Why It Matters? 3 Billion Birds Lost

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Driven to Discover

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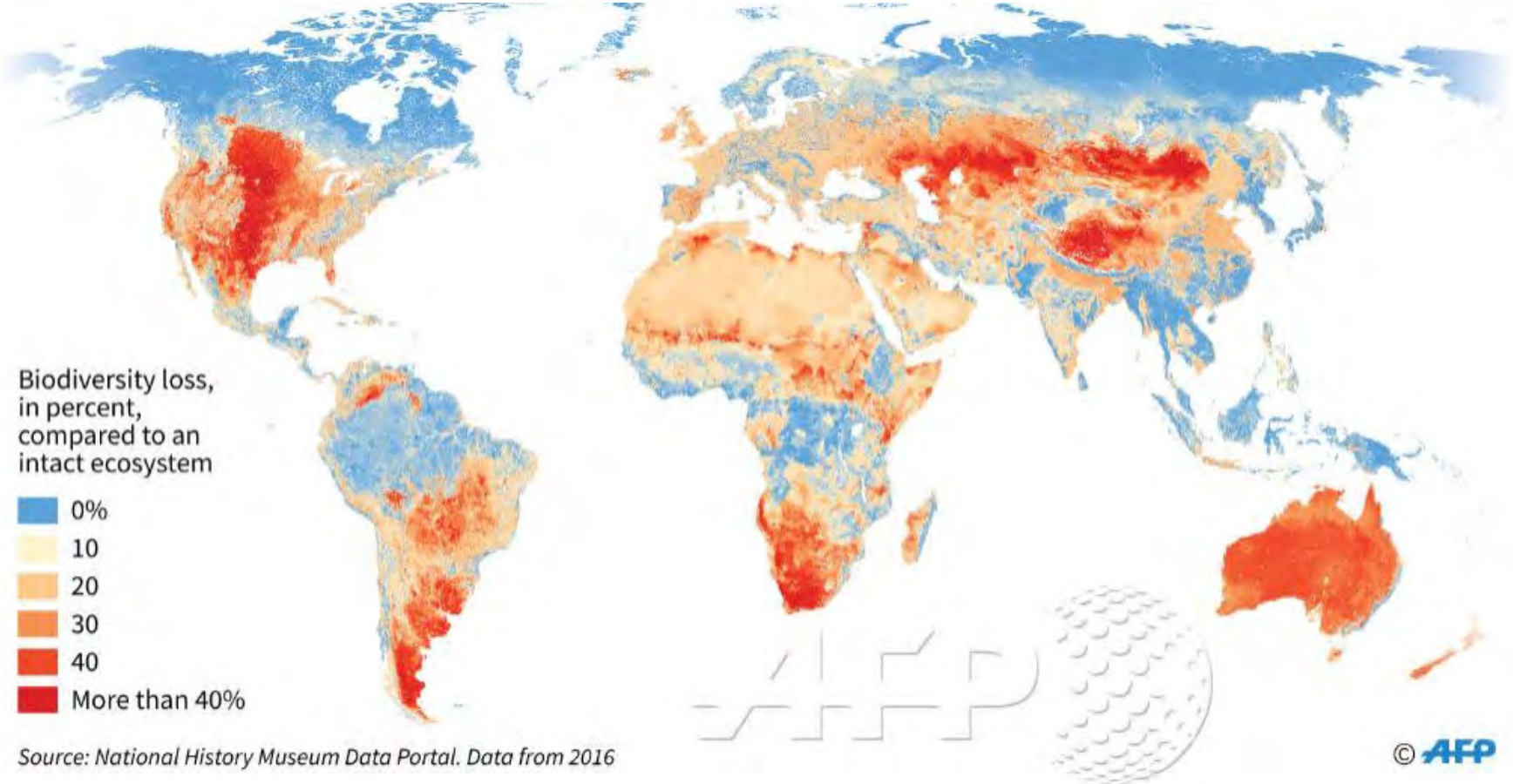
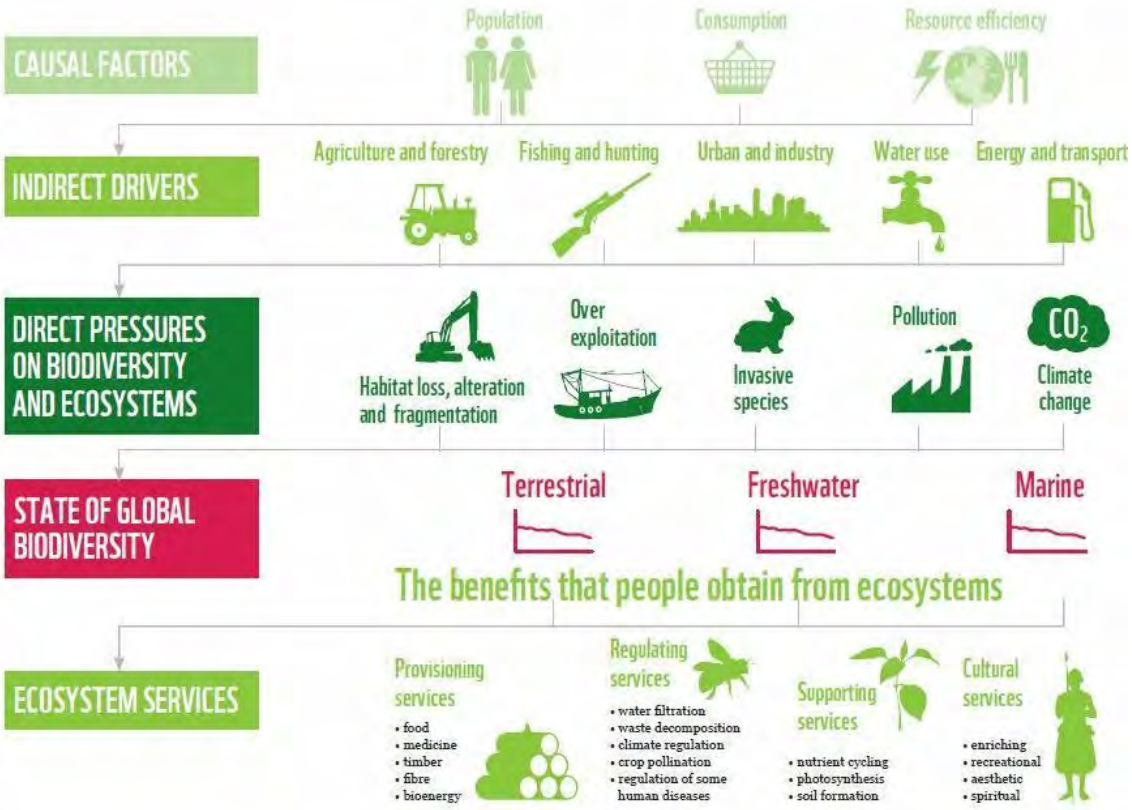
Loss of biodiversity



Díaz, Sandra, et al. (2019). "Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services."

Loss of biodiversity

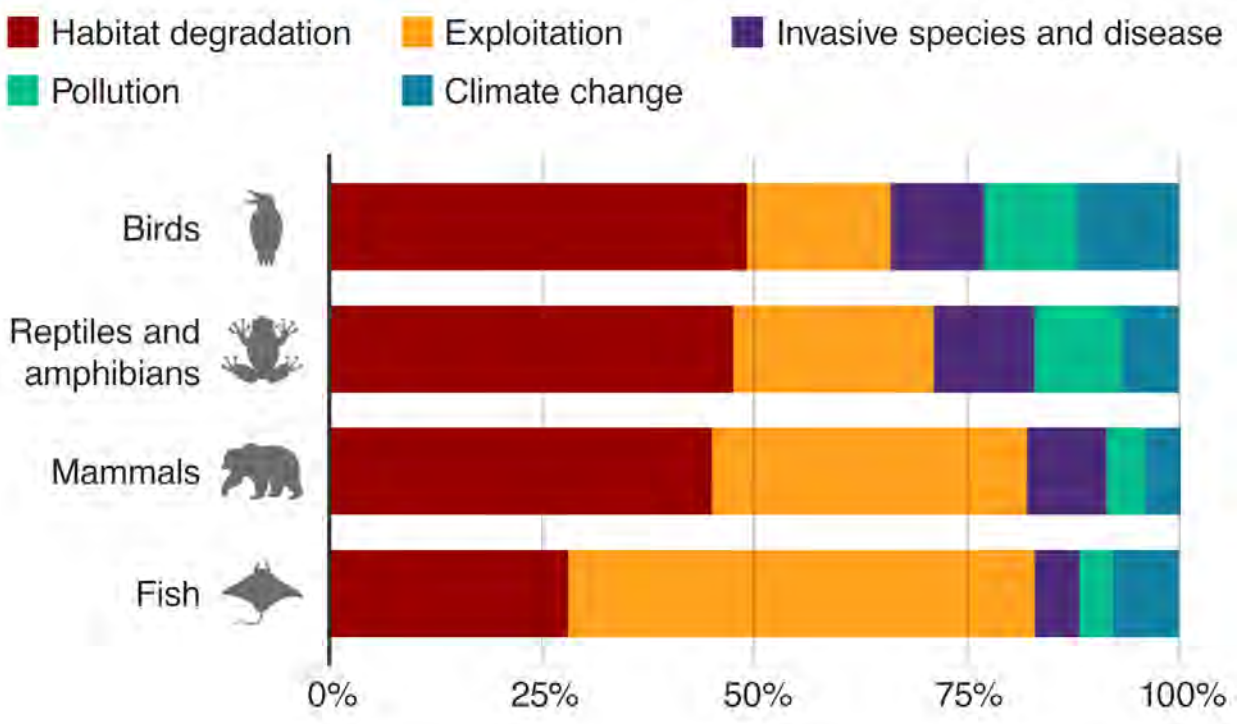


Species diversity promotes ecosystem functioning through positive interspecies interactions

Newbold, T., et al. (2016). Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment. Science (253):288-291

Loss of biodiversity

Habitat loss is a major threat to biodiversity



Maxwell, Sean L., et al. (2016). "Biodiversity: The ravages of guns, nets and bulldozers." *Nature News* 536.7615: 143.

Birds. Who cares?

In U.S. 48 million birders, $82 billion in total industry output, 671,000 jobs, $11 billion in local, state, and federal tax revenue.

Bird watching participation increased **20%** from 2011 to 2016!

2011–2016 Wildlife-Watching Participants, Days, and Expenditures

(U.S. population 16 years and older. Numbers in thousands)

	2011		2016		2011–2016
	Number	Percent	Number	Percent	percent change
Wildlife-watching participants, total	**71,776**	**100**	**86,042**	**100**	**20**
Around the home	68,598	96	81,128	94	18
Observers	45,046	63	43,829	51	*–3
Photographers	25,370	35	30,473	35	20
Feeders	52,817	74	59,083	69	12
Visitors of parks or natural areas	12,311	17	11,359	13	*–8
Maintainers of planting or natural areas	13,399	19	11,024	13	*–18
Away from home	22,496	31	23,720	28	*5
Observers	19,808	28	19,583	23	*–1
Photographers	12,354	17	13,721	16	*11
Feeders	5,399	8	4,869	6	*–10
Days, away form home	335,625	100	386,045	100	*15
Observers	268,798	80	308,769	80	*15
Photographers	110,459	33	151,559	39	*37
Feeders	59,255	18	70,846	18	*20
Wildlife-watching expenditures, total (2016 dollars)	**$58,732,591**	**100**	**$75,867,134**	**100**	***29**
Trip-related	$18,483,902	31	$11,587,870	15	–37
Equipment, total	$29,051,485	49	$55,083,300	73	90
Wildlife-watching equipment	$12,115,802	21	$12,105,745	16	*Z
Auxiliary equipment	$1,664,250	3	$1,043,932	1	*–37
Special equipment	$15,271,434	26	$41,933,623	55	175
Other	$11,197,204	19	$9,195,965	12	*–18

* Not statistically different from zero at the 95 percent confidence level.
Z is less than 0.5 percent.

USFWS (2016).

Birds. Who cares?

Forest birds contribute over **$175 million** each year toward the health of Minnesota's forest industries

Bay-breasted Warblers are one of many bird species that control pest populations in timber stands.
Photo by Arni Stinnissen/ArniWorks Nature Photography, www.arniworks.com.

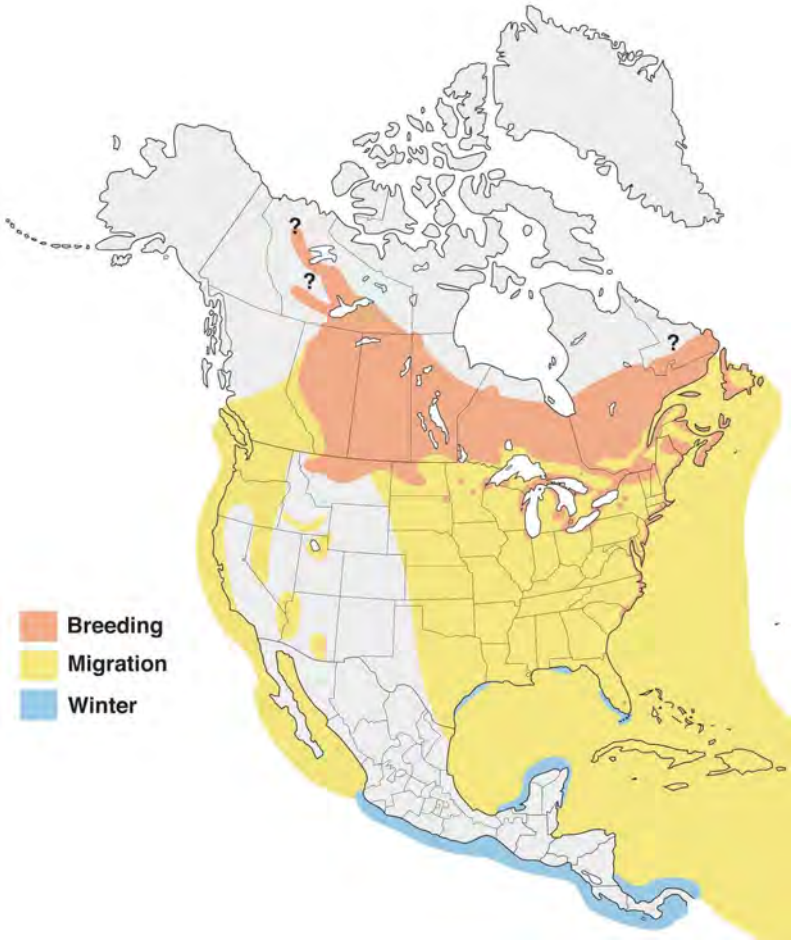
Maintaining avian diversity is critical for ecosystem health.

Plant pollinators, seed distributors, nutrient redistributors, environmental indicators…

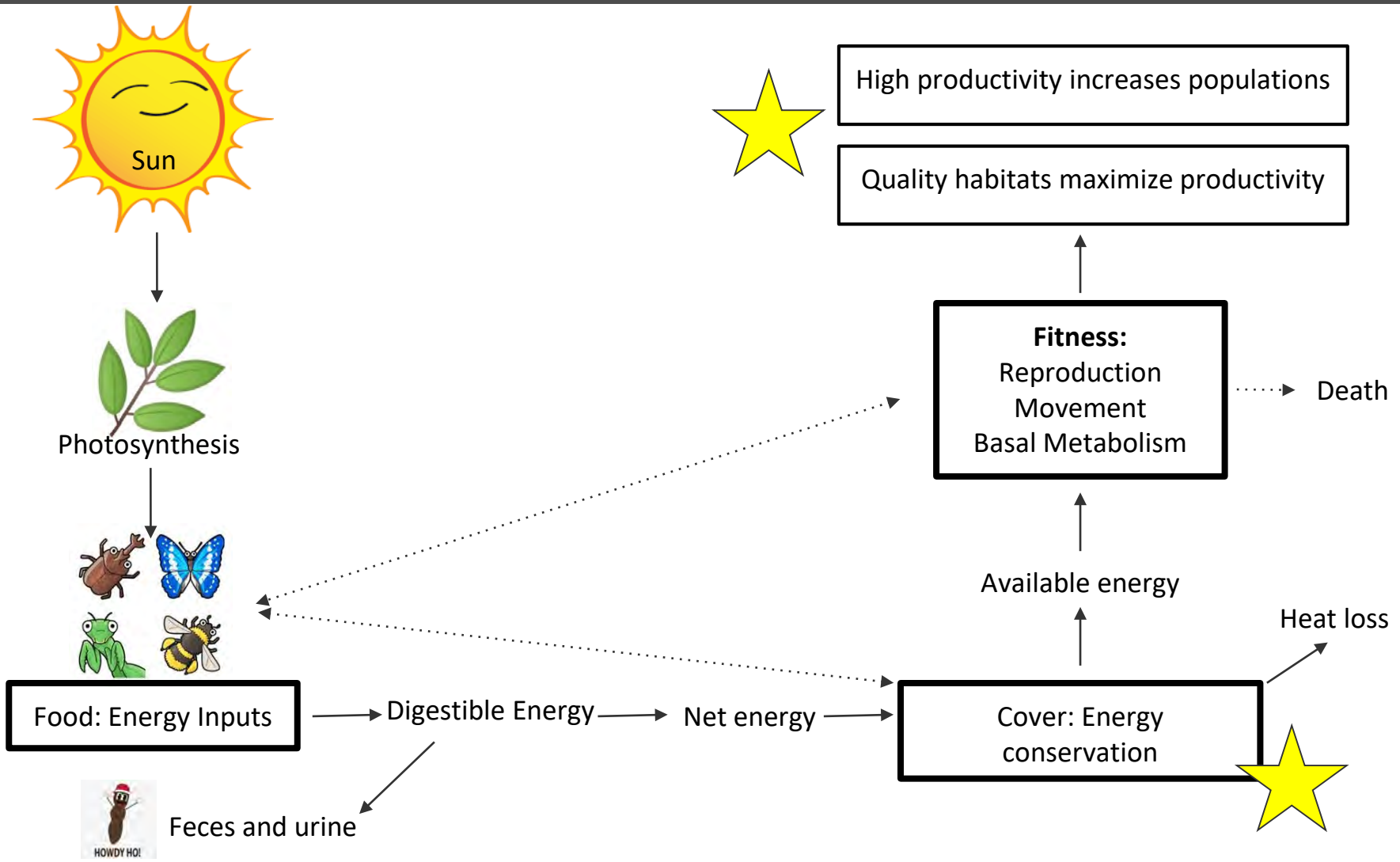
Birds are amazing!!

To see them is to love them ☺

Full annual cycle of birds



Energy flow and productivity



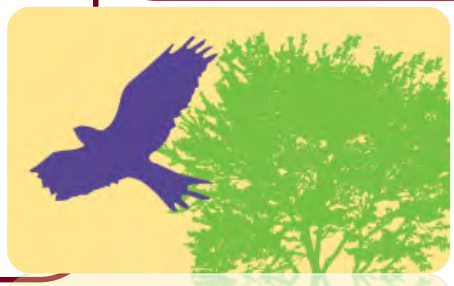
Modified from Wildlife Habitat Management: Concepts and Applications in Forestry. McComb, B. 2016.

Benefits of birds

Quality of life
- Birds songs
- Recreation
- Stress relief
- Education

Ecosystem Services
- Flower pollination
- Pest control
- Nutrient redistribution

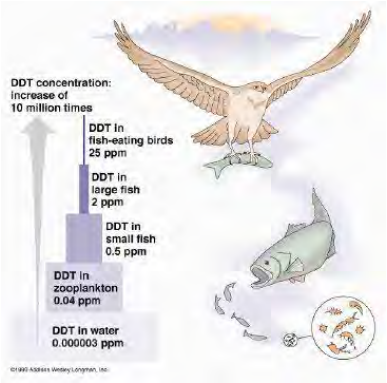
Environmental indicators
- Habitat quality and degradation
- Environmental pollution
- Restoration

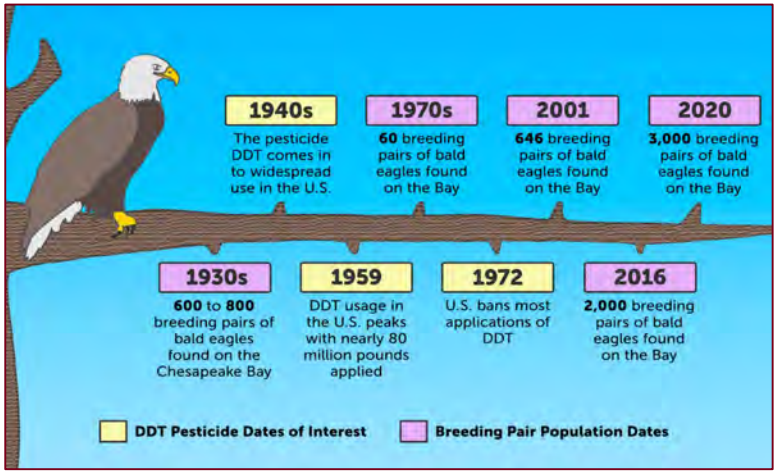


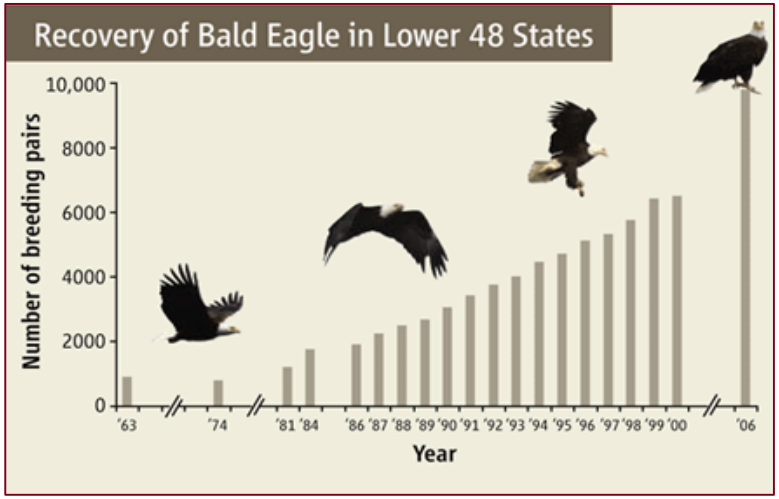
Birds are ecosystem indicators

What is an ecosystem indicator?

A species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem.







Stokstad, E., 2007. Can the bald eagle still soar after it is delisted?. Science, 316(5832), pp.1689-1690.

