



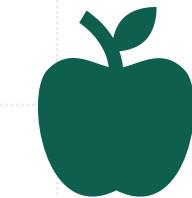
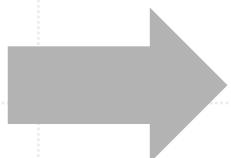
Citizen science as an approach for valuation of biodiversity in Environmental Impact Statements

**Brittany Mason, Carly Winnebald,
Blaze Smith, Laura López-Hoffman,
and Corey T. Callaghan**

UF | IFAS
UNIVERSITY of FLORIDA



Biodiversity and Ecosystem Services



Clean air

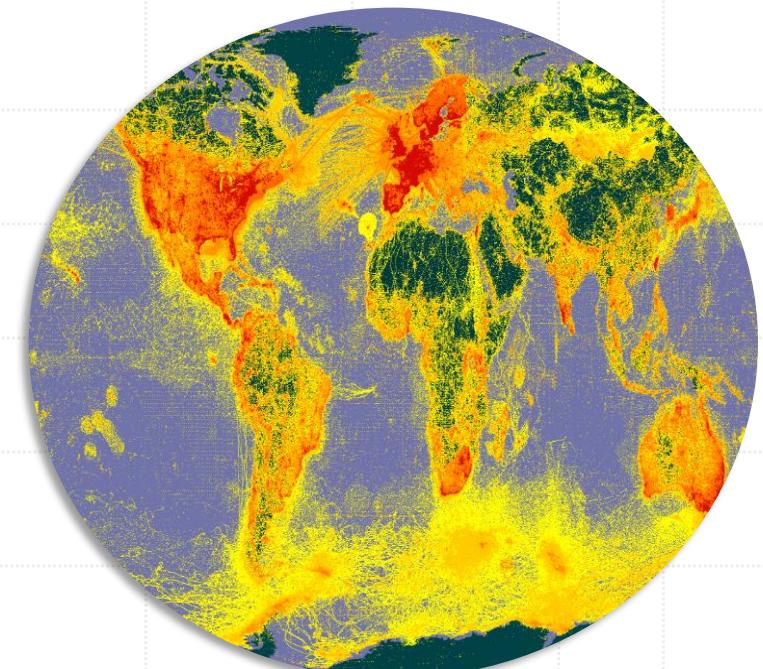
Food

Clean drinking water

Aesthetic benefit

What is Citizen Science?

- Also commonly referred to as participatory science or community science
- Involves public engagement, education, and data collection
- Citizen science programs are interdisciplinary and result in scientific advancement





Observations



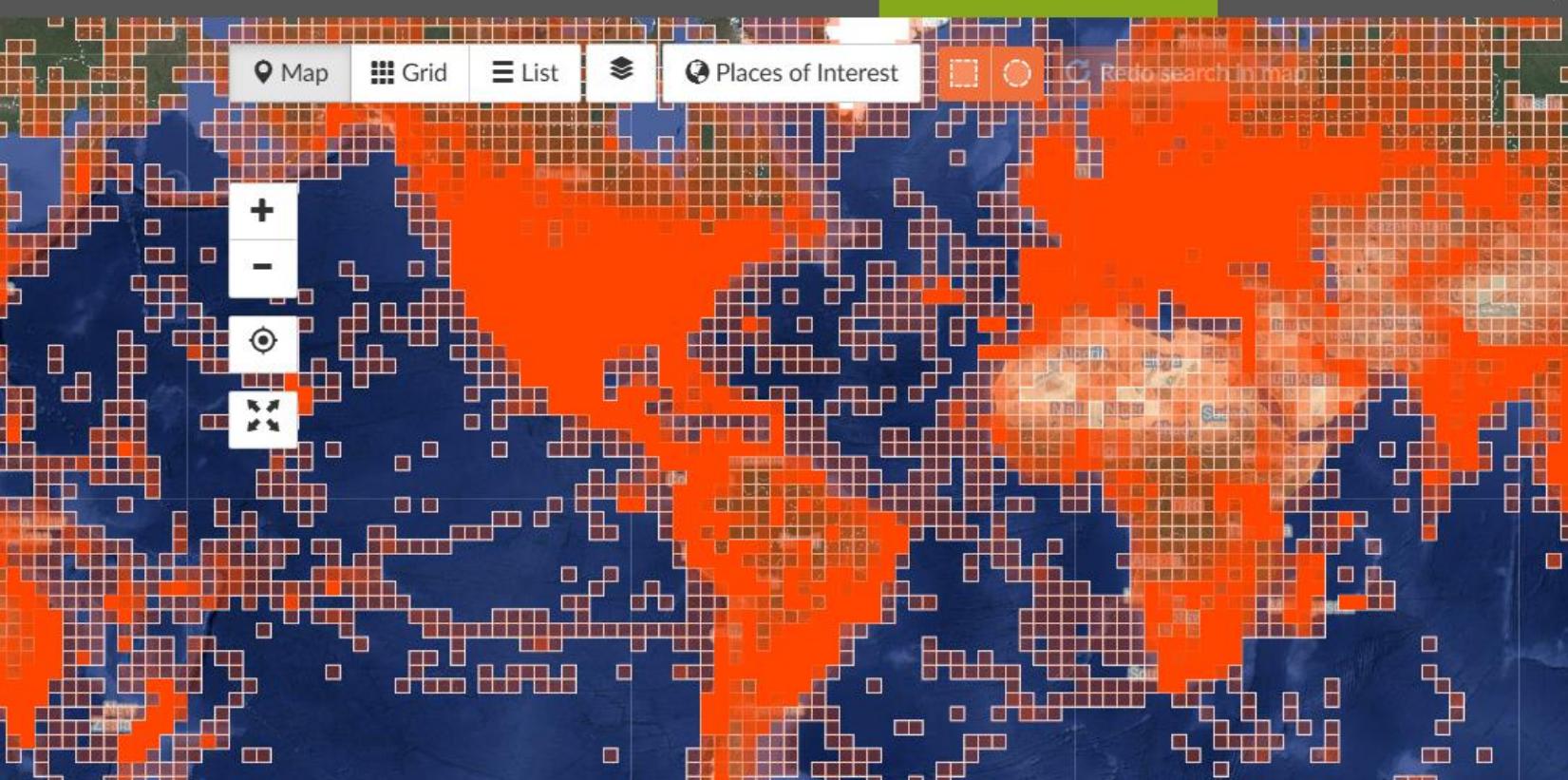
Species

Location

Go

Filters

The World

219,205,708
OBSERVATIONS496,880
SPECIES397,429
IDENTIFIERS3,439,862
OBSERVERS[Map](#) [Grid](#) [List](#) [Places of Interest](#)[+](#)[-](#)[X](#)[Redo search in map](#)**Eastern Pondhawk**
(*Erythemis simplicicollis*)
Mitchell Lake Audubon Center, Mitchell, SD, USA• Jun 14, 2022
2 2h**Eastern Pondhawk**
(*Erythemis simplicicollis*)
Mitchell Lake Audubon Center, Mitchell, SD, USA• Jun 14, 2022
2 2h**Four-spotted Pennant**
(*Brachymesia gravida*)
Mitchell Lake Audubon Center, Mitchell, SD, USA• Jun 14, 2022
2 2h**Eastern Pondhawk**
(*Erythemis simplicicollis*)
Mitchell Lake Audubon Center, Mitchell, SD, USA• Jun 14, 2022
2 2h

 Change Region ▾

Florida

United States

 566
Species 3.22M
Checklists 81,521
eBirdersMy Stats  59  15  39  0

Overview

[Bird List](#)[Recent Checklists](#)[Trip Reports](#)[Subregions](#)[Hotspots](#)[eBirders](#)[Illustrated Checklist](#)

eBirding This Month

Nov 2024

Updated ~5 hours ago

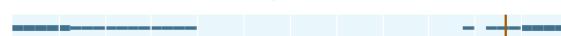
Community Targets

**American Black Duck**

Last observed by Anonymous eBirder on 2 Sep 2024

**Eared Grebe**

Last observed by Hayden Epp on 11 Mar 2024

**Common Goldeneye**

Last observed by Anonymous eBirder on 26 Mar 2024

 348

Species

 17,751

Checklists

 3132

eBirders

New Species

Lapland Longspur

1  18 Nov 2024  Rex Rowan
Old A1A beach at Summer Haven St. Johns

Eurasian Wigeon

1  18 Nov 2024  Glenn Mitchell
Merritt Island NWR–Black Point Wildlife Drive Brevard

Calliope Hummingbird

1  17 Nov 2024  Dalcio Dacol
Hummin' haven (private/restricted access) Alachua

Purple Martin

1  17 Nov 2024  Don Morrow



Get data

How-to

Tools

Community

About



Login



Occurrences



1

Search all fields



Simple filters

All filters

Occurrence status !

TABLE

GALLERY

MAP

TAXONOMY

METRICS

DOWNLOAD

Licence

Scientific name

 Sciurus carolinensis Gmelin, 1788

Dataset

Search

 iNaturalist Research-grade Observations 187,795 The Scottish Squirrel Database 83,074 Living with Mammals survey 59,342 National Mammal Atlas Project, online rec... 35,783 MammalWeb records 14,863 Mammal Mapper App Sighting Records 10,637 Cumbria Non Native Invasive Species 9,556 NBIS Records to December 2016 5,891 Mammal records from Britain from the Atla... 5,889 RECORD Mammal Data 5,230

TABLE

GALLERY

MAP

TAXONOMY

METRICS

DOWNLOAD

Scientific name	Country or area	Coordinates	Event date	Occurrence status
Sciurus carolinensis Gmelin, 1788	United Kingdom of Great ...	51.6N, 0.3W	2024 Jan 01	Present
Sciurus carolinensis Gmelin, 1788	United Kingdom of Great ...	52.1N, 3.1W	2024 Jan 07	Present
Sciurus carolinensis Gmelin, 1788	United Kingdom of Great ...	52.2N, 3.6W	2024 Jan 28	Present



How is the data being used?

