



Inventory and Monitoring Resources for Midwest SWAPs and Regional Conservation Planning

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Midwest Landscape Initiative

By

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The Midwest Landscape Initiative (MLI) is a collaborative of organizations in the 13 states of the Midwest Association of Fish and Wildlife Agencies (MAFWA) that identifies shared conservation priorities and co-develops solutions for healthy, functioning ecosystems in the Midwest. One of the purposes of MLI is to help coordinate voluntary conservation actions throughout the region, including through support of State Wildlife Action Plans and their implementers.

In 2021, the State Wildlife Action Plan (SWAP) and Landscape Conservation Working Group of the Association of Fish and Wildlife Agencies (AFWA) prepared the [Leading At-risk Fish and Wildlife Conservation: A Framework to Enhance Landscape-Scale and Cross-Boundary Conservation through Coordinated State Wildlife Action Plans](#) (AFWA 2021). The first Guiding Principle of this guidance recommends that states “Identify and apply regional and shared approaches for development, implementation and measuring [the] progress of SWAPs, to improve effectiveness, efficiency, cost-savings, and consistency” (AFWA 2021, p. 5).

Each Guiding Principle in the landscape report has specific Recommended Actions, associated outcomes, and a recommended implementation framework. Recommended Actions for Guiding Principle 1 include (AFWA 2021, p. 13):

- 1.4** Promote the development of shared science, data, research, and monitoring protocols.
- 1.5** Use consistent metrics and reporting tools to evaluate conservation effectiveness.

The AFWA Best Practices for SWAPs similarly recommends that states utilize standardized monitoring protocols where available, collaborate with existing monitoring programs and regional associations at multiple scales, and consider engaging partners and community science programs to expand capacity for monitoring (AFWA 2012). The 2024 [Voluntary Lexicon and Best Practice Recommendations for Midwest State Wildlife Action Plans](#) (SWAPs) provides standardized and/or shared resources for each of the eight SWAP elements, including Element 5 for inventory and monitoring (MLI and Terwilliger Consulting, Inc. [TCI] 2024).

MLI compiled the following supplemental collection of inventory and monitoring resources to inform Midwest SWAPs and regional conservation planning, adapting and updating a similar collection of resources prepared for the Northeast Association of Fish and Wildlife Agencies (TCI and Northeast Fish and Wildlife Diversity Technical Committee [NEFWDTC] 2023). Many of these inventory and monitoring programs and projects have collected years to decades worth of information on the fish and wildlife resources of the Midwest and their associated habitats, threats, and conservation actions, which expand their contributions as monitoring programs to also serve as data resources to inform evaluation of status and trends for species populations and habitat condition.

This document organizes inventory and monitoring programs first by scale, and then subdivides by type and organizing entity. Use the table of contents below to find programs of interest.

Table of Contents

I.	<u>INTERNATIONAL INVENTORY & MONITORING (I & M) PROGRAMS</u>	4
II.	<u>NATIONAL I & M PROGRAMS</u>	5
A.	ENVIRONMENTAL PROTECTION AGENCY (EPA)	5
B.	UNITED STATES FISH AND WILDLIFE SERVICE (USFWS)	7
C.	UNITED STATES GEOLOGICAL SURVEY (USGS)	9
D.	UNITED STATES FOREST SERVICE (USFS)	11
E.	NATIONAL PARK SERVICE (NPS)	12
F.	NATURAL RESOURCES CONSERVATION SERVICE (NRCS)	13
G.	UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)	13
H.	UNITED STATES ARMY CORPS OF ENGINEERS (USACE)	14
I.	BUREAU OF LAND MANAGEMENT (BLM)	15
III.	<u>TRIBAL I & M PROGRAMS</u>	16
IV.	<u>REGIONAL I & M PROGRAMS</u>	17
A.	SPECIES-BASED I & M REGIONAL RESOURCES	17
B.	HABITAT-BASED I & M REGIONAL RESOURCES	18
C.	THREAT-BASED I & M REGIONAL RESOURCES	19
D.	ACTION-BASED I & M REGIONAL RESOURCES	21
V.	<u>STATE I & M PROGRAM EXAMPLES</u>	22
A.	SPECIES-BASED I & M STATE RESOURCES	22
B.	HABITAT-BASED I & M STATE RESOURCES	23
C.	THREAT-BASED I & M STATE RESOURCES	24
D.	ACTION-BASED I & M STATE RESOURCES	25
VI.	<u>NON-GOVERNMENTAL ORGANIZATION AND COMMUNITY SCIENCE I & M EXAMPLES</u>	26
A.	SPECIES-BASED I & M RESOURCES	26
B.	HABITAT-BASED I & M RESOURCES	28
C.	THREAT-BASED I & M RESOURCES	29
D.	ACTION-BASED I & M RESOURCES	30
	REFERENCES	37

I. International Inventory & Monitoring (I & M) Programs

- The [North American Breeding Bird Survey](#) is a partnership between the United States Geological Survey (USGS) and Canadian Wildlife Service to monitor the population status and trends of birds across the continent with standardized protocols.
- The [International Shorebird Survey](#) is a volunteer-based range-wide survey during the spring and fall migration periods of shorebirds that began in 1974. Standardized monitoring protocols are available to guide participants.
- Partners in the Program for Regional and International Shorebird Monitoring (PRISM) developed [international nonbreeding shorebird monitoring standards](#) in 2018 to increase consistency among shorebird monitoring programs across the Western Hemisphere (PRISM 2018).
- The US and Canada jointly conduct the aerial [Waterfowl Breeding Population and Habitat Survey](#) to monitor the population status and trends of 19 North American duck or species groups. The United States Fish and Wildlife Service (USFWS) produces annual [Waterfowl Population Status Reports](#) that provide long-term monitoring information dating to 1955.
- The [North American Bird Conservation Initiative \(NABCI\)](#) is a conservation partnership that collaborates on the conservation of 1150+ bird species. The [NABCI Monitoring Subcommittee](#) provides technical expertise, monitoring best practices, and monitoring protocols for avian species.
 - NABCI partners prepare [State of the Birds](#) reports every two years that monitor the long-term population trends of 250+ bird species.
- The [American Woodcock Singing-ground Survey](#) is an international monitoring partnership between the US and Canada that annually surveys the breeding population of American Woodcock to monitor the species' population status and trends at the continental scale.
- The [Motus Wildlife Tracking System](#) is an international program that uses nanotag technology to track and monitor migratory wildlife via a network of 1550+ telemetry receiver stations located in at least 34 countries across five continents, targeting species that are too small for satellite tracking equipment. Monitoring data are publicly available through an [online database](#) maintained by Birds Canada.
- The [North American Bat Monitoring Program](#) monitors multiple species of bats across North America using standardized monitoring protocols. Monitoring data and