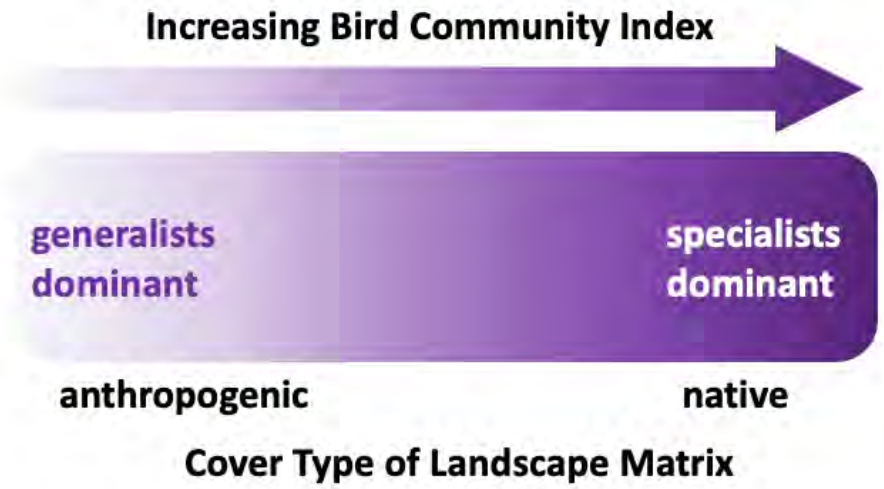
Birds are ecosystem indicators

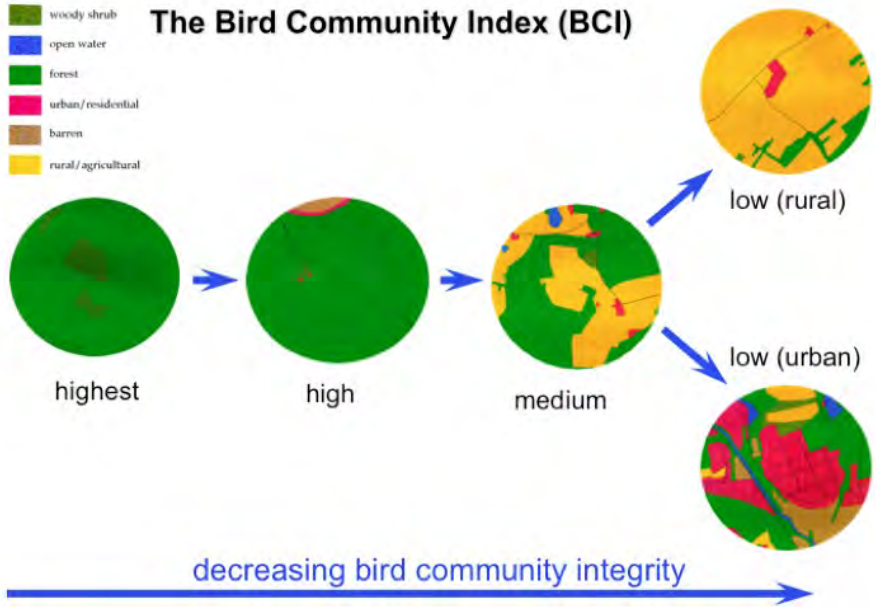
Good indicator species need to meet a few criteria:

- Sensitive to changes in the environment, serve as an early warning
- Responds to changes in a predictable manner
- Easy to compile and interpret data on the species to inform policy decisions

- Bird communities are diverse, have high energy demands, high position on food chain, thus can be sensitive to minor habitat changes
- Birds are relatively *easy* to survey and abundant
- Provide a variety of metrics across multiple scales of interest: abundance (populations), species diversity and richness

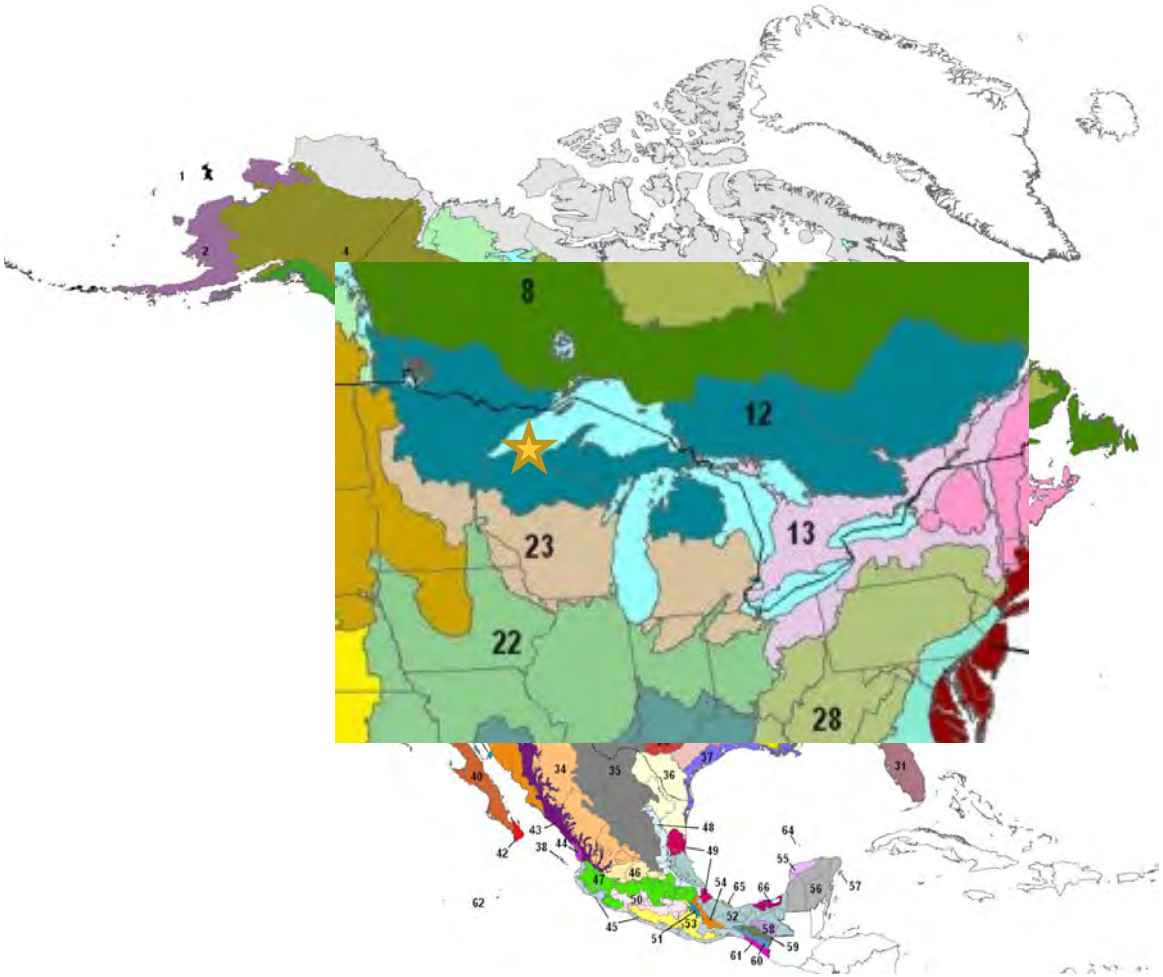
Birds are ecosystem indicators





O'Connell et al. 2007. Sub-sampling data from the North American Breeding Bird Survey for application to the Bird Community Index, an indicator of ecological condition. Ecological Indicators 7: 679–691.

Bird Conservation Regions (BCRs)



BCR 12: Boreal Hardwood Transition

Changes in availability and quality of habitat

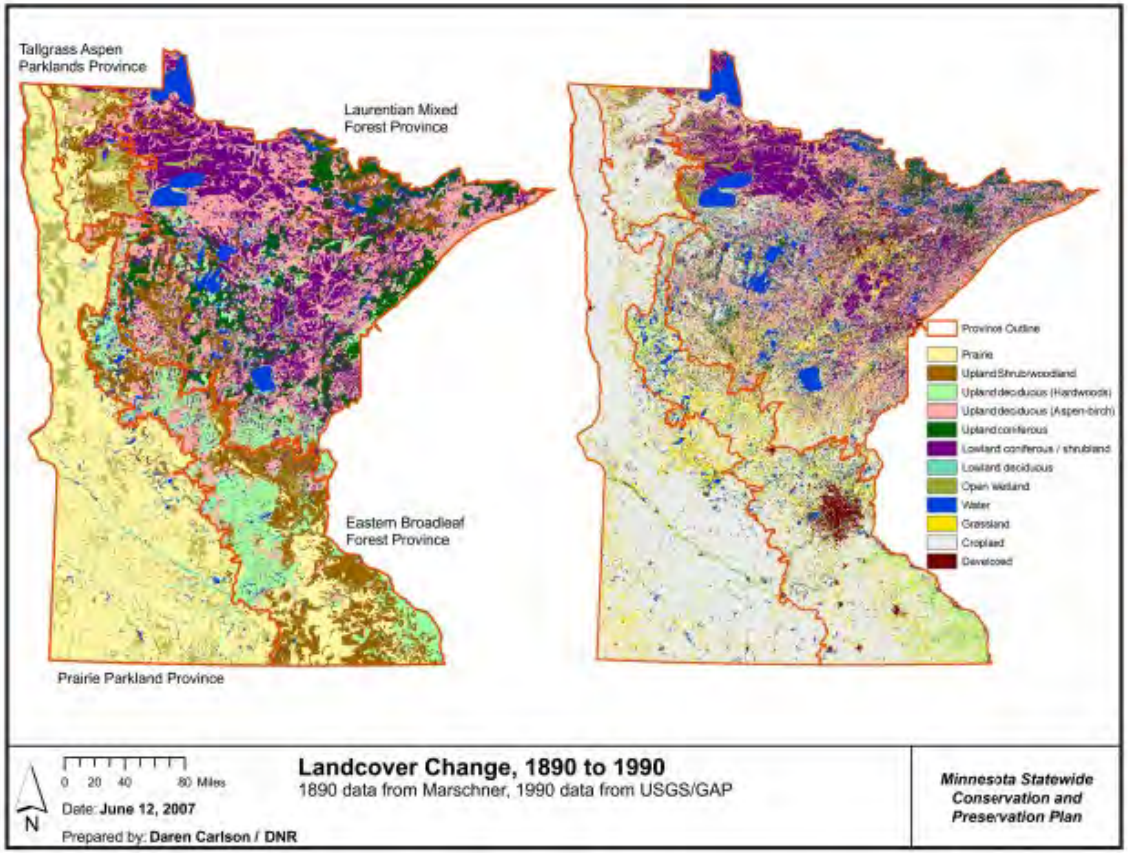


Figure H23. Marschner's map of vegetation around the time of European settlement and contemporary land cover, based on 1990 GAP data. Credit: Daren Carlson, DNR.

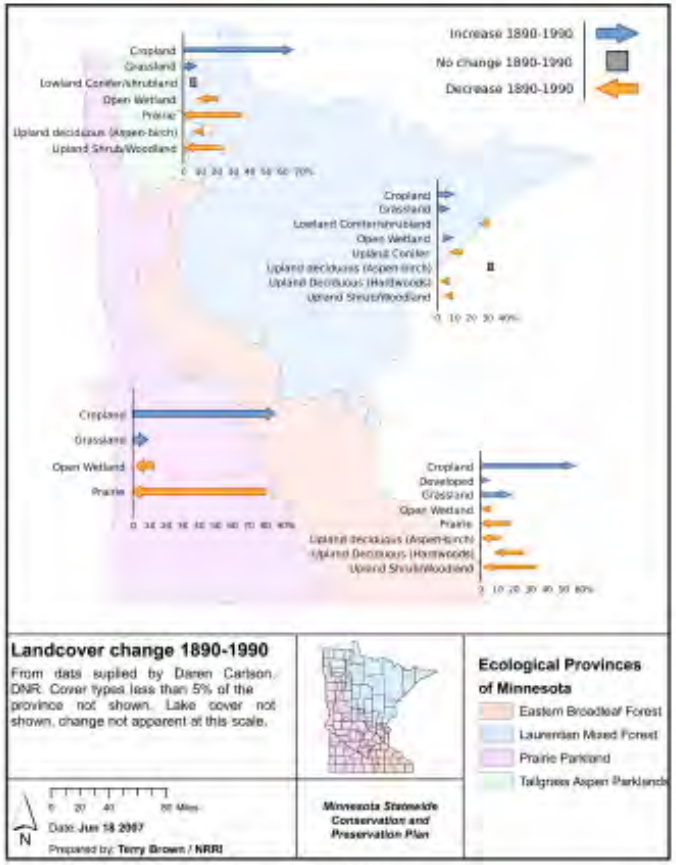


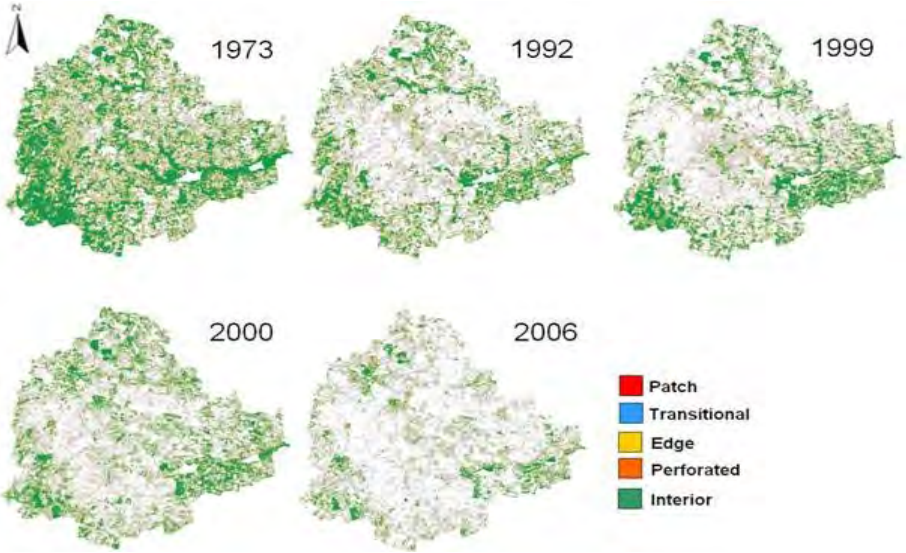
Figure H24. Land cover change, 1890–1990. Credit: Terry Brown, NRRI.

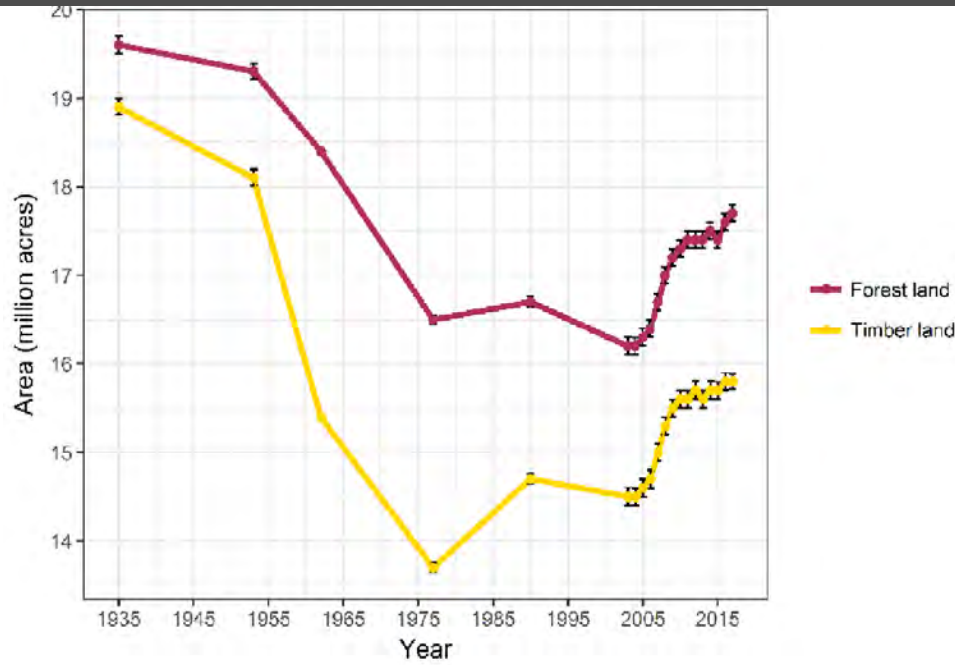
Minnesota Statewide Conservation and Preservation Plan.
https://www.lccmr.leg.mn/documents/scpp/final_plan/habitat_rec.pdf

Changes in availability and quality of habitat

Historic forest landscape:

- Less fragmented
- More heterogeneity in age and composition
- Mosaic of mixed-age stands as a result of fire and other natural disturbances.





Forest land and timberland by year, Minnesota 1935-2017.

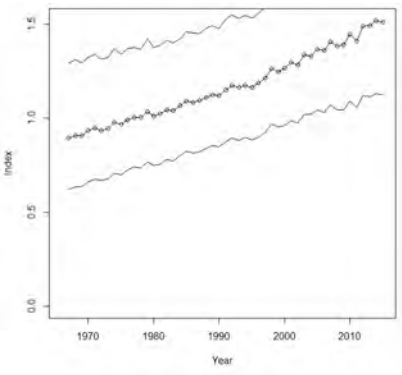
How do we study birds?

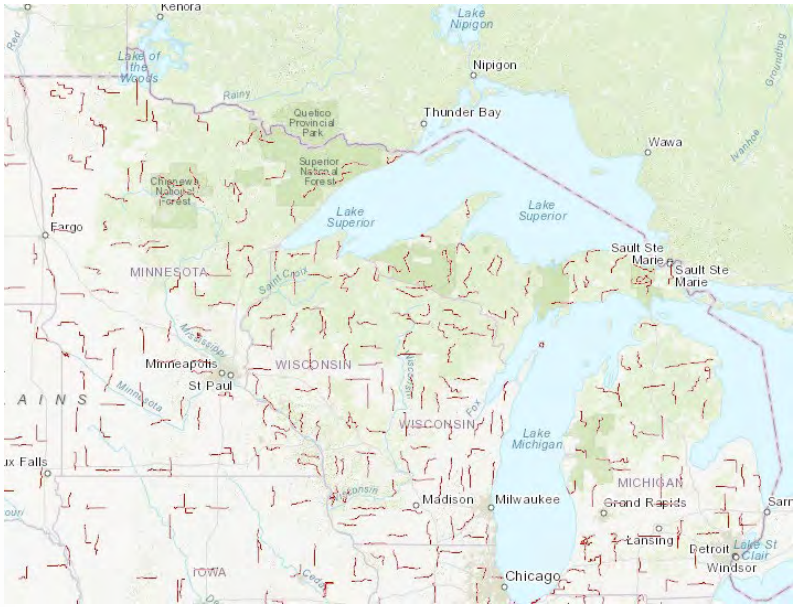
- Long-term monitoring programs
  - Breeding Bird Surveys (BBS)
  - NFB (NRRI)
  - Atlases (BBA); conducted by states
  - Ebird; citizen science (birders)
- Banding
  - MAPS
  - Migration banding
- Field studies
  - Telemetry (and other technologies)
  - Productivity
  - Diet

Breeding Bird Survey (BBS)

Breeding Bird Surveys (BBS)

- 1966- current
- ~4100 continental survey routes
- 50 point count stops/route, 24.5 miles long
- Volunteer, road-side counts

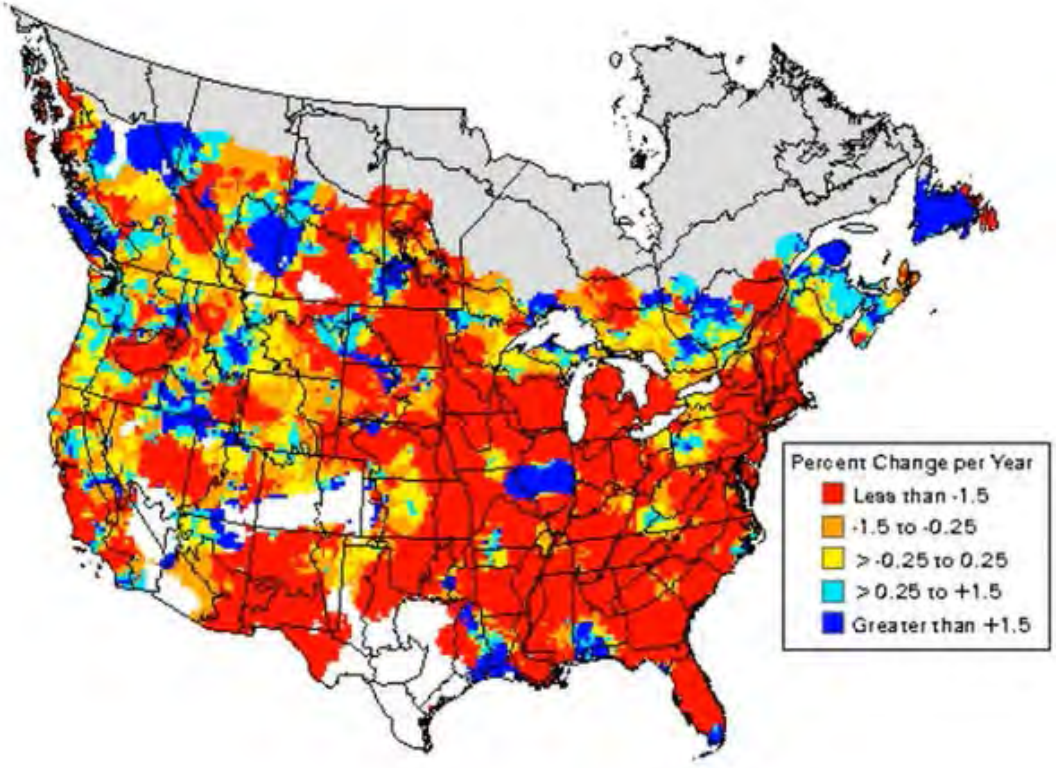




Sauer, John R., et al. (2017). "The first 50 years of the North American Breeding Bird Survey." *The Condor: Ornithological Applications* 119.3: 576-593.

Breeding Bird Survey (BBS)

One of the five most rapidly declining birds in N. America 1966-2013…

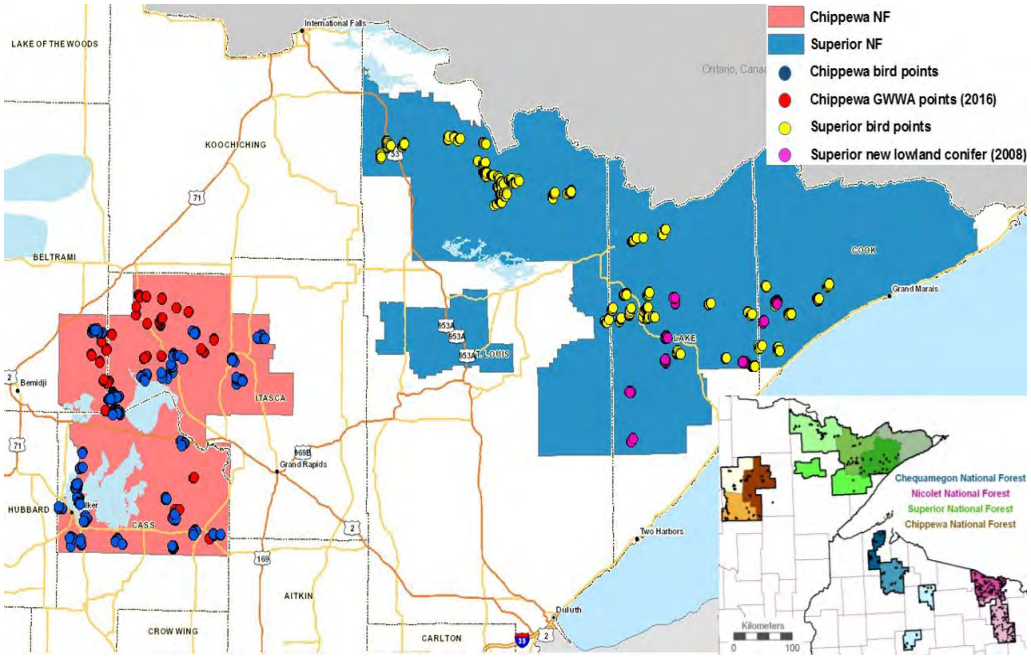


3-7% annual decline

Minnesota's National Forest Bird Monitoring Program

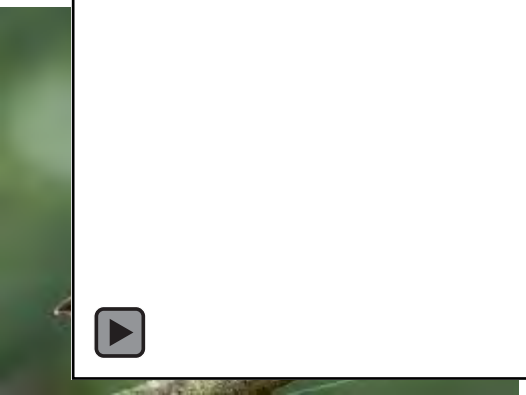
https://z.umn.edu/forestbird

- 1995- current
- 1000+ points surveyed annually
- Off-road monitoring; complimentary to the BBS
- Trained observers



Grinde et al. (2022). **"**Minnesota National Forest Breeding Bird Monitoring Program Annual Report 1995–2022".

eBird



eBird

Abundance

Relative abundance is depicted for each season along a color gradient from a light color indicating lower relative abundance to a dark color indicating a high...

