

*Ambio***Electronic Supplementary Material SS II**

This supplementary material has not been peer reviewed

Title of paper: **Impacts of environmental change on vegetation dynamics and biodiversity in Siberia**

Authors: Sergey N. Kirpotin , Terry V. Callaghan, Anna M. Peregon , Adrei S. Babenko, Daniil I. Berman, Nina A. Bulakhova , Arysia A. Byzaakay, Tatiana M. Chernykh, Vladislav Chursin, Elena A. Interesova, Sergey P. Gureev , Ivan A. Kerchev ,Viacheslav I. Kharuk, Aldynai O. Khovalyg, Leonid A. Kolpashchikov , Svetlana A. Krivets , Zoya N. Kvasnikova, Irina V. Kuzhevskaya, Oleg E. Merzlyakov, Oleg G. Nekhoroshev, Viktor K. Popkov , Andrei I. Pyak , Tatyana O. Valevich , Igor V. Volkov , Irina I. Volkova

Title of ESM SS II: **Supplementary material II: Species lists, changes in bird distributions and references related to Table 1, main text. For literature sources, see bibliographies in Supplementary Material SS1 and main text.**

Region	Type and Direction of change	Example species
Eastern Siberia (Transbaikalia and the basin of Lake Baikal) (Popov 2011; Melnikov 2015, 2016; Melnikov et al. 2018)	a) Range extension: southern bird species to the north	gadwall <i>Anas strepera</i> , eastern spot-billed duck <i>A. poecilorhynchus</i> , demoiselle crane <i>Anthropoides virgo</i> , moorhen <i>Gallinula chloropus</i>
	b) Restoration of previous distributions to the northern part of earlier ranges	lapwing <i>Vanellus vanellus</i> , cormorant <i>Phalacrocorax carbo</i> , white-winged tern <i>Chlidonias leucopterus</i> , starling <i>Sturnus vulgaris</i> , mallard <i>Anas platyrhynchos</i> , wigeon <i>A. penelope</i> , pintail <i>A. acuta</i>
	c) Expansion of northern range boundaries and a shift of their optima to northern latitudes	common species, that have large populations, of near-water and waterfowl (duck's, plovers, accipitrine, water rails, wagtails)
	d) Transition to a settled existence	azure-winged magpie <i>Cyanopica cyanus</i> , daurian jackdaw <i>Corvus dauuricus</i> , rook <i>C. frugilegus</i> , siskin <i>Spinus spinus</i> , highland birds (finches, accentors <i>Prunellidae</i> , lenticils)

Yakutia (Vartapetov et al. 2019)	Range extension to the north of the taiga zones and to the tundra	little and black-headed gull <i>Larus minutus</i> and <i>L. ridibundus</i> , common tern and white-winged tern <i>Sterna hirundo</i> and <i>Chlidonias leucjpterus</i> , whooper swan <i>Cygnus cygnus</i>
Yamal (Sokolov et al. 2016; Ryzhanovskiy 2019)	Range extension to the north	crow <i>Corvus cornix</i> , magpie <i>Pica pica</i> , thrush birds (stonechat <i>Saxicola torquata</i> , redstart <i>Phoenicurus phoenicurus</i> , red-flanked bluetail <i>Tarsiger cyanurus</i> , bluethroat <i>Luscinia svecica</i> , fieldfare <i>Turdus pilaris</i> , redwing <i>T. iliacus</i> , northern wheatear <i>Oenanthe oenanthe</i>
West Siberian Plain (Gashev 2012; Gashev and Kurhinen 2015)	a) Range extension towards north and east from the steppe and forest-steppe regions to the taiga zone.	Central Asian and Mediterranean species (blackbird <i>Turdus merula</i> , blue tit <i>Parus caeruleus</i> , greenfinch <i>Chloris chloris</i> , linnet <i>Accanthis cannabina</i>), steppe and forest-steppe species (imperial eagle <i>Aquila heliaca</i> , steppe eagle <i>A. nipalensis</i> , booted eagle <i>Hieraetus pennatus</i> , lesser kestrel <i>Falco naumanni</i> , great bustard <i>Otis tarda</i> , black-winged pratincole <i>Glareola nordmanni</i> , scops owl <i>Otus scops</i> , hoopoe <i>Upupa epops</i> , isabelline wheatear <i>Oenanthe isabellina</i> etc.) and birds of the wetland fauna (dalmatian pelican <i>Pelecanus crispus</i> , white pelican <i>P. onocrotalus</i> , great egret <i>Egretta alba</i> , bittern <i>Botaurus stellaris</i> , little bittern <i>Ixobrychus minutus</i> , glossy ibis <i>Plegadis falcinellus</i> , ferruginous duck <i>Aythya nyroca</i> , black-winged stilt <i>Himantopus himantopus</i> , avocet <i>Recurvirostra avocetta</i> , great black-headed gull <i>Larus ichthyaetus</i> , caspian tern <i>Sterna caspia</i>).
	b) Range extension from east to west	carrion crow <i>Corvus orientalis</i> , Pallas's grasshopper warbler <i>Losustella certhiola</i> , Pallas's leaf warbler <i>Phulloscopus proregulus</i> , dusky warbler <i>Ph. fuscatu</i> s, dark-sided flycatcher <i>Muscicapa sibirica</i> , brown flycatcher <i>M. dauurica</i> , siberian thrush <i>Zoothera sibirica</i> , long-tailed rosefinch <i>Uragus sibiricus</i> , black-faced bunting <i>Ocyris spodocephalus</i>