population status and trends information are available online through an interactive [NABat Partner Portal](#), which is managed by the USGS.

- The [Global Lake and River Ice Phenology Database](#), which is maintained by the National Snow and Ice Data Center, collects monitoring data on ice cover, freeze dates, and breakup dates for 865 Lakes and Rivers across the Northern Hemisphere, with 66 water bodies having more than 100 years of records. Other data included in this database provide information on power plant discharges, shoreline length, water depths, watershed size, conductivity, secchi depth, surface area, and other physical features.
- [Conservation Evidence](#) offers a searchable database of the documented effectiveness of conservation actions, with [synopses](#) for individual taxonomic groups, habitats, and types of management.
- The *Open Standards for the Practice of Conservation*, or [Conservation Standards](#), developed by the Conservation Measures Partnership is an open-source set of best conservation practices and principles for planning, monitoring, and management (CMP 2020).
- For international Great Lakes resources shared by the US and Canada, see Section IV below for Regional I & M Programs.

II. National I & M Programs

A. Environmental Protection Agency (EPA)

- The [Report on the Environment](#) measures dozens of environmental, biological, and physical indicators to monitor the condition of the environment and human health over time at the national level. Indicators address air quality, water quality, water quantity, ecological condition, environmental contaminants, human health, disease, and more.
- The [National Coastal Condition Assessment](#) uses standardized monitoring protocols to monitor the condition of the Great Lakes and other coastal environments of the United States (U.S.), with condition assessment reports issued every five years.
 - The [Sanitary Survey App for Marine and Fresh Waters](#), developed by the EPA in 2021, is a mobile app that allows the public and communities to monitor and export recreational beach water quality with the input of community scientists.

- The [National Wetlands Condition Assessment](#) monitors the physical, chemical, and biological integrity condition of the nation’s wetlands using standardized indicators, with assessments published every five years.
- The [National Rivers and Streams Assessment](#), prepared every five years, monitors the water quality and ecological conditions of the nation’s rivers and streams.
 - [StreamCat](#) is an EPA database of condition data on over 2.65 million stream segments throughout the conterminous U.S., with over 600 spatial metrics of natural and anthropogenic variables.
 - The EPA has developed *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers* that guide monitoring of fish, benthic macroinvertebrates, and periphyton (Barbour et al. 1999, US EPA 2007, US EPA 2022). The original 1999 biomonitoring standards include the known regional pollution tolerances of hundreds of species of fish, mussels, crayfish, odonates, mayflies, stoneflies, caddisflies, and other aquatic species (Barbour et al. 1999). The most recent 2023 standards focus on protocols and technical guidance for the National Rivers and Streams Assessment (US EPA 2022).
- The [National Lakes Assessment](#) monitors the condition of over 378,000 lakes, ponds, and reservoirs, issuing condition assessments every five years.
 - [LakeCat](#) is an EPA database of condition data on 378,088 lakes in the conterminous U.S., with over 300 spatial metrics of natural and anthropogenic variables.
- The EPA monitors [Climate Change Indicators in the United States](#) at the national scale, with more than 50 indicators that monitor the causes and effects of climate change such as species range shifts, snow and ice cover, lake and stream temperature, streamflow, wildfire, plant growth, agricultural growing season, infectious disease, and severe weather events.
- The EPA issues [National Water Quality Inventory Reports](#) every two years that monitor water quality, with an inventory of waters that are impaired due to pollution.
 - The [Assessment and Total Maximum Daily Load Tracking and Implementation System \(ATTAINS\)](#) is the EPA national database for state assessment reports on the status of impaired surface waters.
 - The [How’s My Waterway?](#) online platform provides public access to water quality monitoring data in the ATTAINS database at community, state, and national scales.

B. United States Fish and Wildlife Service (USFWS)

- The Midwest Fisheries Center and its [La Crosse Fish Health Center](#) surveys, inspects, and researches fish health for Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. The [Bozeman Fish Health Center](#) provides these programs for Kansas, Nebraska, North Dakota, and South Dakota.
- The [National Fish Health Survey](#) monitors pathogens in wild aquatic animal populations with real-time surveillance.
 - The [National Wild Fish Health Database](#) includes monitoring data since 1997 on the presence or absence of aquatic animal pathogens to inform management of hatchery and wild fish populations.
 - The [National Wild Fish Health Survey Mapper](#) is an online spatial tool of the National Wild Fish Health Database that allows users to explore and download data of interest.
- The [National Fish Passage Program](#) recently launched a data dashboard that monitors conservation projects removing barriers to fish passage and restoring aquatic connectivity that have been funded through the Bipartisan Infrastructure Law, with an online map exploration tool for the entire U.S. and its territories.
- The [USFWS Fish Passage Field Survey Manual](#) describes protocols for inventorying aquatic barriers to fish passage.
- The USFWS Fish and Aquatic Conservation Program and many other federal, state, and non-governmental partners maintain The national [Aquatic Barrier Inventory and Prioritization Tool](#) monitors the status of aquatic connectivity barriers, allowing partners to explore, identify and prioritize projects through an interactive map viewer that address aquatic barriers from dams to culverts and waterfalls.
- The [Waterfowl Breeding Population and Habitat Survey](#) (also known as the Breeding Population Survey) monitors breeding waterfowl populations in the U.S. and Canada annually, with monitoring data for 22 North American waterfowl species or species groups since 1955.
 - Annual [Waterfowl Population Status Reports](#) based on the Breeding Population Survey are available in a library collection that monitors population status and trends.
- The [North American Bird Conservation Initiative \(NABCI\)](#) and its Monitoring Subcommittee have developed best practices and protocols for bird monitoring programs.

