidden lifestyle during late spring what makes it difficult to detect. Although we obtained additional information about the distribution of these species during woodpecker-counts, in order to estimate the population density correctly, special counts in the earlier period need to be carried out (Lõhmus & Rosenvald 2005). We suggest that a reasonable way to observe the changes in the number of early breeders in the frame of a complex survey of bird fauna would be a special point or line-transect count accompanied with this performed for estimating woodpecker numbers. Obviously, multiple counts would give better estimates also for other passerines but that however requires considerable amount of energy on the cost of the rest of the fieldwork. Our estimations on several common species (Wren *Troglodytes troglodytes*, Blackbird *Turdus merula*, Song Trush *T. philomelos*, Blackcap *Sylvia atricapilla*, Willow Warbler, Great Tit) presented in the current study are similar to those obtained during other counts in the recent years in Tartumaa and Pärnumaa (Ellermaa 2003, 2005; Lõhmus 2003, 2004). However, the population density of Tree Pipit *Anthus trivialis*, Robin, Garden Warbler *Sylvia borin*, Common Whitethroat *S. communis* and Wood Warbler *Phylloscopus sibilatrix* is lower in Kõpu.

The approximate number of each particular species within Kõpu nature reserve can be obtained by multiplying the determined population density by 25 (forested area makes up more than 80% of the total 30.2 km² nature reserve area). However, relevant estimations can be given only for a few numerous species since the confidence interval of rare species is very large due to the small number of transects, even though the transect area seemed to cover the small nature reserve rather well. Accuracy of counts is also determined by the nature of the

population density – large confidence interval was also registered for species that aggregated on single paths (Red-breasted Flycatcher, Wood Warbler, Common Whitethroat). It is necessary to keep in mind that single counts might not provide objective estimates of long-term mean numbers of birds.

Special surveys on species groups

Raptors. Only one record of the Common Buzzard *Buteo buteo* was made during transect counts. However, special surveys carried out in the Kõpu national reserve enabled to confirm four species of birds of prey breeding in that area. We registered a breeding territory of the White-tailed Eagle *Haliaeetus albicilla* was registered whereas 2 pairs altogether might breed in the nature reserve and 3–4 on the entire Kõpu peninsula. The corresponding numbers for the Common Buzzard are 6, ca 10 and ca 30; for the Goshawk *Accipiter gentilis* 1, 1-2 and 3-5; for the Sparrowhawk *Accipiter nisus* 2, 3-5 and 5-10. Estimates for the Goshawk might be the least accurate since observing this species is rather complicated (Lõhmus 2001). On the Kõpu peninsula, though outside the nature reserve, two more raptor species were observed – Honey Buzzard *Pernis apivorus* (some 5 pairs may breed on the peninsula) and Hobby *Falco subbuteo* (up to 10 pairs). Additionally, one migrating Rough-legged Buzzard was sighted on the 19th of April.

Owls were represented in transect counts only by Tawny Owl *Strix aluco*. Special studies however provided a lot of additional information: altogether 6 breeding territories of the Tawny Owl were registered but only one of them remained in the boundaries of the nature reserve. This species was mostly residing near human settlements even though it has been breeding in deep forests elsewhere in Hiiumaa (probably due to the absence of Ural Owl *Strix uralensis*). Breeding territories were located quite non-randomly, every 2–3.5 km. In total, some 10 Tawny Owl pairs were estimated to breed on Kõpu peninsula whereas only a few of them breed within the nature reserve. Altogether 5–6 territories of the Tengmalm's Owl *Aegolius funereus* were registered within the

nature reserve and three more outside it. Yet it is complicated to estimate the actual number of this species since the sound activity of these birds varied in time a lot. Therefore, it is possible that many breeding territories remained unregistered while at the same time migrating individuals could have been mistaken for local breeders. We did not record any Eagle Owl in Kõpu nature reserve even though this species has been observed in the past. However, one nest was found outside the nature reserve boundaries. The presence of Pygmy Owl *Glaucidium passerinum* was registered only by finding its (winter) food storage and therefore cannot be included in the list of local breeding species.

