

Supplementary Materials

TABLES

Table S1. List of 245 species included in the study, ordered alphabetically by their scientific name.

Scientific Name	Common Name		
<i>Accipiter cooperii</i>	Cooper's Hawk	<i>Campylorhynchus</i>	Cactus Wren
<i>Accipiter striatus</i>	Sharp-shinned Hawk	<i>brunneicapillus</i>	
<i>Aeronautes saxatalis</i>	White-throated Swift	<i>Cardellina canadensis</i>	Canada Warbler
<i>Agelaius phoeniceus</i>	Red-winged Blackbird	<i>Cardellina pusilla</i>	Wilson's Warbler
<i>Aimophila ruficeps</i>	Rufous-crowned Sparrow	<i>Cardinalis cardinalis</i>	Northern Cardinal
<i>Ammodramus savannarum</i>	Grasshopper Sparrow	<i>Cardinalis sinuatus</i>	Pyrrhuloxia
<i>Amphispiza bilineata</i>	Black-throated Sparrow	<i>Cathartes aura</i>	Turkey Vulture
<i>Aphelocoma californica</i>	California Scrub-jay	<i>Catharus fuscescens</i>	Veery
<i>Aphelocoma woodhouseii</i>	Woodhouse's Scrub-jay	<i>Catharus guttatus</i>	Hermit Thrush
<i>Aquila chrysaetos</i>	Golden Eagle	<i>Catharus ustulatus</i>	Swainson's Thrush
<i>Archilochus alexandri</i>	Black-chinned Hummingbird	<i>Catherpes mexicanus</i>	Canyon Wren
<i>Archilochus colubris</i>	Ruby-throated Hummingbird	<i>Centronyx henslowii</i>	Henslow's Sparrow
<i>Artemisospiza nevadensis</i>	Sagebrush Sparrow	<i>Certhia americana</i>	Brown Creeper
<i>Auriparus flaviceps</i>	Verdin	<i>Chaetura pelagica</i>	Chimney Swift
<i>Baeolophus atricristatus</i>	Black-crested Titmouse	<i>Chamaea fasciata</i>	Wrentit
<i>Baeolophus bicolor</i>	Tufted Titmouse	<i>Chondestes grammacus</i>	Lark Sparrow
<i>Baeolophus inornatus</i>	Oak Titmouse	<i>Circus hudsonius</i>	Northern Harrier
<i>Baeolophus ridgwayi</i>	Juniper Titmouse	<i>Cistothorus palustris</i>	Marsh Wren
<i>Bombycilla cedrorum</i>	Cedar Waxwing	<i>Cistothorus stellaris</i>	Sedge Wren
<i>Bonasa umbellus</i>	Ruffed Grouse	<i>Coccothraustes vespertinus</i>	Evening Grosbeak
<i>Buteo jamaicensis</i>	Red-tailed Hawk	<i>Coccyzus americanus</i>	Yellow-billed Cuckoo
<i>Buteo lineatus</i>	Red-shouldered Hawk	<i>Coccyzus erythrophthalmus</i>	Black-billed Cuckoo
<i>Buteo platypterus</i>	Broad-winged Hawk	<i>Colaptes auratus</i>	Northern Flicker
<i>Buteo regalis</i>	Ferruginous Hawk	<i>Colinus virginianus</i>	Northern Bobwhite
<i>Buteo swainsoni</i>	Swainson's Hawk	<i>Columba livia</i>	Rock Pigeon
<i>Calamospiza melanocorys</i>	Lark Bunting	<i>Columbina passerina</i>	Common Ground Dove
<i>Calcarius ornatus</i>	Chestnut-collared Longspur	<i>Contopus cooperi</i>	Olive-sided Flycatcher
<i>Callipepla californica</i>	California Quail	<i>Contopus sordidulus</i>	Western Wood-pewee
<i>Callipepla gambelii</i>	Gambel's Quail	<i>Contopus virens</i>	Eastern Wood-pewee
<i>Callipepla squamata</i>	Scaled Quail	<i>Coragyps atratus</i>	Black Vulture
<i>Calypte anna</i>	Anna's Hummingbird	<i>Corvus brachyrhynchos</i>	American Crow
		<i>Corvus corax</i>	Common Raven
		<i>Corvus cryptoleucus</i>	Chihuahuan Raven
		<i>Corvus ossifragus</i>	Fish Crow
		<i>Cyanocitta cristata</i>	Blue Jay
		<i>Cyanocitta stelleri</i>	Steller's Jay