- [State of the Birds](#) reports are prepared every two years by the USFWS, NABCI, and partners to monitor the long-term trends of bird populations.
- The [American Woodcock Singing-Ground Surveys](#) monitors the breeding population of American Woodcock throughout the U.S. and Canada, with annual population status reports.
- The USFWS and partners monitor four populations of [Sandhill Cranes](#) each year using seasonal surveys that vary with the population. The Mid-Continent Population and Eastern Population occur within the MAFWA region, with the former surveyed during the breeding and pre-migration season in late March and the latter surveyed during fall migration. The USFWS issues annual population status and survey reports, with the [Eastern Population Sandhill Crane Data Portal](#) also providing an interactive observation map.
- The annual [National Migratory Bird Harvest Survey](#) monitors the harvest of migratory birds and associated hunting information to inform decision-making of state and federal hunting seasons.
 - The [Parts Collection Survey](#) collects wings and tail feathers of birds from hunters to monitor bird sex and age ratios for 27 species.
- The [National Survey of Fishing, Hunting, and Wildlife-Associated Recreation](#), conducted approximately every five years since 1955, monitors demographic and economic trends in outdoor recreation, hunting, and fishing across the U.S.
- The [National Wetlands Inventory](#) monitors the status and trends of the nation's non-tidal wetlands, riparian wetlands, and tidal wetlands and flats with geospatial datasets and periodic status and trends reports.
- The [Prairie Reconstruction Initiative](#), a partnership led by the USFWS, has developed monitoring protocols for reconstructed prairie grassland habitat and maintains a database of prairie reconstruction projects.
- The [National Resource Program Center](#) of the USFWS conducts inventory and monitoring programs of National Wildlife Refuges and their natural resources, including responses to management actions.
 - The Wildlife Health Office of the National Resource Program Center, in partnership with the National Wildlife Health Center of the U.S. Geological Survey (see below), monitors wildlife health, wildlife morbidity and mortality events, harmful algal blooms, and animal diseases that have the potential to spread to humans.

C. United States Geological Survey (USGS)

- The USGS Biological Threats and Invasive Species Research Program monitors several biological threats at the national level.
 - The [Nonindigenous Aquatic Species Database](#) has spatially referenced biogeographic accounts of each species, with distribution maps, spatial datasets, and scientific reports. The USGS is currently accepting eDNA genetic material monitoring data into the database.
 - The [Flood and Storm Tracker \(FaST\)](#) integrates the Nonindigenous Aquatic Species Database with storm surge and flood events information to assess the potential spread of nonindigenous freshwater species due to flooding associated with storms.
 - The [Invasive Species Habitat Tool \(INHABIT\)](#) provides an online interactive national map of known and modeled distributions for selected species of interest with risk management information.
- The USGS launched development of [Siren: The National Early Detection and Rapid Response \(EDRR\) Information System](#) in 2023 to collate EDRR data and information products from federal, state, local, and academic partners who monitor, assess, and manage invasive species. Recent and planned resources include surveillance resources, mapped results of surveillance activities, a project portal, and an [Invasive Species Experts Database \(iSED\)](#).
- The USGS [National Wildlife Health Center](#) partners with state, tribal, other federal agencies, and academic institutions to conduct disease surveillance, diagnostic services, and holistic research studies.
 - The Center facilitates information sharing to quickly identify and mitigate wildlife health issues through the Wildlife Health Information Sharing Partnership, or [WHISPers](#), event reporting system.
 - The Center maintains an online [index of wildlife disease information sources](#), including quarterly monitoring reports on wildlife mortality.
- The [Amphibian Research and Monitoring Initiative \(ARMI\)](#) of the USGS monitors the status and trends of amphibian populations, recently publishing a [State of Amphibians in the US](#) report.
 - The ARMI maintains an online [National Amphibian Atlas](#) that monitors the known distribution of amphibians across the US, which can be searched by species, state, or county.
 - The ARMI recently initiated a [national surveillance monitoring program](#) for the infectious chytrid fungal pathogen *Batrachochytrium salamandrivorans* (Bsal).