The Great Spotted Woodpecker was the commonest species among **woodpeckers**. A total of 27 breeding territories were registered whereas during transect counts it was recorded only once (Table 2). Population density of this species was estimated as up to 3.3 pairs/km² which equals to one breeding territory per 30.7 ha. Regardless of the fact that this estimation highly depends on the size of the considered area surrounding the counting point it is obvious that the woodland of Kõpu is very suitable breeding habitat for the Great Spotted Woodpecker – for example, up to five pairs could be registered in a single playback point. The population is most likely concentrated to the nature reserve because of the high number of old trees suitable for excavating nest cavities. The mean age of the (most abundant) tree in the sites where Great Spotted Woodpecker was recorded was 73 years. However, several individuals were observed to feed in young stands with no suitable breeding conditions but surrounded by oldgrowth forest. After replacing young stands where Great Spotted Woodpecker was seen with those neighbouring mature stands in the analyses, the mean age of the breeding stand was estimated as 102 years. The most common *Natura* habitat type where Great Spotted Woodpeckers were registered was western taiga (13 times). Some individuals were recorded also in Fennoscandinavian herb-rich spruce forests (1) and deciduous swamp forests (1; the total area of these habitat types was also clearly smaller than the area of western taiga, see appendix 3). Most often the species was recorded in pine forests (19), and in lesser extent in birch (5) and

spruce forests (3). The numbers of the Great Spotted Woodpecker fluctuate largely (Leibak *et al.* 1994). Our estimate for Kõpu nature reserve is 50–100 pairs, depending on year.

Only three breeding territories of the Lesser Spotted Woodpecker *D. Minor* were found, which gives nine times smaller breeding density (0.4 pairs/km² or one pair per 276 ha). The most common habitat for this species was moist forest stands with old deciduous trees: swamp in the middle of 130-year-old spruce stand (Fennoscandian deciduous swamp woods), 80-year-old mixed stands (western taiga) and 80-year-old moist deciduous stand. The total numbers of the Lesser Spotted Woodpeckers within the nature reserve might reach to 10 pairs.

Somewhat surprising was the absence of Black Woodpeckers *Dryocopus martius* during the woodpecker counts; during transect counts this species was heard only once. However, in 1978 the species was registered in three transects out of five (Kallas 1988)! Since this species is easily detectable its absence cannot be explained by methodology but rather by actual low numbers. Moreover, we assume that the numbers of the Black Woodpecker have been declining recently since several its old nest cavities were present. Wryneck *Jynx torquilla* was recorded twice – one during transect counts and another during occasional observations.

Other species valuable in terms of nature conservation. Small mire patches within Kõpu woodland are obviously good breeding sites for the Common Crane *Grus grus*. During the current survey a total of 5 breeding territories were registered within the nature reserve (one nest was found). Estimates from transect counts using the correction factor gave the numbers as 5–10 pairs (Table 1). Probably the actual numbers still remain at the lower limit of this estimation since Common Cranes can be heard for several kilometres and therefore registered birds might have bred outside the areas of the nature reserve. In the past the total crane population of Kõpu peninsula has been estimated to the same level (Leito 2000) that is clearly underestimated according to the present data. However, the number of this species has probably been increasing in Kõpu like it has also been observed in the rest of Estonia during the past years (Leito *et al.* 2005).

Nightjar *Caprimulgus europaeus* was heard in 32 breeding territories during counts of nocturnal birds whereas 9 of these territories were located within the nature reserve. We were able to register the exact location of 14 individuals: 10 were displaying in clearcuts, one above a young-growth and three within mature pine stands. In Kõpu, Nightjar was possible to be heard from distance of 400 m. Since the counting tracks lied apart from each other, we considered this distance as transect width and estimated the total size of covered area as 30 km² that is about half of the entire Kõpu peninsula. The number of Nightjars on Kõpu peninsula can be estimated to 50 pairs considering that there are less dry pine stands outside the studied area. Probably less than quarter of this population breeds within the nature reserve.

Seven Woodlarks *Lullula arborea* were heard on Kõpu peninsula. Only two birds were recorded within the nature reserve, both of them in coastal dunes with pine forests. Three territories were registered on meadows near small villages. Unfortunately, we could not study suitable habitats – sparse dune forests of pine – thoroughly, thus several individuals remained unregistered. However, clearcuts in Kõpu were probably occupied only by a few Woodlarks since only one individual was heard in this biotope, although many clearcuts were visited by us.

Five out of six Greenish Warblers *Phylloscopus trochiloides* were heard in mature western taiga (mixed stands with 110-130-year-old spruce as the main tree species) and one in a boggy deciduous forest with old pine trees (the dominant tree species being 200-year-old pine). Even though this species has also been registered in other habitat types elsewhere in Estonia (Leibak *et al.* 1994) it seems to be the species typical to oldgrowth natural forest in Kõpu nature reserve. Therefore, the Greenish Warbler was distributed unevenly and remained unregistered during transect counts. The number of breeding pairs within Kõpu nature reserve was estimated to 15-30.