Citizen Science in Research

Literature Search



Google Scholar
Scopus



Web of Science™

Screened articles for:



Peer-review



Electronically available

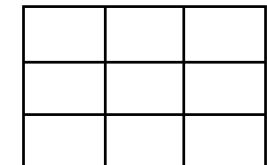


Written in English or Spanish

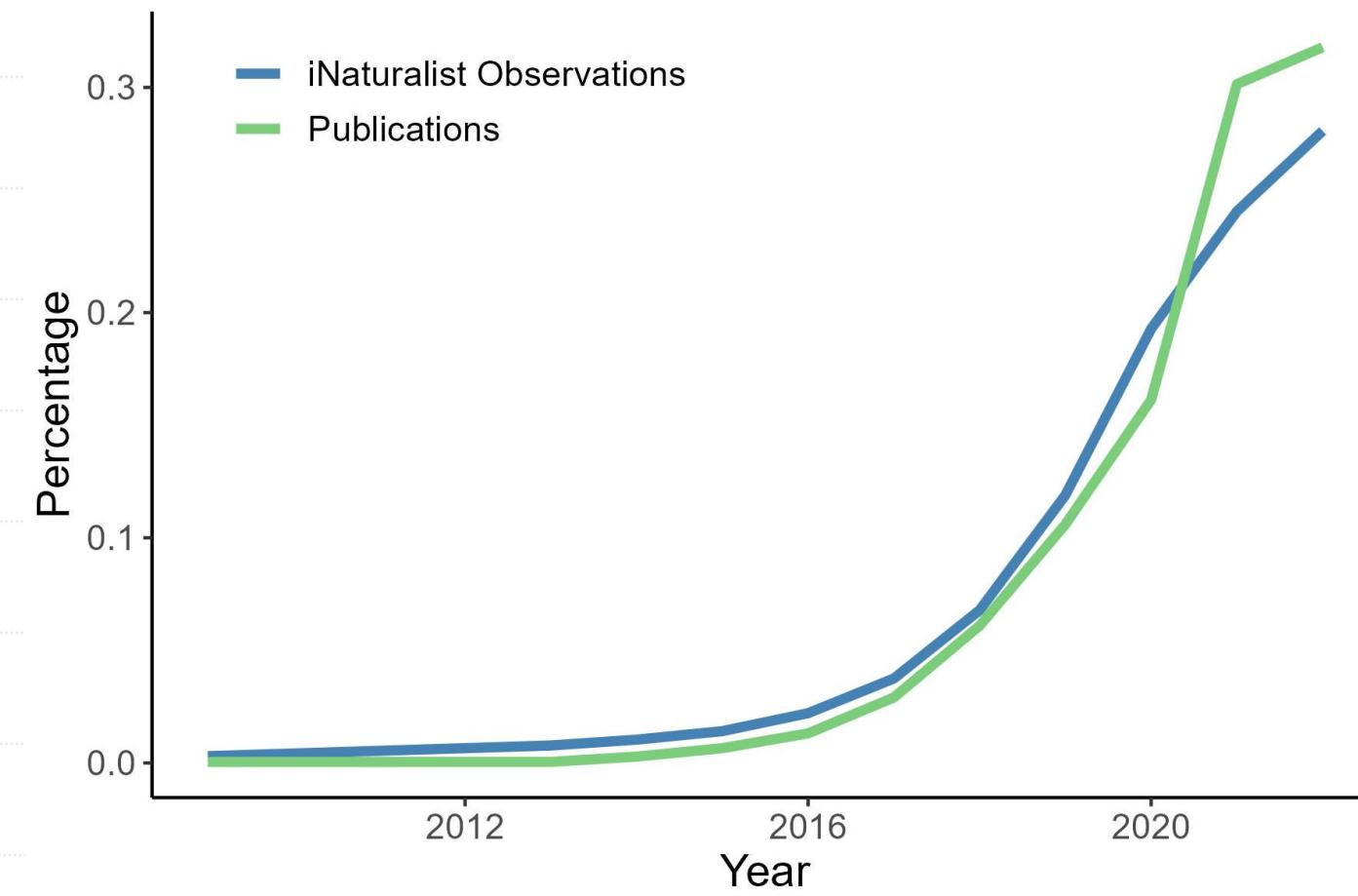
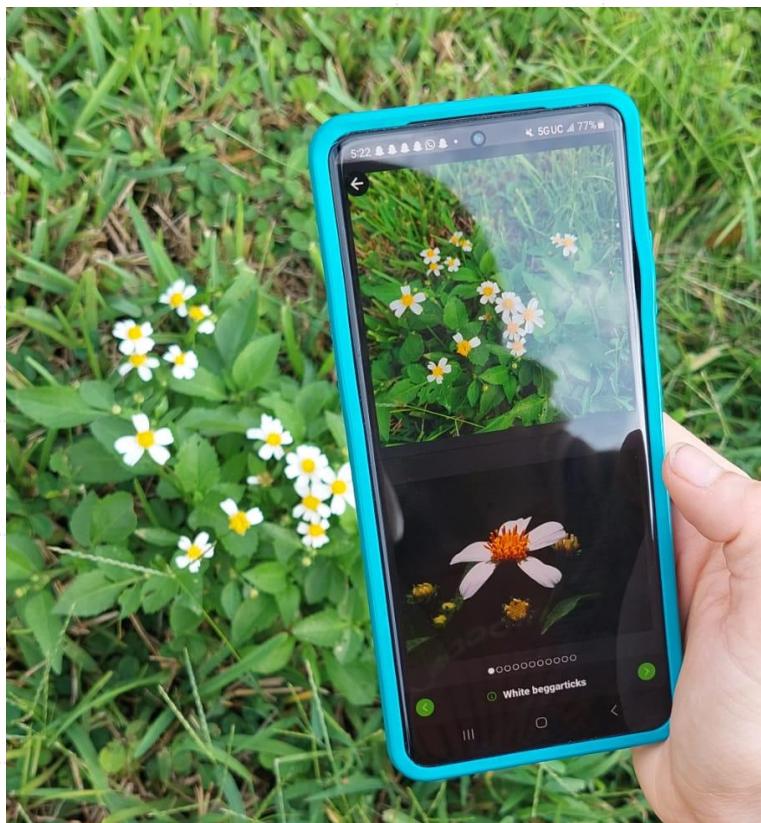


Used iNaturalist data or review of iNaturalist

Tag articles

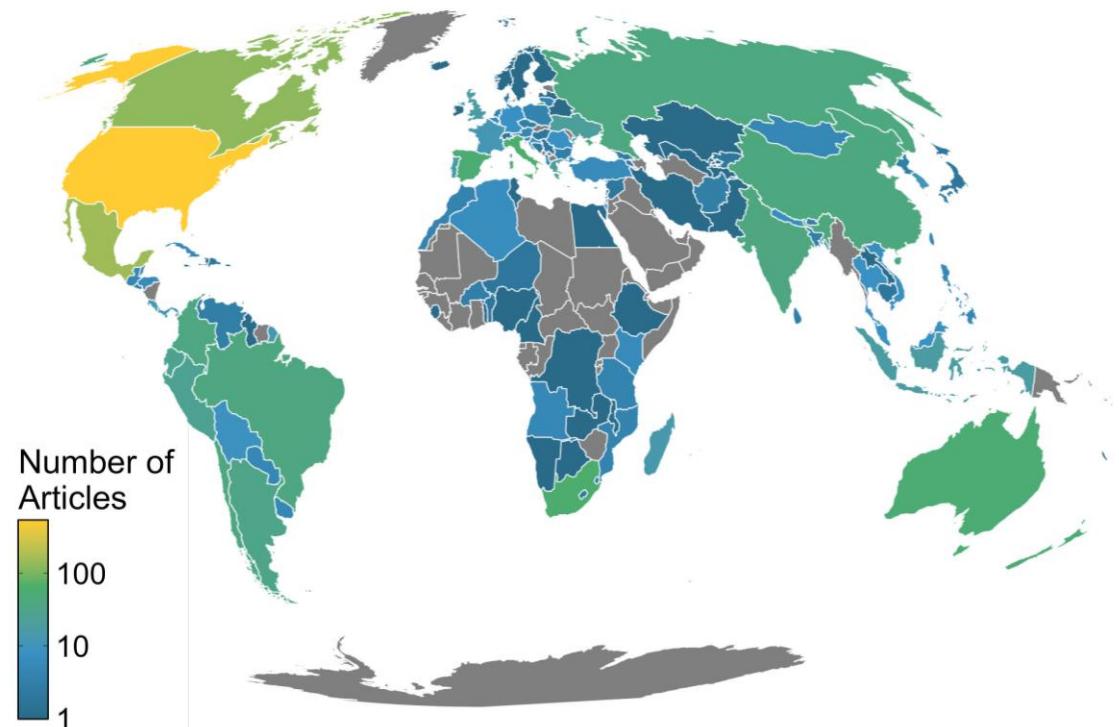


The use of iNaturalist data in scientific literature has grown significantly, paralleling the rapid increase in data availability from the platform.