<i>Dolichonyx oryzivorus</i>	Bobolink
<i>Dryobates pubescens</i>	Downy Woodpecker
<i>Dryobates scalaris</i>	Ladder-backed Woodpecker
<i>Dryobates villosus</i>	Hairy Woodpecker
<i>Dryocopus pileatus</i>	Pileated Woodpecker
<i>Dumetella carolinensis</i>	Gray Catbird
<i>Elanoides forficatus</i>	Swallow-tailed Kite
<i>Empidonax alnorum</i>	Alder Flycatcher
<i>Empidonax difficilis</i>	Pacific-slope Flycatcher
<i>Empidonax flaviventris</i>	Yellow-bellied Flycatcher
<i>Empidonax hammondi</i>	Hammond's Flycatcher
<i>Empidonax minimus</i>	Least Flycatcher
<i>Empidonax oberholseri</i>	Dusky Flycatcher
<i>Empidonax occidentalis</i>	Cordilleran Flycatcher
<i>Empidonax traillii</i>	Willow Flycatcher
<i>Empidonax virescens</i>	Acadian Flycatcher
<i>Empidonax wrightii</i>	Gray Flycatcher
<i>Eremophila alpestris</i>	Horned Lark
<i>Euphagus cyanocephalus</i>	Brewer's Blackbird
<i>Falco sparverius</i>	American Kestrel
<i>Geococcyx californianus</i>	Greater Roadrunner
<i>Geothlypis formosa</i>	Kentucky Warbler
<i>Geothlypis philadelphia</i>	Mourning Warbler
<i>Geothlypis tolmiei</i>	MacGillivray's Warbler
<i>Geothlypis trichas</i>	Common Yellowthroat
<i>Gymnorhinus cyanocephalus</i>	Pinyon Jay
<i>Haemorhous cassinii</i>	Cassin's Finch
<i>Haemorhous mexicanus</i>	House Finch
<i>Haemorhous purpureus</i>	Purple Finch
<i>Haliaeetus leucocephalus</i>	Bald Eagle
<i>Helmitheros vermivorum</i>	Worm-eating Warbler
<i>Hirundo rustica</i>	Barn Swallow
<i>Hylocichla mustelina</i>	Wood Thrush
<i>Icteria virens</i>	Yellow-breasted Chat
<i>Icterus bullockii</i>	Bullock's Oriole
<i>Icterus galbula</i>	Baltimore Oriole
<i>Icterus parisorum</i>	Scott's Oriole
<i>Icterus spurius</i>	Orchard Oriole

<i>Ictinia mississippiensis</i>	Mississippi Kite
<i>Ixoreus naevius</i>	Varied Thrush
<i>Junco hyemalis</i>	Dark-eyed Junco
<i>Lanius ludovicianus</i>	Loggerhead Shrike
<i>Leiothlypis celata</i>	Orange-crowned Warbler
<i>Leiothlypis ruficapilla</i>	Nashville Warbler
<i>Leiothlypis virginiae</i>	Virginia's Warbler
<i>Loxia curvirostra</i>	Red Crossbill
<i>Melanerpes carolinus</i>	Red-bellied Woodpecker
<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker
<i>Melanerpes formicivorus</i>	Acorn Woodpecker
<i>Meleagris gallopavo</i>	Wild Turkey
<i>Melospiza georgiana</i>	Swamp Sparrow
<i>Melospiza lincolnii</i>	Lincoln's Sparrow
<i>Melospiza melodia</i>	Song Sparrow
<i>Melospiza crissalis</i>	California Towhee
<i>Melospiza fusca</i>	Canyon Towhee
<i>Mimus polyglottos</i>	Northern Mockingbird
<i>Mniotilta varia</i>	Black-and-white Warbler
<i>Molothrus ater</i>	Brown-headed Cowbird
<i>Myadestes townsendi</i>	Townsend's Solitaire
<i>Myiarchus cinerascens</i>	Ash-throated Flycatcher
<i>Myiarchus crinitus</i>	Great Crested Flycatcher
<i>Nucifraga columbiana</i>	Clark's Nutcracker
<i>Oreoscoptes montanus</i>	Sage Thrasher
<i>Pandion haliaetus</i>	Osprey
<i>Parkesia motacilla</i>	Louisiana Waterthrush
<i>Parkesia noveboracensis</i>	Northern Waterthrush
<i>Passer domesticus</i>	House Sparrow
<i>Passerculus sandwichensis</i>	Savannah Sparrow
<i>Passerella iliaca</i>	Fox Sparrow
<i>Passerina amoena</i>	Lazuli Bunting
<i>Passerina caerulea</i>	Blue Grosbeak
<i>Passerina ciris</i>	Painted Bunting
<i>Passerina cyanea</i>	Indigo Bunting
<i>Patagioenas fasciata</i>	Band-tailed Pigeon