Learn more

Breeding season 14 Jun - 27 Jul

Non-breeding season 9 Nov - 22 Mar

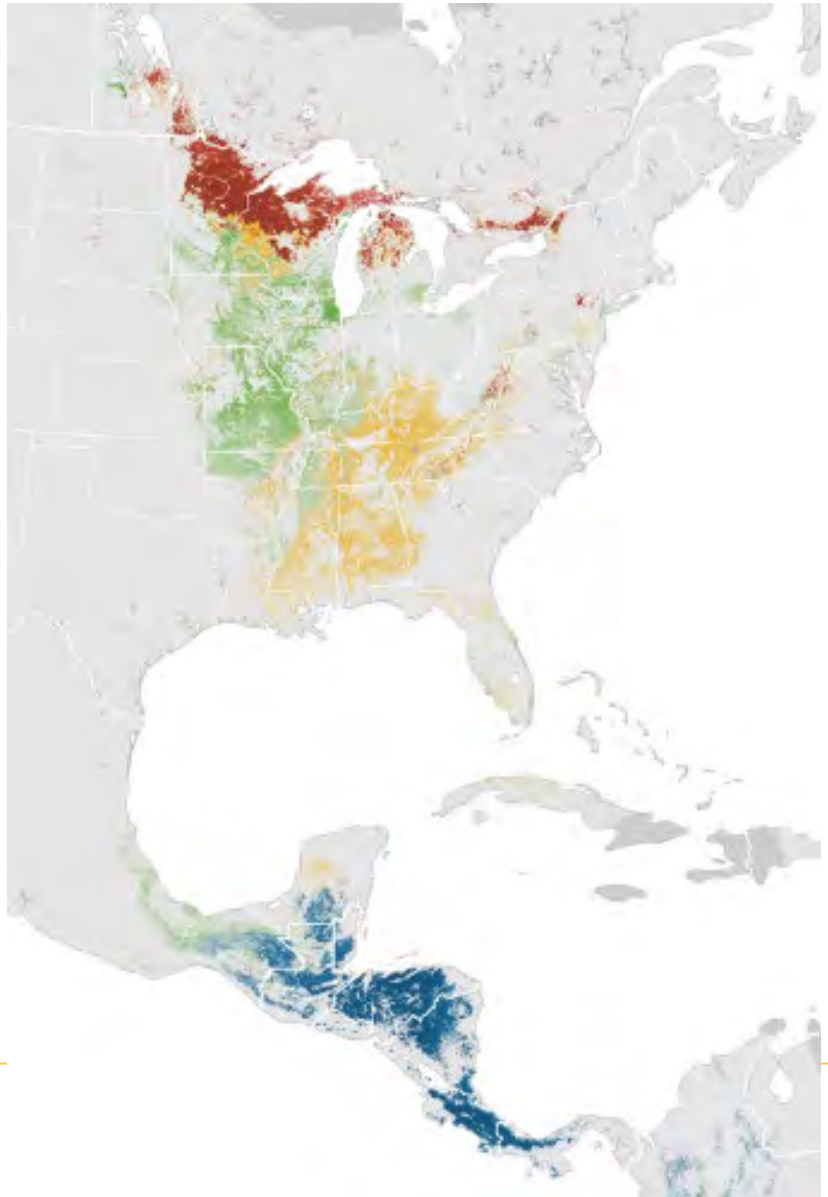
Pre-breeding migratory season 29 Mar - 7 Jun

Post-breeding migratory season 3 Aug - 2 Nov

0 0.04 0.26

Seasons timeline

J F M A M J J A S O N D



eBird

Trends 2007-2021

Breeding season, 14 Jun - 6 Jul

This map depicts the cumulative change in estimated relative abundance from 2007 through 2021 with circles representing 27km x 27km regions. Red indicates decline and blue indicates increase. The darker the color, the stronger the trend. White circles represent locations where the trend estimate is not significantly different from zero (i.e., the 80% confidence interval contains zero). Circle sizes are scaled by the estimated relative abundance at the middle of the time period.

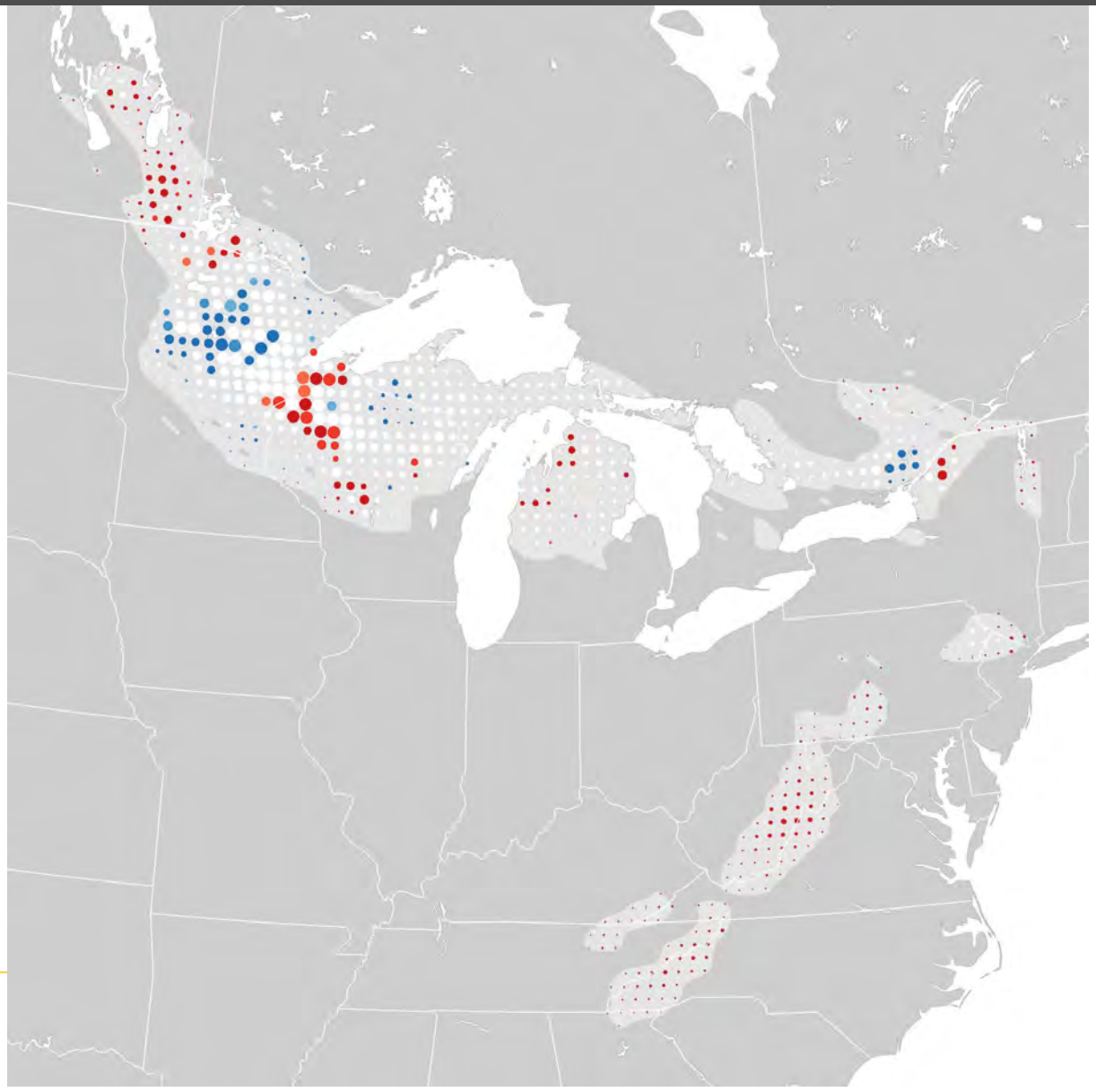
Learn more

Abundance trend Pct. change, 2007-2021

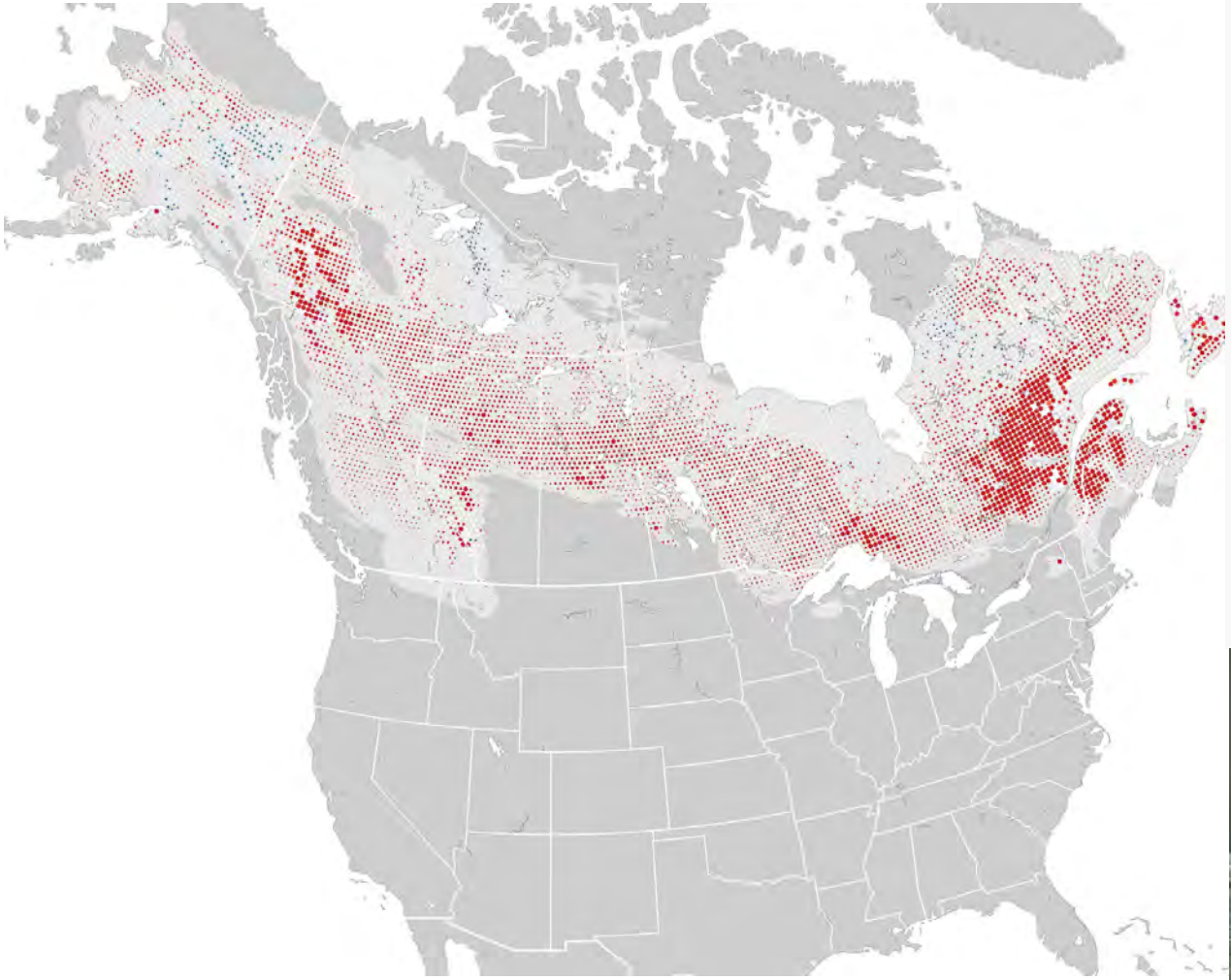
-30% -20 -10 Uncertain +10 +20 +30

Relative abundance Middle year of range, 2014

Lower Higher



eBird



Trends 2007-2021

Year-round

This map depicts the cumulative change in estimated relative abundance from 2007 through 2021 with circles representing 27km x 27km regions. Red indicates decline and blue indicates increase. The darker the color, the stronger the trend. White circles represent locations where the trend estimate is not significantly different from zero (i.e., the 80% confidence interval contains zero). Circle sizes are scaled by the estimated relative abundance at the middle of the time period.

Learn more

Abundance trend Pct. change, 2007-2021

-30% -20 -10 Uncertain +10 +20 +30

Relative abundance Middle year of range, 2014

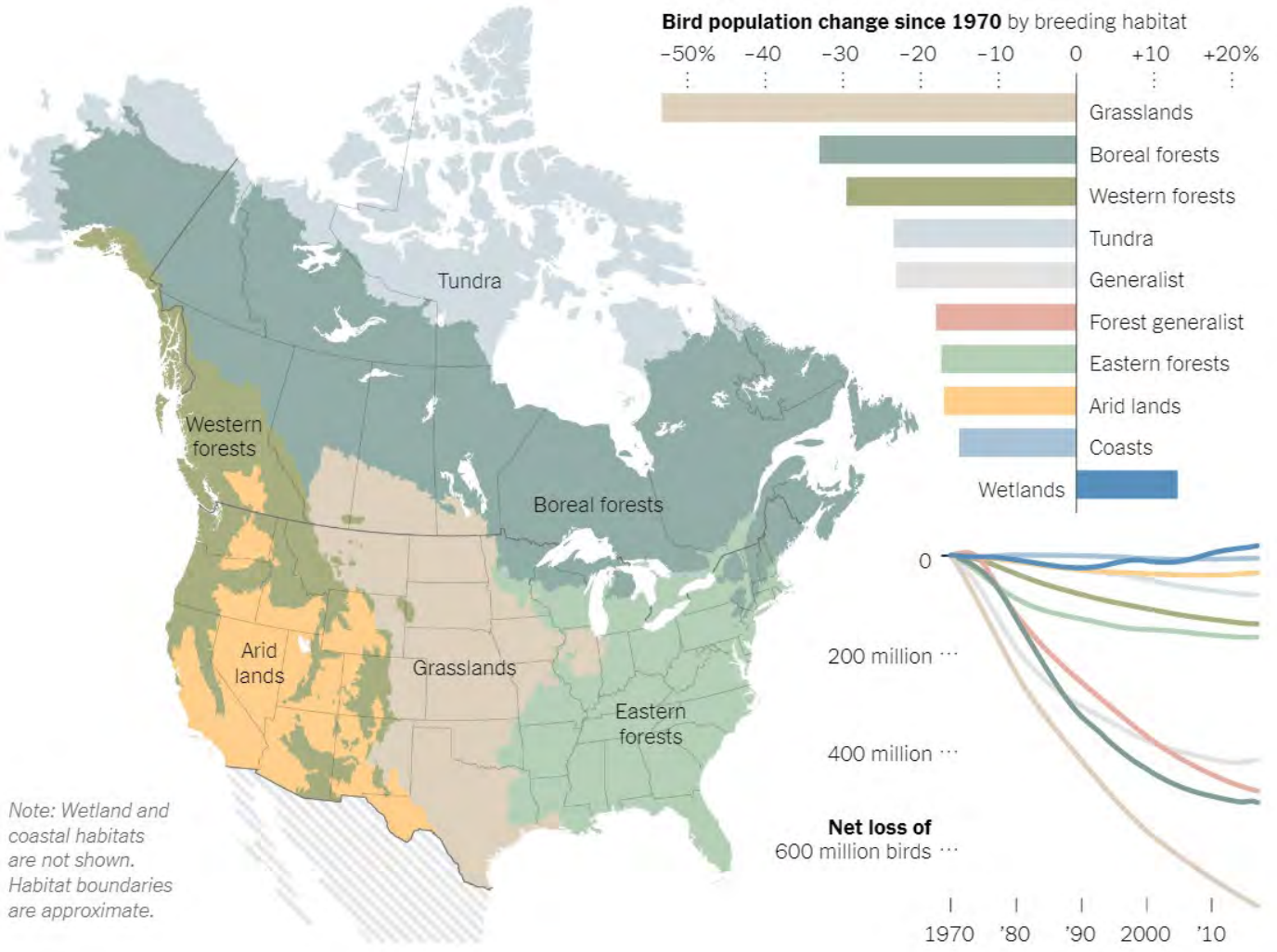
Lower Higher

Review

- Birds are awesome
- Birds are ecosystem indicators
- Across North America, the forested landscape has changed including forests of the Great Lakes region (BCR12)
- We have several datasets that can provide information about bird populations and diversity

What are the birds telling us?

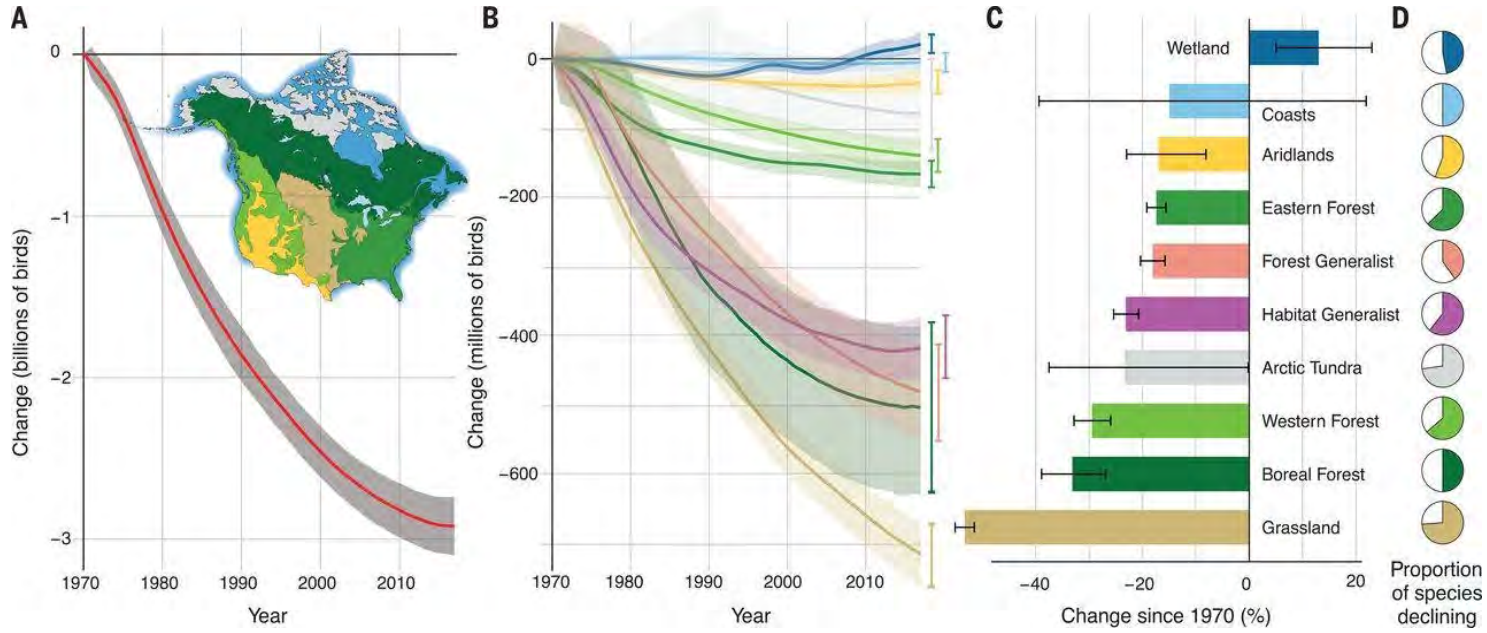
3 billion birds gone



Rosenberg, Kenneth V., et al. (2019) "Decline of the North American avifauna." *Science* 366.6461:120-124.

3 billion birds gone

- "…population losses across much of the North American avifauna over 48 years, including once-common species and from most biomes."
- "Integration of range-wide population trajectories…indicates a net loss approaching 3 billion birds, or 29% of 1970 abundance."

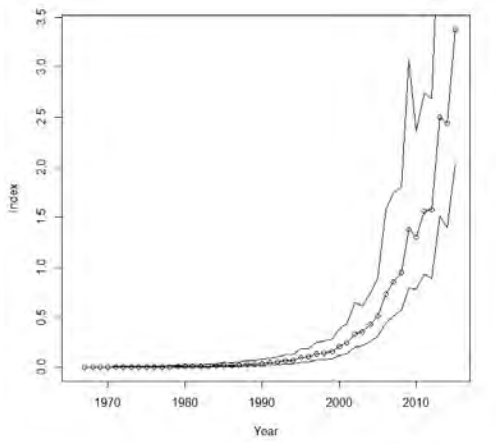


Rosenberg, Kenneth V., et al. (2019) "Decline of the North American avifauna." *Science* 366.6461:120-124.