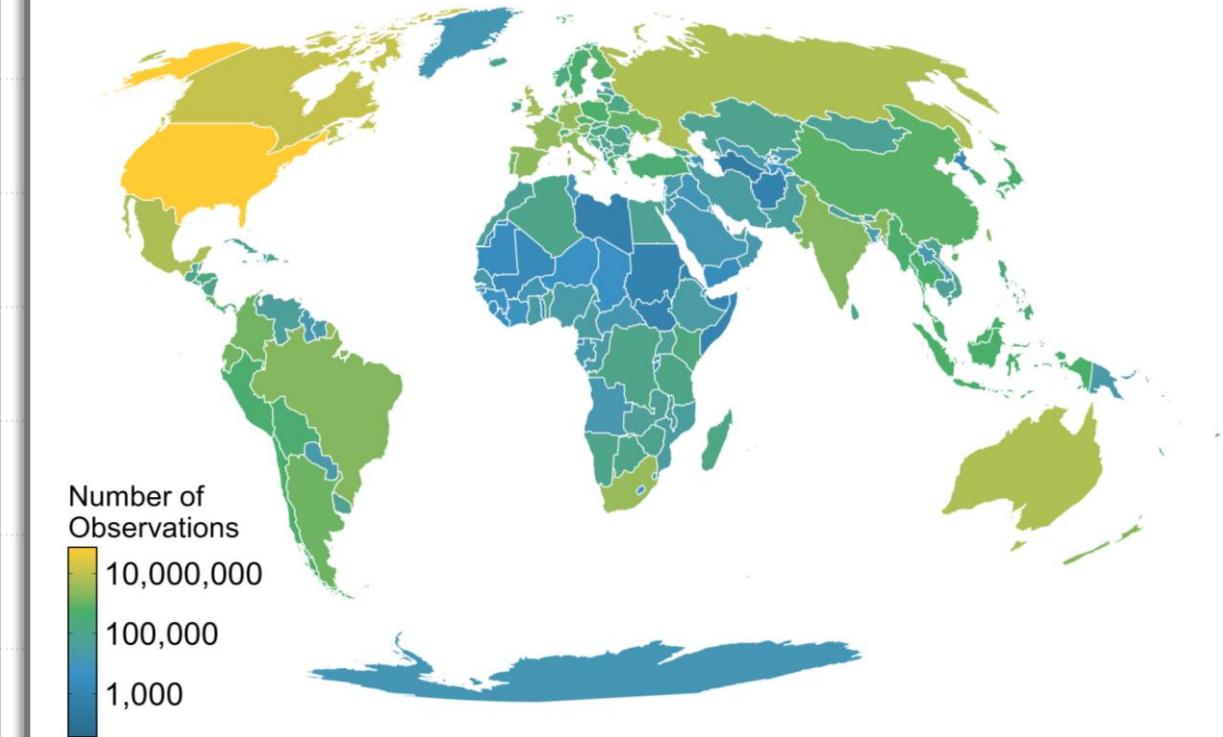


Global Distribution

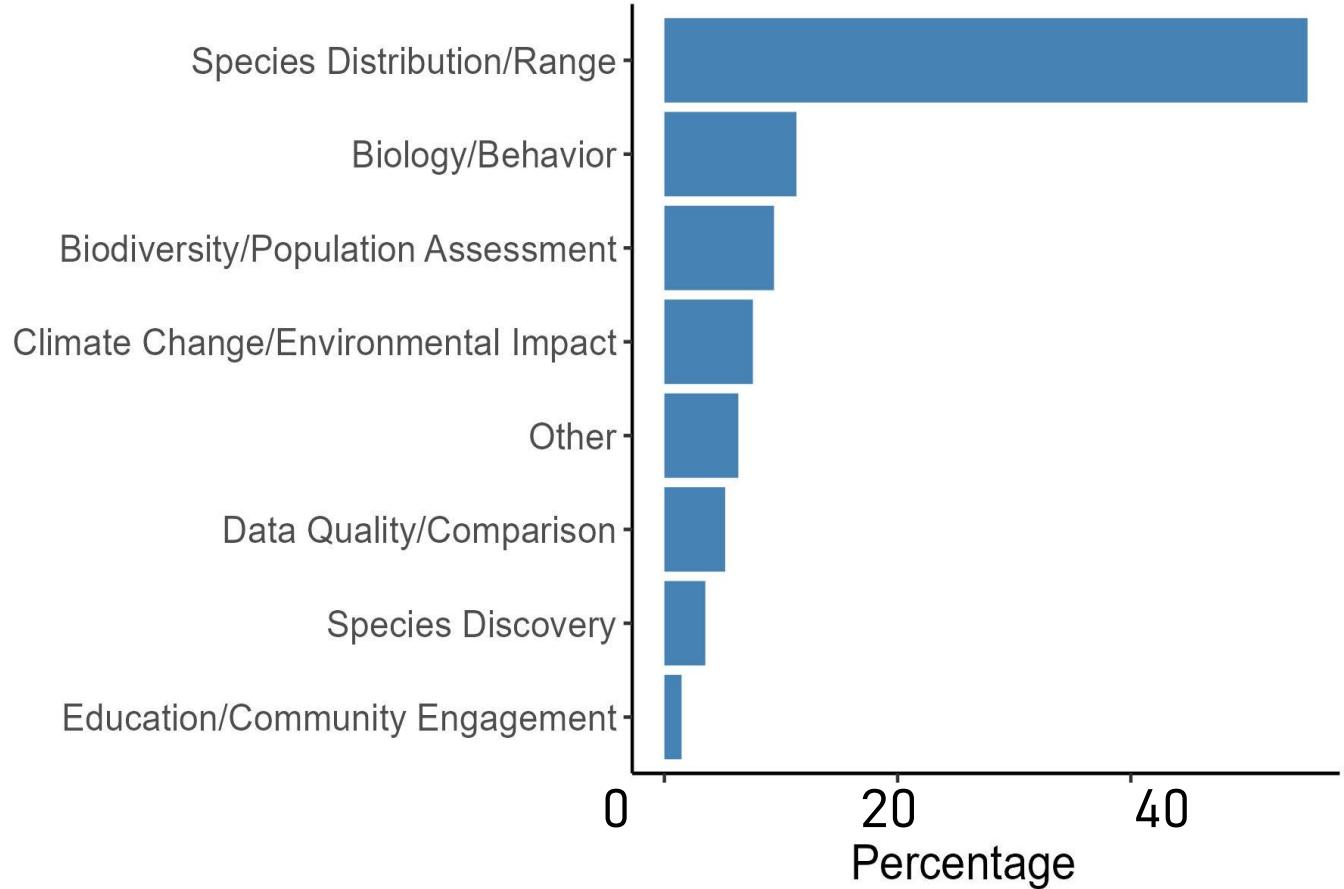
iNaturalist literature



iNaturalist observations



Range of topics

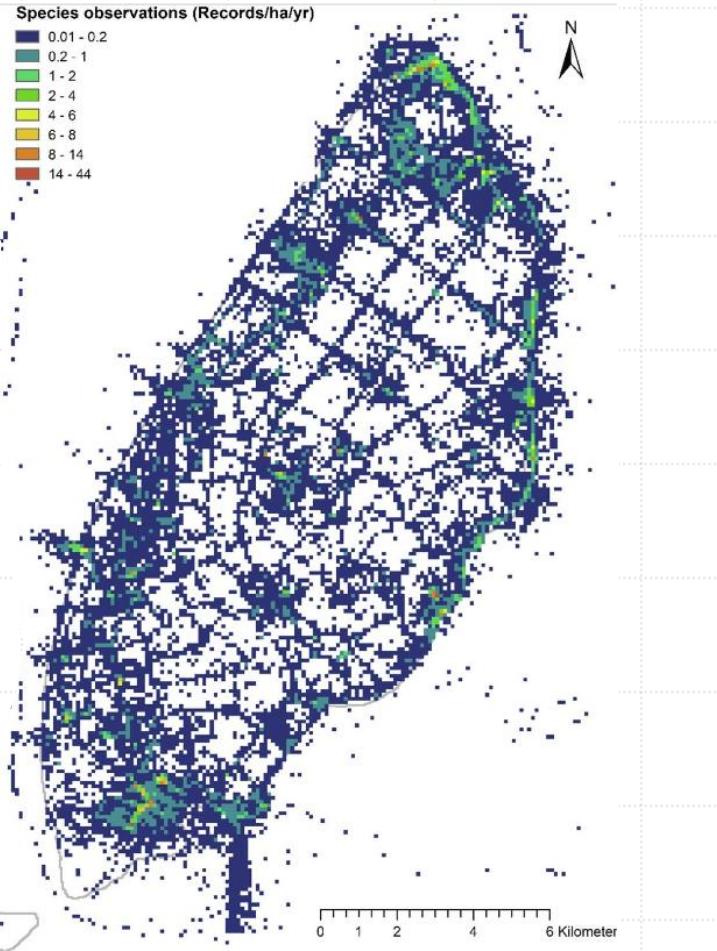


The word cloud illustrates the following themes:

- Conservation:** biodiversity, new species, invasive, climate change, habitat, range expansion, potential, first record, geographic, modelling, modelling, distribution models, spatial, evolution, checklist, updated, changes.
- Biodiversity:** biodiversity, new species, invasive, climate change, habitat, range expansion, potential, first record, geographic, modelling, modelling, distribution models, spatial, evolution, checklist, updated, changes.
- Ecological:** ecological, citizen, niche, global, science, data, new, invasive, plant, flora, expanding, learning, history, common, taxonomic, management, spread, landscape.
- Geographic:** biological, north american, populations, hemiptera, range expansion, spatial, potential distribution, bird, fish, marine, dynamics, interactions, deep, geographical, pacific, southern, new species, description.
- Species Distribution:** species distribution, distribution, new species, invasive, plant, flora, expanding, learning, history, common, taxonomic, management, spread, landscape.
- Invasive Species:** invasive, plant, flora, expanding, learning, history, common, taxonomic, management, spread, landscape.
- Climate Change:** climate change, north, using, forest, alien, record, modeling, factors, introduced, genetic, case study, habitat suitability, first records, analysis.
- Conservation:** conservation, checklist, updated, changes, evolution, reveals, first record, geographic, distribution models, endangered.
- Biogeography:** biogeography, distribution, new species, invasive, plant, flora, expanding, learning, history, common, taxonomic, management, spread, landscape.
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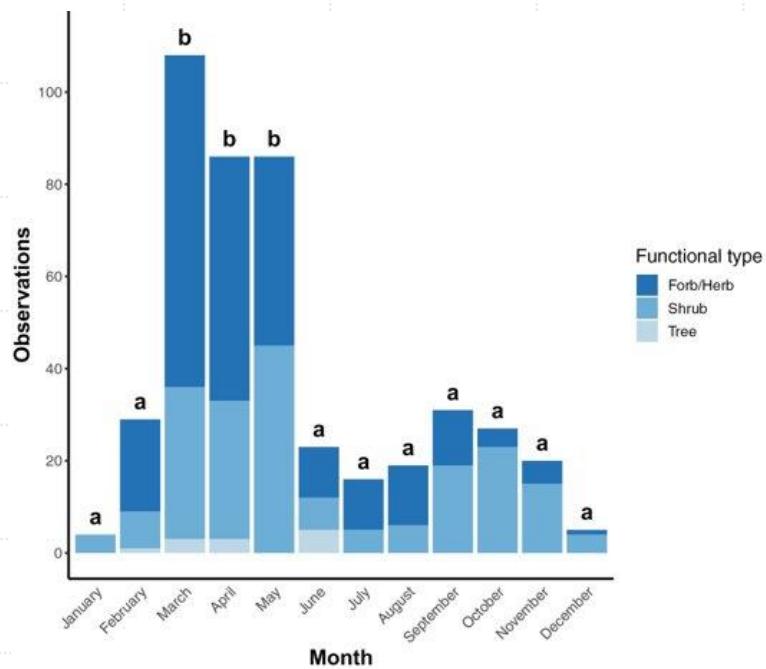
Citizen Science to Study Ecosystem Services

Map cultural ecosystem services



Havinga, I., Bogaart, P. W., Hein, L., & Tuia, D. (2020). Defining and spatially modelling cultural ecosystem services using crowdsourced data. *Ecosystem Services*, 43, 101091.