<i>Perisoreus canadensis</i>	Canada Jay
<i>Petrochelidon pyrrhonota</i>	Cliff Swallow
<i>Peucaea aestivalis</i>	Bachman's Sparrow
<i>Peucaea cassinii</i>	Cassin's Sparrow
<i>Phasianus colchicus</i>	Ring-necked Pheasant
<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak
<i>Pheucticus melanocephalus</i>	Black-headed Grosbeak
<i>Pica hudsonia</i>	Black-billed Magpie
<i>Pipilo chlorurus</i>	Green-tailed Towhee
<i>Pipilo erythrophthalmus</i>	Eastern Towhee
<i>Pipilo maculatus</i>	Spotted Towhee
<i>Piranga ludoviciana</i>	Western Tanager
<i>Piranga olivacea</i>	Scarlet Tanager
<i>Piranga rubra</i>	Summer Tanager
<i>Poecile atricapillus</i>	Black-capped Chickadee
<i>Poecile carolinensis</i>	Carolina Chickadee
<i>Poecile gambeli</i>	Mountain Chickadee
<i>Poecile rufescens</i>	Chestnut-backed Chickadee
<i>Poliophtila caerulea</i>	Blue-gray Gnatcatcher
<i>Pooecetes gramineus</i>	Vesper Sparrow
<i>Progne subis</i>	Purple Martin
<i>Protonotaria citrea</i>	Prothonotary Warbler
<i>Psaltriparus minimus</i>	Bushtit
<i>Quiscalus major</i>	Boat-tailed Grackle
<i>Quiscalus mexicanus</i>	Great-tailed Grackle
<i>Quiscalus quiscula</i>	Common Grackle
<i>Corthylio calendula</i>	Ruby-crowned Kinglet
<i>Regulus satrapa</i>	Golden-crowned Kinglet
<i>Riparia riparia</i>	Bank Swallow
<i>Salpinctes obsoletus</i>	Rock Wren
<i>Sayornis nigricans</i>	Black Phoebe
<i>Sayornis phoebe</i>	Eastern Phoebe
<i>Sayornis saya</i>	Say's Phoebe
<i>Seiurus aurocapilla</i>	Ovenbird
<i>Selasphorus platycercus</i>	Broad-tailed Hummingbird
<i>Selasphorus rufus</i>	Rufous Hummingbird
<i>Setophaga americana</i>	Northern Parula