Altogether eight Red-breasted Flycatchers were registered during counts. Every single breeding territory was located within woodland belonging to ageclass 5 (dominant tree being 110, 100, 80, and 50-year-old pine, 55 and 30-year-old birch, 55-year-old European alder) however, an at least 100-year-old woodland belonging to ageclass 7

always was located next to it. One Red-breasted Flycatcher was heard in western taiga, one in paludified black alder stand and one in a overgrown wooded meadow. The rest of habitats remained unspecified but they were located next to a habitat type that was valuable in terms of nature conservation (western taiga, Fennoscandian herb-rich forests with spruce, Fennoscandian deciduous swamp woods) and included substantial structural elements characteristic to oldgrowth forest needed by the Red-breasted Flycatcher (Väli 2005a). The number of breeding pairs within the nature reserve reached 100 when extrapolating the line transects method whereas the Finnish variant of the line transect method estimated it to 40. Probably the numbers of this unevenly distributed bird species (often breeding several pairs close together) are some 40-60 pairs.

Red-backed Shrike *Lanius collurio* was registered only three times, always somewhat outside the nature reserve. Even though woodland is not a natural habitat of this species it often inhabits clearcuts (Väli 2005b). Apparently logged areas within dry pine stands in Kõpu are not suitable breeding sites for the Red-backed Shrike since we registered the species only in two clearcuts (and once on a coastal meadow). More suitable breeding biotopes (mosaic cultural landscape, coastal juniper stands, clearcuts on fertile soil) were poorly represented in the current study and therefore conclusions on population density in Kõpu cannot be drawn. The number of breeding pairs within Kõpu nature reserve is not high.

Conclusions

The current study provided valuable information about the population density and species diversity of birds in one of the best oldgrowth natural woodland areas in Estonia. It also contributed to clarifying the importance of various forest types to birds. The results of the current observations are well comparable to the ones obtained from the rest of Estonia however, remarkable is the high number of

Tengmalm's Owls and Nightjars while at the same time grouse and several species of woodpeckers and owls were completely lacking.

Counts carried out on randomly chosen transects provided an adequate overview of the population density of most forest birds but even specifying the numbers of common species demands for far more transects (see Lõhmus 2004), even within a rather small area. In order to obtain precise numbers of vulnerable species even multiple counts would not be sufficient. However, putting somewhat more effort and applying various methods provided valuable information about species of conservation concern. For instance altogether four species and 40 individuals of birds of prey, owls and woodpeckers could be registered by extrapolating the results of transect counts whereas special survey confirmed the existence of 9 species and 175 individuals. Even though confidence limits are hard to determine in the latter case there is no doubt that estimates coming from special surveys are more accurate than estimates relying on records of single individuals met during transect counts. Nevertheless, when various methods are used, one should follow widely used methods if possible, provide detailed information about the methods used, and present results of each method separately. In that case results will be useful even several decades later.

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Metsalinnustiku koosseis ja asustustihedus Kõpu looduskaitsealal Hiiumaal

Kokkuvõte. Hiiumaa lääneosas asuva Kõpu looduskaitseala metsalinnustiku koosseisu ning arvukust selgitati 2005. aastal erinevate meetodite abil. Linnustiku üldine asustustihedus ning tavalisemate liikide arvukus määrati joontakseerimisega, igale liigirühmale spetsiifilised loendusmeetodid võimaldasid mitmekordselt tõhustada arvukuse määramist haukalistel, pistrikulistel, rähnistel ning kakulistel ja teistel öölindudel. Kõigi liikide leviku ning haruldaste lindude arvukuse andmeid täiendasid juhuvaatlused. Kokku registreeriti kaitsealal 56 liigist linde, keskmine asustustihedus oli 365 ± 53 pesitsevat paari ruutkilomeetril. Loodusdirektiivi alusel kaitstavates metsatüüpides tervikuna ei erinenud asustustihedus oluliselt keskmisest, kuigi läänetaiga elupaigatüübis oli tihedus keskmisest kõrgem, soostunud ja soo-lehtmetsades aga madalam. Linnustik leht- ja segametsades oli märksa rikkalikum kui puistutes, kus peapuuliigiks on mänd. Arvukaimaks liigiks oli metsvint *Fringilla coelebs*, kellele järgnesid siisike *Carduelis spinus*, väike- ja salu-lehelind *Phylloscopus collybita*, *P. trochilus*. Vanade loodusmetsadega seotuks osutusid rohe-lehelind *Phylloscopus trochiloides* ning väike-kärbsenäpp *Ficedula parva*. Mandril suhteliselt sageli esinevaid kanalisi ning mitmeid kaku- ja rähniliike ei kohatud.

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