

Read me file for:

S. Yalcin, S.J Leroux. [in review]. An empirical test of the relative and combined effects of land-cover and climate change on species range shifts.
Global Change Biology.

Please see below for description and summary of each item.

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File: 1_a_Sp_env_GAA.csv

File: 2_a_Sp_env_LPP.csv

This data file includes information on species colonization patterns (columns) and environmental variables (columns) in each grid (rows). See manuscript for methods to determine the species occurrence patterns.

Column headings and definitions:

SQUARE_ID: Ontario Breeding Birds Atlas grid numbers (unique values)

From column NOGO to WTSP, the row values show either colonization or extinction (1), not-colonized or persist (0), or NA (species wasn't observed in that grid). See methods and Figure 1 in the manuscript for the details.

NOGO: Species name code. Northern Goshawk. *Accipiter gentilis*.

SSHA: Species name code. Sharp-shinned Hawk. *Accipiter striatus*.

SPSA: Species name code. Spotted Sandpiper. *Actitis macularius*.

NSWO: Species name code. Northern Saw-whet Owl. *Aegolius acadicus*.

BOOW: Species name code. Boreal Owl. *Aegolius funereus*.

RWBL: Species name code. Red-winged Blackbird. *Agelaius phoeniceus*.

WODU: Species name code. Wood Duck. *Aix sponsa*.

GWTE: Species name code. Green-winged Teal. *Anas crecca*.

MALL: Species name code. Mallard. *Anas platyrhynchos*.

ABDU: Species name code. American Black Duck. *Anas rubripes*.

RTHU: Species name code. Ruby-throated Hummingbird. *Archilochus colubris*.

GBHE: Species name code. Great Blue Heron. *Ardea herodias*.

RNDU: Species name code. Ring-necked Duck. *Aythya collaris*.

CEDW: Species name code. Cedar Waxwing. *Bombus cedrorum*.

RUGR: Species name code. Ruffed Grouse. *Bonasa umbellus*.

AMBI: Species name code. American Bittern. *Botaurus lentiginosus*.

CAGO: Species name code. Canada Goose. *Branta canadensis*.

GHOW: Species name code. Great Horned Owl. *Bubo virginianus*.

BUFF: Species name code. Bufflehead. *Bucephala albeola*.

COGO: Species name code. Common Goldeneye. *Bucephala clangula*.

RTHA: Species name code. Red-tailed Hawk. *Buteo jamaicensis*.

BWHA: Species name code. Broad-winged Hawk. *Buteo platypterus*.

PISI: Species name code. Pine Siskin. *Carduelis pinus*.

AMGO: Species name code. American Goldfinch. *Carduelis tristis*.

PUFI: Species name code. Purple Finch. *Carpodacus purpureus*.

TUVU: Species name code. Turkey Vulture. *Cathartes aura*.

VEER: Species name code. Veery. *Catharus fuscescens*.

HETH: Species name code. Hermit Thrush. *Catharus guttatus*.

SWTH: Species name code. Swainson's Thrush. *Catharus ustulatus*.

BRCR: Species name code. Brown Creeper. *Certhia americana*.

BEKI: Species name code. Belted Kingfisher. *Ceryle alcyon*.

KILL: Species name code. Killdeer. *Charadrius vociferus*.

CONI: Species name code. Common Nighthawk. *Chordeiles minor*.