<i>Setophaga caerulescens</i>	Black-throated Blue Warbler
<i>Setophaga cerulea</i>	Cerulean Warbler
<i>Setophaga citrina</i>	Hooded Warbler
<i>Setophaga coronata</i>	Yellow-rumped Warbler
<i>Setophaga discolor</i>	Prairie Warbler
<i>Setophaga dominica</i>	Yellow-throated Warbler
<i>Setophaga fusca</i>	Blackburnian Warbler
<i>Setophaga magnolia</i>	Magnolia Warbler
<i>Setophaga nigrescens</i>	Black-throated Gray Warbler
<i>Setophaga occidentalis</i>	Hermit Warbler
<i>Setophaga pensylvanica</i>	Chestnut-sided Warbler
<i>Setophaga petechia</i>	Yellow Warbler
<i>Setophaga pinus</i>	Pine Warbler
<i>Setophaga ruticilla</i>	American Redstart
<i>Setophaga townsendi</i>	Townsend's Warbler
<i>Setophaga virens</i>	Black-throated Green Warbler
<i>Sialia currucoides</i>	Mountain Bluebird
<i>Sialia mexicana</i>	Western Bluebird
<i>Sialia sialis</i>	Eastern Bluebird
<i>Sitta canadensis</i>	Red-breasted Nuthatch
<i>Sitta carolinensis</i>	White-breasted Nuthatch
<i>Sitta pusilla</i>	Brown-headed Nuthatch
<i>Sitta pygmaea</i>	Pygmy Nuthatch
<i>Sphyrapicus nuchalis</i>	Red-naped Sapsucker
<i>Sphyrapicus ruber</i>	Red-breasted Sapsucker
<i>Sphyrapicus varius</i>	Yellow-bellied Sapsucker
<i>Spinus pinus</i>	Pine Siskin
<i>Spinus psaltria</i>	Lesser Goldfinch
<i>Spinus tristis</i>	American Goldfinch
<i>Spiza americana</i>	Dickcissel
<i>Spizella breweri</i>	Brewer's Sparrow
<i>Spizella pallida</i>	Clay-colored Sparrow
<i>Spizella passerina</i>	Chipping Sparrow
<i>Spizella pusilla</i>	Field Sparrow

<i>Stelgidopteryx serripennis</i>	Northern Rough-winged Swallow
<i>Sturnella magna</i>	Eastern Meadowlark
<i>Sturnella neglecta</i>	Western Meadowlark
<i>Sturnus vulgaris</i>	European Starling
<i>Tachycineta bicolor</i>	Tree Swallow
<i>Tachycineta thalassina</i>	Violet-green Swallow
<i>Thryomanes bewickii</i>	Bewick's Wren
<i>Thryothorus ludovicianus</i>	Carolina Wren
<i>Toxostoma curvirostre</i>	Curve-billed Thrasher
<i>Toxostoma rufum</i>	Brown Thrasher
<i>Troglodytes aedon</i>	House Wren
<i>Troglodytes hiemalis</i>	Winter Wren
<i>Troglodytes pacificus</i>	Pacific Wren
<i>Turdus migratorius</i>	American Robin
<i>Tyrannus forficatus</i>	Scissor-tailed Flycatcher
<i>Tyrannus tyrannus</i>	Eastern Kingbird
<i>Tyrannus verticalis</i>	Western Kingbird
<i>Tyrannus vociferans</i>	Cassin's Kingbird
<i>Vermivora chrysoptera</i>	Golden-winged Warbler
<i>Vermivora cyanoptera</i>	Blue-winged Warbler
<i>Vireo bellii</i>	Bell's Vireo
<i>Vireo cassinii</i>	Cassin's Vireo
<i>Vireo flavifrons</i>	Yellow-throated Vireo
<i>Vireo gilvus</i>	Warbling Vireo
<i>Vireo griseus</i>	White-eyed Vireo
<i>Vireo huttoni</i>	Hutton's Vireo
<i>Vireo olivaceus</i>	Red-eyed Vireo
<i>Vireo plumbeus</i>	Plumbeous Vireo
<i>Vireo solitarius</i>	Blue-headed Vireo
<i>Xanthocephalus</i>	Yellow-headed
<i>xanthocephalus</i>	Blackbird
<i>Zenaida asiatica</i>	White-winged Dove
<i>Zenaida macroura</i>	Mourning Dove
<i>Zonotrichia albicollis</i>	White-throated Sparrow
<i>Zonotrichia leucophrys</i>	White-crowned Sparrow

Table S2. Cutoff values of the rate of change in total assemblage dissimilarity.

Group	Criterion	Cutoff Values
Rapid decline	Minimum value to 33 rd percentile of negative values	< -0.00081980
Medium decline	> 33 rd to 66 th percentile of negative values	-0.00081980 to -0.00029378
Slow decline	> 66 th percentile of negative values to zero	-0.00029377 to 0
Slow increase	zero to 33 rd percentile of positive values	0 to 0.000546410
Medium increase	> 33 rd to 66 th percentile positive values	0.000546411 to 0.001066718
Rapid increase	> 66 th percentile to maximum of positive values	> 0.001066718

Table S3. Rapid, medium, and slow biodiversity decline and increase in five US ecoregions (Level I) between 1990 and 2019.