- The USGS Bird Banding Laboratory at the Eastern Ecological Science Center manages a monitoring program for bird band sightings, through the [North American Bird Banding Program Bander Portal](#).
- The USGS developed the [iPlover](#) mobile app that systematically collects information about beach and dune habitat and their surrounding environments.
- The USGS, USFWS, US Army Corps of Engineers and other partners conduct an annual [Midwinter Bald Eagle Survey](#) in early January, monitoring long-term population status and trends of Bald Eagles since 1979 with standardized survey techniques.
- The USGS [Native Bee Inventory and Monitoring Lab](#) designs and develops small- and large-scale native bee surveys, developing identification tools and keys for native species.
- [Nature's Notebook](#) tracks seasonal changes in plants and animals across the US in a citizen science project sponsored by the USGS and the National Phenology Network.
- The [National Waterflow Dashboard](#) allows exploration of more than 13,500 USGS monitoring stations and associated real-time data for the nation's streams, lakes, reservoirs, and groundwater.
- The [Water Quality Portal](#), operated by the National Water Quality Monitoring Council in partnership with the USGS, EPA and more than 400 other data sources, provides downloadable water quality monitoring data for any selected location in the country.
- The [National Groundwater Monitoring Network Data Portal](#) compiles data from groundwater monitoring wells across the United States, with more than 17,700 water level wells and 4150 water quality wells participating in the network as of mid-2024.
- The USGS National Water Information System's [Water Data for the Nation](#) collates water resources monitoring data from all 50 states, the District of Columbia, and five territories into one tool.
- [StreamStats](#) provides statistics on streamflow and spatial analysis tools for water resources applications. Users select an area of interest from an interactive online map, delineate a catchment area of interest, select parameters of interest (e.g., basin characteristics), and download a summary report.
- The [National Modeled Water Atlas](#) is a new monitoring information resource for water availability, quality, and use that provides nationally consistent datasets of past and future conditions at the HUC12 level over multiple decades.
- The [Flow Photo Explorer](#) is an online platform developed by the USGS, EPA, and other partners to engage community scientists and researchers to monitor

streamflow and other hydrologic conditions in rivers, riparian zones, lakes, and other waterbodies using timelapse imagery from remote cameras. Monitoring imagery submitted to the database are modeled with machine learning to develop continuous streamflow and other hydrological data for a location of interest, with results publicly available on the platform.

- [CrowdHydrology](#) is a USGS public project that engages citizen scientists to submit water level data from stream gaging staffs or stations to the CrowdHydrology database via text messages. The database is publicly available for researchers, students, resource managers and others to explore and use.
- The USGS [Dam Removal Information Portal \(DRIP\)](#) monitors dam removal projects in the US and offers a searchable database of scientific studies that evaluate the environmental response of dam removals.
- The USGS monitors flooding and drought conditions, maintaining current flood and streamflow conditions through its online [WaterWatch](#) platform. The [Flood Event Viewer](#) provides geospatial monitoring information on specific flood and storm events.
- The Fire Science program of the USGS works to improve scientific understanding of wildland fires to inform decision-making by fire and land managers. The [Intterra National Fire Situation](#) map tool monitors current wildfires and provides related information for each in an interactive online map.
- The USGS is a partner with the US Forest Service (USFS) and other federal agencies in remote sensing monitoring of the landscape through [LANDFIRE](#) spatial datasets of land cover and wildfire related information.
- The USGS Landslide Hazard Program has developed an inventory of landslides across the US, recording the date, causes, number of fatalities, and a confidence rating for each landslide. The [US Landslide Inventory](#), most recently updated in 2019, is available with an interactive online map viewer.
- Other monitoring programs conducted by the USGS include those dedicated to climate change, natural hazards, shoreline erosion, and energy development. Information from these inventory, monitoring and research programs and projects are available through the [Science Data Catalog](#).

D. United States Forest Service (USFS)

- The national [Forest Inventory and Analysis \(FIA\) Program](#) collects, analyzes, and reports information on the status, trends, and conditions of US forests since 1930. The FIA includes the:

- [Nationwide Forest Inventory](#) of permanent plots of forested lands,
- [National Resource Use Monitoring](#) survey of manufacturers,
- [National Woodland Owners Survey](#),
- [Urban Inventory](#) program to monitor urban forests, and
- [forest and grassland carbon](#) monitoring program.
- The USFS [Wildfire Hazard Explorer](#) portal contains the spatial footprints and associated metadata for known wildfire risk, threat, hazard, and burn probability maps, inventorying the resources available for wildfire data.
- The USFS provides technical assistance to state and private forestry programs, including guiding the development of State Forest Action Plans that are required to incorporate SWAP priorities. [State Forest Action Plans](#) are updated every ten years with an inventory and assessment of each state’s forested lands, along with needed conservation strategies. The USFS maintains a searchable inventory of [Landscape Scale Restoration Projects](#) funded by the Landscape Scale Restoration Grant Program to implement State Forest Action Plans and other forest and woodland conservation priorities.
- The [Reforestation, Nurseries and Genetic Resources Program](#) is a collaborative partnership sponsored by the US Forest Service to share technical information with land managers and nurseries related to the production and planting of trees and other native plant species for reforestation, restoration and conservation of forests and woodlands. Numerous guidelines and resources have been developed by the Program and its partners, including a [Propagation Protocol Database](#) and the [Native Plant Network](#).
- The USFS [Urban and Community Forestry Program](#) assesses the status of urban and community forests with ten-year Urban and Community Forestry Action Plans and five-year Benchmark Reports.

E. National Park Service (NPS)

- The National Park Service maintains several [inventory and monitoring programs](#) at each of its 32 Inventory and Monitoring Networks across the country. The Midwest region is covered by three separate NPS inventory and monitoring networks:
 - [Great Lakes Inventory and Monitoring Network](#)
 - [Norther Great Plains Inventory and Monitoring Network](#)
 - [Heartland Inventory and Monitoring Network](#)

F. Natural Resources Conservation Service (NRCS)

- The NRCS maintains an [inventory of state plant lists](#) that are available online.
- A [Conservation Innovation Grant project database](#) supported by the NRCS provides a searchable inventory of more than 1700 natural resource conservation projects across the US.
- The Natural Resources Conservation Service [RCA Data Viewer](#) provides a tool to graph, map, and download customizable datasets based on survey data and the best practices applied to private agricultural and forestry lands throughout all their federal conservation programs. The RCA Data Viewer includes data on best practices, acres in conservation, easement programs, financial assistance programs, and land use trends at the state and county level.