Determine plants visited by painted lady butterflies



Saldivar, J. L. A., Romero, A. N., & Wilson Rankin, E. E. (2022). Community science reveals high diversity of nectaring plants visited by painted lady butterflies (Lepidoptera: Nymphalidae) in California sage scrub. *Environmental Entomology*, 51(6), 1141-1149.

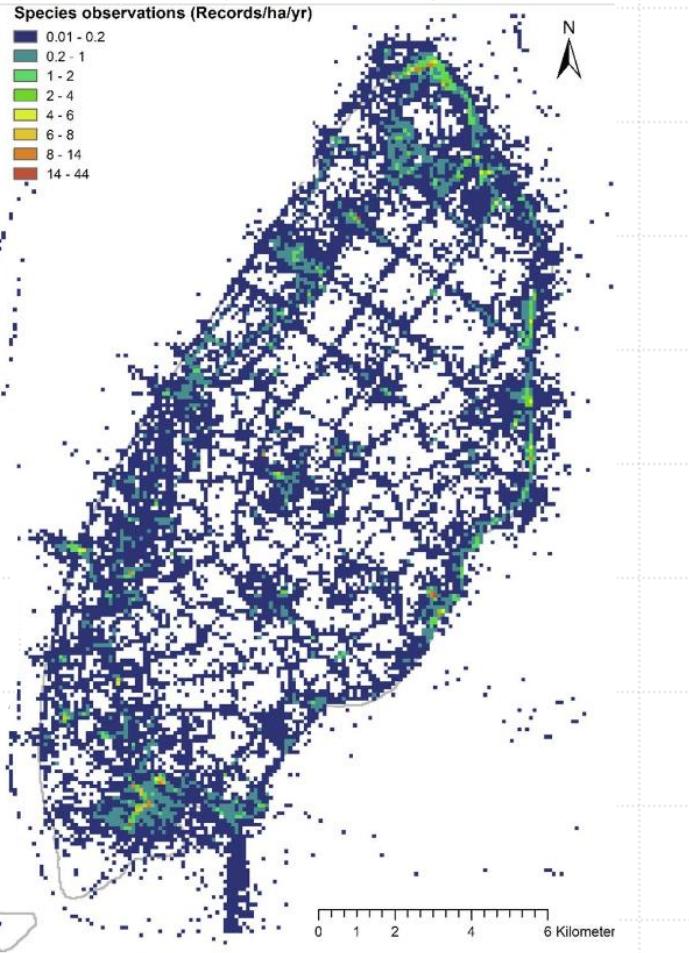
Connect urban farmers to useful insect data



Prudic, K. L., Wilson, J. K., Toshack, M. C., Gerst, K. L., Rosemartin, A., Crimmins, T. M., & Oliver, J. C. (2019). Creating the urban farmer's almanac with citizen science data. *Insects*, 10(9), 294.

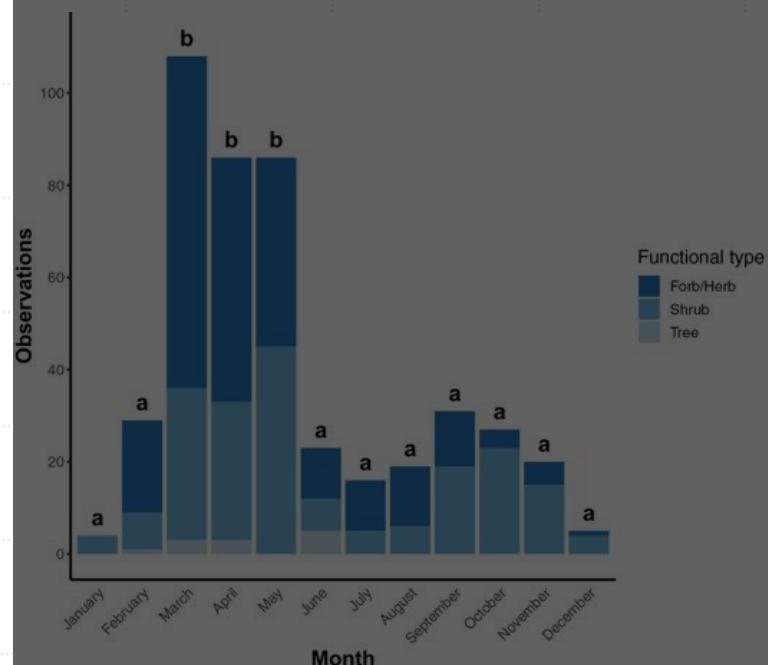
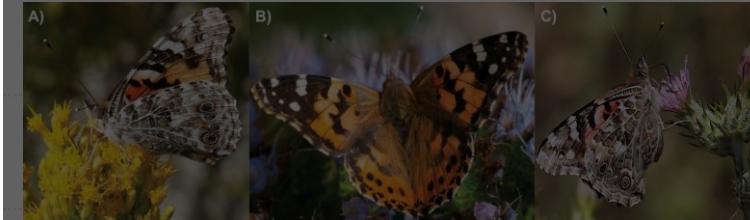
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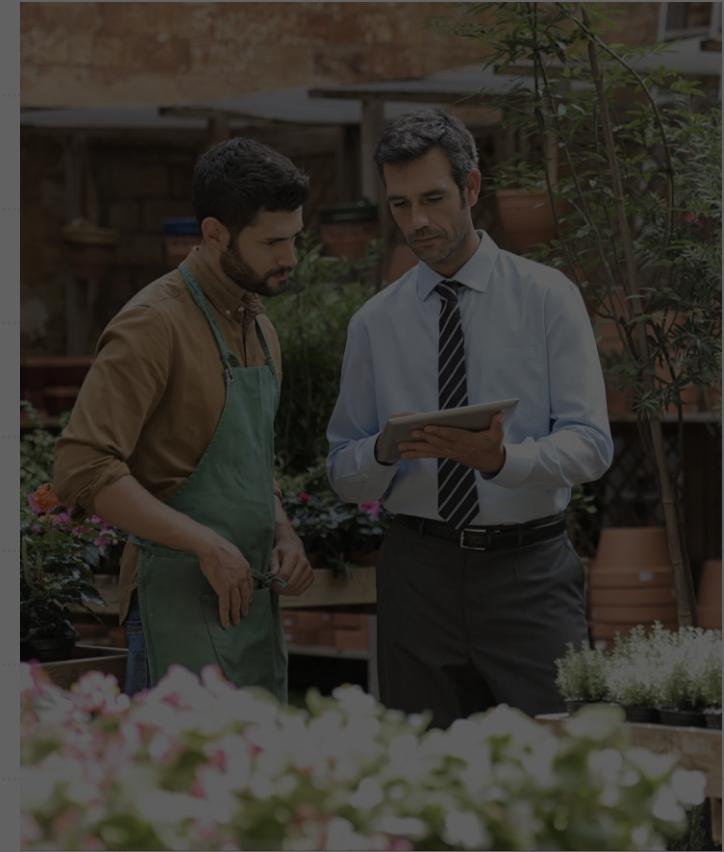
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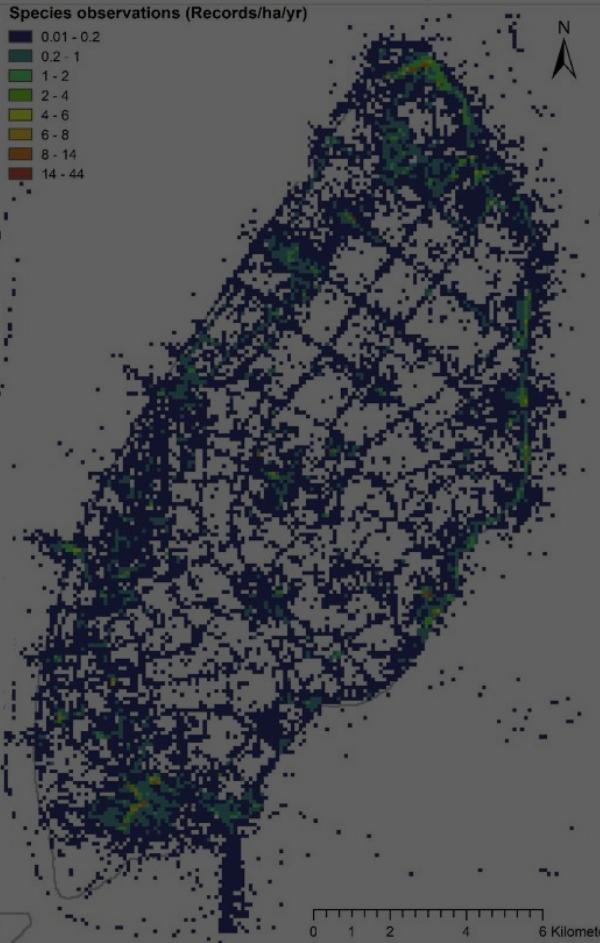
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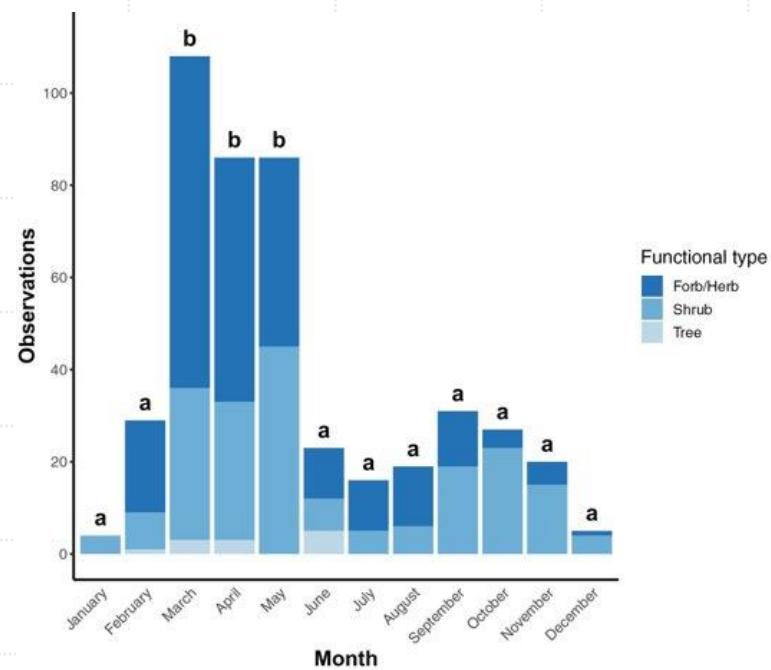
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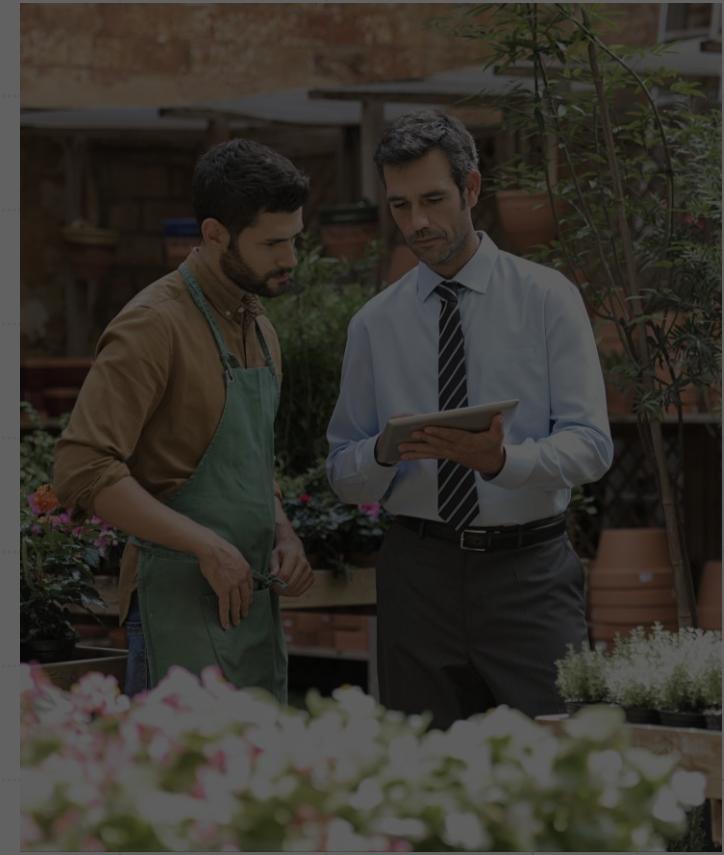
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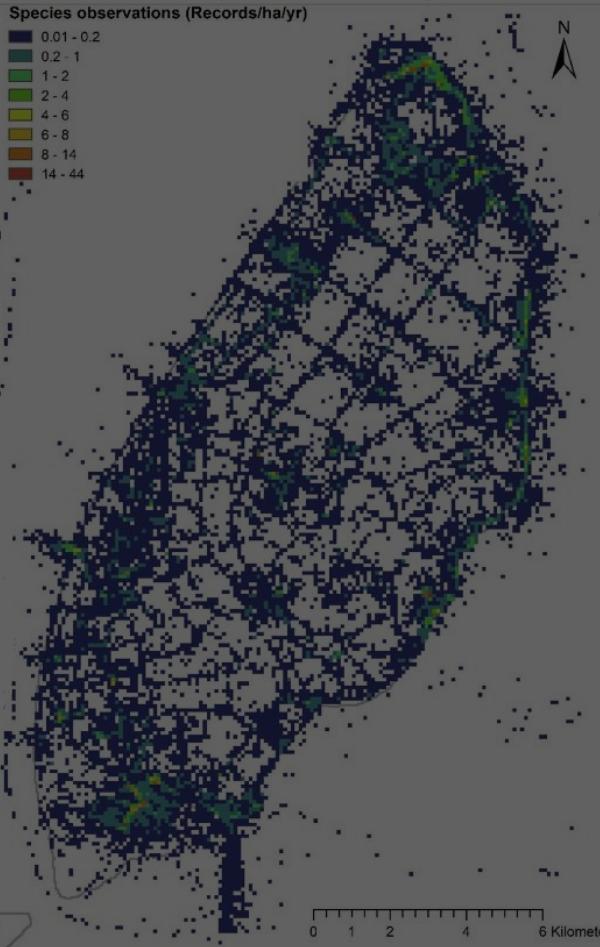
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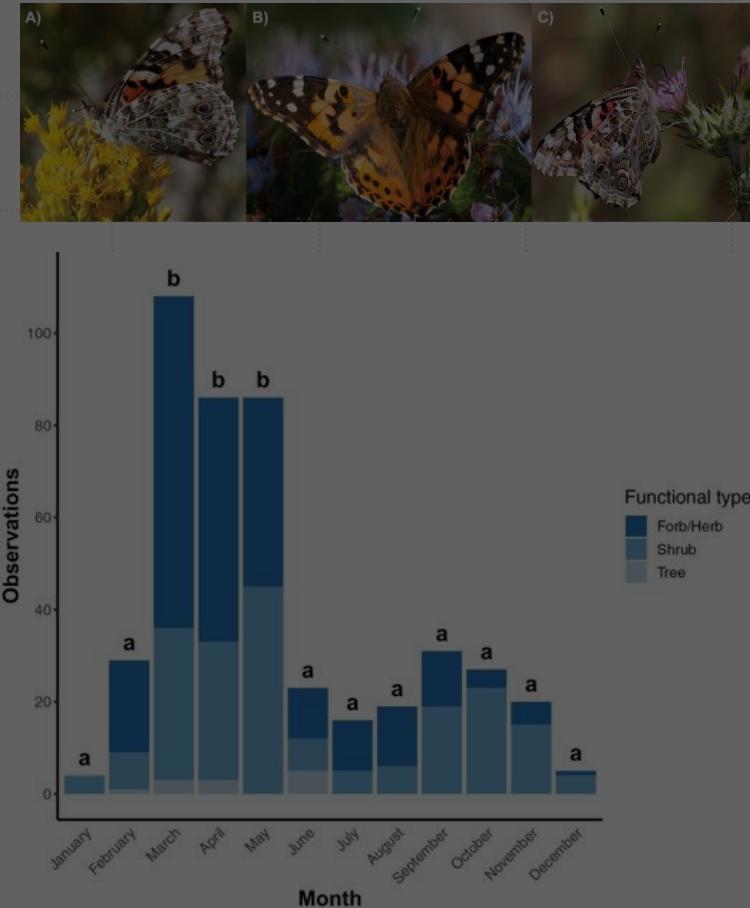
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Citizen Science in Policy