Biodiversity measure	Ecoregion (Total # assemblages)	Decline			Increase		
		Rapid ($< -8.2 \times 10^{-4}$)*	Medium (-8.2×10^{-4} , -2.9×10^{-4})*	Slow (-2.9×10^{-4} , -1×10^{-7})*	Rapid ($> 1.07 \times 10^{-3}$)^	Medium (5.5×10^{-4} , 1.07×10^{-3})^	Slow (1×10^{-7} , 5.5×10^{-4})^
Total Dissimilarity	ETF (309)	-2.2×10^{-3} , -8.5×10^{-4}	-8.1×10^{-4} , -3×10^{-4}	-2.9×10^{-4} , -8×10^{-6}	1.1×10^{-3} , 5.3×10^{-3}	5.5×10^{-4} , 1×10^{-3}	1.7×10^{-6} , 5.5×10^{-4}
	GP (95)	-3×10^{-3} , -8.3×10^{-4}	-5.7×10^{-4} , -3.1×10^{-4}	-2.3×10^{-4} , -2.5×10^{-5}	1.1×10^{-3} , 2.8×10^{-3}	6.1×10^{-4} , 1.1×10^{-3}	3.4×10^{-5} , 5.2×10^{-4}
	NAM (50)	-2.1×10^{-3} , -9.5×10^{-4}	-7.8×10^{-4} , -3×10^{-4}	-2.9×10^{-4} , -1.3×10^{-4}	1.1×10^{-3} , 1.9×10^{-3}	6.2×10^{-4} , 1.1×10^{-3}	7.9×10^{-5} , 4.9×10^{-4}
	NF (61)	-3.2×10^{-3} , -8.7×10^{-4}	-5.7×10^{-4} , -3.2×10^{-4}	-1.9×10^{-4} , -3.3×10^{-5}	1.1×10^{-3} , 2.3×10^{-3}	5.7×10^{-4} , 1.1×10^{-3}	4.3×10^{-6} , 4.2×10^{-4}
	NFM (56)	-3.4×10^{-3} , -8.2×10^{-4}	-8×10^{-4} , -2.9×10^{-4}	-2.4×10^{-4} , -2×10^{-5}	1.2×10^{-3} , 2.2×10^{-3}	5.6×10^{-4} , 1×10^{-3}	3.1×10^{-5} , 4.9×10^{-4}
	All Eco (571)	-3.4×10^{-3} , -8.2×10^{-4}	-8.1×10^{-4} , -2.9×10^{-4}	-2.9×10^{-4} , -8×10^{-6}	1.1×10^{-3} , 5.3×10^{-3}	5.5×10^{-4} , 1.1×10^{-3}	1.7×10^{-6} , 5.4×10^{-4}
Species Replacement (Turnover)	ETF (309)	-5.2×10^{-3} , -8.7×10^{-4}	-8×10^{-4} , -3×10^{-4}	-2.7×10^{-4} , -3.7×10^{-6}	1.1×10^{-3} , 3.2×10^{-3}	5.8×10^{-4} , 1×10^{-3}	4.7×10^{-6} , 5.4×10^{-4}
	GP (95)	-2.5×10^{-3} , -8.7×10^{-4}	-7×10^{-4} , -3.5×10^{-4}	-2.3×10^{-4} , -8.1×10^{-5}	1.1×10^{-3} , 2.4×10^{-3}	5.5×10^{-4} , 1.1×10^{-3}	9.9×10^{-6} , 5.3×10^{-4}