NOHA: Species name code. Northern Harrier. *Circus cyaneus*.
EVGR: Species name code. Evening Grosbeak. *Coccothraustes vespertinus*.
NOFL: Species name code. Northern Flicker. *Colaptes auratus*.
OSFL: Species name code. Olive-sided Flycatcher. *Contopus cooperi*.
EAWP: Species name code. Eastern Wood-Pewee. *Contopus virens*.
AMCR: Species name code. American Crow. *Corvus brachyrhynchos*.
CORA: Species name code. Common Raven. *Corvus corax*.
BLJA: Species name code. Blue Jay. *Cyanocitta cristata*.
BTBW: Species name code. Black-throated Blue Warbler. *Dendroica caerulescens*.
BBWA: Species name code. Bay-breasted Warbler. *Dendroica castanea*.
YRWA: Species name code. Yellow-rumped Warbler. *Dendroica coronata*.
BLBW: Species name code. Blackburnian Warbler. *Dendroica fusca*.
MAWA: Species name code. Magnolia Warbler. *Dendroica magnolia*.
PAWA: Species name code. Palm Warbler. *Dendroica palmarum*.
CSWA: Species name code. Chestnut-sided Warbler. *Dendroica pensylvanica*.
YWAR: Species name code. Yellow Warbler. *Dendroica petechia*.
PIWA: Species name code. Pine Warbler. *Dendroica pinus*.
CMWA: Species name code. Cape May Warbler. *Dendroica tigrina*.
BTNW: Species name code. Black-throated Green Warbler. *Dendroica virens*.
PIWO: Species name code. Pileated Woodpecker. *Dryocopus pileatus*.
ALFL: Species name code. Alder Flycatcher. *Empidonax alnorum*.
YBFL: Species name code. Yellow-bellied Flycatcher. *Empidonax flaviventris*.
LEFL: Species name code. Least Flycatcher. *Empidonax minimus*.
RUBL: Species name code. Rusty Blackbird. *Euphagus carolinus*.
SPGR: Species name code. Spruce Grouse. *Falcapennis canadensis*.
MERL: Species name code. Merlin. *Falco columbarius*.
AMKE: Species name code. American Kestrel. *Falco sparverius*.
COSN: Species name code. Wilson's Snipe. *Gallinago gallinago*.
COLO: Species name code. Common Loon. *Gavia immer*.
COYE: Species name code. Common Yellowthroat. *Geothlypis trichas*.
SACR: Species name code. Sandhill Crane. *Grus canadensis*.
BAEA: Species name code. Bald Eagle. *Haliaeetus leucocephalus*.
BARS: Species name code. Barn Swallow. *Hirundo rustica*.
DEJU: Species name code. Dark-eyed Junco. *Junco hyemalis*.
HERG: Species name code. Herring Gull. *Larus argentatus*.
RBGU: Species name code. Ring-billed Gull. *Larus delawarensis*.
BOGU: Species name code. Bonaparte's Gull. *Larus philadelphia*.
HOME: Species name code. Hooded Merganser. *Lophodytes cucullatus*.
WWCR: Species name code. White-winged Crossbill. *Loxia leucoptera*.
SWSP: Species name code. Swamp Sparrow. *Melospiza georgiana*.
LISP: Species name code. Lincoln's Sparrow. *Melospiza lincolni*.
SOSP: Species name code. Song Sparrow. *Melospiza melodia*.
COME: Species name code. Common Merganser. *Mergus merganser*.
BAWW: Species name code. Black-and-white Warbler. *Mniotilta varia*.
CONW: Species name code. Connecticut Warbler. *Oporornis agilis*.
MOWA: Species name code. Mourning Warbler. *Oporornis philadelphia*.
OSPR: Species name code. Osprey. *Pandion haliaetus*.
NOPA: Species name code. Northern Parula. *Parula americana*.