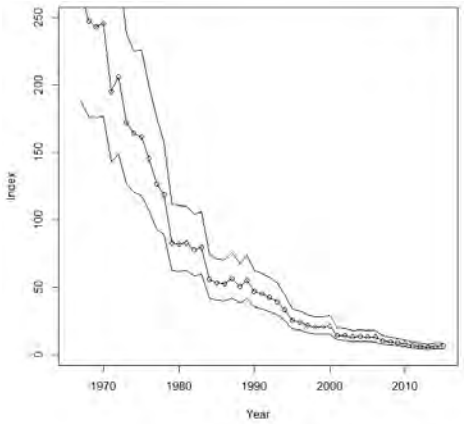
Photo: Steve Kolbe

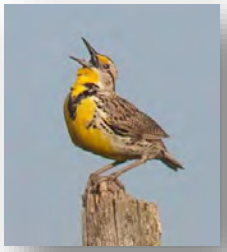
Trends in BCR 12: Boreal Hardwood Transition

Positive Trends

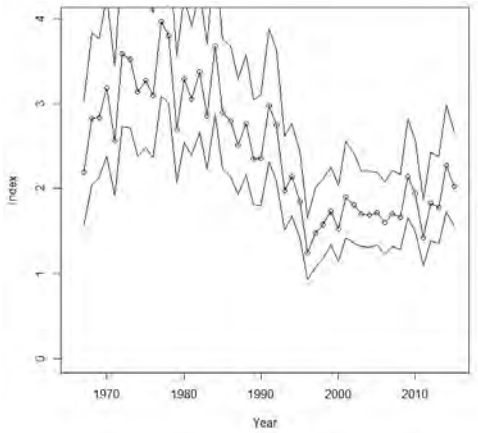


Negative Trends

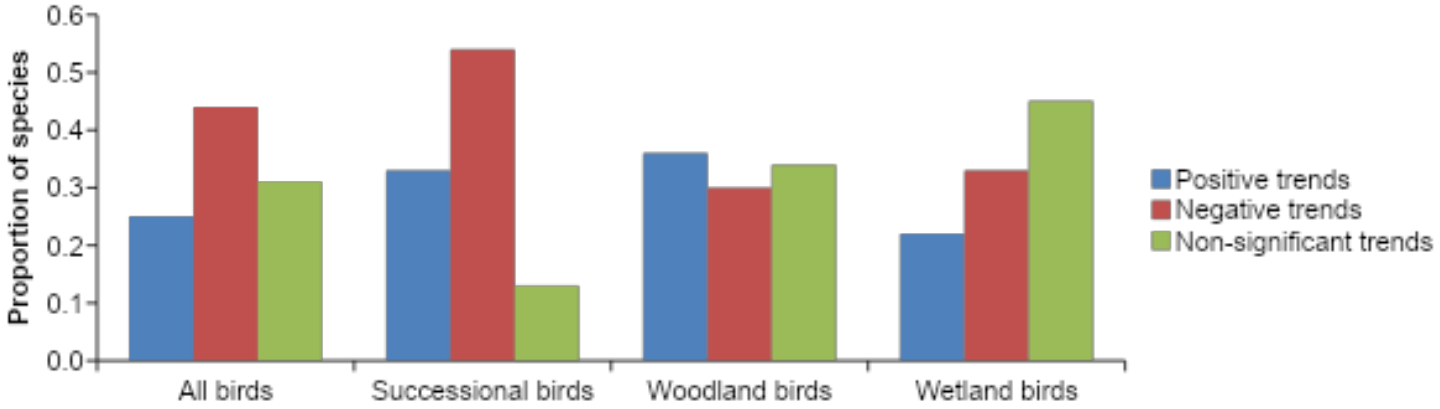




Non-significant Trends



Trends in BCR 12: Boreal Hardwood Transition

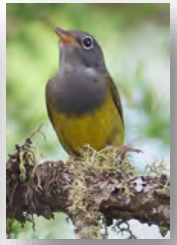


Conservation successes

- ~70% of forest bird species have stable or increasing trends (NFB 2022)

Conservation issues

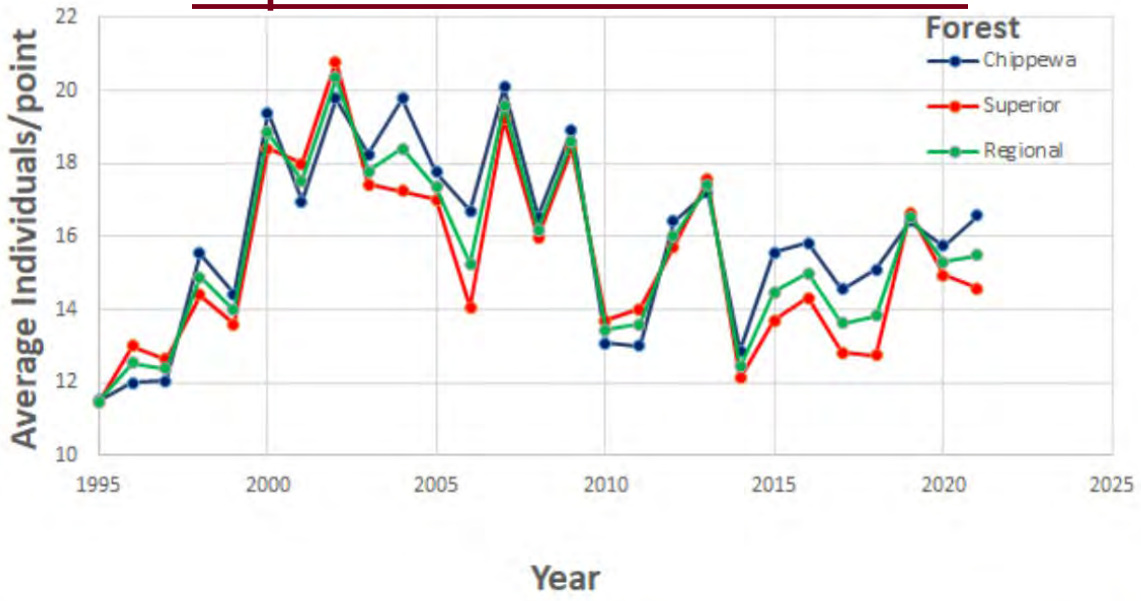
- Climate change
- Habitat loss and fragmentation



Grinde et al. (2022). **“**Minnesota National Forest Breeding Bird Monitoring Program Annual Report 1995–2022”.

Minnesota's Forest Birds

https://z.umn.edu/forestbird



Over 409,000 individual birds of 166 species have been detected in the Chippewa and Superior NFs during the 27 field seasons of the Minnesota National Forest Breeding Bird Monitoring Project.

In Chippewa National Forest:

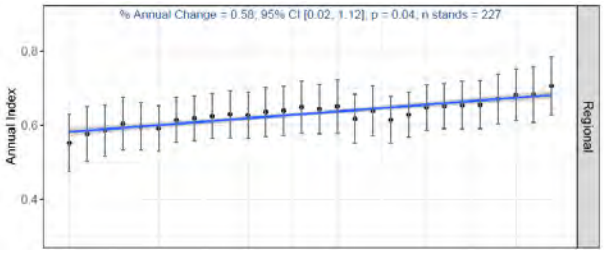
- **52 bird species (75%)** had **stable or increasing trends** over the past 27 years.
- **17 species (25%)** had significantly decreasing trends over the past 27 years.

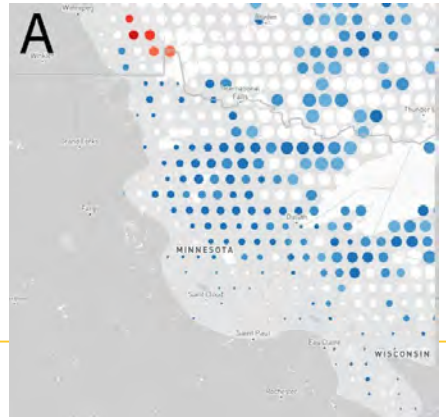
In Superior National Forest:

- **42 bird species (62%)** had **stable or increasing trends** over the past 27 years.
- **25 species (37%)** had significantly decreasing trends over the past 27 years.

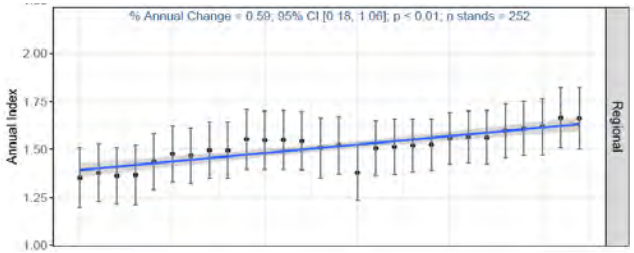
Species that are increasing

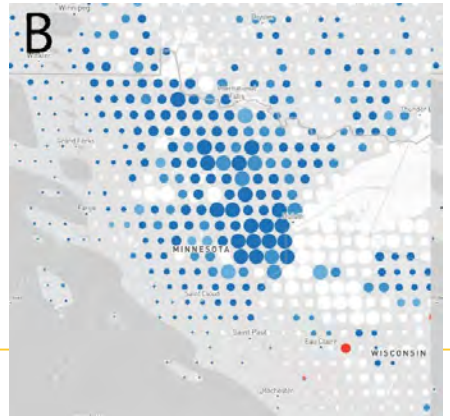
Blackburnian Warbler



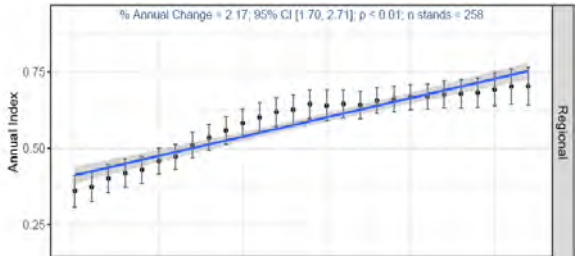


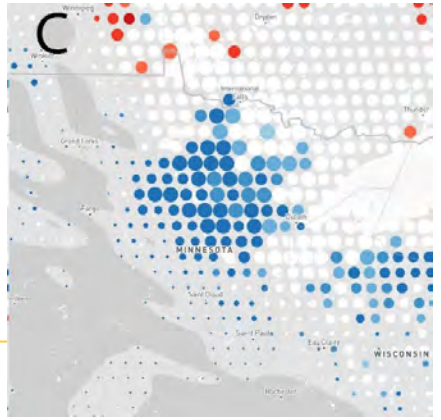
Veery





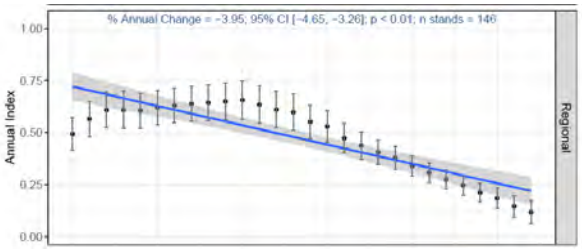
Black-and-white Warbler



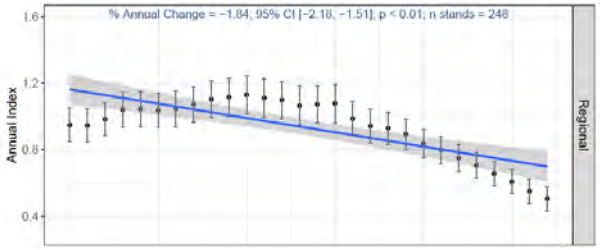


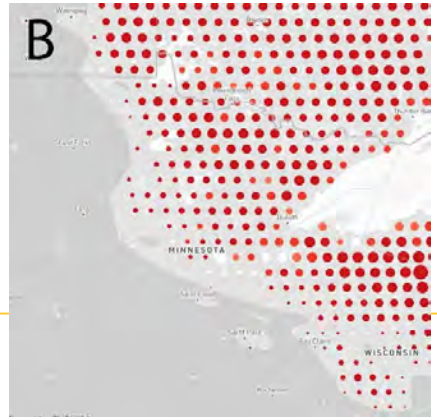
Species that are decreasing

Chipping Sparrow

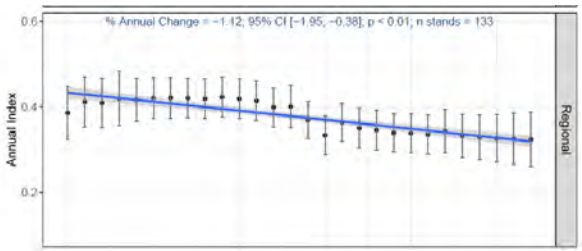


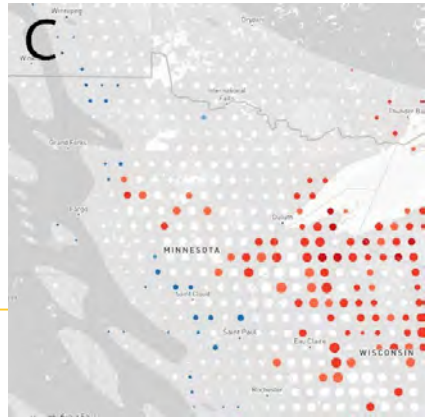
Hermit Thrush





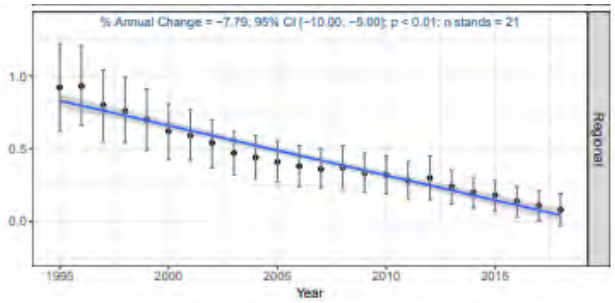
Scarlet Tanager

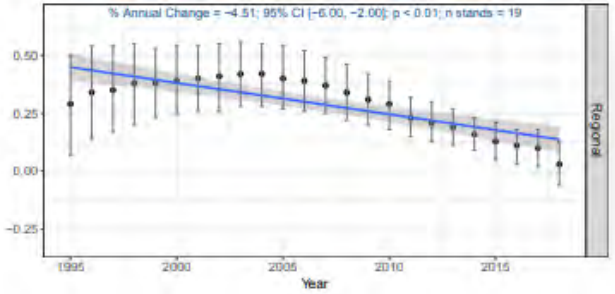


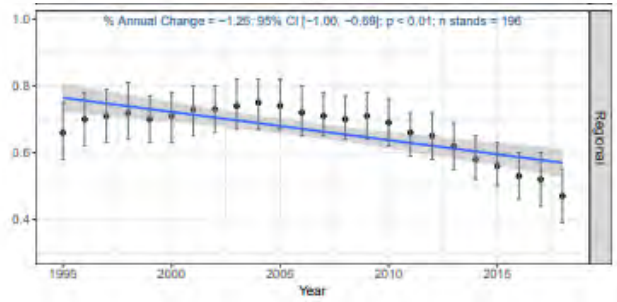


Trends in BCR 12: Boreal Hardwood Transition

Lowland conifer species are declining.



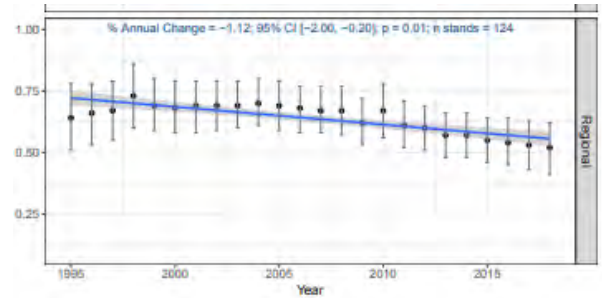


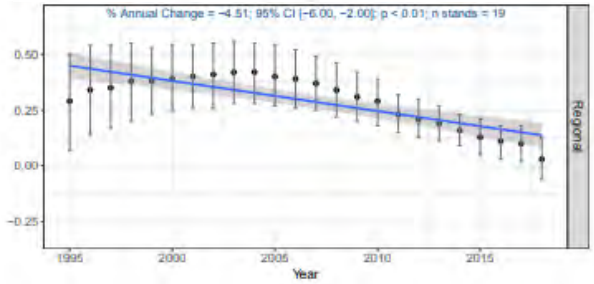


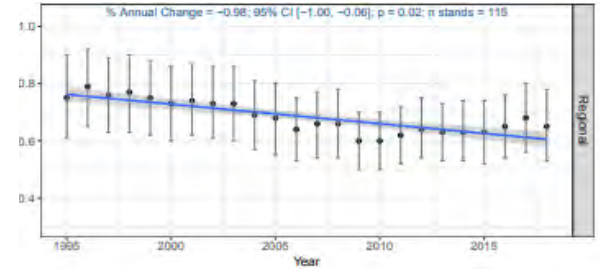
Grinde et al. (2022). **“**Minnesota National Forest Breeding Bird Monitoring Program Annual Report 1995–2022”.

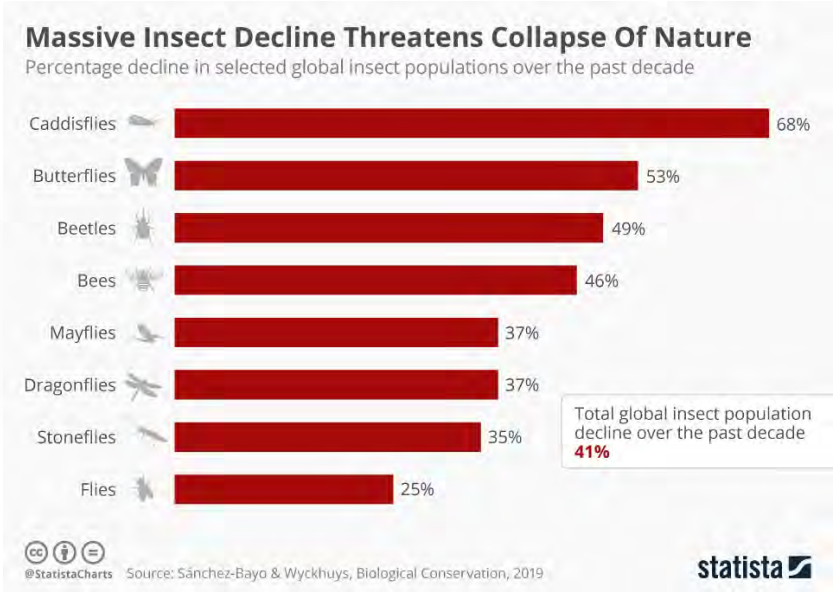
Trends in BCR 12: Boreal Hardwood Transition

Aerial Insectivores are declining.





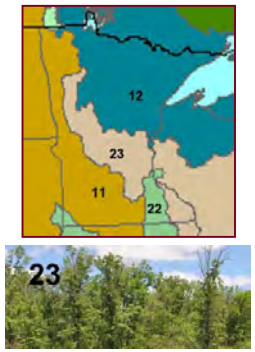


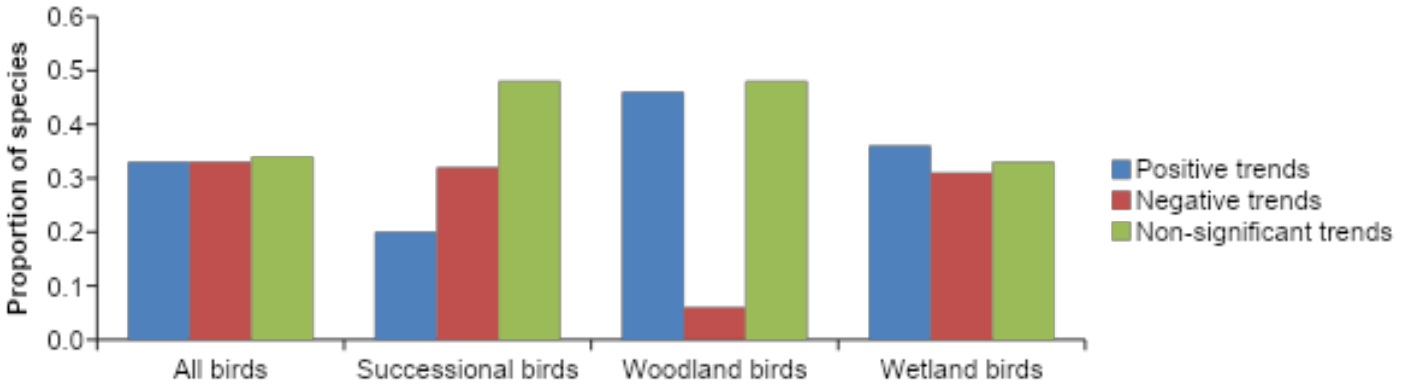


Wagner, David L. (2019). "Insect declines in the Anthropocene." *Annual review of entomology* 65.

Grinde et al. (2022). **"**Minnesota National Forest Breeding Bird Monitoring Program Annual Report 1995–2022".

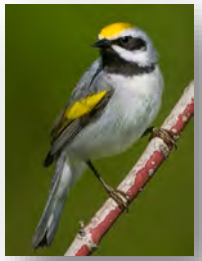
Trends in BCR 23: Prairie Hardwood Transition

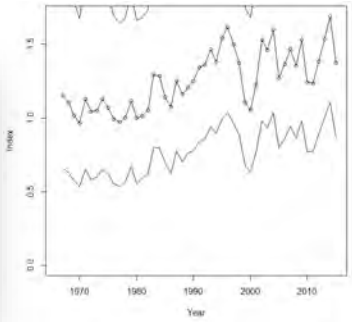




Conservation successes

- Golden-winged Warbler habitat restoration

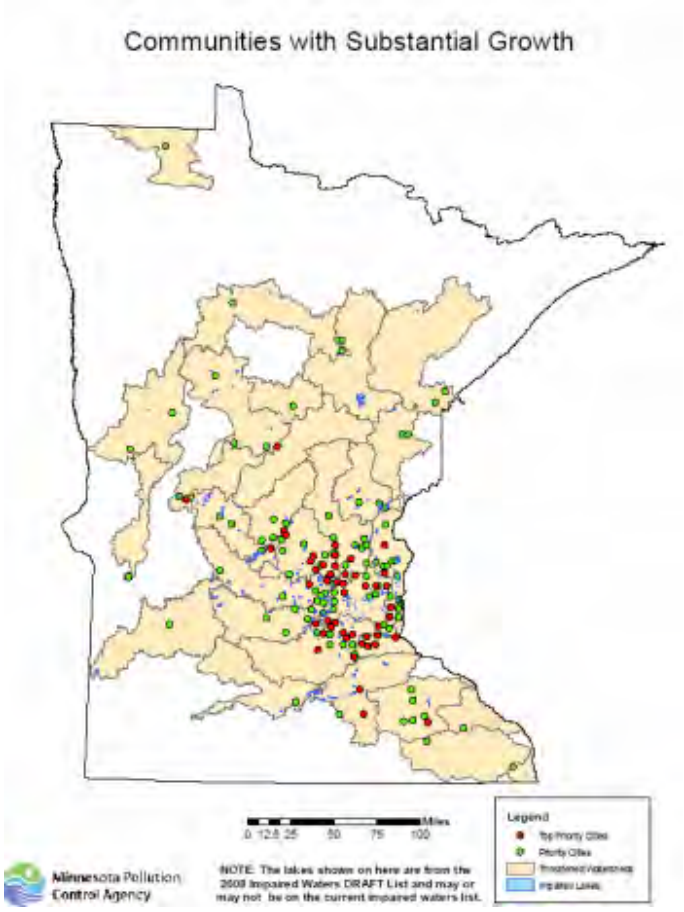


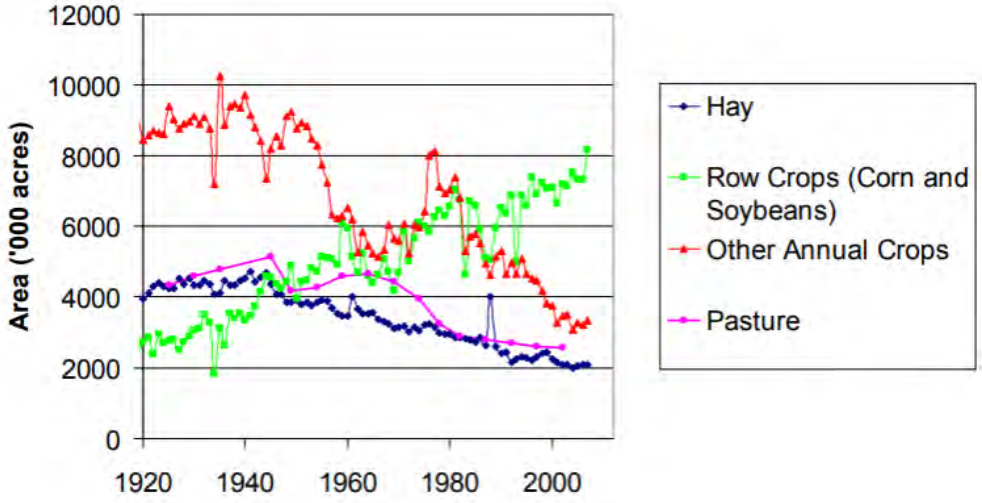


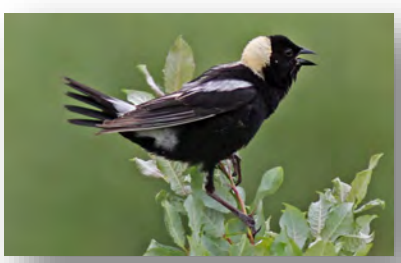
Conservation challenges

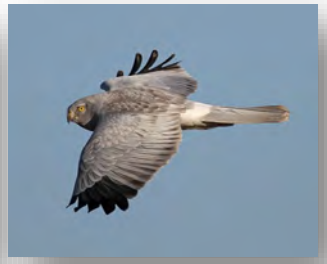
- Land use changes
- Habitat loss
- Water quality