	NAM (50)	-3.1×10^{-3} , -1×10^{-3}	-6.7×10^{-4} , -4.5×10^{-4}	-2.5×10^{-4} , -1.6×10^{-5}	1.1×10^{-3} , 3.7×10^{-3}	5.6×10^{-4} , 1×10^{-3}	1.1×10^{-4} , 5.2×10^{-4}
	NF (61)	-3.8×10^{-3} , -8.4×10^{-4}	-7.3×10^{-4} , -3.8×10^{-4}	-2.7×10^{-4} , -4.3×10^{-5}	1.1×10^{-3} , 3.7×10^{-3}	5.5×10^{-4} , 1×10^{-3}	3.8×10^{-6} , 5×10^{-4}
	NFM (56)	-2.5×10^{-3} , -1×10^{-3}	-7.8×10^{-4} , -3.5×10^{-4}	-2.3×10^{-4} , -1.2×10^{-4}	1.1×10^{-3} , 2.7×10^{-3}	5.9×10^{-4} , 1.1×10^{-3}	9.8×10^{-5} , 4.6×10^{-4}
	All Eco (571)	-5.2×10^{-3} , -8.4×10^{-4}	-8×10^{-4} , -3×10^{-4}	-2.7×10^{-4} , -3.7×10^{-6}	1.1×10^{-3} , 3.7×10^{-3}	5.5×10^{-4} , 1.1×10^{-3}	3.8×10^{-6} , 5.4×10^{-4}
Species loss (Nestedness)	ETF (309)	-3.2×10^{-3} , -8.5×10^{-4}	-7.3×10^{-4} , -3×10^{-4}	-2.7×10^{-4} , -4.2×10^{-6}	1.1×10^{-3} , 5.8×10^{-3}	5.5×10^{-4} , 9.8×10^{-4}	3.6×10^{-6} , 5.5×10^{-4}
	GP (95)	-2.4×10^{-3} , -8.5×10^{-4}	-8.1×10^{-4} , -3×10^{-4}	-2.8×10^{-4} , -5.3×10^{-5}	1.1×10^{-3} , 2.9×10^{-3}	5.6×10^{-4} , 1×10^{-3}	3.4×10^{-5} , 5.1×10^{-4}
	NAM (50)	-2.5×10^{-3} , -1.1×10^{-3}	-5.4×10^{-4} , -4.9×10^{-4}	-2.9×10^{-4} , -8.2×10^{-5}	1.1×10^{-3} , 3.7×10^{-3}	5.7×10^{-4} , 7.6×10^{-4}	3.8×10^{-5} , 5.2×10^{-4}
	NF (61)	-1.7×10^{-3} , -8.9×10^{-4}	-4.9×10^{-4} , -3.3×10^{-4}	-2.8×10^{-4} , -8.2×10^{-6}	1.2×10^{-3} , 2.4×10^{-3}	5.9×10^{-4} , 1×10^{-3}	2×10^{-7} , 5.2×10^{-4}
	NFM (56)	-2.5×10^{-3} , -9.1×10^{-4}	-8.2×10^{-4} , -3×10^{-4}	-2.4×10^{-4} , -3×10^{-5}	1.1×10^{-3} , 1.8×10^{-3}	5.9×10^{-4} , 9.4×10^{-4}	3.3×10^{-5} , 3×10^{-4}
	All Eco (571)	-3.2×10^{-3} , -8.5×10^{-4}	-8.2×10^{-4} , -3×10^{-4}	-2.9×10^{-4} , -4.2×10^{-6}	1.1×10^{-3} , 5.8×10^{-3}	5.5×10^{-4} , 1×10^{-3}	2×10^{-7} , 5.5×10^{-4}
Species Richness	ETF (309)	-1.1, -4.2×10^{-3}	-	-	2.6×10^{-3} , 1	-	-