SAVS: Species name code. Savannah Sparrow. *Passerculus sandwichensis*.
INBU: Species name code. Indigo Bunting. *Passerina cyanea*.
GRAJ: Species name code. Gray Jay. *Perisoreus canadensis*.
CLSW: Species name code. Cliff Swallow. *Petrochelidon pyrrhonota*.
DCCO: Species name code. Double-crested Cormorant. *Phalacrocorax auritus*.
RBGR: Species name code. Rose-breasted Grosbeak. *Pheucticus ludovicianus*.
BBWO: Species name code. Black-backed Woodpecker. *Picoides arcticus*.
DOWO: Species name code. Downy Woodpecker. *Picoides pubescens*.
HAWO: Species name code. Hairy Woodpecker. *Picoides villosus*.
SCTA: Species name code. Scarlet Tanager. *Piranga olivacea*.
PBGR: Species name code. Pied-billed Grebe. *Podilymbus podiceps*.
BCCH: Species name code. Black-capped Chickadee. *Poecile atricapillus*.
BOCH: Species name code. Boreal Chickadee. *Poecile hudsonica*.
SORA: Species name code. Sora. *Porzana carolina*.
COGR: Species name code. Common Grackle. *Quiscalus quiscula*.
RCKI: Species name code. Ruby-crowned Kinglet. *Regulus calendula*.
GCKI: Species name code. Golden-crowned Kinglet. *Regulus satrapa*.
EAPH: Species name code. Eastern Phoebe. *Sayornis phoebe*.
AMWO: Species name code. American Woodcock. *Scolopax minor*.
OVEN: Species name code. Ovenbird. *Seiurus aurocapilla*.
NOWA: Species name code. Northern Waterthrush. *Seiurus noveboracensis*.
AMRE: Species name code. American Redstart. *Setophaga ruticilla*.
EABL: Species name code. Eastern Bluebird. *Sialia sialis*.
RBNU: Species name code. Red-breasted Nuthatch. *Sitta canadensis*.
WBNU: Species name code. White-breasted Nuthatch. *Sitta carolinensis*.
YBSA: Species name code. Yellow-bellied Sapsucker. *Sphyrapicus varius*.
CHSP: Species name code. Chipping Sparrow. *Spizella passerina*.
COTE: Species name code. Common Tern. *Sterna hirundo*.
GGOW: Species name code. Great Gray Owl. *Strix nebulosa*.
BDOW: Species name code. Barred Owl. *Strix varia*.
EUST: Species name code. European Starling. *Sturnus vulgaris*.
TRES: Species name code. Tree Swallow. *Tachycineta bicolor*.
GRYE: Species name code. Greater Yellowlegs. *Tringa melanoleuca*.
SOSA: Species name code. Solitary Sandpiper. *Tringa solitaria*.
WIWR: Species name code. Winter Wren. *Troglodytes troglodytes*.
AMRO: Species name code. American Robin. *Turdus migratorius*.
EAKI: Species name code. Eastern Kingbird. *Tyrannus tyrannus*.
TEWA: Species name code. Tennessee Warbler. *Vermivora peregrina*.
NAWA: Species name code. Nashville Warbler. *Vermivora ruficapilla*.
REVI: Species name code. Red-eyed Vireo. *Vireo olivaceus*.
PHVI: Species name code. Philadelphia Vireo. *Vireo philadelphicus*.
BHVI: Species name code. Blue-headed Vireo. *Vireo solitarius*.
CAWA: Species name code. Canada Warbler. *Wilsonia canadensis*.
WIWA: Species name code. Wilson's Warbler. *Wilsonia pusilla*.
MODO: Species name code. Mourning Dove. *Zenaida macroura*.
WTSP: Species name code. White-throated Sparrow. *Zonotrichia albicollis*.
AreaGFWCgr: Area of grid (km2).

DiffEvent: Difference between the event number of Atlas 1 and Atlas 2. See manuscript for the details.

NPP: Change in net primary productivity (NPP) in grid.

NPP_5km: Change in net primary productivity (NPP) in the area of 5 km buffer around grid.

NPP_10km: Change in net primary productivity (NPP) in the area of 10 km buffer around grid.

NPP_15km: Change in net primary productivity (NPP) in the area of 15 km buffer around grid.

NPP_20km: Change in net primary productivity (NPP) in the area of 20 km buffer around grid.

PercGFWC_5km: Change in physical land-cover change in the area of 5 km buffer around grid.

PercGFWC_10km: Change in physical land-cover change in the area of 10 km buffer around grid.

PercGFWC_15km: Change in physical land-cover change in the area of 15 km buffer around grid.

PercGFWC_20km: Change in physical land-cover change in the area of 20 km buffer around grid.

PercGFWC: Change in physical land-cover change in grid.

bio1: Annual mean temperature in grid.

bio1_5km: Annual mean temperature in the area of 5 km buffer around grid.

bio1_10km: Annual mean temperature in the area of 10 km buffer around grid.

bio1_15km: Annual mean temperature in the area of 15 km buffer around grid.

bio1_20km: Annual mean temperature in the area of 20 km buffer around grid.

bio2: Mean diurnal range in grid.

bio2_5km: Mean diurnal range in the area of 5 km buffer around grid.

bio2_10km: Mean diurnal range in the area of 10 km buffer around grid.

bio2_15km: Mean diurnal range in the area of 15 km buffer around grid.

bio2_20km: Mean diurnal range in the area of 20 km buffer around grid.

bio3: Isothermality in grid.