Trends in BCR 23: Prairie Hardwood Transition



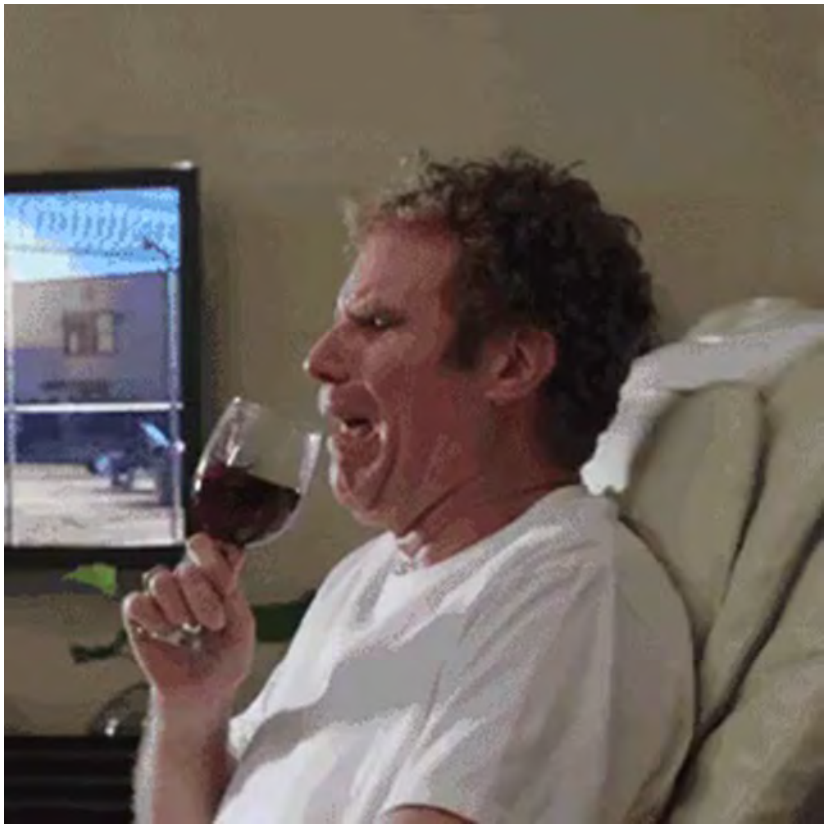




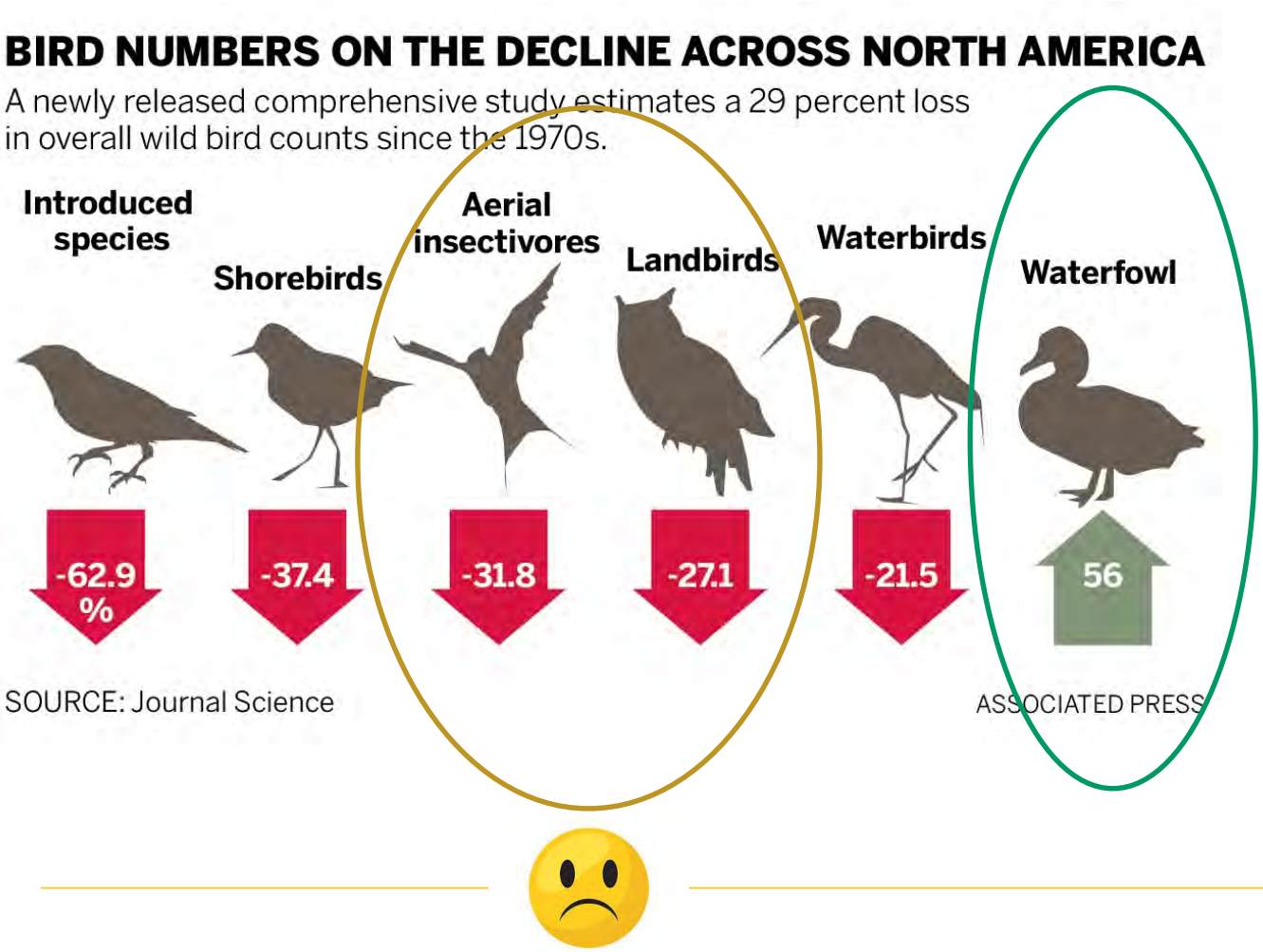


[Minnesota Statewide Conservation and Preservation Plan. https://www.lccmr.leg.mn/documents/scpp/final_plan/habitat_rec.pdf](https://www.lccmr.leg.mn/documents/scpp/final_plan/habitat_rec.pdf)

MMMK, so….
What do we do about it?



Birds are ecosystem indicators



Protecting and restoring habitat is effective to increase bird populations!

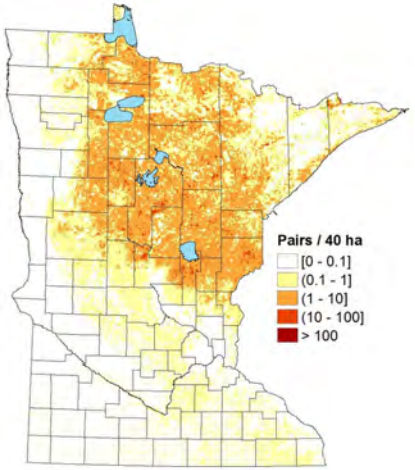
Birds are ecosystem indicators

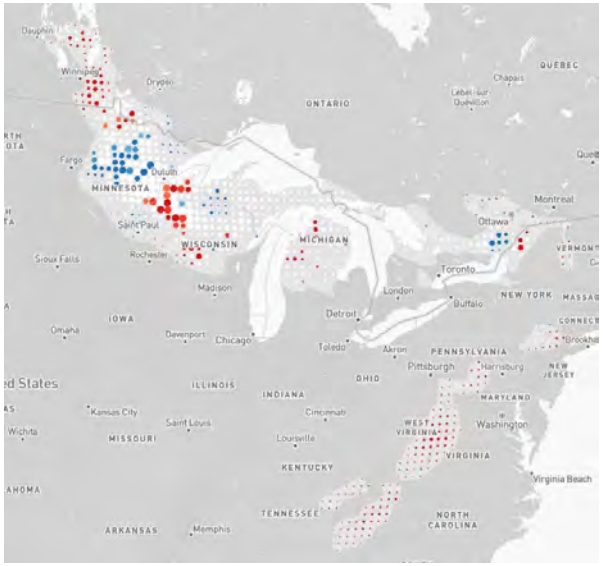
Birds serve as indicators of habitat quality, reflecting the ecosystem's diversity and health.

https://maineaudubon.org/wp-content/uploads/2020/07/FFMB-11x17-Mural.pdf

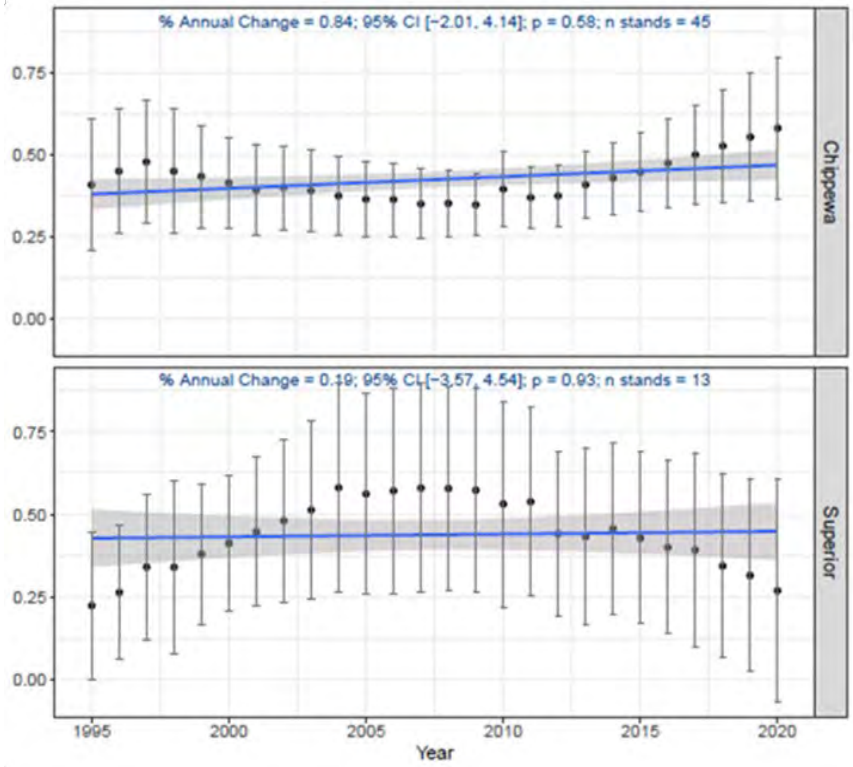
Golden-winged Warbler

Minnesota populations are stable and increasing in some parts of the state!



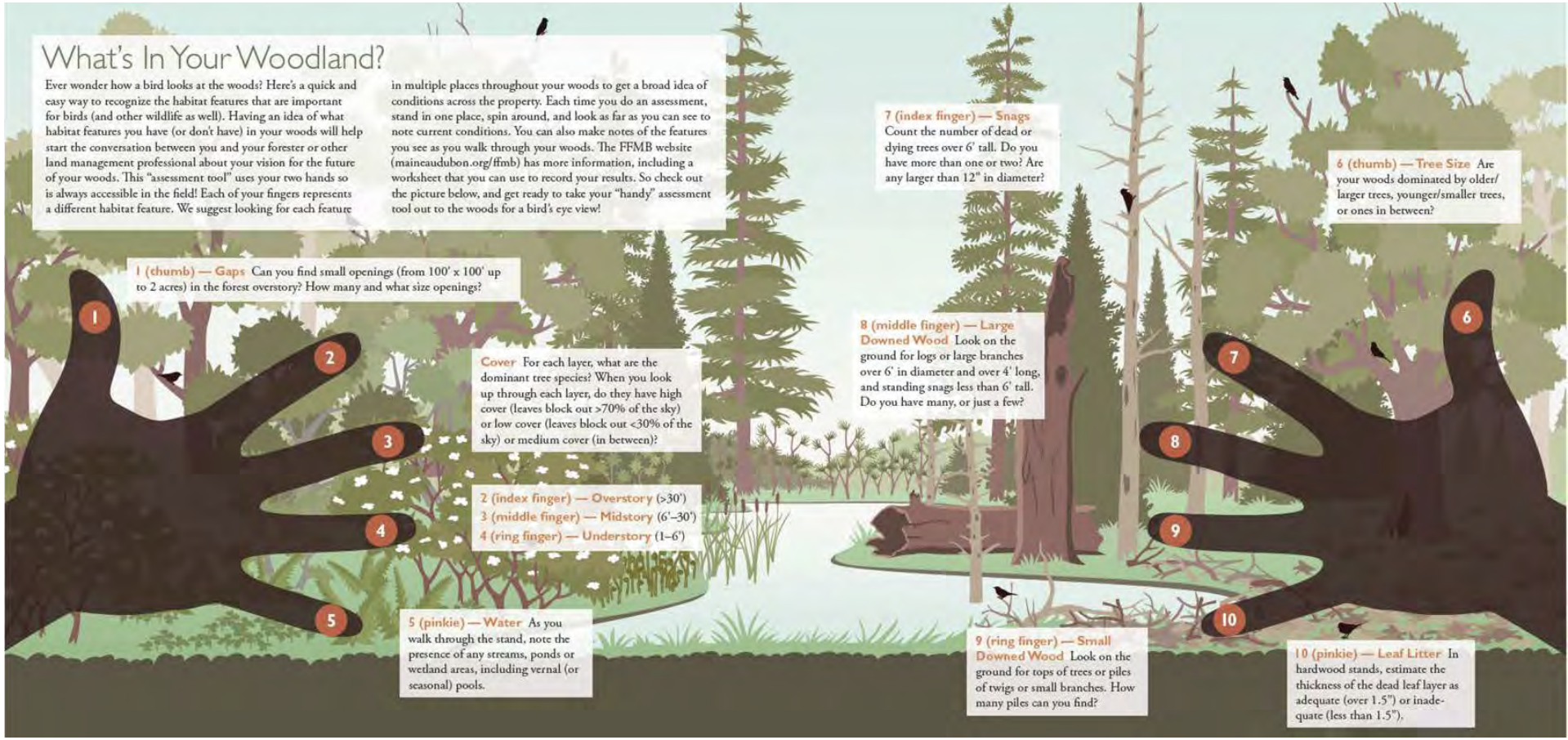


Minnesota National Forest Bird Monitoring (1995–2021)

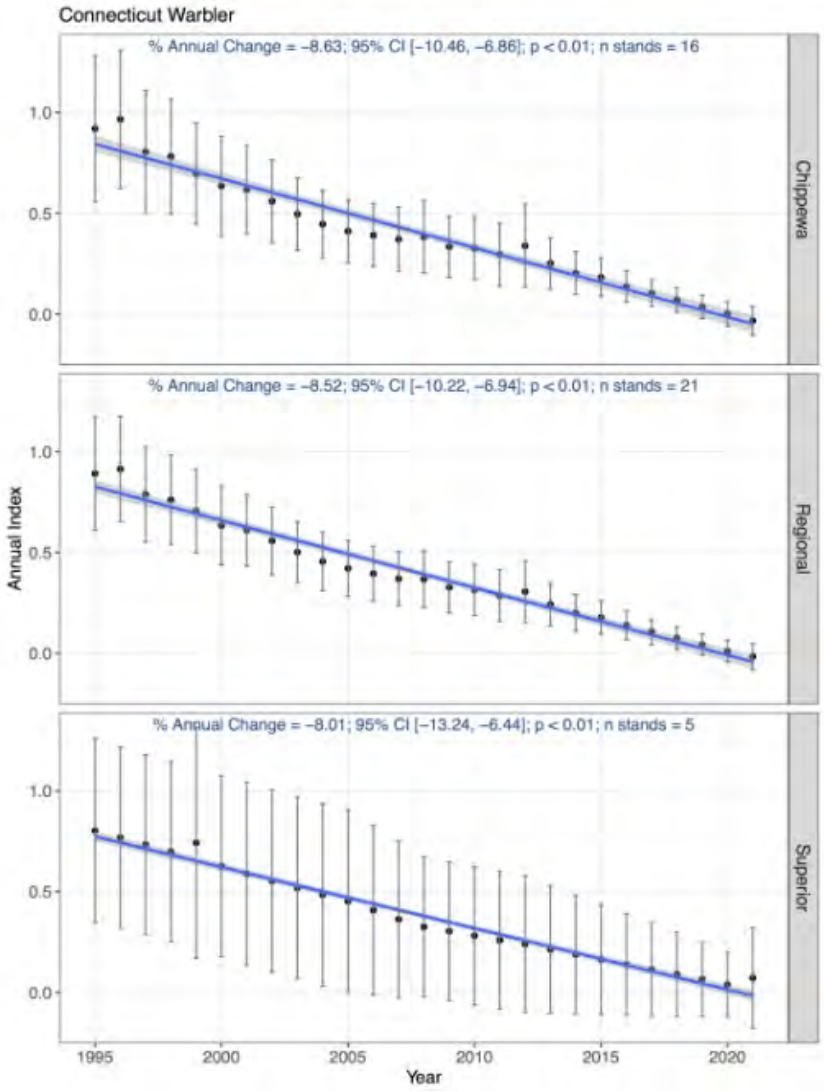


Birds are ecosystem indicators

Managing forests to meet the diverse needs of birds can enhance overall forest ecosystem health.



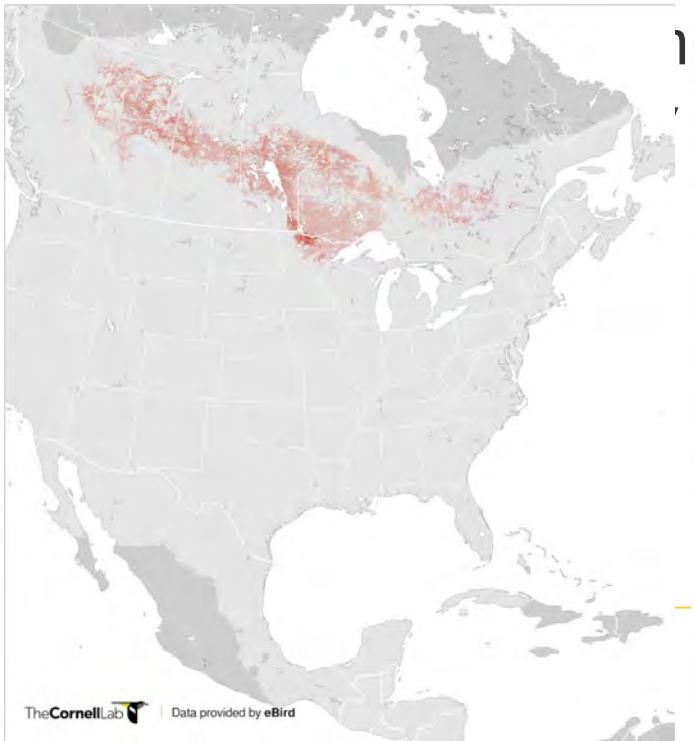
Connecticut Warbler

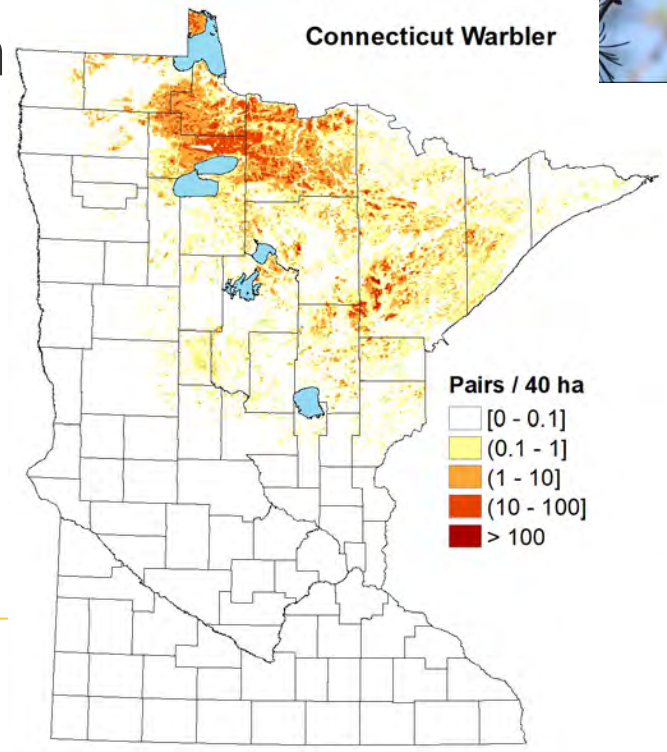


Connecticut Warbler has shown the most consistent decline of any species in the monitoring program.

Connecticut Warbler

- Breeds exclusively in black spruce-tamarack lowlands
- Habitat specialist
- Large blocks of lowland conifer habitat
- Stand structure is key





Birds are ecosystem indicators

Birds provide a compelling incentive for individuals to participate in forest stewardship efforts.

Birds are ecosystem indicators

“How sad to think that nature speaks and mankind doesn’t listen.” — Victor Hugo

Photo: Steve Kolbe

Alexis Grinde, PhD

Avian Ecologist
Program Manager, Avian Ecology Lab
Natural Resources Research Institute
University of Minnesota Duluth
agrinde@d.umn.edu
z.umn.edu/nrribirdlab

Wherever there are birds, there is hope

- Mehmet Murat ildan

Impacts of Climate Change on Forest Birds

Alexis Grinde
Avian Ecologist, Avian Ecology Lab
University of Minnesota Duluth
agrinde@d.umn.edu

Natural Resources Research Institute
University of Minnesota Duluth
Driven to Discover℠

Date: 10-18-23
Presented to: Forestry for Birds in a Changing Climate, NFBN

There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know.

Donald Rumsfeld

WHAT I KNOW

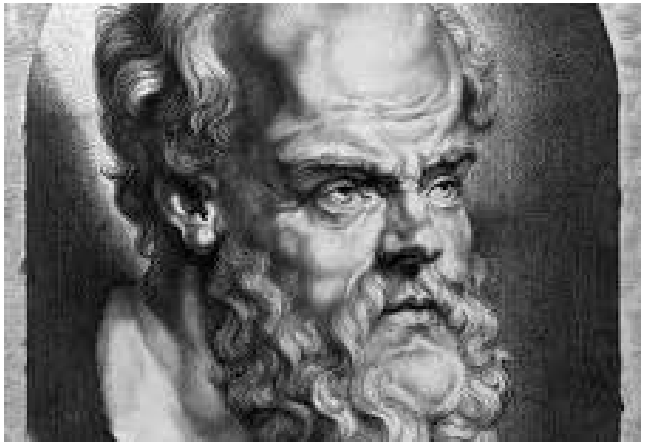
Things I know I know

Things I know

Things I think I know

Things I don't know

"True knowledge exists in knowing that you know nothing."