[Danaus plexippus ssp. plexippus](#) ↗

>20,000

Literature

Committee, I. (2023) IUCN Red List of Threatened Species

Danaus plexippus ssp. plexippus has most recently been assessed for The IUCN Red List of Threatened Species in 2023. Danaus plexippus ssp. plexippus has been listed as Vulnerable under criteria A2b.

Report

[Russula alnijorullensis](#) ↗

Literature

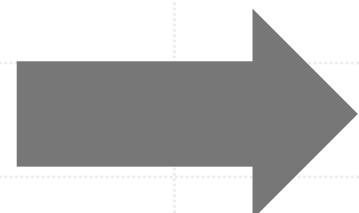
Pelissero, D. Maubet, Y. Ranieri, C. Torres, D. Niveiro, N. (2023) IUCN Red List of Threatened Species

Russula alnijorullensis has most recently been assessed for The IUCN Red List of Threatened Species in 2023. Russula alnijorullensis has been listed as Vulnerable under criteria A3c; C2a(ii).

Report

Research Question

What is the frequency and type of citizen science use in policy documents?



Citizen science as a valuable tool for environmental review

Corey T Callaghan^{1*}, Carly Winnebald², Blaze Smith², Brittany M Mason¹, and Laura López-Hoffman²

Human development and population growth are placing immense pressure on natural ecosystems, necessitating the establishment of a balance between development and biodiversity preservation. Citizen science may serve as a valuable resource for monitoring biodiversity and informing decision-making processes, but its use has not been investigated within the realm of environmental review. We sought to quantify the extent to which citizen science data are currently being used, mentioned, or suggested in environmental impact statements (EISs) by analyzing more than 1300 EISs produced under the US National Environmental Policy Act. Among the sampled EISs, we found increasing incorporation of citizen science within the environmental review process, with 40% of EISs in 2022 using, mentioning, or suggesting use of such information, as compared with just 3% in 2012. Citizen science offers substantial potential to enhance biodiversity monitoring and conservation efforts within environmental review, but numerous considerations must be broadly discussed before citizen science data can be widely adopted.

United States National Environmental Policy Act (NEPA)



Involves science and the public in federal decision-making



Requires environmental review of potential impacts of proposed federal action



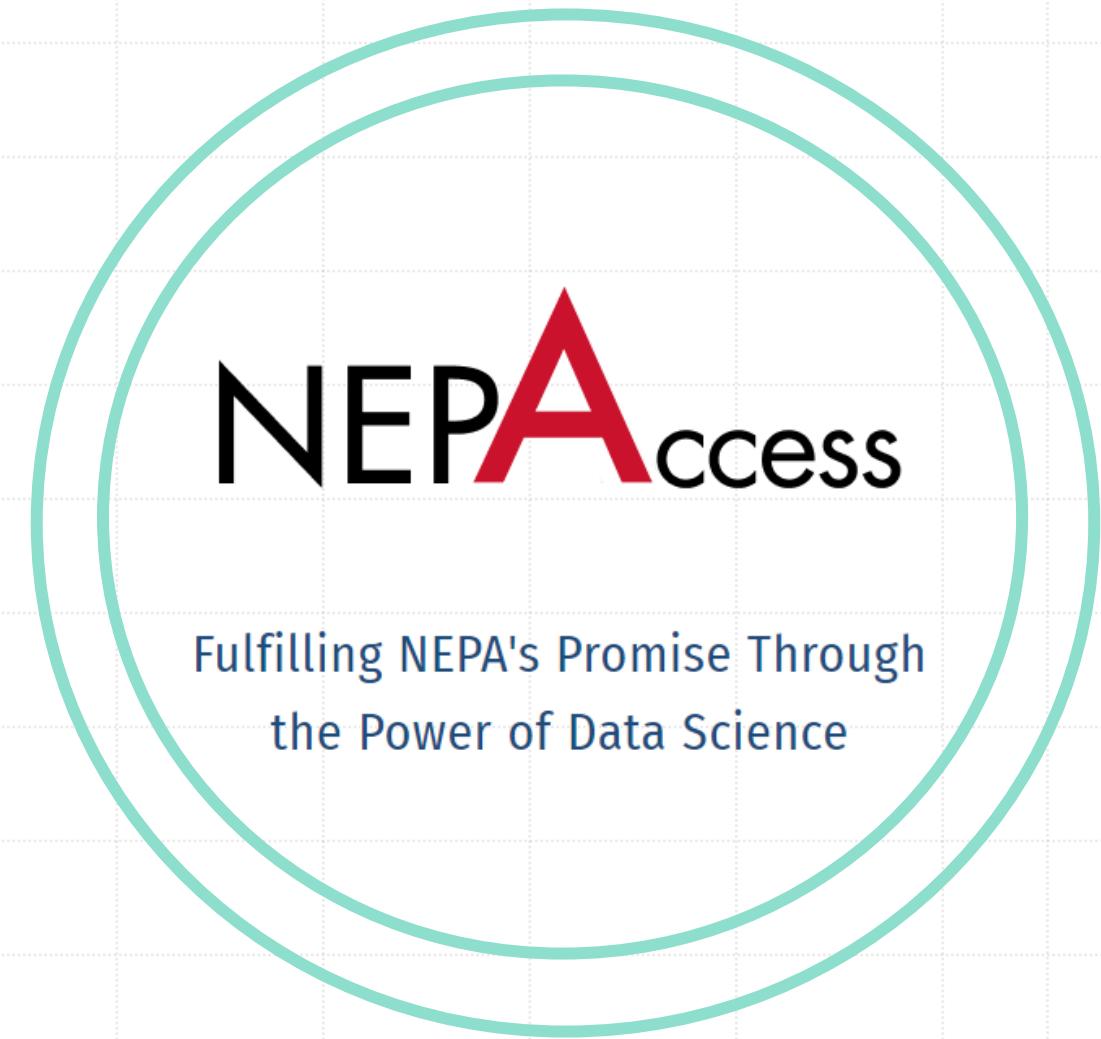
There are three levels of analysis under NEPA – Environmental Impact Statements (EIS), Environmental Assessment, and Categorical Exclusion