G. United States Department of Agriculture (USDA)

- The Animal and Plant Health Inspection Service (APHIS) of the USDA conducts animal disease surveillance of both wildlife and agricultural and aquacultural animals through the [National Animal Health Surveillance System](#).
- The APHIS [National Wildlife Disease Program](#) protects the nation's natural and agricultural resources from emerging pathogens through monitoring and surveillance.
- The [National Veterinary Services Laboratories](#) monitors animal diseases, offers diagnostic services, and hosts an international reference library for animal diseases of importance to the Americas.
- The USDA maintains the [Plant List of Attributes, Names, Taxonomy, and Symbols \(PLANTS\) Database](#). This inventory provides a standardized information about the vascular plants, liverworts, mosses, lichens, and hornworts of the US and its territories. The [2020 National Wetland Plant List](#) identifies wetland indicator species (8000+) and is included in the PLANTS Database with species profile pages, searchable by region.
- The [National Invasive Species Information Center](#) is within the USDA, providing invasive species information from local, state, federal, and international sources.
 - An [Invasive Species Profiles List](#) for aquatic and terrestrial species declared as invasive, noxious, prohibited, or otherwise harmful or potentially harmful in the United States. Species profiles include taxonomy, imagery, native

range, the date of introduction to the US, how it was introduced, current known distribution, and the location of any quarantine areas.

- The [Early Detection and Distribution Mapping System \(EDDMapS\) app](#), recently expanded to cover the entire US, provides identification information for top invasive species and an observation reporting system. The EDDMapS Pro app allows professionals to download offline invasive species map data.
- The USDA National Agricultural Statistics Service monitors agricultural lands with [CropScape](#), an interactive online mapping tool and associated data layer of cropland across the country. Datasets are available for every year starting from 1997 and distinguish croplands by type (e.g., corn, cotton, rice, soybeans), pasture, wetlands, forest, developed, and other land cover types.
- The National Statistics Service conducts a [Census of Agriculture](#) every five years that is a complete count of all farms and ranches in the country, with the most recent census from 2022 now available. A series of atlas maps illustrate the data from the Census of Agriculture and are publicly available. Census of Agriculture data are available by state, county, tribal reservation, watershed, and zip code.
- The USDA conducts regular [monitoring assessments and evaluations](#) of the agency's programs and initiatives, such as bird conservation benefits from the Conservation Reserve Program, the benefits of prairie strips and saturated buffers, Mississippi River basin or Prairie Pothole benefits from the Conservation Reserve Program, water quality and quantity studies, pollinator studies, and other wildlife studies (e.g., grassland birds, amphibians).
- The USDA maintains a [Satellite Imagery Archive](#) and aerial photography of agricultural lands in the US, which generally includes non-agricultural land areas as well. Historical aerial photography is available dating back to 1955, and in some areas even older. An interactive online map shows the availability of historical imagery at the county level.

H. United States Army Corps of Engineers (USACE)

- The USACE launched a public [Harmful Algal Bloom \(HAB\) Explorer](#) tool online in 2024 that provides near real-time spatial monitoring of freshwater systems (primarily lakes, reservoirs, and ponds) for relative estimations of chlorophyll *a*, a water quality indicator of HABs.
- The USACE maintains a [National Levee Database](#) that is searchable by location or levee name for over 6,600 levees across the US. Data are available for levee name, location, ownership, construction year, wall height, flood source, and

authorization. Detailed summary reports for each levee provide information on flooding hazard, property and communities protected, levee condition, levee dimensions, adjacent tribal lands, and whether any endangered species live behind the levee.

- The USACE monitors water level, streamflow, precipitation, and temperature conditions in the Missouri River basin in real-time, providing hourly data through the [Missouri River Water Management](#) program.
- The USACE annually monitors the federally-listed Piping Plover, Interior Least Tern, and Pallid Sturgeon within the Missouri River system as part of the agency's [Missouri River Recovery Program](#).
- The USACE monitors and manages aquatic invasive species through its [Watercraft Inspection and Decontamination Program](#) in the Upper Missouri River Basin; Upper Colorado, South Platte, and Arkansas River Basins; and US-Canada Border Authority States. The USACE also monitors the presence of terrestrial and aquatic invasive species on their public lands.

I. Bureau of Land Management (BLM)

- The BLM has an [Assessment, Inventory and Monitoring \(AIM\) Strategy](#) that sets monitoring standards for natural resources on public lands owned by the federal agency. Standardized field survey methods are available for grasslands, shrublands, savannas, rivers and streams, riparian zones and floodplains, and wetlands. Monitoring data and ecological assessments are available online with an interactive mapping and data exploration tool on the BLM [AIM Data Viewer](#).
- The BLM has initiated multiple [Rapid Ecoregional Assessments](#) (REA) at the landscape scale, with the Northwestern Plains REA and Southern Great Plains REA partially within the MAFWA region. Monitoring and assessment data, maps, models, and reports produced by the agency for each REA are available through a [REA data hub](#) online.
- The [Seeds of Success](#) project is a collaboration led by the Bureau of Land Management to collect and bank native plant seeds at the national scale to increase the availability and supply of seeds for restoration projects. Since 2000, the project has collected seeds from more than 5,600 plant species across 43 states.
- The BLM maintains an [inventory of active and approved renewable energy projects](#) on public lands as well as an inventory of recent and upcoming lease sales.

- The Oil and Gas Program has an [inventory of oil and gas lease information](#) on federal lands, including successful reclamation projects and orphaned wells.
- The [Mineral & Land Records System](#) records mineral rights and realty transactions and tracks, maps, and manages associated data for the for the BLM. Datasets available include land status, land use authorizations (e.g., rights-of-way, leases, easements), mineral and land activity, designated Areas of Critical Environmental Concern, mining claims, and lease information for oil, gas, and geothermal resources.
- The BLM maintains an online, interactive [inventory of outcome based grazing demonstration projects](#).
- The BLM manages public rangelands for multiple uses and has an online [Rangeland Resources](#) collection of monitoring guidelines, protocols, and resources for rangeland, wetland, lentic, lotic, and riparian habitats.
- The [Air Resource Management Program](#) monitors air quality impacts from its authorized activities and the effectiveness and efficiency of monitoring analyses.
- The [Abandoned Mine Lands and Hazardous Material Management Programs](#) monitor BLM managed lands for environmental contamination from past activities on those public lands.