West Siberian Plain - middle and northern taiga (Vartapetov 1998, 2014)	a) Decrease in population numbers	many forest and meadow-bog species of birds, including birds of prey and hunting species (white-tailed sea eagle <i>Haliaeetus albicilla</i> , sparrowhawk <i>Accipiter nisus</i> , merlin <i>Falco columbarius</i> , hawk owl <i>Surnia ulula</i> , ural owl <i>Strix uralensis</i> , olive-backet pipit <i>Anthus hodgsoni</i> , greenish warbler <i>Phylloscopus trochiloides</i> , red-flanked bluetail <i>Tarsiger cyanurus</i> , willow tit <i>Parus montanus</i> , siberian tit <i>P.cinctus</i> , bramling <i>Fringilla montifringilla</i> , capercaillie <i>Tetrao urogallus</i>)
	b) Increase in population numbers	species inhabiting forest edges and open spaces, including forest tundra (sandpipers, horned lark <i>Eremophila alpestris</i> , citrine wagtail <i>Motacilla citreola</i> , meadow and red-throated pipit <i>Anthus pratensis</i> and <i>A. cervinus</i> , lapland longspur <i>Calcarius lapponicus</i> , pallas's reed bunting <i>Schoeniclus pallasii</i>)
South-east of Western Siberia (Tomsk Ob River region) (Milovidov and Nekhoroshev 2007; Toropov and Shor 2012; Adam and Toropov 2016; Gureev et al. 2019; our materials)	a) 20-30% decrease in past 30 to 40 years	starling's <i>Sturnus vulgaris</i>
	b) Decrease in past 10-15 years	skylark <i>Alauda arvensis</i> , Richard's pipit <i>Anthus richardi</i> , red-footed falcon <i>Falco vespertinus</i> , lapwing <i>Vanellus vanellus</i> , linnet <i>Acanthis cannabina</i> , thick-billed warbler <i>Phragmaticola aedo</i> , rustig bunting <i>Ocyris rusticus</i> , reed bunting <i>Schoeniclus schoenicls</i> and whinchat <i>Saxicola rubetra</i> .
	c) Local absence	slender-billed curlew <i>Numenius tenuirostris</i> , aquatic warbler <i>Acrocephalus paludicola</i> (not found for more than 30 years), yellow-breasted bunting <i>Ocyris aureola</i> (once numerous – from 250-300 individuals per km ² to complete absence
	d) New nesting find	grey heron <i>Ardea cinerea</i> , blackbird <i>Turdus merula</i> , marsh warbler <i>Acrocephalus palustris</i> and pale swallow <i>Riparia diluta</i> .
	e) Regular flights and nesting meetings of new species	great white egret <i>Casmerodius albus</i> , pink flamingo <i>Phoenicopterus roseus</i> (only in autumn), ruddy shelduck <i>Tadorna ferruginea</i> , and shelduck <i>T. tadorna</i> , eastern spot-billed duck <i>Anas poeciloryncha</i> , eurasian vulture <i>Gyps fulvus</i> and hoopoe <i>Upupa epops</i>

	f) Range extension to the north and east of the forest and taiga species	blyth's reed warbler <i>Acrocephalus dumetorum</i> , chaffinch <i>Fringilla coelebs</i> and brambling <i>F. montifringilla</i> (past 30 years), dusky warbler <i>Phylloscopus fuscatus</i> , siberian blue robin <i>Luscinia cyane</i> , and greenfinch <i>Chloris chloris</i> (past 10-15 years)
Mountains of the Altai-Sayan region southern Siberia (Baranov and Voronina, 2016; Zabelin 2018)	a) Range extension to the east	chaffinch <i>Fringilla coelebs</i> , linnet <i>Acanthis cannabina</i> , goldfinch <i>Carduelis carduelis</i> , whinchat <i>Saxicola rubetra</i> , pied flycatcher <i>Ficedula hypoleuca</i> , stock dove <i>Columba oenas</i> , wood pigeon <i>Columba palumbus</i> , greenfinch <i>Chloris chloris</i> , moorhen <i>Gallinula chloropus</i> , ferruginous duck <i>Aythya nyroca</i> , alpine chough <i>Pyrrhocorax graculus</i>
	b) Range extension to the west	pine bunting <i>Emberiza leucocephala</i> , siberian blue robin <i>Luscinia cyane</i> , swihoe's robin <i>L. sibilans</i> , daurian redstart <i>Phoenicurus aureoreus</i> , eyebrowed thrush <i>Turdus obscurus</i>
	c) Resettlement of steppe species to the north	Upland buzzard <i>Buteo hemilasius</i> , eurasiens scops owl <i>Otus scops</i> , hill pigeon <i>Columba rupestris</i> , meadow bunting <i>Emberiza cioides</i> ,
	d) Distribution of forest species to the steppe through the forests of river valleys	Redpoll <i>Acanthis flammea</i> , rustig bunting <i>Ocyris rusticus</i> , little bunting <i>O. pusilla</i>
	e) Population decline in high mountain habitats	mountain species (rock ptarmigan <i>Lagopus mutus</i> , güldenstädt's redstart <i>Phoenicurus erythrogaster</i> , alpine accentor <i>Prunella collaris</i>)
	f) Upwards range extension	species of foothill and low mountain ornitho-complexes (short-eared owl <i>Asio flammeus</i> , linnet <i>Acanthis cannabina</i> , willow grouse <i>Lagopus lagopus</i> , stonechat <i>Saxicola torquata</i> , bluethroat <i>Luscinia svecica</i> , skylark <i>Alauda arvensis</i> , blyth's pipit <i>Anthusgodlewskii</i> , northern wheatear <i>Oenanthe oenanthe</i>)