Socrates

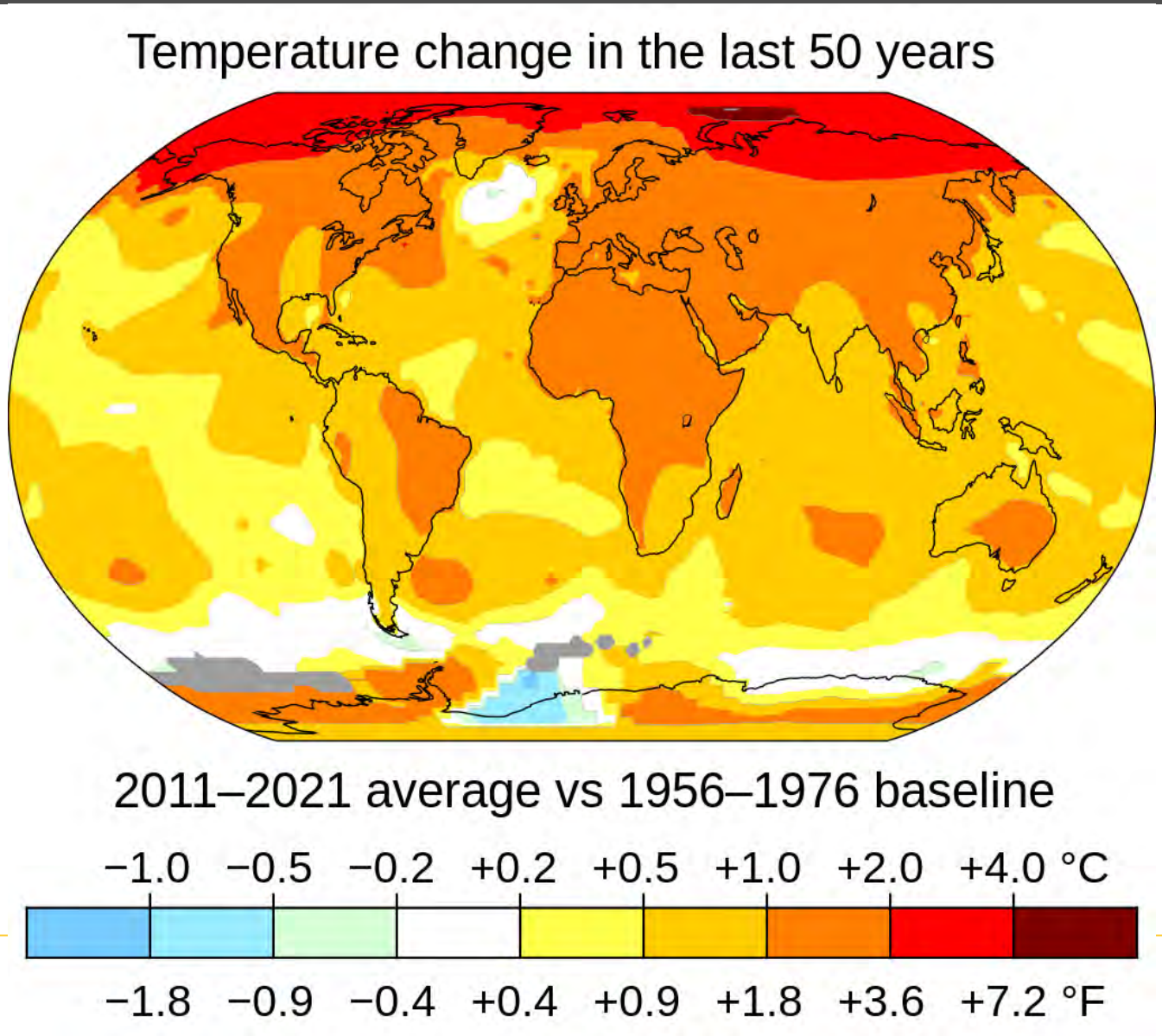
Share your knowledge

- What are you / your organization currently doing to address climate change?
- What information / tools do you need to address climate change?
- What do we know, we don't know, we know, we don't know? ☺

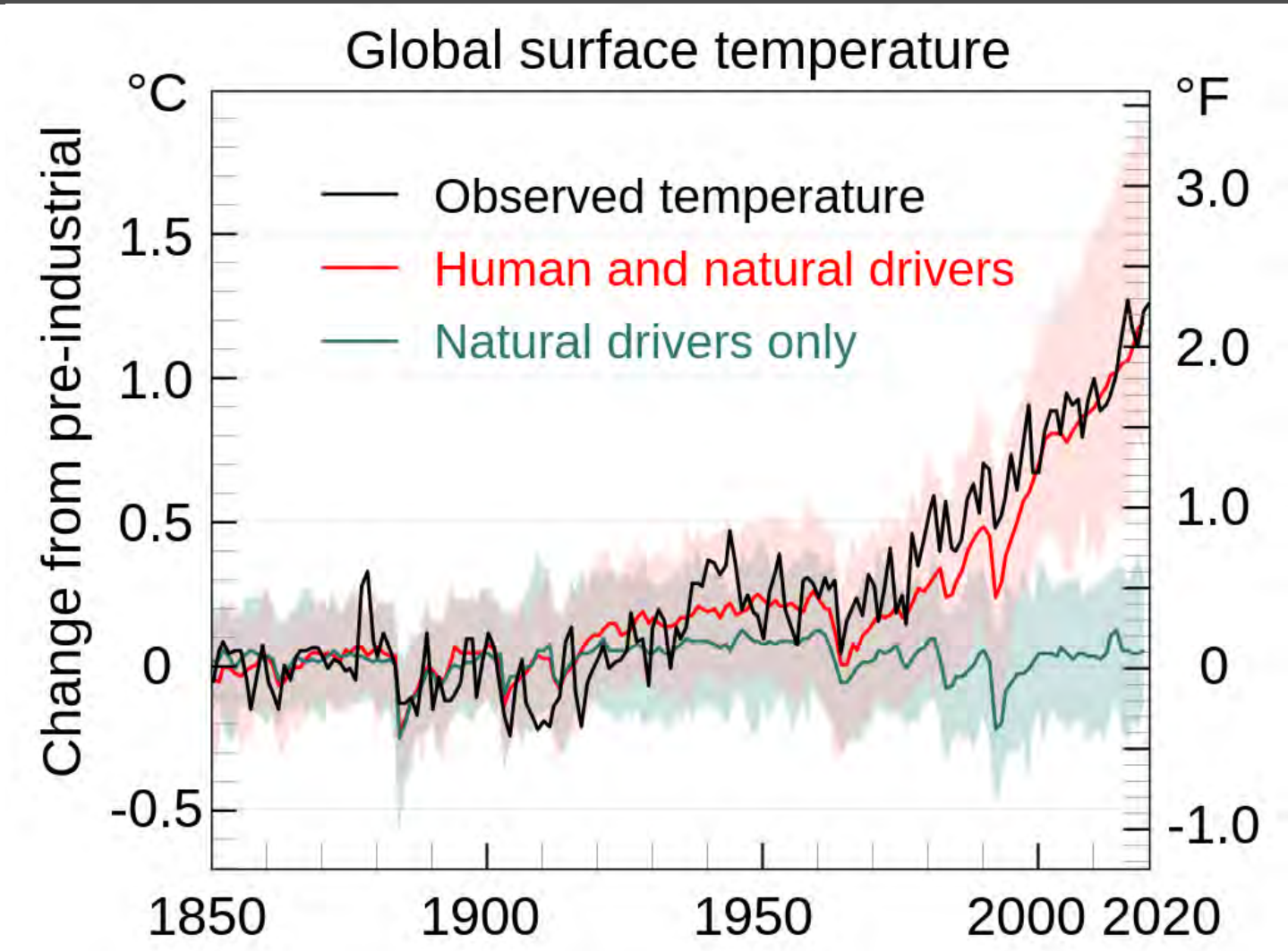
Here is what “we” know

The climate is changing…

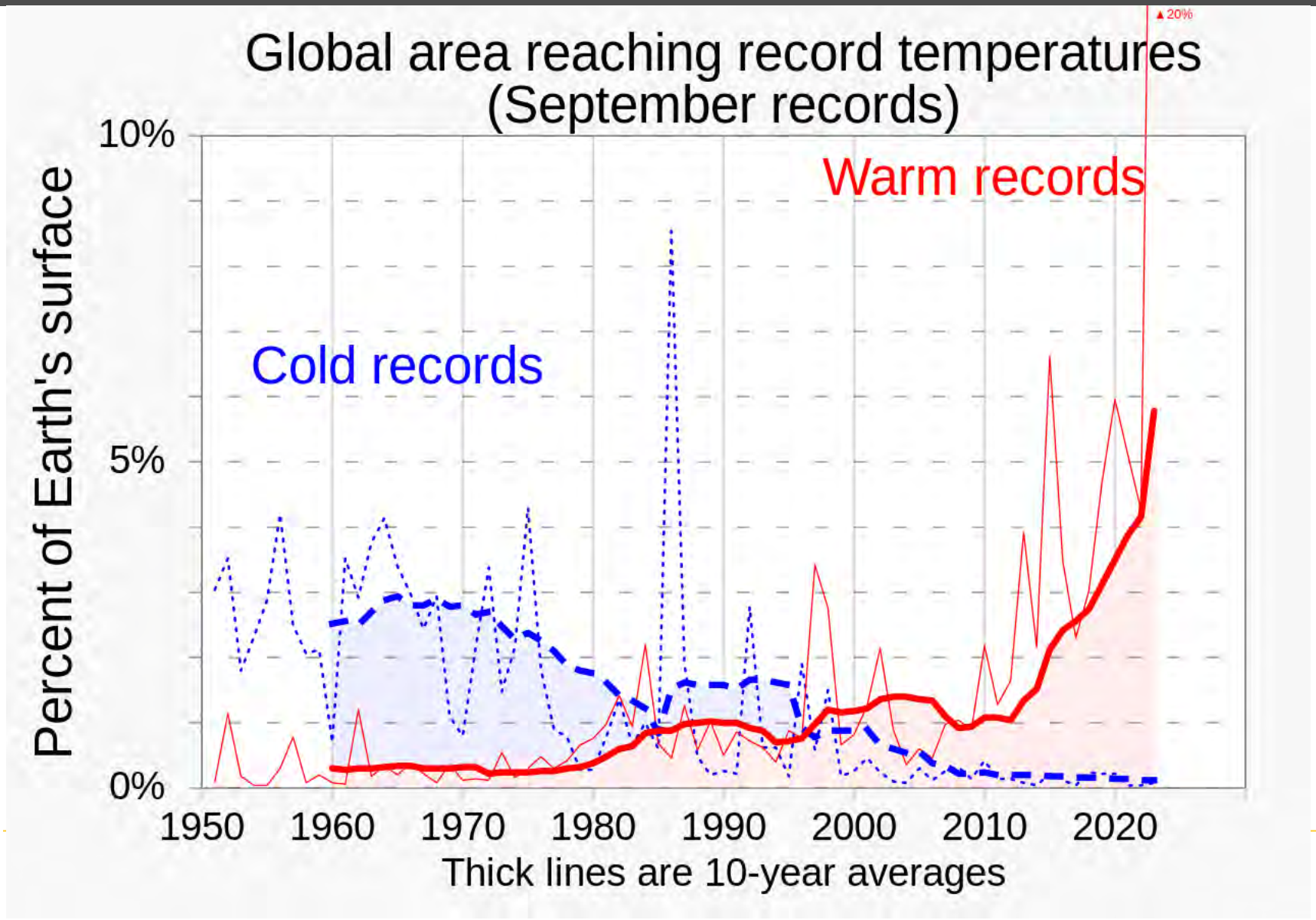
The climate is changing…



The climate is changing…



The climate is changing…



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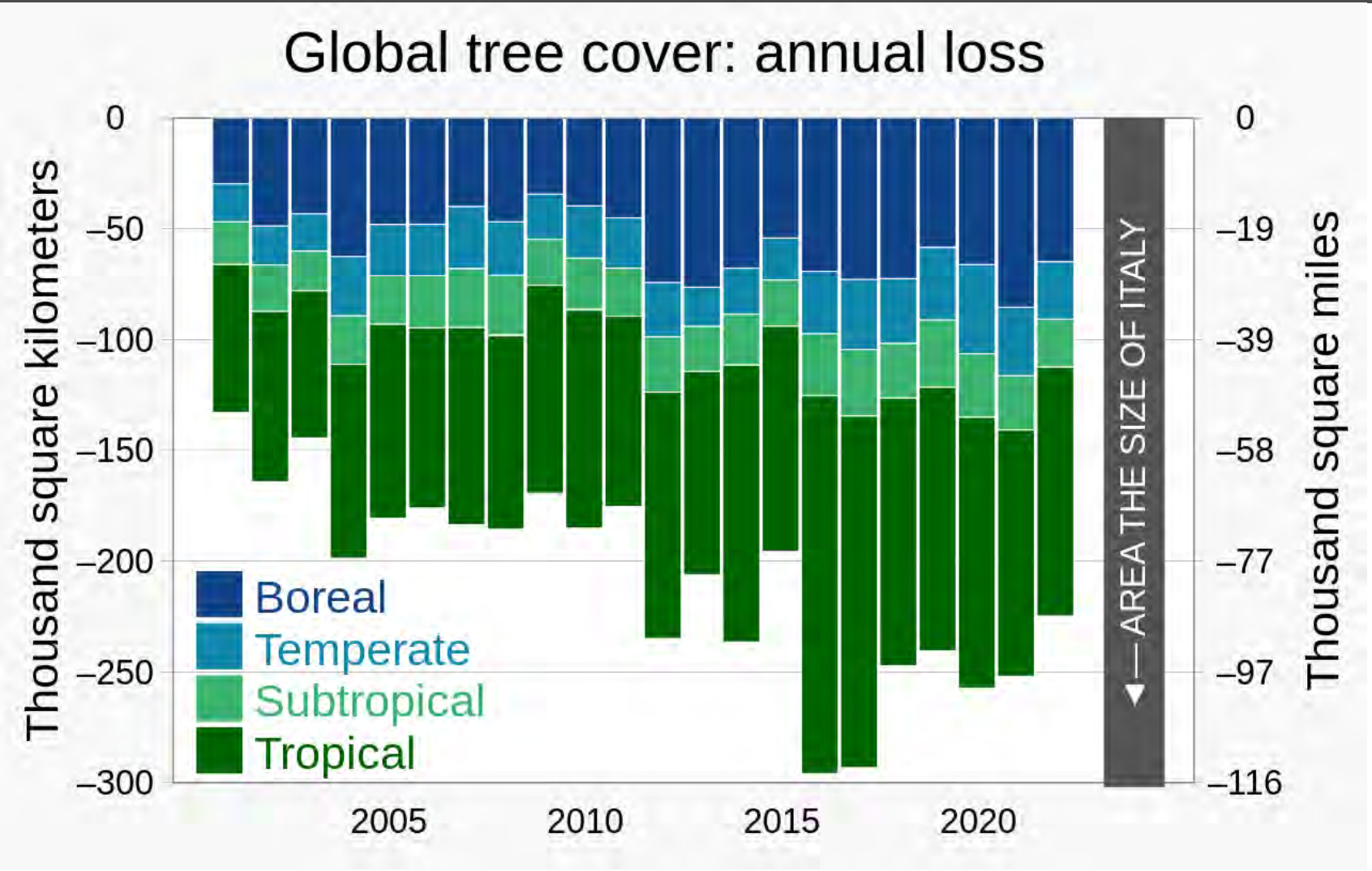
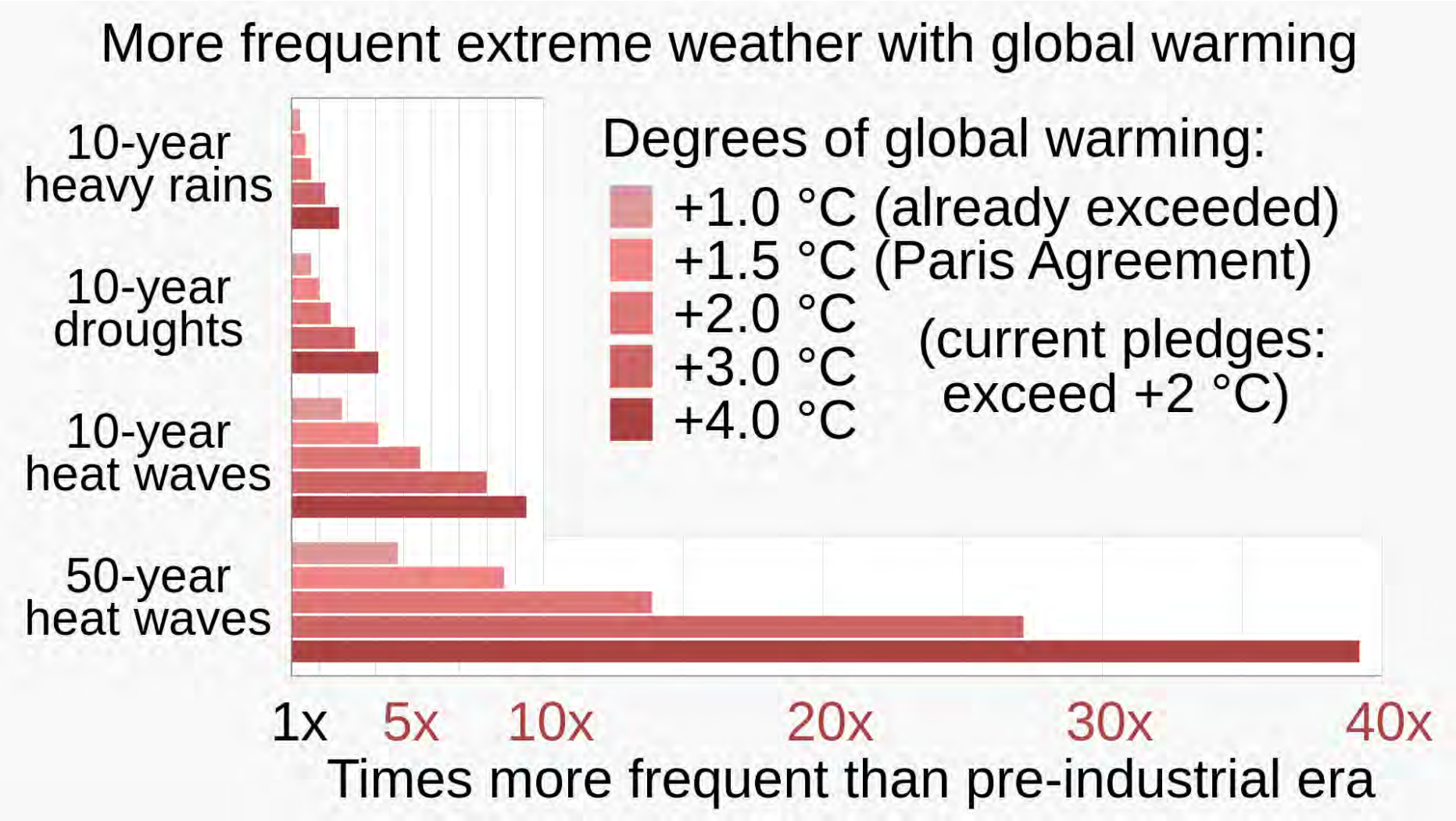
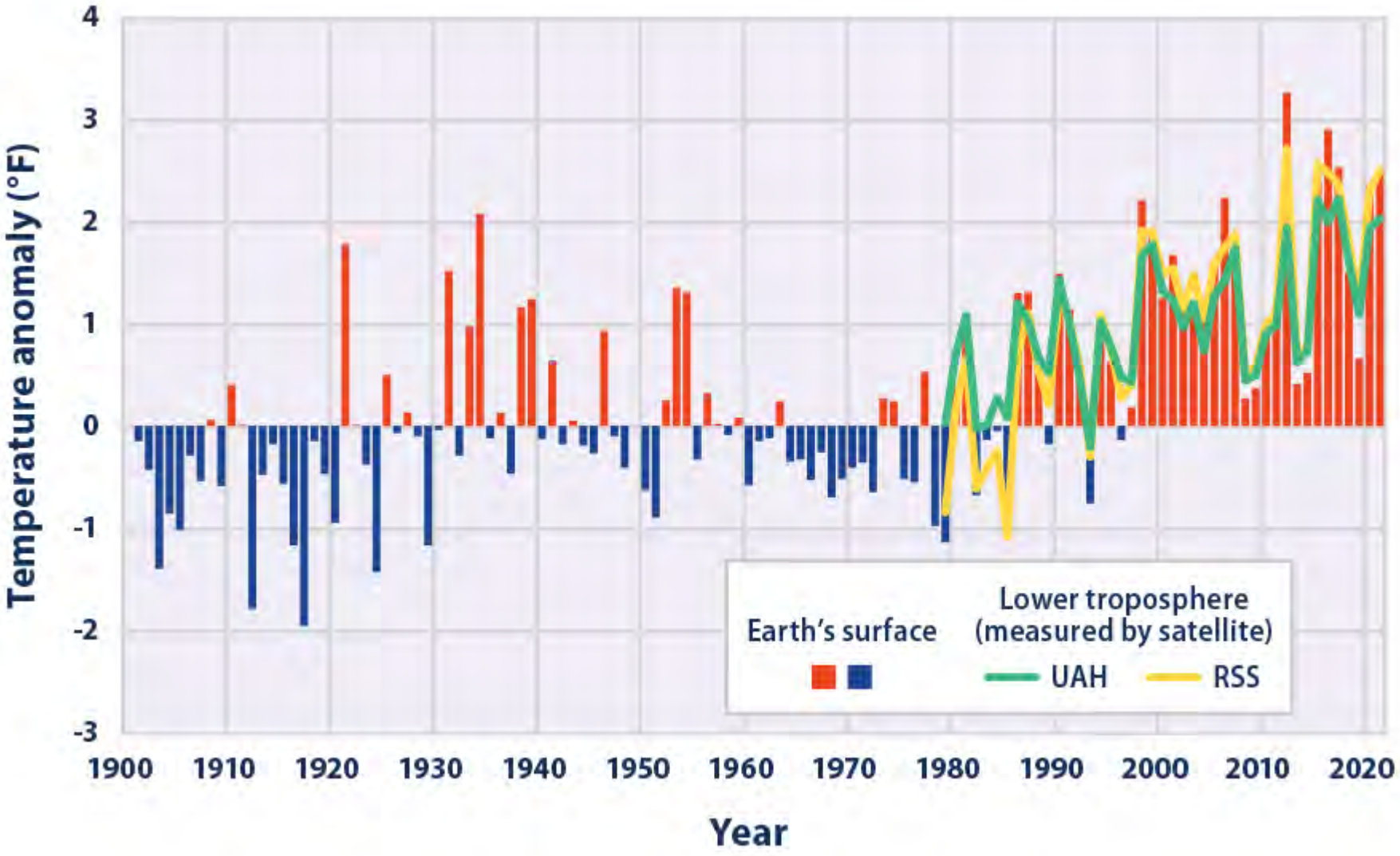