GP (95)	-4.6x10 ⁻¹ , -1.8x10 ⁻²	-	-	7.1x10 ⁻³ , 7.9x10 ⁻¹	5.9x10 ⁻⁴ , 5.9x10 ⁻⁴	-
NAM (50)	-3.9x10 ⁻¹ , -4.4x10 ⁻³	-	-	6x10 ⁻³ , 5.3x10 ⁻¹	-	-
NF (61)	-8.9x10 ⁻¹ , -3.5x10 ⁻²	-	-	4.3x10 ⁻³ , 1.1	-	-
NFM (56)	-3.1x10 ⁻¹ , -8.8x10 ⁻³	-	-	1.7x10 ⁻² , 8.9x10 ⁻¹	-	1.5x10 ⁻⁴ , 1.5x10 ⁻⁴
All Eco (571)	-1.1, -4.2x10 ⁻³	-	-	2.6x10 ⁻³ , 1.1	5.9x10 ⁻⁴ , 5.9x10 ⁻⁴	1.5x10 ⁻⁴ , 1.5x10 ⁻⁴

*Cutoff values of decline of biodiversity measures.

^ Cutoff values of increase of biodiversity measures.

ETF: Eastern Temperate Forests, GP: Great Plains, NAD: North American Deserts, NF: Northern Forests, NFM: Northwestern Forested Mountains, All Eco: All Ecoregions.

Table S4. Percentage of breeding bird assemblages that show an increase, decrease, or not significant change in their rate of change in total assemblage dissimilarity (total beta diversity), partitioned by the significance of the rate of change in species replacement (turnover) and species loss (nestedness). Results are shown for the period 1990 – 2019 by ecoregion and for all ecoregions pooled together. (+) a significantly positive rate of change, (-) a significantly negative rate of change, and (ns) a non-significant rate of change.

Ecoregion	Turnover rate of change	Nestedness rate of change	% of assemblages		
			Increasing Total beta diversity	Decreasing Total beta diversity	No change in Total beta diversity
Eastern Temperate Forests (N = 309)	+	+	5.83	0	0
		-	1.29	0.97	4.53
		ns	15.86	0	1.94
	-	+	1.62	1.62	8.09
		-	0	0.32	0
		ns	0	2.59	0.65
	ns	+	7.77	0	11
		-	0	1.94	2.27
		ns	3.56	0.97	27.18
Total			35.92	8.41	55.66
Great Plains (N = 95)	+	+	1.05	0	0
		-	12.63	1.05	5.26
		ns	20	0	2.11
	-	+	1.05	3.16	3.16
		-	0	1.05	0
		ns	0	1.05	0

	ns	+	4.21	0	0
		-	0	1.05	5.26
		ns	10.53	0	27.37
Total			49.47	7.37	43.16
North American Deserts (N = 50)	+	+	0	0	0
		-	8	0	0
		ns	4	0	0
	-	+	2	4	8
		-	0	0	0
		ns	0	2	0
	ns	+	2	0	8
		-	0	2	0
		ns	8	2	50
Total			24	10	66
Northern Forests (N = 61)	+	+	4.92	0	0
		-	1.64	0	3.28
		ns	22.95	0	3.28
	-	+	0	1.64	9.84
		-	0	1.64	0
		ns	0	1.64	0
	ns	+	3.28	0	4.92
		-	0	1.64	4.92
		ns	8.2	3.28	22.95
Total			40.98	9.84	49.18
Northwestern Forested Mountains (N = 56)	+	+	1.79	0	0
		-	5.36	0	7.14
		ns	1.79	0	1.79
	-	+	0	3.57	0
		-	0	3.57	0
		ns	0	8.93	3.57

	ns	+	1.79	0	5.36
		-	0	5.36	7.14
		ns	0	3.57	39.29
Total			10.71	25	64.29
All ecoregions (N = 571)	+	+	4.03	0	0
		-	4.2	0.7	4.38
		ns	14.89	0	1.93
	-	+	1.23	2.28	6.65
		-	0	0.88	0
		ns	0	2.8	0.7
	ns	+	5.6	0	7.71
		-	0	2.1	3.33
		ns	5.25	1.4	29.95
Total			35.2	10.16	54.64