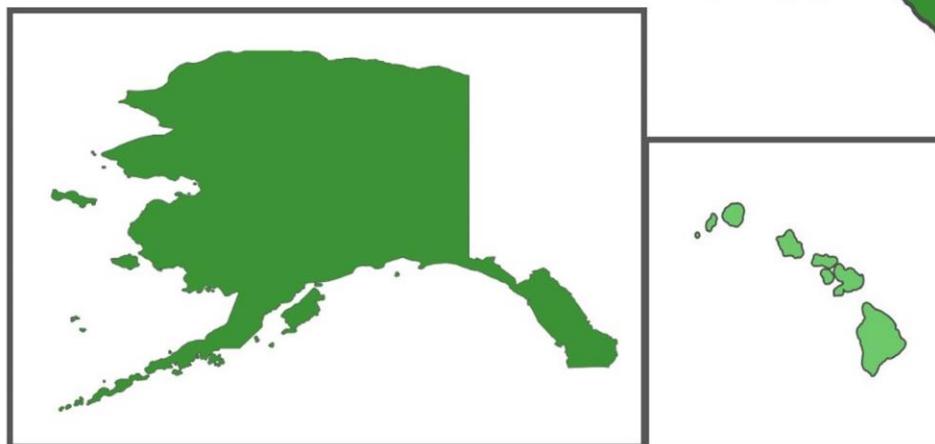
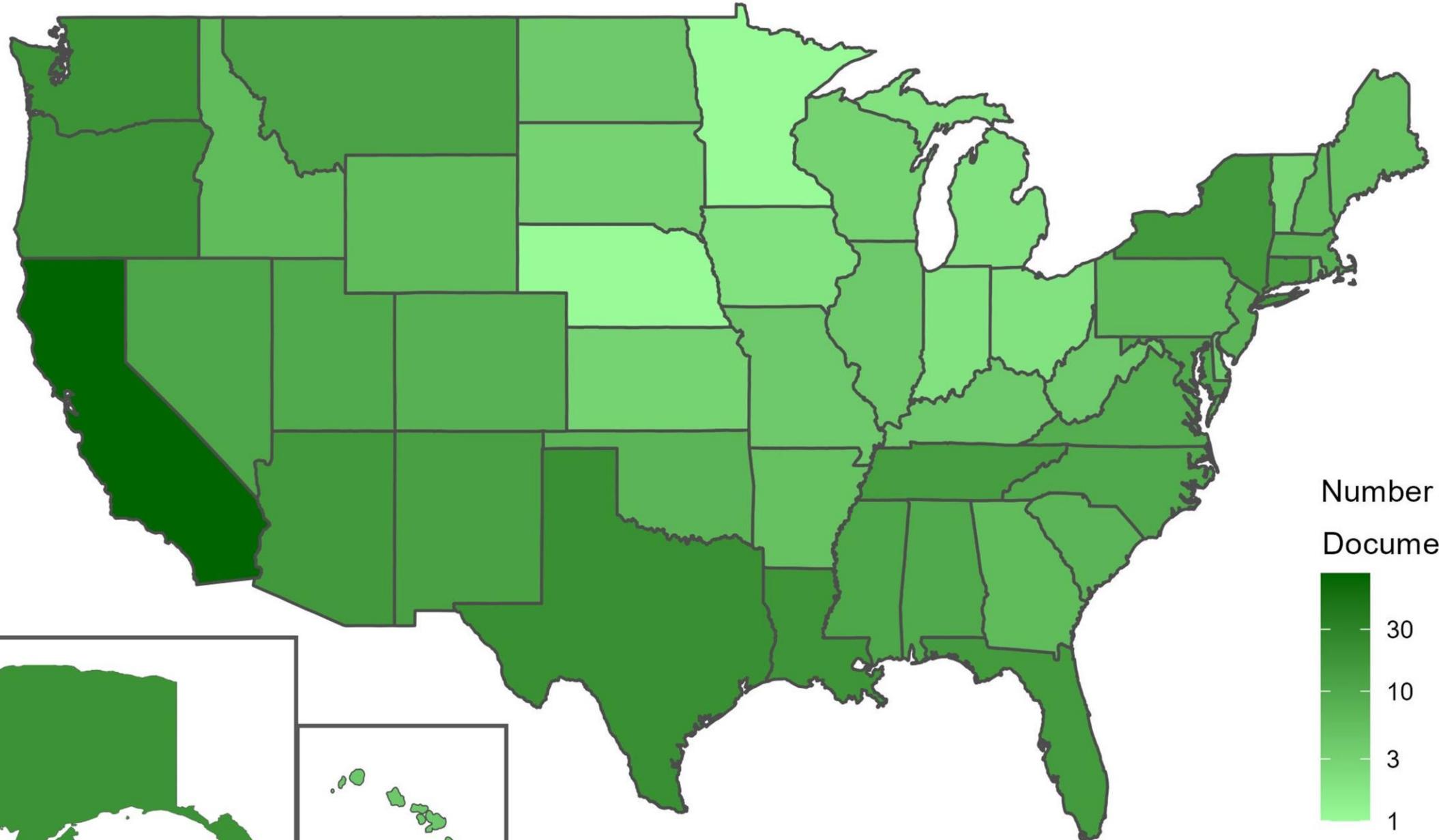
Environmental Impact Statement Search

We searched the NEPAcces database
for EISs completed between 2012-2022
that contain the following keywords:

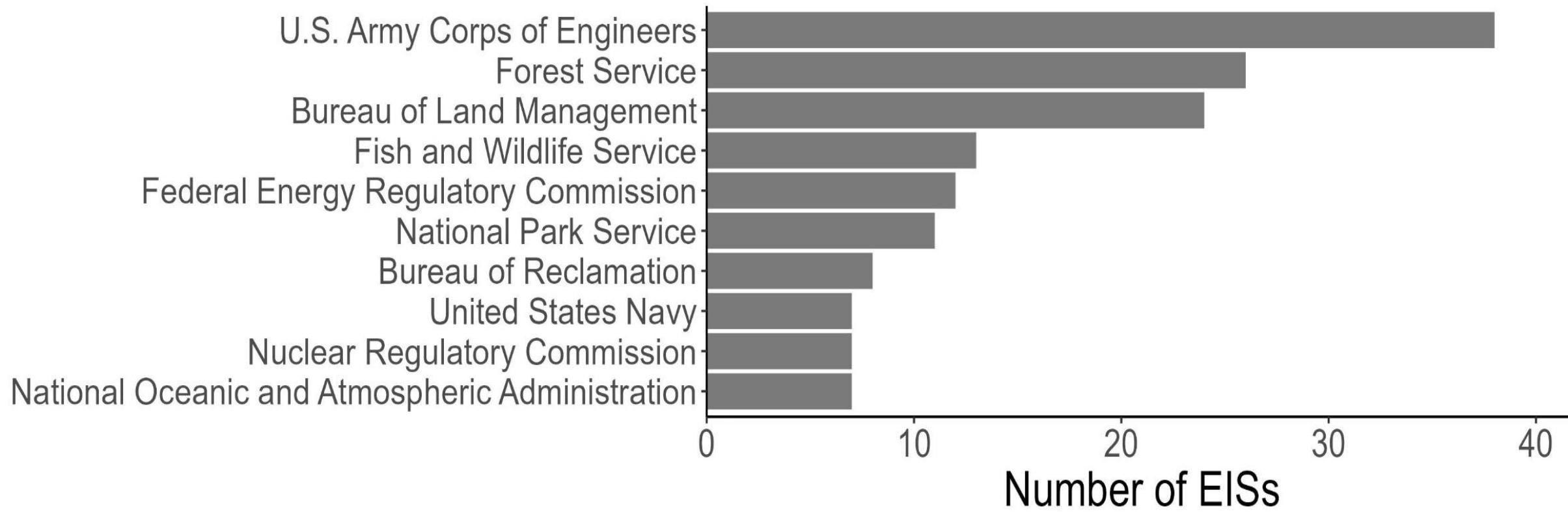
- Citizen science
- Community science
- eBird
- iNaturalist

We searched 1,355 EIS documents of
which 228 were used in analysis





EISs using citizen science data were present across 45 agencies



Presence: “In eBird, there are 687 records of 969 [olive-sided flycatcher] individuals on the Inyo National Forest” (Forest Service 2019).

Absence: “No records of [Arkansas river shiner] have been submitted to iNaturalist (2021) from within or close to the landscape analysis area” (Rural Utilities Service 2022).

Definition: Citizen science methods were directly applied to identify species of interest in the EIS.

Definition: The use of citizen science methods in the EIS was unclear.