bio3_5km: Isothermality in the area of 5 km buffer around grid.

bio3_10km: Isothermality in the area of 10 km buffer around grid.

bio3_15km: Isothermality in the area of 15 km buffer around grid.

bio3_20km: Isothermality in the area of 20 km buffer around grid.

bio4: Temperature seasonality in grid.

bio4_5km: Temperature seasonality in the area of 5 km buffer around grid.

bio4_10km: Temperature seasonality in the area of 10 km buffer around grid.

bio4_15km: Temperature seasonality in the area of 15 km buffer around grid.

bio4_20km: Temperature seasonality in the area of 20 km buffer around grid.

bio5: Max temperature of warmest period in grid.

bio5_5km: Max temperature of warmest period in the area of 5 km buffer around grid.

bio5_10km: Max temperature of warmest period in the area of 10 km buffer around grid.

bio5_15km: Max temperature of warmest period in the area of 15 km buffer around grid.

bio5_20km: Max temperature of warmest period in the area of 20 km buffer around grid.

bio6: Min temperature of coldest period in grid.

bio6_5km: Min temperature of coldest period in the area of 5 km buffer around grid.

bio6_10km: Min temperature of coldest period in the area of 10 km buffer around grid.

bio6_15km: Min temperature of coldest period in the area of 15 km buffer around grid.

bio6_20km: Min temperature of coldest period in the area of 20 km buffer around grid.

bio7: Temperature annual range in grid.

bio7_5km: Temperature annual range in the area of 5 km buffer around grid.

bio7_10km: Temperature annual range in the area of 10 km buffer around grid.

bio7_15km: Temperature annual range in the area of 15 km buffer around grid.

bio7_20km: Temperature annual range in the area of 20 km buffer around grid.

bio8: Mean temperature of wettest quarter in grid.

bio8_5km: Mean temperature of wettest quarter in the area of 5 km buffer around grid.
bio8_10km: Mean temperature of wettest quarter in the area of 10 km buffer around grid.
bio8_15km: Mean temperature of wettest quarter in the area of 15 km buffer around grid.
bio8_20km: Mean temperature of wettest quarter in the area of 20 km buffer around grid.
bio9: Mean temperature of driest quarter in grid.
bio9_5km: Mean temperature of driest quarter in the area of 5 km buffer around grid.
bio9_10km: Mean temperature of driest quarter in the area of 10 km buffer around grid.
bio9_15km: Mean temperature of driest quarter in the area of 15 km buffer around grid.
bio9_20km: Mean temperature of driest quarter in the area of 20 km buffer around grid.
bio10: Mean temperature of warmest quarter in grid.
bio10_5km: Mean temperature of warmest quarter in the area of 5 km buffer around grid.
bio10_10km: Mean temperature of warmest quarter in the area of 10 km buffer around grid.
bio10_15km: Mean temperature of warmest quarter in the area of 15 km buffer around grid.
bio10_20km: Mean temperature of warmest quarter in the area of 20 km buffer around grid.
bio11: Mean temperature of coldest quarter in grid.
bio11_5km: Mean temperature of coldest quarter in the area of 5 km buffer around grid.
bio11_10km: Mean temperature of coldest quarter in the area of 10 km buffer around grid.
bio11_15km: Mean temperature of coldest quarter in the area of 15 km buffer around grid.
bio11_20km: Mean temperature of coldest quarter in the area of 20 km buffer around grid.
bio12: Annual precipitation in grid.
bio12_5km: Annual precipitation in the area of 5 km buffer around grid.
bio12_10km: Annual precipitation in the area of 10 km buffer around grid.
bio12_15km: Annual precipitation in the area of 15 km buffer around grid.
bio12_20km: Annual precipitation in the area of 20 km buffer around grid.
bio13: Precipitation of wettest period in grid.
bio13_5km: Precipitation of wettest period in the area of 5 km buffer around grid.
bio13_10km: Precipitation of wettest period in the area of 10 km buffer around grid.
bio13_15km: Precipitation of wettest period in the area of 15 km buffer around grid.
bio13_20km: Precipitation of wettest period in the area of 20 km buffer around grid.
bio14: Precipitation of driest period in grid.
bio14_5km: Precipitation of driest period in the area of 5 km buffer around grid.
bio14_10km: Precipitation of driest period in the area of 10 km buffer around grid.
bio14_15km: Precipitation of driest period in the area of 15 km buffer around grid.
bio14_20km: Precipitation of driest period in the area of 20 km buffer around grid.
bio15: Precipitation seasonality in grid.
bio15_5km: Precipitation seasonality in the area of 5 km buffer around grid.
bio15_10km: Precipitation seasonality in the area of 10 km buffer around grid.
bio15_15km: Precipitation seasonality in the area of 15 km buffer around grid.
bio15_20km: Precipitation seasonality in the area of 20 km buffer around grid.
bio16: Precipitation of wettest quarter in grid.
bio16_5km: Precipitation of wettest quarter in the area of 5 km buffer around grid.
bio16_10km: Precipitation of wettest quarter in the area of 10 km buffer around grid.
bio16_15km: Precipitation of wettest quarter in the area of 15 km buffer around grid.
bio16_20km: Precipitation of wettest quarter in the area of 20 km buffer around grid.
bio17: Precipitation of driest quarter in grid.
bio17_5km: Precipitation of driest quarter in the area of 5 km buffer around grid.
bio17_10km: Precipitation of driest quarter in the area of 10 km buffer around grid.
bio17_15km: Precipitation of driest quarter in the area of 15 km buffer around grid.