III. Tribal I & M Programs

- The [Great Lakes Indian Fish and Wildlife Commission](#) and its eleven Ojibwe tribes in Minnesota, Wisconsin, and Michigan provide natural resource management expertise, legal and policy analysis, conservation enforcement, and public information services throughout treaty ceded territories. Environmental education materials and technical reports are available, including materials on monitored threats to fish and wildlife resources, invasive species control, cumulative impacts assessments of proposed pipeline construction projects, and application of climate change adaptation frameworks to Tribal lands.
- The Native Lands Advocacy Project and [Native Land Information System](#), established in 2019 and sponsored by the Indian Land Tenure Foundation, Native American Agriculture Fund, and Village Earth, includes five thematic hubs of information, with all of the project's datasets available in the [Native Land Data Portal](#):

- The [Agriculture Resource Management Plans – Integrated Resource Management Plans Planning Portal](#) is a toolkit for Tribal Resource Management Plans, enabled by the American Indian Agricultural Resource Management Act of 1993.
- The [Food-System Transition Index for US Native Land](#) is a tool of 20 key indicators that measure the transition to healthy food-systems in support of sustainable Tribal land use planning.
- The [Lost Agriculture Revenue Database](#) helps to quantify the impacts of land cessions and discriminatory agriculture policies of the US government by allowing more than 175 years of county-level agriculture census data to be disaggregated into smaller blocks, facilitating data re-aggregation for areas that overlap county boundaries.
- The [Native Agriculture](#) hub collates datasets and other resources to inform the current extent, demographics, and potential for expanding agriculture on Indigenous lands.
- The [Status of Native Lands](#) collects data resources to inform assessment of the US Bureau of Indian Affairs’ management of lands and subsurface mineral estates held in trust for Indigenous peoples and Tribes.
- The [Native Land Digital](#) platform is a global map of the best available information on the extent of Indigenous territories but does not represent the current legal boundaries of those territories. For each territory on the map, there is an associated resource with Tribal links, related maps, information sources, a list of updates or changes to the known extent of the territory, and a place to submit corrections.
- The [Institute for Tribal Environmental Professionals \(ITEP\)](#) has extensive resources for Indigenous natural resource management on climate change, air and water quality standards, clean transportation, status assessments, and more.

IV. Regional I & M Programs

A. Species-based I & M Regional Resources

- The [Great Plains Bumble Bee Atlas](#) is a partnership between the USFWS and Xerces Society to use community science to track and conserve native bumble bees across Kansas, North Dakota, and South Dakota using standardized survey protocols.

- The [Midwest Bumble Bee Atlas](#) is a partnership between the USFWS and Xerces Society to use community science to track and conserve native bumble bees across Minnesota, Missouri, Nebraska, and Iowa using standardized survey protocols.
- The USFWS and regional partners monitor the Aransas / Wood Buffalo Whooping Crane migration population along the Central Flyway, tracking spring and fall migrations to assess migration progress, the status of banded or radioed individuals, and potential safety issues to address.
- Bird Conservancy of the Rockies and regional partners annually monitor the status and trends of North American bird populations across western North America through the [Integrated Monitoring in Bird Conservation Regions](#) program.
- The [Great Lakes Fishery Commission](#) monitors fish populations and habitat within the Great Lakes, producing [State of the Lake Reports](#) every five years. Committees and Task Forces focused on individual lakes and/or species prepare [annual reports](#).
- The [Great Lakes Acoustic Telemetry Observation System \(GLATOS\)](#) is similar to Motus but is aquatic, also using acoustic telemetry and a network of monitoring stations on the lakebeds of the Great Lakes and some of its tributaries to monitor the movements of tagged fish. A [searchable index](#) of monitoring projects and species is publicly available for each of the Great Lakes.
- The Midwest Partnership in Amphibian and Reptile Conservation (PARC) maintains a resource library on amphibian and reptile resources in the region and its [Cricket Frog Task Team](#) is monitoring the status and current distribution of Blanchard's Cricket Frogs.
- The [Mid-America Monarch Conservation Strategy](#) is updated periodically to incorporate monitoring information and the status of habitat conservation implementation in an adaptive management framework. The Monarch Conservation Database is managed by the USFWS and contains an inventory of conservation actions planned or implemented since 2014.

B. Habitat-based I & M Regional Resources

- The [Great Lakes Observing System \(GLOS\)](#) is a network of monitoring stations through the Great Lakes and their watersheds, part of the Integrated Ocean Observing System. Monitoring data on physical, biological, and biogeochemical

- indicators are shared publicly through the Seagull and GLOS apps managed by the [Smart Great Lakes Initiative](#), a partnership between the US and Canada.
- The [Great Lakes Cooperative Science and Monitoring Initiative](#) is a coordinated effort between the EPA and Environment and Climate Change Canada federal agencies to fill data gap priorities identified in Lakewide Action and Management Plans under the Great Lakes Water Quality Agreement, rotating field years among the five Great Lakes.
 - The [Great Lakes Fishery Commission](#) monitors fish populations and habitat within the Great Lakes, producing [State of the Lake Reports](#) every five years. Committees and Task Forces focused on individual lakes and/or species prepare [annual reports](#).
 - Two National Estuarine Research Reserves (NERR) are located in the MAFWA region, the [Lake Superior NERR](#) and [Old Woman Creek NERR](#) on the Great Lakes. Each NERR has a management plan and maintains a collection of survey, monitoring, and management resources for their landscape.
 - The National Fish Habitat Partnership monitors the condition of fish habitat across the US every five years with a series of [National Fish Habitat Assessments](#). A [framework for assessing habitat](#) and a [standardized operating procedure for data sharing](#) are available.
 - Several regional Fish Habitat Partnerships (FHP) focus on particular sub-regions within the Midwest have developed strategic conservation plans that include research and monitoring needs. As these plans are implemented, habitat assessment reports are periodically developed:
 - [Great Lakes Basin FHP](#)
 - [Great Plains FHP](#)
 - [Midwest Glacial Lakes Partnership](#)
 - [Ohio River Basin FHP](#)
 - [Fishers & Farmers Partnership for the Upper Mississippi River Basin](#)