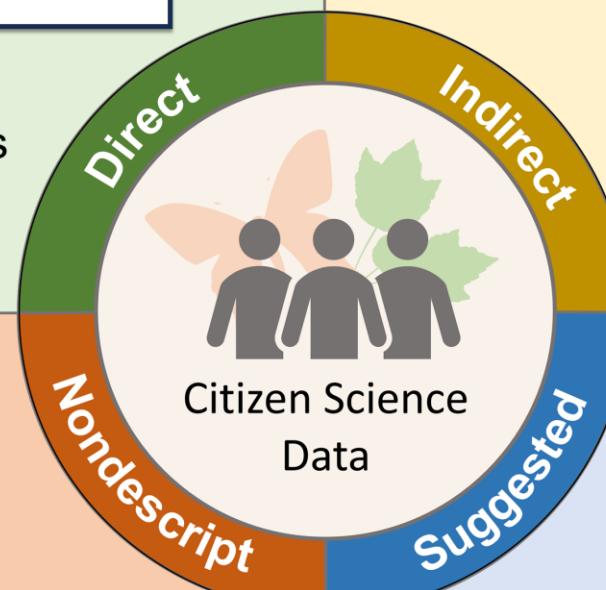
“Programs . . . offered . . . focus on historical/cultural resources (e.g., Carroll Homestead Tours) and natural resources (e.g., iNaturalist Walk)” (National Park Service 2019).

“[Rufa red knot] is generally restricted to ocean coasts during winter and occurs primarily along the coast during migration . . . (eBird 2019)” (DOS 2019).

Definition: Background or reference material obtained from a citizen science platform.

Definition: Citizen science methods were recommended or suggested to bridge data gap.

“The [National Bison Range] will use online, citizen science bird monitoring platform (eBird.org) for continued surveillance of occurrence” (Fish and Wildlife Service 2019).



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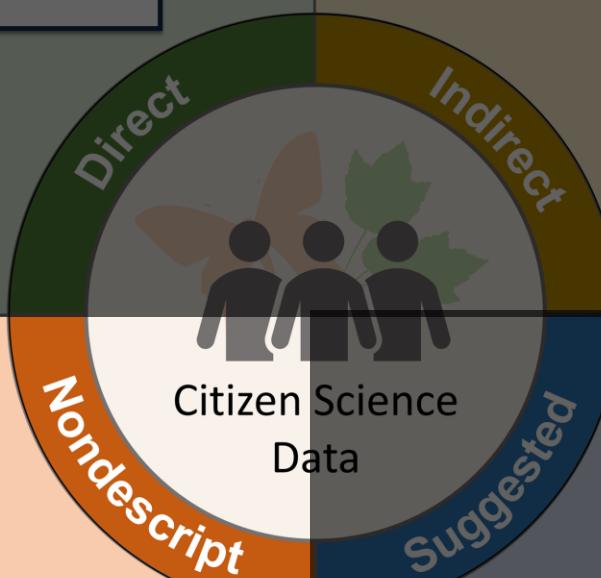
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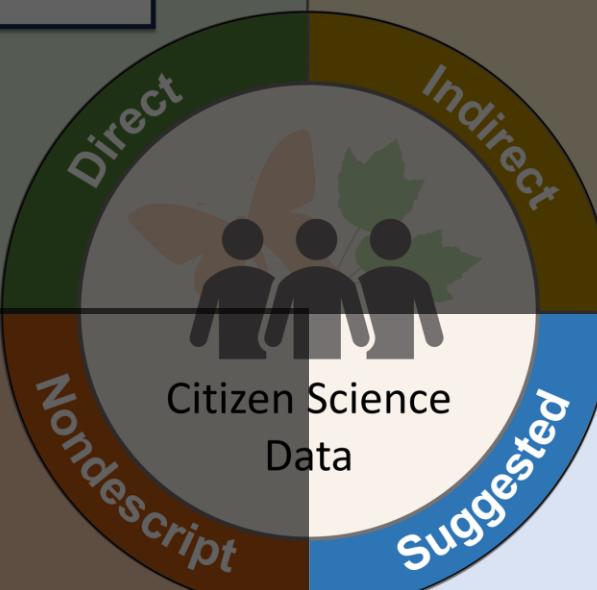
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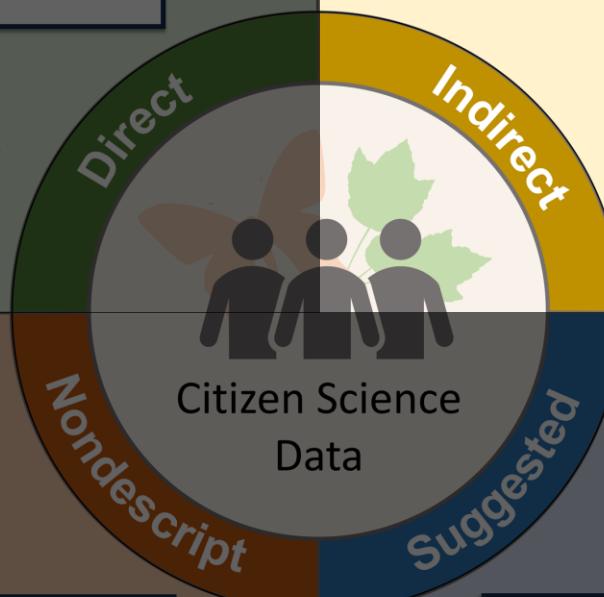
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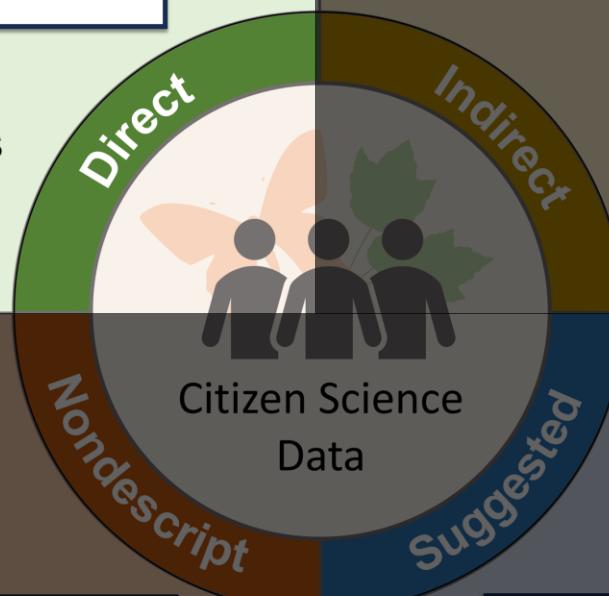
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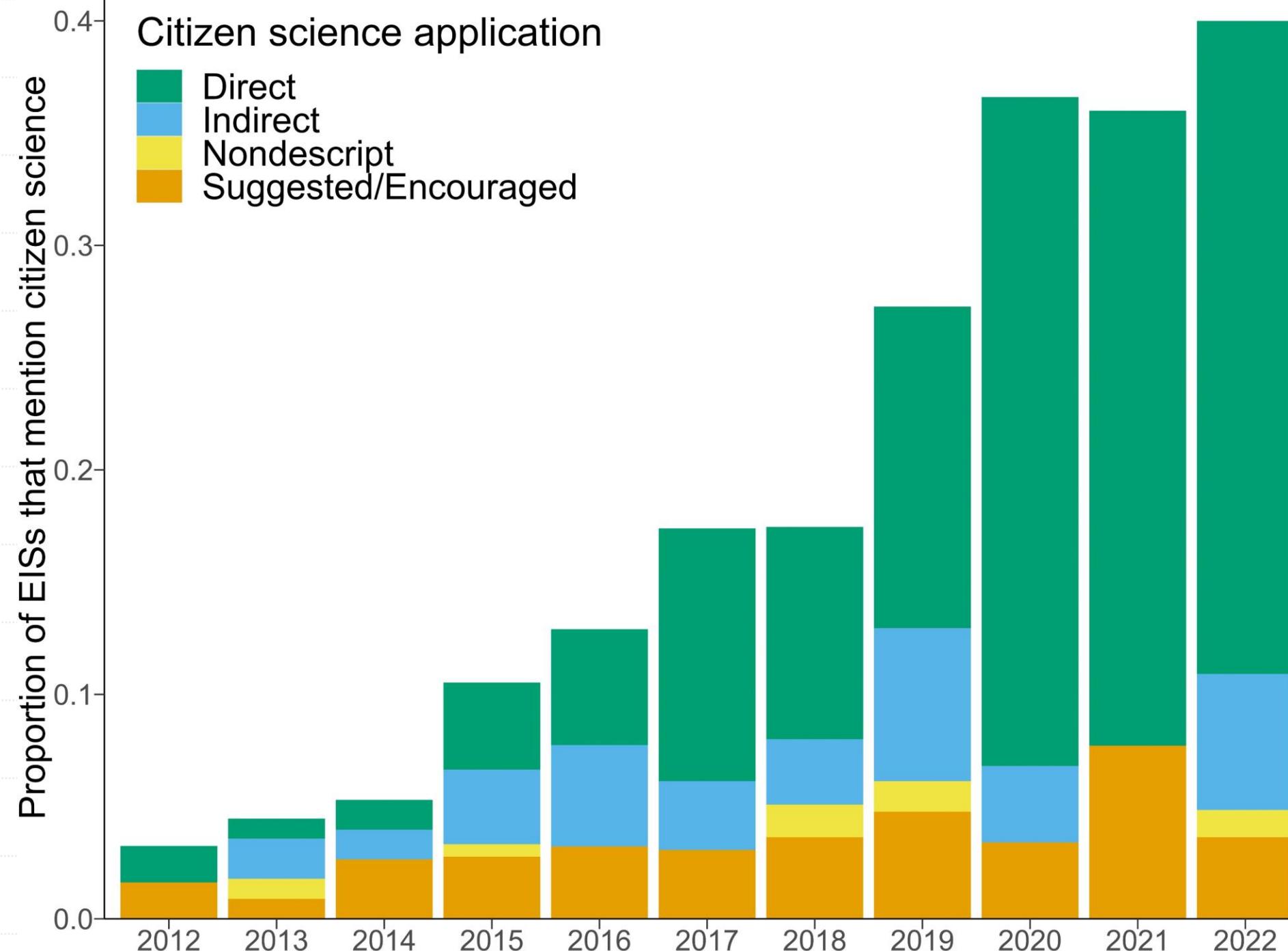
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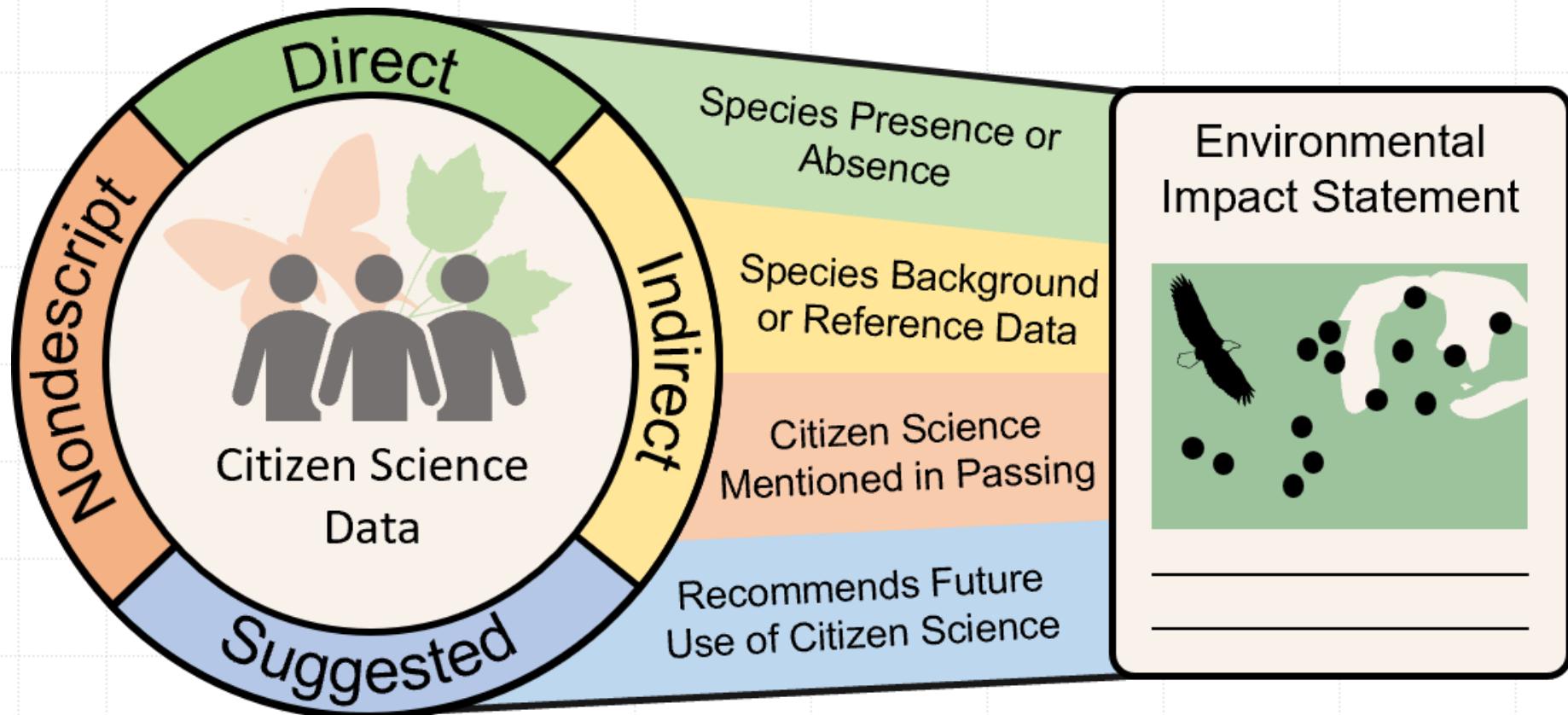
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Numbers