bio17_20km: Precipitation of driest quarter in the area of 20 km buffer around grid.
bio18: Precipitation of warmest quarter in grid.
bio18_5km: Precipitation of warmest quarter in the area of 5 km buffer around grid.
bio18_10km: Precipitation of warmest quarter in the area of 10 km buffer around grid.
bio18_15km: Precipitation of warmest quarter in the area of 15 km buffer around grid.
bio18_20km: Precipitation of warmest quarter in the area of 20 km buffer around grid.
bio19: Precipitation of coldest quarter in grid.
bio19_5km: Precipitation of coldest quarter in the area of 5 km buffer around grid.
bio19_10km: Precipitation of coldest quarter in the area of 10 km buffer around grid.
bio19_15km: Precipitation of coldest quarter in the area of 15 km buffer around grid.
bio19_20km: Precipitation of coldest quarter in the area of 20 km buffer around grid.

File: 1_b_Results_GAA.csv

File: 2_b_Results_LPP.csv

This data file includes the model results of all species including all variables. See Table 1 for the model definitions.

Please see the following R codes to generate these datasets:

File R: 1_a_LogisticModels_colonization.R

File R: 2_a_LogisticModels_extinction.R

Column headings and definitions:

Species: Species name codes: See File 1: 1_a_Sp_env_GAA.csv column definitions.

Modnames: Model name codes: See Table 1 in manuscript.

K: number of parameters including to the model

AIC: Akaike information criterion value

Delta_AIC: Delta Akaike information criterion value

LL: Log-likelihood

(Intercept): Coefficient estimation of intercept term

DiffEvent: Coefficient estimation of survey effort

PercGFWC: Coefficient estimation of physical land-cover change

NPP: Coefficient estimation of change in NPP

PercGFWC_20kmd: Coefficient estimation of physical land-cover change in 20 km buffer areas

bio11: Coefficient estimation of mean winter temperature

bio17: Coefficient estimation of summer precipitation

Interval: value mark for the columns from (Intercept) to bio17. Value means coefficient estimation for the value, 2.50% means tail interval, and 97.50% means tail interval.

N: Sample size

R2: Nagelkerke's R^2 value

File: 1_c_Results_Colonization_Models.csv

File: 2_c_Results_Extinction_Models.csv

This data file includes the model results of all species after excluding any pretending (uninformative) variables for species.

Please see the following R codes to generate these datasets:

File R: 1_c_afterPVmodels_GAA.R

File R: 2_c_afterPVmodels_LPP.R

Column headings and definitions:

Species: Species name codes: See File 1: 1_a_Sp_env_GAA.csv column definitions.

Modnames: Model name codes: See Table 1 in manuscript.