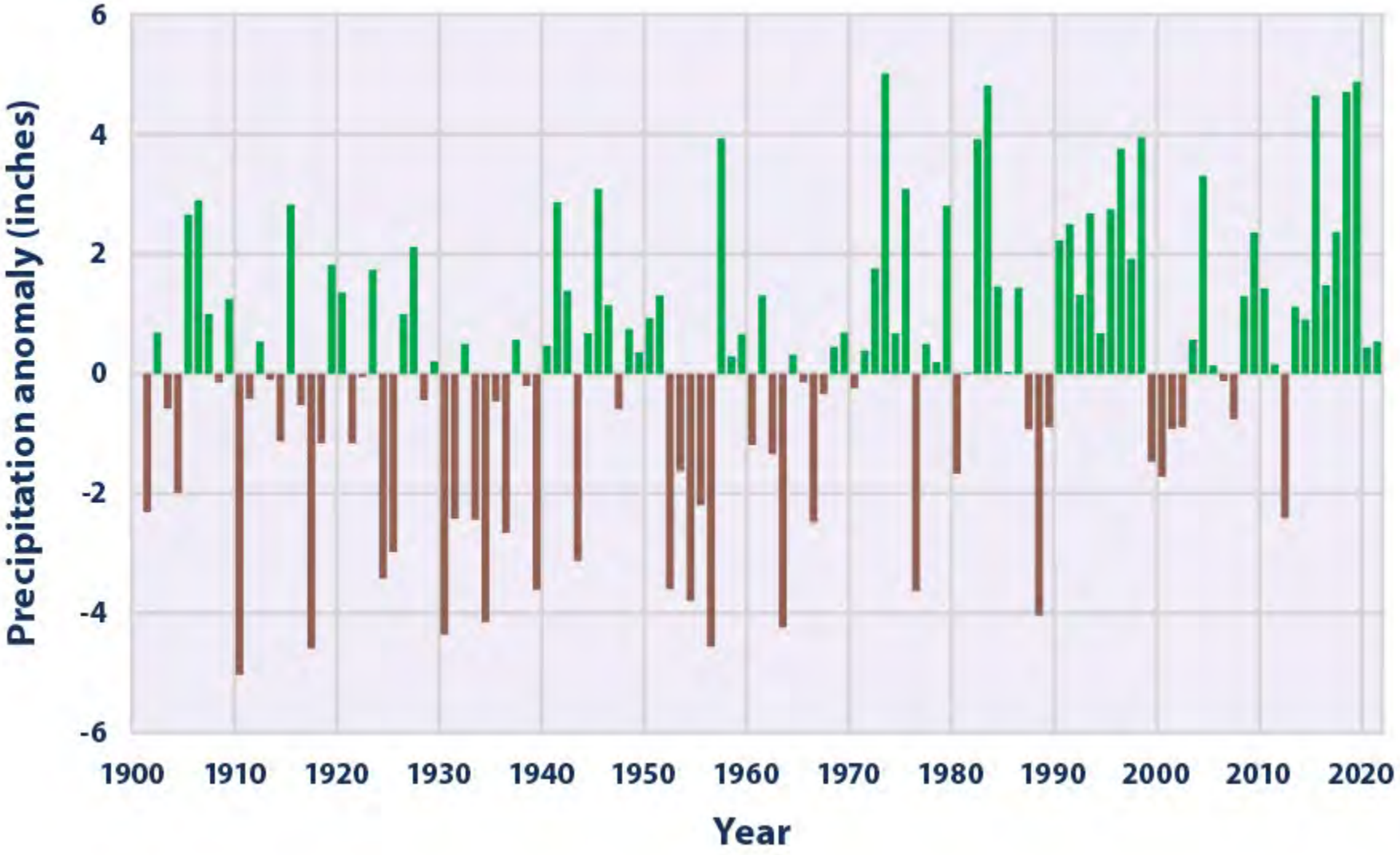
The climate is changing…



The climate is changing…

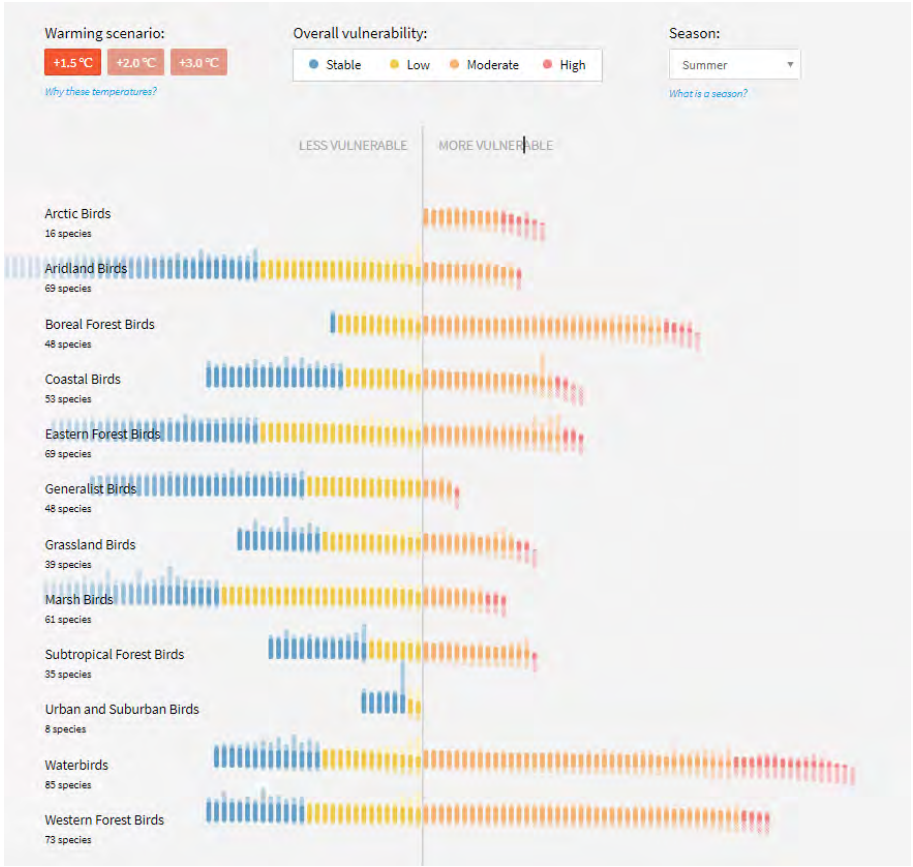


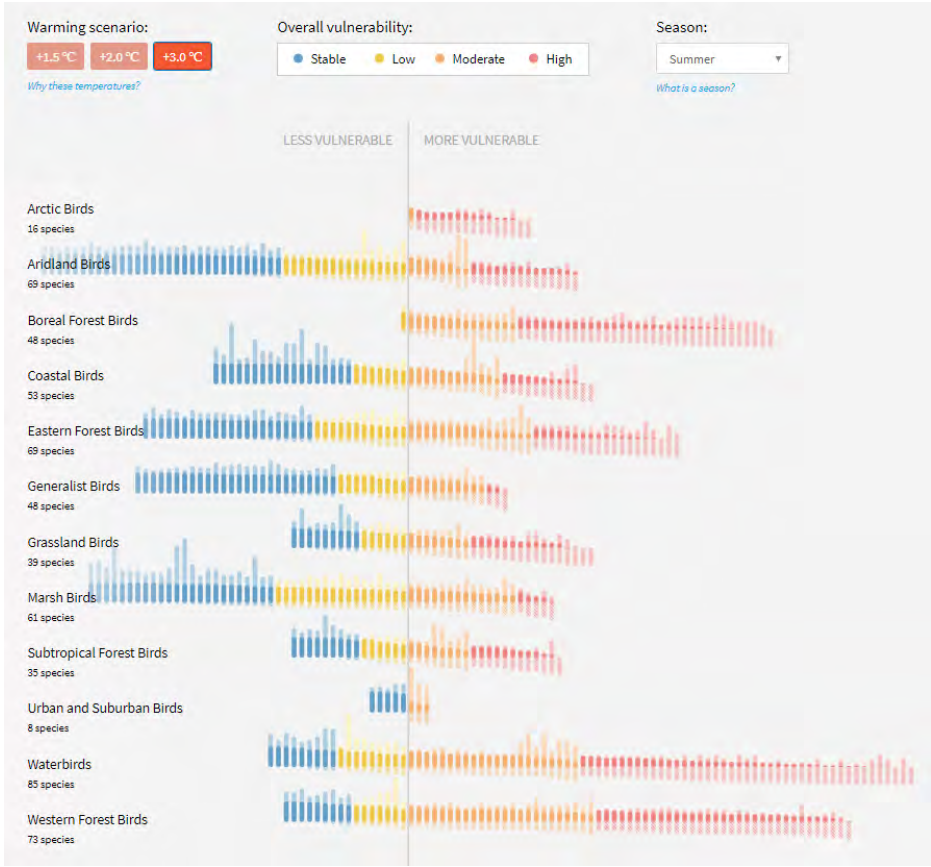
The climate is changing…



The climate is changing…

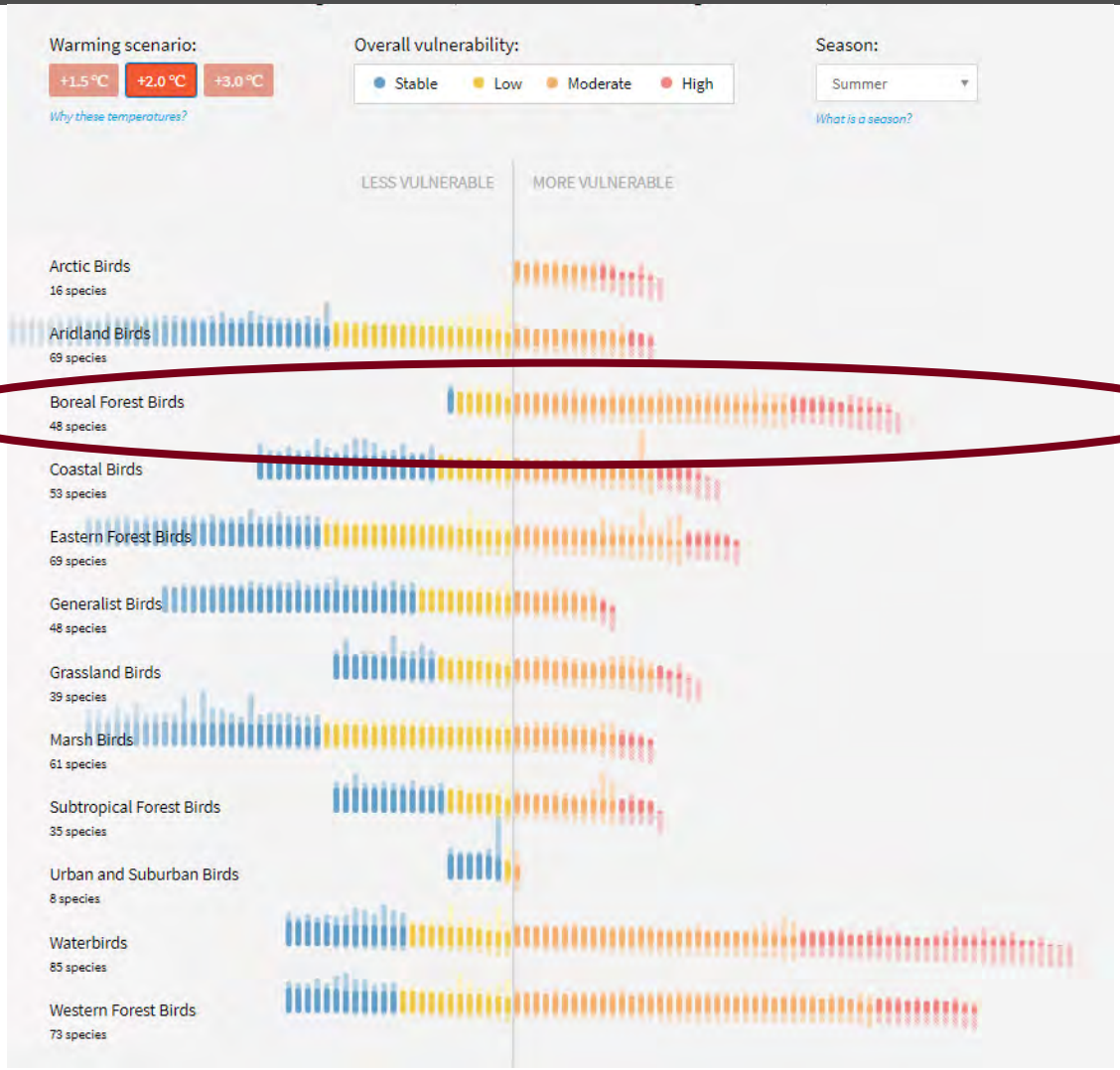
"The results are clear: Birds will be forced to relocate to find favorable homes. **And they may not survive."**





https://www.audubon.org/climate/survivalbydegrees

The climate is changing…



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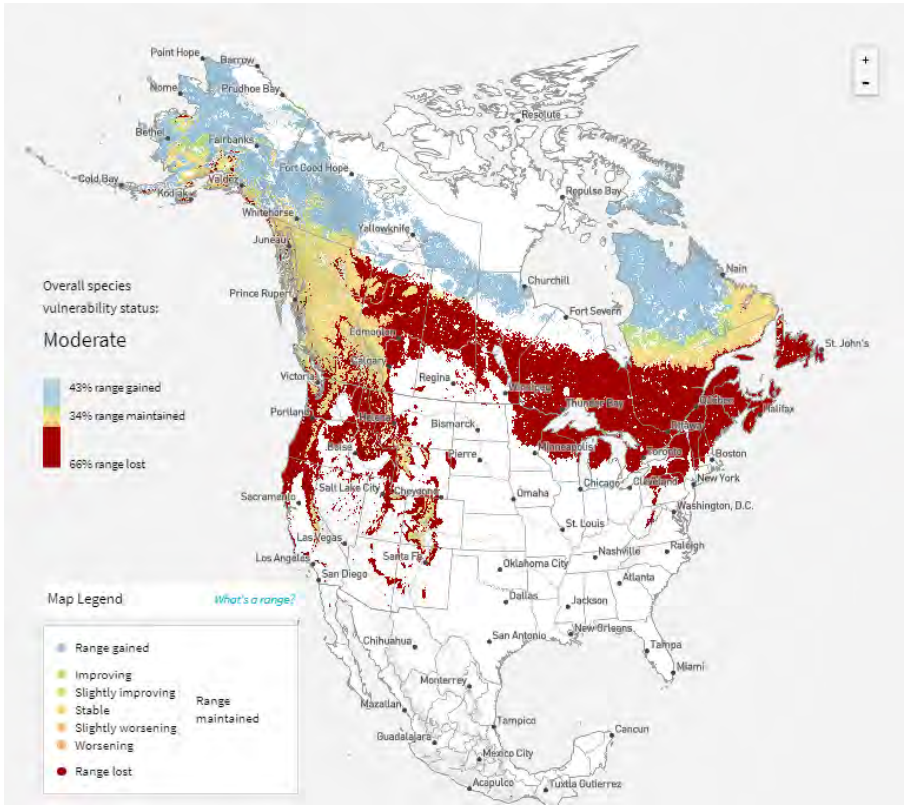
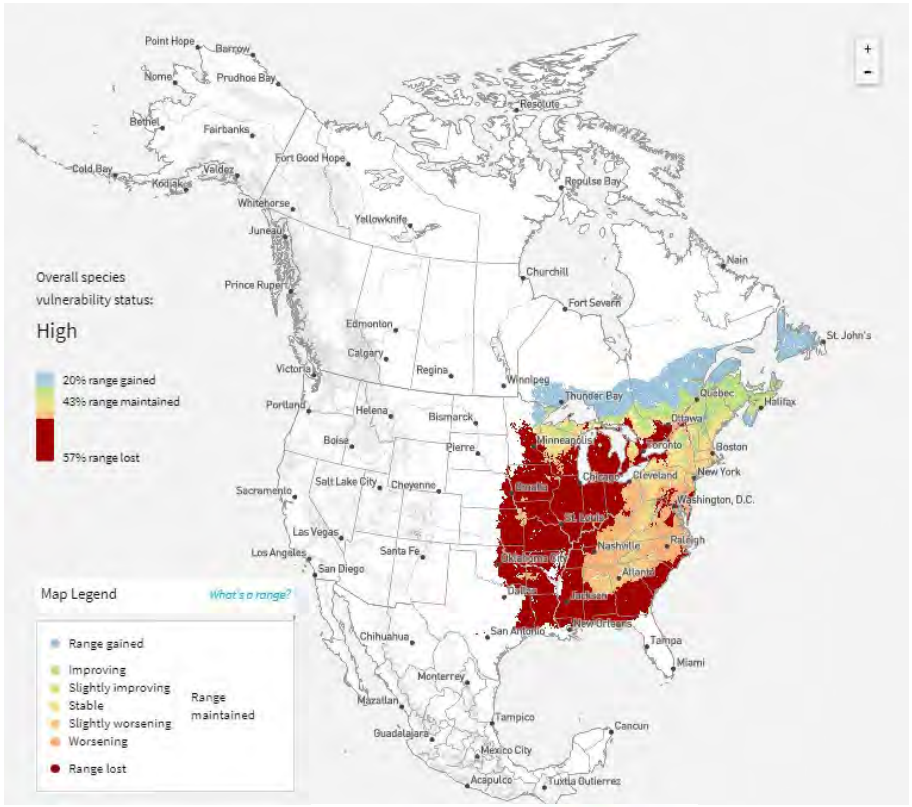
The climate is changing…





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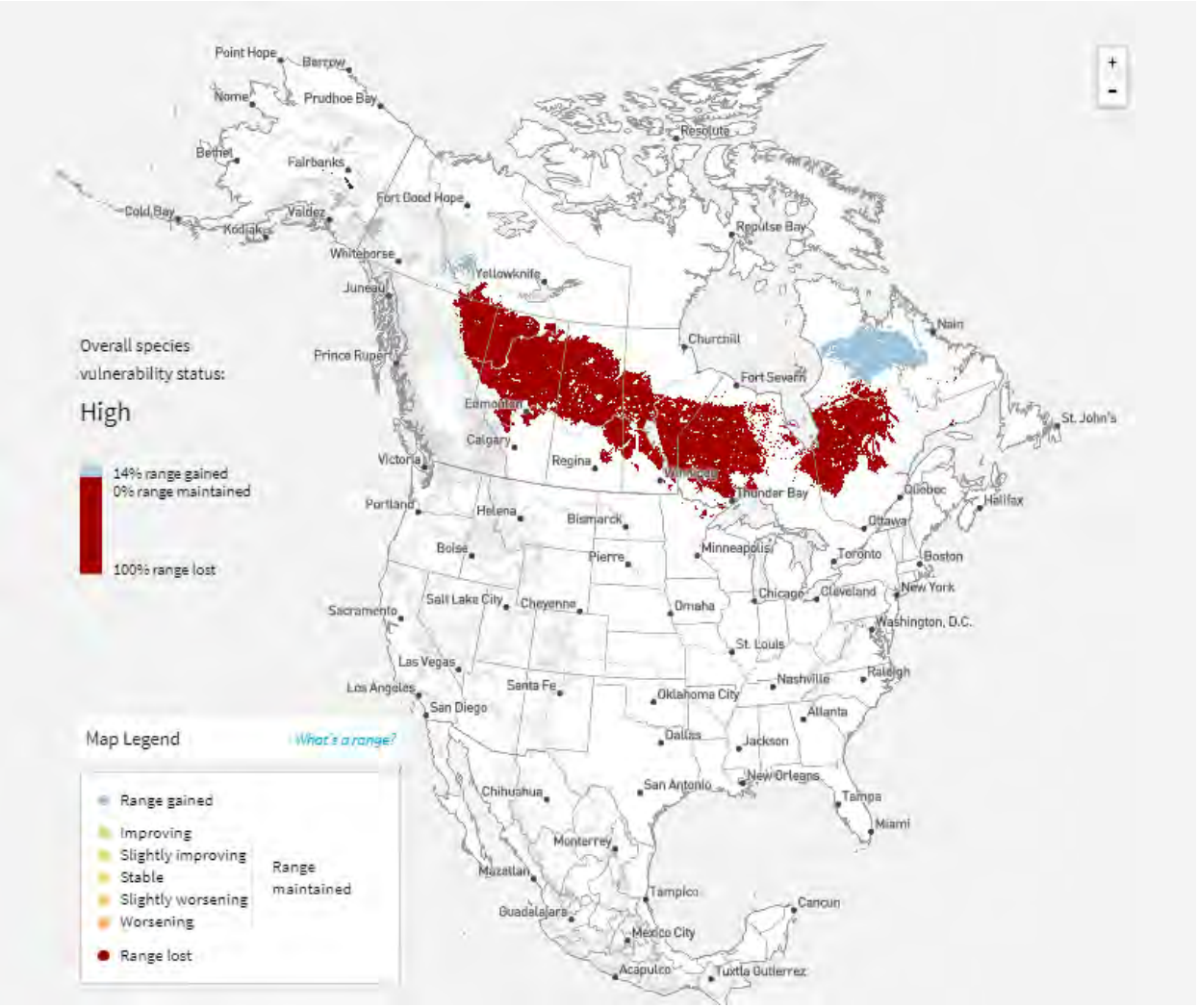

The climate is changing…

Will there be habitat?

The climate is changing…

Novel

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species interactions.

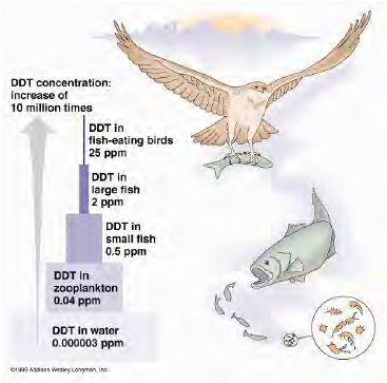
Fontúrbel, Francisco E., et al. "Climate change can disrupt ecological interactions in mysterious ways: Using ecological generalists to forecast community-wide effects." Climate Change Ecology 2 (2021): 100044.

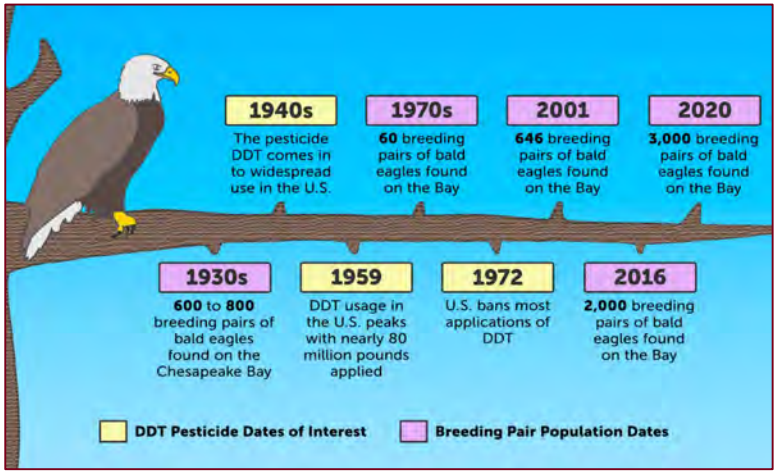
The climate is changing…

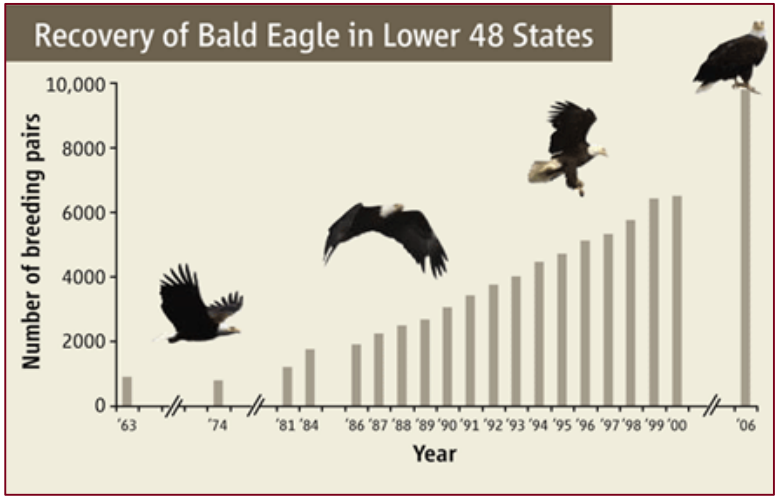
Birds are ecosystem indicators

What is an ecosystem indicator?