FIGURES

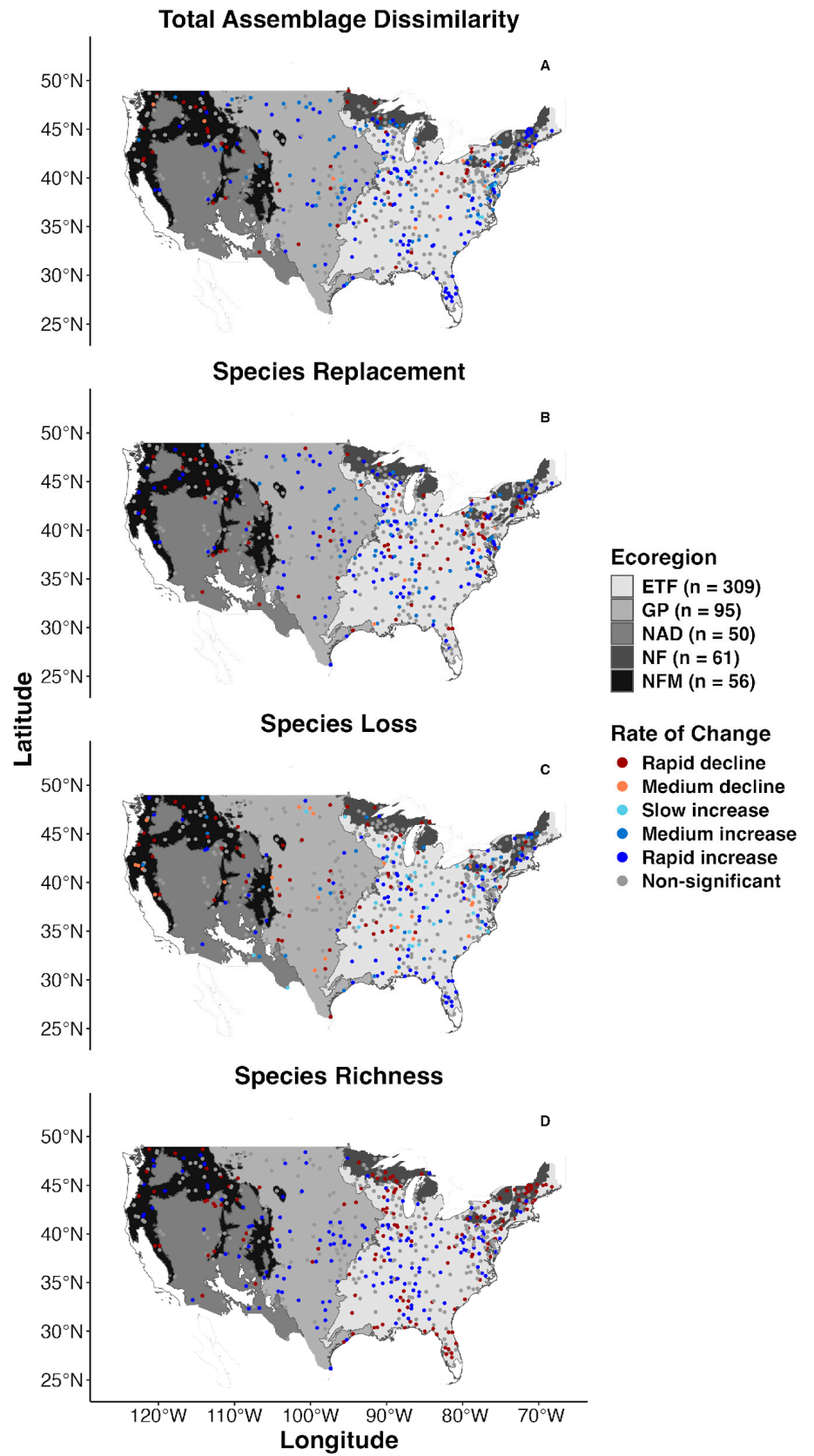


Figure S1. Spatial representation of the rate of change in four biodiversity measures of 571 breeding bird assemblages across five ecoregions of the US (1990 – 2019). A: Total Assemblage Dissimilarity (Total beta diversity), B: Species Replacement (Turnover), C: Species Loss (Nestedness), and D: Species Richness (alpha diversity). ETF: Eastern Temperate Forests, GP: Great Plains, NAD: North American Deserts, NF: Northern Forests, NFM: Northwestern Forested Mountains. The number of BBS routes in each ecoregion is indicated in parentheses. Cutoff values of rate of change: Rapid decline: ($< -8.2 \times 10^{-4}$), Medium decline ($[-8.2 \times 10^{-4}, -2.9 \times 10^{-4}]$), Rapid increase ($> 1.07 \times 10^{-3}$), Medium increase ($[5.5 \times 10^{-4}, 1.07 \times 10^{-3}]$), and Slow increase ($[1 \times 10^{-7}, 5.5 \times 10^{-4}]$)