87% eBird 6%  iNaturalist

Observations

The World

Arkansas River Shiner

1 OBSERVATION 1 SPECIES

Map Grid List

Arkansas River Shiner
(*Notropis girardi*)

Nov '19

1

“No records of [Arkansas river shiner] have been submitted to iNaturalist (2021) from within or close to the landscape analysis area” (Rural Utilities Service 2022)

12% of all EIJs used no sighting of a species as evidence of absence of that species

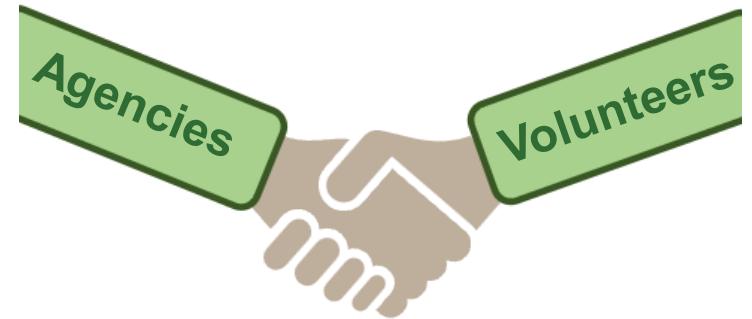
- Worthy of future discussion
- Not clear how they accounted for sampling effort or the iNaturalist location buffer for threatened species

Future of Citizen Science in Environmental Review

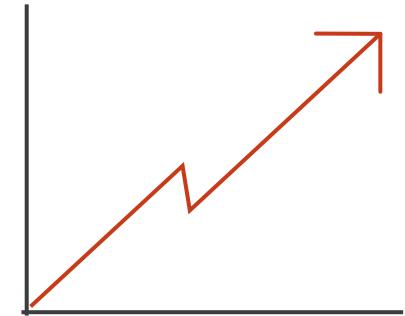
Our results show increasing use and future potential of citizen science in environmental review



Value of Citizen Science in Environmental Review



Agencies interacting with volunteers



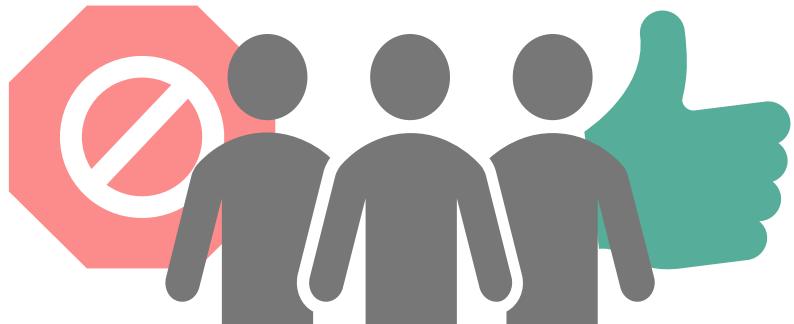
More Data



Increased public engagement

Future of Citizen Science in Environmental Review

The future of citizen science use in environmental consulting is worthy of further discussion



Consider the extent that citizen science participants are willing to share data



- Nuanced understanding of the data
- Appropriate statistical analyses

Ensure conclusions are scientifically sound

Take home messages



Citizen science democratizes the data gathering process, potentially leading to more informed and inclusive environmental governance.



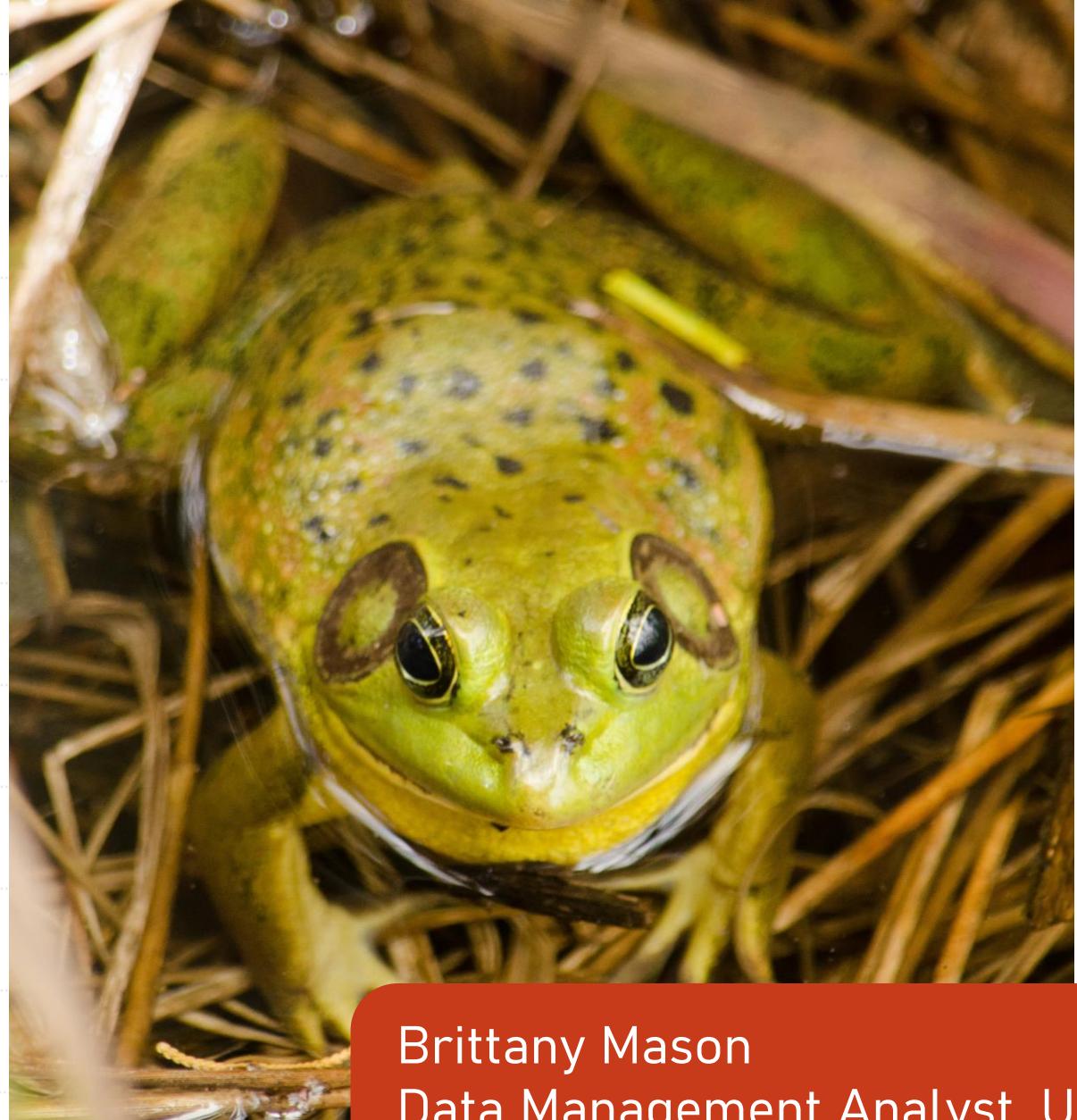
Broader adaptation requires considerations around data validity, participant engagement, and policy alignment.



Our work highlights the transformative potential of citizen science in bridging the gap between community involvement and ecosystem service conservation.



Thank you!



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