C. Threat-based I & M Regional Resources

- The [Midwest Invasive Species Information Network](#) (MISIN) has an online reporting tool and smartphone app where the public can report observations of invasives species, facilitating regional scale monitoring, early detection, and rapid response to new invasive species. Invasive species survey and control projects funded by the [Michigan Invasive Species Grant Program](#) are reported to MISIN, facilitating monitoring of conservation actions across that state.

- The [Invasive Carp Regional Coordinating Committee](#) monitors the spread of invasive carp (i.e., Bighead, Black, Grass, and Silver Carp) to prevent their establishment in the Great Lakes and the Mississippi River basin. The [Monitoring and Response Work Group](#) of the interagency committee coordinates monitoring, response, control, and management actions in the Chicago Area Waterway and Illinois River, such as using eDNA monitoring for early detection.
- The [Great Lakes Aquatic Nonindigenous Species Information System \(GLANSIS\)](#) monitors the presence and distribution of nonindigenous aquatic species in the Great Lakes of the US and Canada, with a “one-stop shop” of monitoring data, maps, risk assessments, and related resources.
- The Great Lakes Commission, with support from the USGS, has developed three regional collaborative partnerships to inventory, monitor, and address threats in the Great Lakes basin:
 - The [Great Lakes Harmful Algal Blooms Collaborative](#) monitors and addresses the threats and information needs of harmful algal blooms in the Great Lakes.
 - The [Great Lakes Phragmites Collaborative](#) develops and shares resources to identify, map, monitor, and adaptively manage for the non-native forms of *Phragmites* in the Great Lakes basin.
 - The [Invasive Mussel Collaborative](#) monitors, conducts research, manages, and controls invasive freshwater mussels throughout the Great Lakes system.
- The [Great Lakes Regional Water Use Database](#) maintains an inventory of water withdrawals, diversions, and consumptive uses in the basin, implementing portions of the Great Lakes – St. Lawrence River Basin Water Resources Compact and Great Lakes – St. Lawrence River Basin Sustainable Water Resources Agreement.
- The USGS Integrated Water Science program is undertaking high-density monitoring and research programs in ten regional river basins across the country, including the Illinois River basin in the Midwest. The [Next Generation Water Observing System \(NGWOS\)](#) in the Illinois River basin will enhance and expand water quality monitoring and associated harmful algal blooms at high temporal and spatial resolution.
- The [Midwest Climate Adaptation Science Center](#) maintains an inventory of resources related to climate change in the region, from assessments of long-term trends in changing environmental conditions to the latest research on biological responses to those changing conditions.

- The [Upper Mississippi River Restoration Program](#) partnership of federal and state agencies monitors the ecological status and trends of the Upper Mississippi and Illinois Rivers with indicators for fish, aquatic vegetation, water quality, invertebrates, land cover, bathymetry, and other metrics.

D. Action-based I & M Regional Resources

- The Monarch Conservation Database is managed by the USFWS and contains an inventory of conservation actions planned or implemented since 2014, which inform periodic updates to the adaptive management framework of the [Mid-America Monarch Conservation Strategy](#).
- The [Great Lakes Restoration Initiative \(GLRI\)](#) monitors performance measures for conservation projects funded by the regional program, with focus on toxic substances and areas of concern, invasive species, nonpoint source pollution impacts on nearshore health, species and habitats, and foundations for future restoration actions. The GLRI publishes annual reports on monitoring of conservation progress.
- The Great Lakes Commission's [Blue Accounting](#) framework and interactive map tracks regional progress on meeting the shared goals of the Great Lakes Water Quality Agreement.
- The National Fish Habitat Partnership maintains an inventory of conservation projects implemented or underway for more than ten years, annually identifying [Waters to Watch](#) that are implementing the National Fish Habitat Action Plan.
- The US Departments of Agriculture, Defense, and Interior established the [Sentinel Landscapes Partnership](#) in 2013 to collaborate in areas where conservation, national defense interests, and working lands converge in high priority areas. The partnership shares a tracking inventory of conservation projects and environmental and land use information for each Sentinel Landscape online to the public and partners. In the Midwest, the [Camp Ripley Sentinel Landscape](#) consists of more than 805,000 acres of lands and waters in the northern Mississippi River basin of Minnesota. The [Southern Indiana Sentinel Landscape](#) in Indiana encompasses over 3.5 million acres, including four military installations, three National Wildlife Refuges, one National Forest, and 61 state parks, forests, fish and wildlife areas, and nature preserves.
- The Northern Great Plains Joint Venture collaborates with partners and private landowners to monitor the impacts of conservation actions on grasslands, in part by maintaining an inventory of conservation projects supported by the

[Northern Grassland Restoration Incentive Program \(N-GRIP\)](#). To date more than 1,751 acres of grassland have been restored and nearly 55,000 acres managed across four states.

- The [JV8 Central Grasslands Conservation Initiative](#) is a regional partnership of eight migratory Joint Ventures across North America that has developed an inventory of needed conservation actions that are monitored for implementation.
- The [Prairie Pothole Region Landscape Conservation and Restoration Project](#) is a multi-state, landscape scale project led by the USFWS and partners to enhance, restore, and/or reconstruct at least 15,000 acres of grasslands and 5,000 acres of wetland habitat. The USFWS tracks implementation of actions funded by the Inflation Reduction Act towards this regional effort.