K: number of parameters including to the model

AIC: Akaike information criterion value

Delta_AIC: Delta Akaike information criterion value

LL: Log-likelihood

AICWt: Akaike information criterion weight

N: Sample size

R2: Nagelkerke's R^2 value

Exclusion: the name tag of the pretending variable of a species. For instance, NPPbio1117 means NPP (change in net primary productivity), bio11 (change in mean winter temperature) and bio17 (change in summer precipitation) are pretending variable in OSFL (Olive-sided Flycatcher)'s extinction patterns models.

File: 1_d_Results_Colonization_Models_coefavgs.csv

File: 2_d_Results_Extinction_Models_coefavgs.csv

This data file includes the estimated variable coefficients of top models of all species after excluding any pretending (uninformative) variables for species.

Please see the following R codes to generate these datasets:

File R: 1_c_afterPVmodels_GAA.R

File R: 2_c_afterPVmodels_LPP.R

Column headings and definitions:

Species: Species name codes: See File 1: 1_a_Sp_env_GAA.csv column definitions.

Modset: Model set number. Colonization models included 24 and extinction models included 16 model sets.

Variable: Variables included into the analysis. See Manuscript for the detailed methods to prepare these variables. PercGFWC: physical land-cover change in grids (%), PercGFWC_20km = physical land-cover change in 20 km buffer area, NPP=Changes in net primary productivity, bio11= changes in mean winter temperature, bio17= changes in mean summer precipitation, DiffEvent = survey effort.

Value: Coefficient estimates.

Valueexp: Natural exponential value of estimated coefficients.

File: 3_a_Species_Traits.xlsx

This data file includes information on species extinction patterns (columns) and environmental variables (columns) in each grid (rows). See manuscript for methods to determine the species occurrence patterns.

Column headings and definitions:

ID: Unique number of species

Common.name: Common name of species

Scientific.name: Scientific name of species.

SpeciesCode: Species name code.

OBBA1.obs: Number of total observation during the first atlas.

OBBA2.obs: Number of total observation during the second atlas.

Mean.BM.Dunning.g: Mean body mass gathered from Dunning (2007).

Range: Coverage of species range in the study area.

AAB_links: Web-link of All about Birds.

BBs.URLs: Web-link of Boreal Songbird Initiative.

BNA.Migration.URLs Web-link for migration info from Birds of North America

Habitat.AAB: Habitat information gathered from All about Birds.

Habitat.BBs: Habitat information gathered from Boreal Songbird Initiative.

Habitat.Class: Consensus habitat class code (1: Forest, 2: Non-forest; 3: Wetland) according the information gathering All about Birds and Boreal Songbird Initiative.

Habitat: Habitat type as text. See Habitat.Class definition.

Food.AAB: food information gathered from All about Birds.

Nesting.AAB: Nesting information gathered from All about Birds.

Behaviour.AAB: Behavior information gathered from All about Birds.

IUCN.AAB: IUCN status gathered from All about Birds.

Length.cm.AAB: Body length gathered from All about Birds.

migraDF.AAB: Migration information gathered from All about Birds.

Migration.BNA: Migration information gathered from Birds of North America.

Boreal.Songbird.Initiative.Migration.raw: Migration information gathered from Boreal Songbird Initiative.

Migration.Class: Consensus migration behavior of species

Migration.Code: Migration code value (1: Migrant, 2: Resident; 3: partial migrant).

Migration: Migration behavior of species as text.

File: 3_b_TraitSPs_G.csv

File: 3_c_TraitSPs_L.csv

Species: Species name code.

AA: The number of grids that are not occupied by the species during both atlases

PP: The number of grids that are occupied by the species during both atlases

G: The number of grids that are not occupied during atlas 1 but occupied during atlas 2

L: The number of grids that are occupied during atlas 1 but not occupied during atlas 2

LossRate: The calculated regional extinction rate. See manuscript for the details.

GainRate: The calculated regional colonization rate. See manuscript for the details.

MBM: Mean body mass (g).

Habitat: Habitat preferences.

Migration: Migration status.

File: Modcodes.csv

Modnames: The number tag of models. See Table 1 for the explanation of models.

Modcodes: Unique number of each model.

File: Variablecodes.csv

Pretending: Variable names. PercGFWC: landcover change, NPP: changes in net primary productivity; PercGFWC_20kmd: landcover change, bio11: changes in mean winter temperature, bio17: changes in winter precipitation, bio8: changes in summer temperature.

Moddiff: Variable unique number.