A species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem.







Stokstad, E., 2007. Can the bald eagle still soar after it is delisted?. Science, 316(5832), pp.1689-1690.

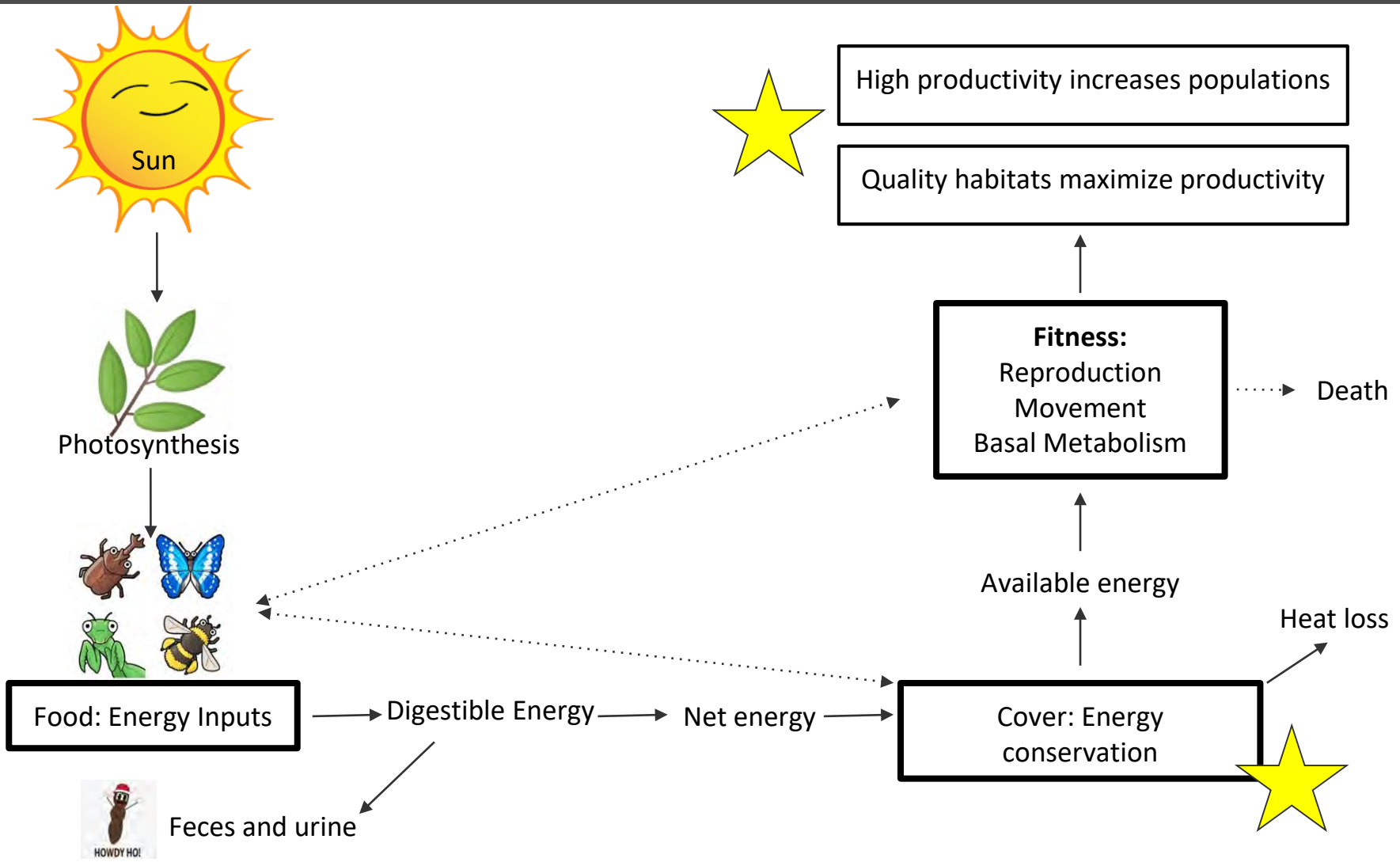
Birds are ecosystem indicators

Good indicator species need to meet a few criteria:

- Sensitive to changes in the environment, serve as an early warning
- Responds to changes in a predictable manner
- Easy to compile and interpret data on the species to inform policy decisions

- Bird communities are diverse, have high energy demands, high position on food chain, thus can be sensitive to minor habitat changes
- Birds are relatively *easy* to survey and abundant
- Provide a variety of metrics across multiple scales of interest: abundance (populations), species diversity and richness

Energy flow and productivity



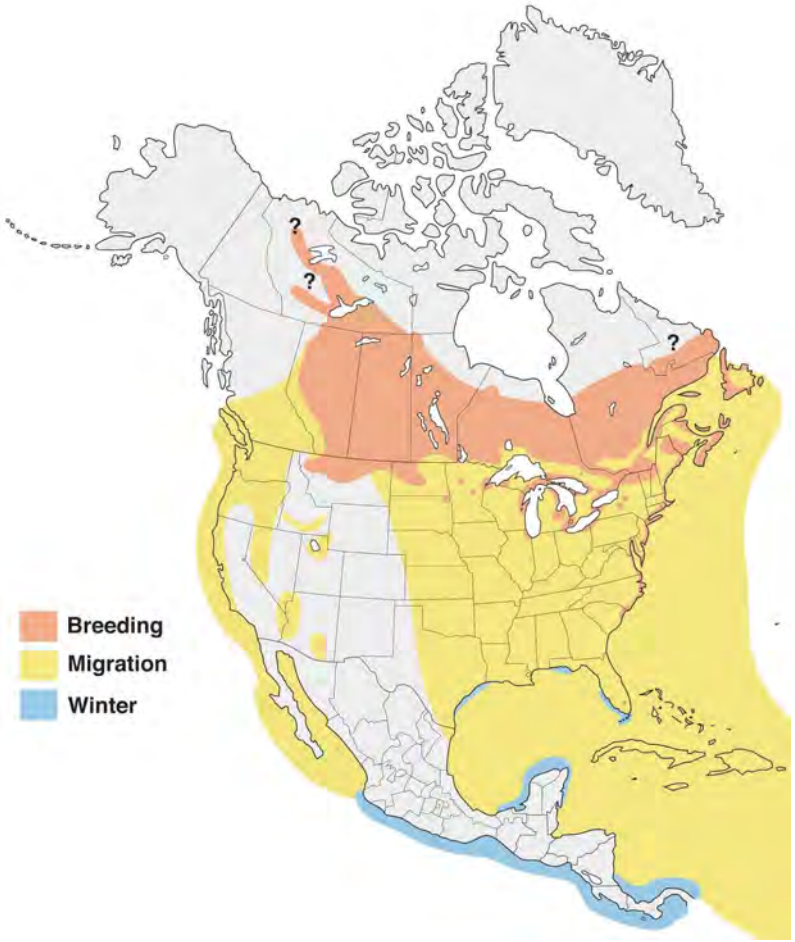
Modified from Wildlife Habitat Management: Concepts and Applications in Forestry. McComb, B. 2016.

Impacts of Climate Change on Birds

Climate change affects birds both directly and indirectly

- Increased temperatures and weather events can disrupt migration and reproduction
- Uncoupling of phenology (e.g., timing of insect hatch) can reduce food availability
- Birds may shift their ranges to areas with suitable thermal conditions
- Habitat and resource availability may limit adaptive responses

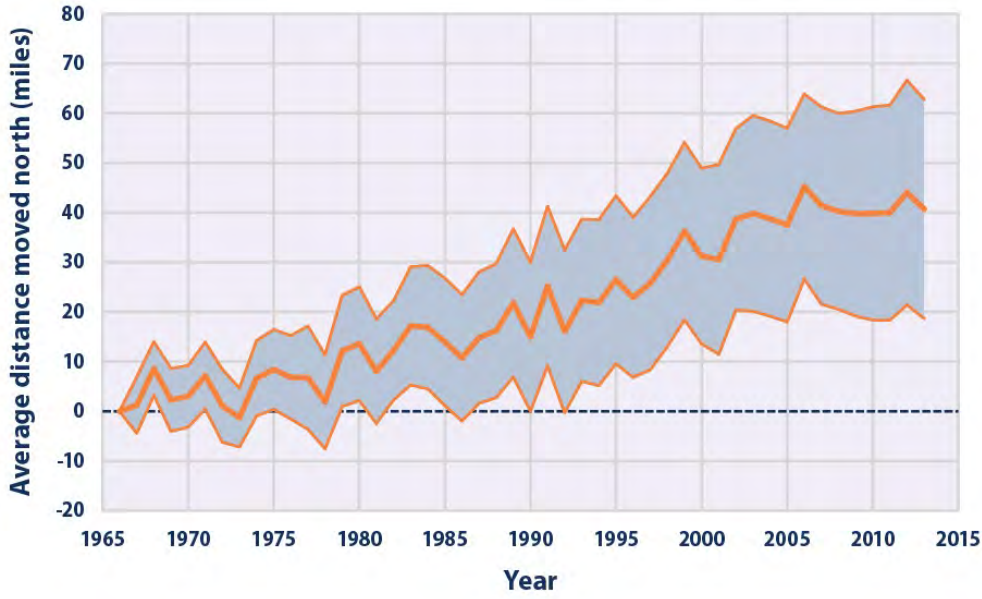
Are “we” seeing climate impacts on birds?



Are “we” seeing climate impacts on birds?

Are winter ranges of North American birds shifting?

- Data collected from the National Audubon Society’s Christmas Bird Count (citizen science)
- The average mid-December to early January center of abundance moved northward 40 miles shift (305 species)
- Some species have moved farther than others, 48 species shifted northward by more than 200 miles



Are “we” seeing climate impacts on birds?

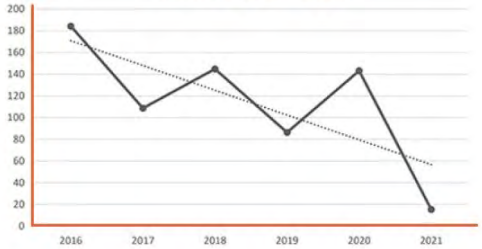
Does extreme winter weather in the US impact overwinter survival of short-distance migrants?

EASTERN BLUEBIRD

STATEWIDE TREND FROM 1970-2019

Meehan, T.D., LeBaron, G.S., Dale, K., Krump, A., Michel, N.L., Wilsey, C.B. 2020. Abundance trends of birds wintering in the USA and Canada, from Audubon Christmas Bird Counts, 1966-2019, version 3.0 National Audubon Society, New York, New York, USA.

AVERAGE OF 8 REPORTING COUNTS FROM 2016 - 2021



Counts reported as of Feb. 10, 2022: Sooner Lake, Stillwater, Fort Gibson Reservoir, Salt Plains National Wildlife Refuge, Tulsa, Tishomingo National Wildlife Refuge, Kenton (Black Mesa), and Norman.

Are “we” seeing climate impacts on birds?

Is climate change impacting spring migration?

- Data collected from the Minnesota National Forest Bird Monitoring Program (NRRI) shows significant declines in Chippewa NF (-1.06%), Superior NF (-0.85%), and regionally (-0.94%).
- Short-distance migrants are arriving on the breeding grounds earlier as spring phenology advances.
- Increasingly volatile weather during the spring season may be causing declines in short-distance migrants.

Migration Guilds	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Long-distance migrants	18.4	18.8	19.2	19.5	19.9	20.3	20.5	20.8	21.1	21.5	21.6	21.4	21.1	20.9	20.6	20.2	19.9	19.5	19.5	19.4	19.4	19.4	19.4	19.3	19.4	19.4	19.5	19.5
Permanent residents	1.9	2.0	2.1	2.2	2.4	2.4	2.5	2.6	2.7	2.9	2.9	3.0	2.9	3.0	2.9	2.9	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.7	2.7	2.7	2.7	2.7
Short-distance migrants	7.0	7.3	7.4	7.7	7.8	8.1	8.3	8.5	8.7	9.0	9.0	9.0	9.0	9.0	8.8	8.7	8.3	8.1	7.9	7.7	7.4	7.2	7.1	6.5	6.4	6.1	5.7	5.5

Are “we” seeing climate impacts on birds?

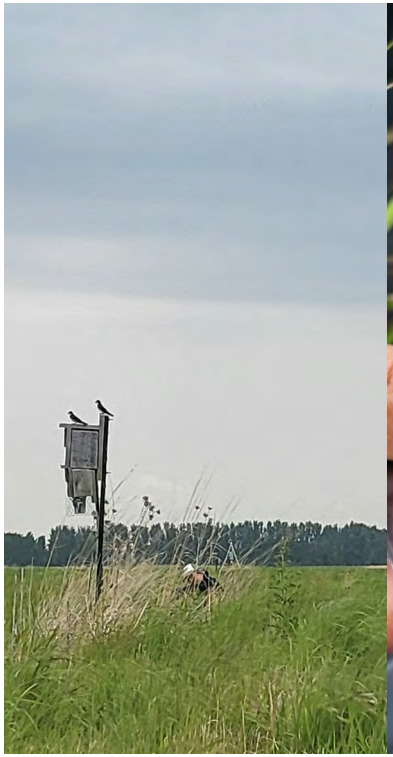
Is climate change impacting the breeding season?

- Extreme precipitation events in June and July -> Flooded nests and dead baby birds

Are “we” seeing climate impacts on birds?

Is climate change impacting the breeding season?

- Insect (food) quantity and quality- What’s “Bugging” MNs’ insect eating birds? ☺




Are “we” seeing climate impacts on birds?

Is climate change impacting the breeding season?

- Drought ☹

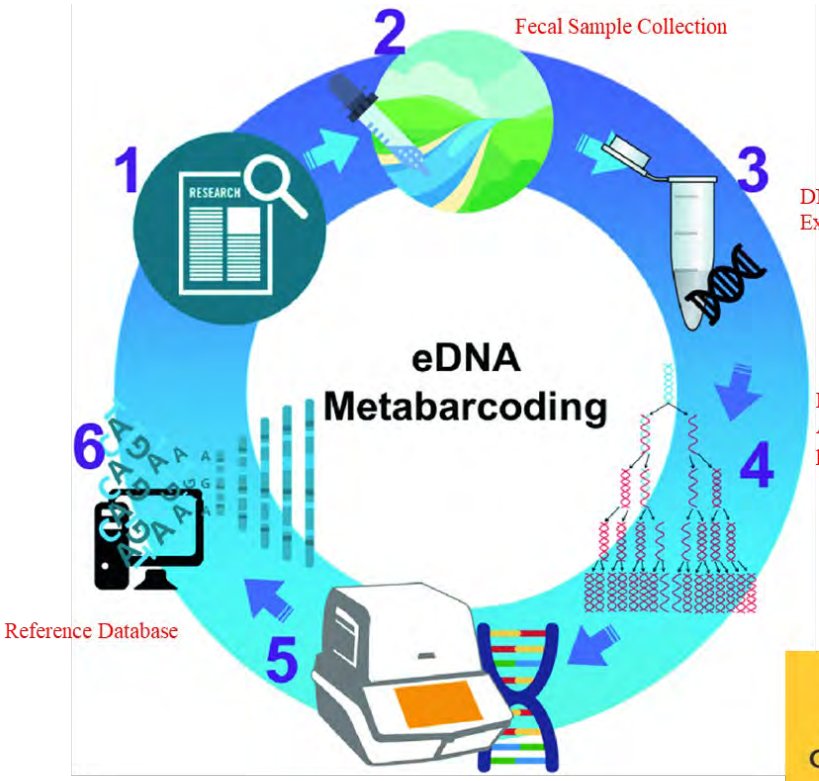



Are “we” seeing climate impacts on birds?

Are “we” seeing climate impacts on birds?

Is climate change impacting the breeding season?

Fecal samples taken 3 times during nestling stage

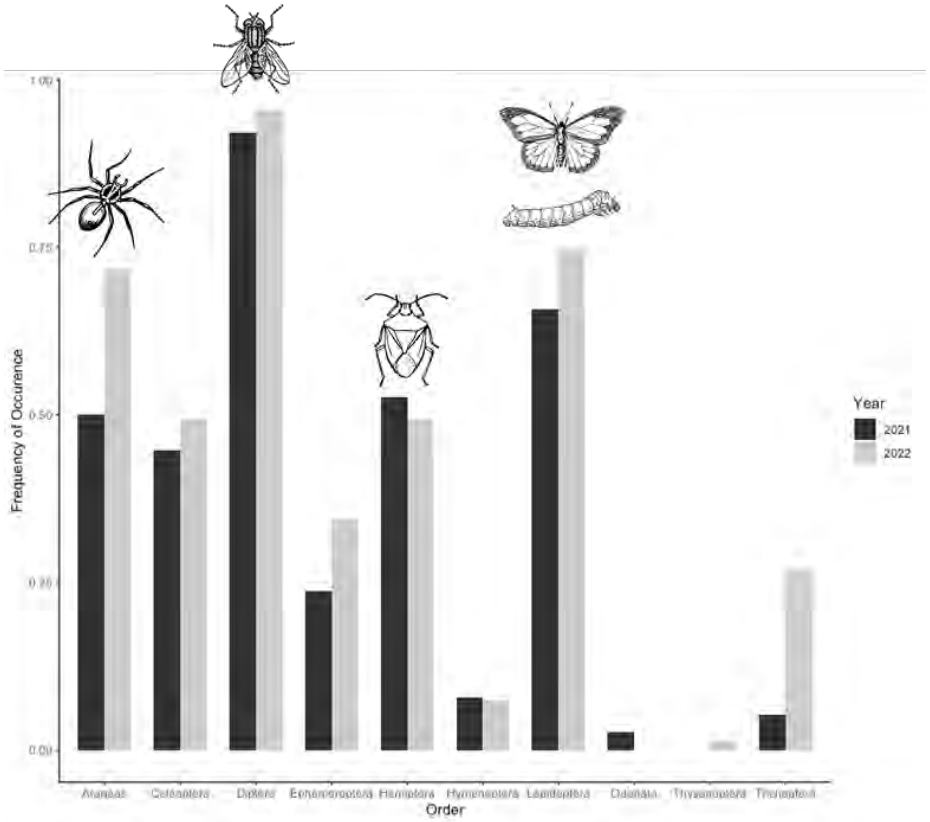


GENOMICS CENTER

Are “we” seeing climate impacts on birds?

Is climate change impacting the breeding season?

Fecal samples taken 3 times during nestling stage

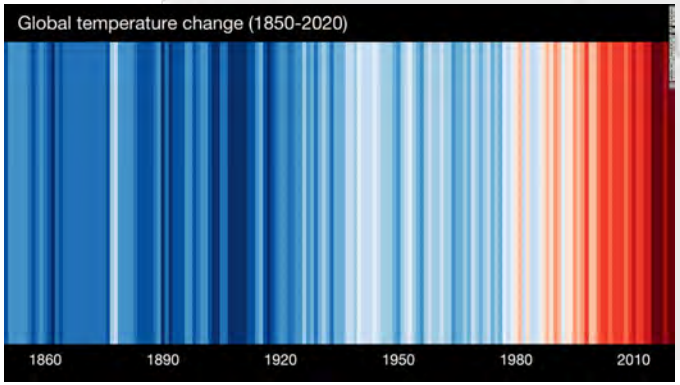


Are “we” seeing climate impacts on birds?

Is climate change impacting fall migration?

Are “we” seeing climate impacts on birds?

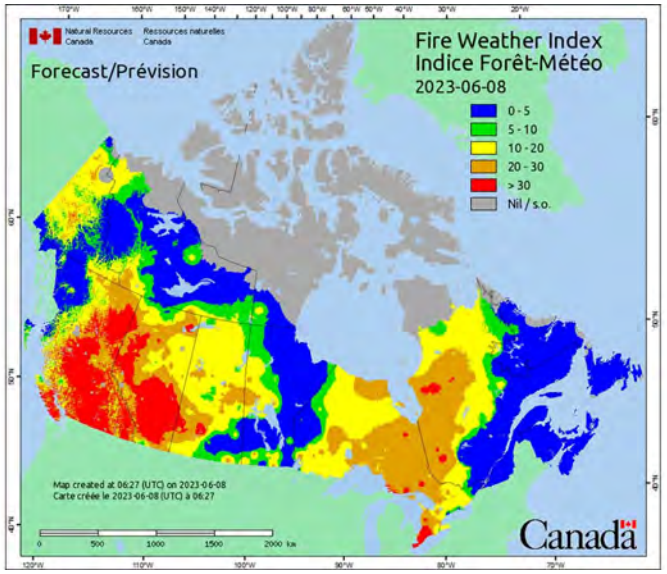
Does range-edge texture predict population trends?



WANTED: ability to understand and predict which species are more likely to shift their ranges

Climate change is impacting habitat quality

- Pests
- Invasive species
- Fires
- Disease
- Decreased regeneration



Climate change is impacting habitat quality

Climate change is impacting habitat quality

- Evidence suggests:
  - Old-growth and structurally diverse forests provide thermal refuge for wildlife, including birds.
  - Forested wetlands are VERY, VERY, VERY important for maintaining large-scale bird diversity.
- Conserving mature / over mature forests on the landscape may be beneficial for a majority of species.
- Landscape-level, collaborative planning is necessary for ensuring diverse habitats are available.
- Climate adaptation needs to be a part of forest and habitat management plans.

Mitigation and Adaptation

- Mitigation: Reducing greenhouse gas emissions and promoting carbon sequestration
  - Mitigation focuses on global cycles and works on a longer time frame
- Adaptation: Addressing the physical manifestations of climate change in current and future actions
  - Adaptation addresses observed or anticipated effects of climate change in the present
  - Adaptation is complementary to existing sustainable forest management practices

Mitigation and Adaptation

- There is no “silver bullet” for managing forests for wildlife and climate change
- We need to learn from each other!

- What were / are your management goals, objectives and timelines?
- What wildlife species were you focusing on?
- What climate impact / vulnerabilities were you addressing?
- **Monitor! (pre-treatment and post-treatment surveys are best to look at impact)**
- Communicate. What worked what didn’t?
- Let’s try it again!

Let’s save the world.

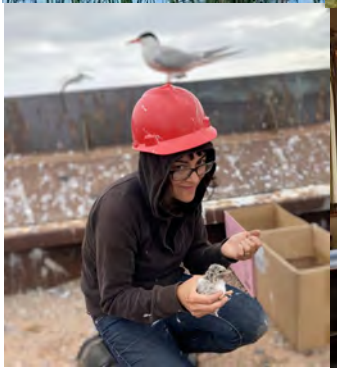
“How sad to think that nature speaks and mankind doesn’t listen.” — Victor Hugo

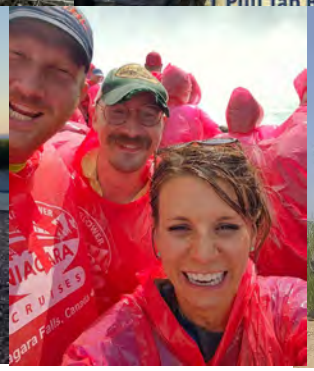
Photo: Steve Kolbe

THANK YOU!







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Wherever there are birds, there is hope

- Mehmet Murat ildan