V. State I & M Program Examples

A. Species-based I & M State Resources

- The [Wisconsin Aquatic and Terrestrial Resources Inventory](#) partnership manages a [Citizen-based Monitoring Network](#). [Citizen-based monitoring projects and programs](#) through the Wisconsin DNR and partners include:
 - The [Wisconsin Breeding Bird Atlas](#) comprehensively surveyed 1,283 priority and specialty Atlas blocks over a five-year period with over 2,000 volunteers. The Wisconsin Society for Ornithology summarizes results of the Atlas data, which were collected via eBird using [set protocols](#).
 - Since 1981 the [Wisconsin Frog and Toad Survey](#) has used [standardized protocols](#) to monitor amphibians along annual survey routes.
 - A [Carnivore Volunteer Tracking Program](#) engages citizens in conducting wolf track surveys.
 - [Snapshot Wisconsin](#) is a volunteer-based project to monitor wildlife year-round with a statewide network of trail cameras.
 - The [Wisconsin Odonata Survey](#) allows the public to submit observations of dragonflies and damselflies in partnership with the Wisconsin Dragonfly Society.
 - The [Wisconsin Mussel Monitoring Program](#) offers training materials and standardized survey techniques for citizen volunteers to assist in monitoring freshwater mussels across the state.

- Iowa has developed a [Multiple Species Inventory and Monitoring \(MSIM\) program](#) which uses a randomized sampling design to select representative habitats, from which statewide inferences can be made about wildlife in Iowa. An associated MSIM Technical Manual describes standardized monitoring protocols for multiple taxa and habitats (Iowa Department of Natural Resources 2016).
- The [Michigan Herp Atlas](#) engages community volunteers to monitor reptile and amphibian species to monitor population and wildlife health trends across the state.
- The [Michigan Natural Features Inventory \(MNFI\)](#) conducts several rare species and natural community monitoring projects, including citizen science projects:
 - The public can report [observations of rare species](#) in Michigan online or through a Survey123 field app.
 - The [Vernal Pool Patrol](#) community science program uses standardized protocols to survey vernal pool habitats with data collected in the Michigan Vernal Pool Database.
 - The [Michigan Bumble Bee Atlas](#) community science project follows a standard protocol developed by the Xerces Society to inventory the bumble bee species in the state and their associated habitat.
 - The [Osprey Adopt-A-Nest](#) program engages volunteers to monitor Osprey nests and track the reproductive success of nesting pairs.
 - Marsh Bird Surveys are conducted using the [North American Marsh Bird Monitoring Protocols](#) developed by the USGS.
 - Standardized protocols, modified as needed for Michigan, guide monitoring surveys for Blanding’s Turtle (American Turtle Observatory 2017), Eastern Spotted Turtle (Spotted Turtle Working Group 2019), and Wood Turtle (Wilson 2013).
 - Surveys for rare butterflies on Michigan state lands follow a survey protocol for Poweshiek Skipperling, [Mitchell’s Satyr](#), and [Karner Blue](#).
- The [Wild Turkey Brood Survey](#) monitors turkey populations in Michigan and other states annually in July and August with standardized protocols and data collected by Michigan DNR and the [National Wild Turkey Federation](#).

B. Habitat-based I & M State Resources

- Iowa has developed [Fish Habitat Indicators for the Assessment of Wadeable, Warmwater Streams](#) that correlates environmental indicators of the physical stream habitat with a Fish Index of Biotic Integrity as part of the state’s stream bioassessment program (Wilton 2015), with associated [standardized operating](#)

[procedures](#) for monitoring the indicators (Iowa Department of Natural Resources 2015).

- The [Michigan Natural Features Inventory \(MNFI\)](#) conducts several rare species and natural community monitoring projects, including citizen science projects:
 - The public can report [observations of rare species](#) in Michigan online or through a Survey123 field app.
 - The [Vernal Pool Patrol](#) community science program uses standardized protocols to survey vernal pool habitats with data collected in the Michigan Vernal Pool Database.
- The Michigan Department of Natural Resources (MI DNR) monitors inland lakes with several agencies and local partners in accordance with an [Inland Lakes Monitoring Strategy](#).
- The [Minnesota – Wisconsin Wetland Functional Assessment Initiative](#) developed wetland assessment tools and protocols that inform wetland conservation, planning, and regulatory management.
- The Wisconsin Department of Natural Resources (WI DNR) and partners have developed and implement several vegetation community monitoring protocols such as for [Oak Woodlands](#), [Oak Openings](#), [Pine Barrens](#), and [Oak Barrens](#).

C. Threat-based I & M State Resources

- The Michigan DNR [Eyes in the Field](#) project provides a reporting mechanism for the public to submit information on diseased wildlife, invasive plants and algae, and poaching as well as observations of mammals, fish, birds, reptiles and amphibians, and insects.
- Michigan’s [Watch List of invasive species](#) encourages the public to report observations and early detections of designated invasive species, with identification information for each.
- The Wisconsin [Aquatic Invasive Species Program](#) encourages the public to monitor for aquatic invasive species and submit observations to inform early detection monitoring in a [Wisconsin First Detector Network](#).
- The [Eyes on the Forest](#) project is a citizen science project sponsored by Michigan State University to select and monitor healthy sentinel trees across Michigan and to assist in the identification of invasive pest outbreaks of three priority species: Asian Longhorned Beetle, Hemlock Woolly Adelgid, and Spotted Lanternfly.

- The [Michigan DNR Wildlife Disease lab](#) monitors wildlife diseases, with an online public reporting form and an inventory of wildlife disease resources.
- The [Illinois Biological Stream Rating System](#) evaluates and ranks stream health based on biological diversity, integrity indices, and biological significance using data from multiple taxonomic groups, with a formal designation of Biologically Significant Streams (Illinois Department of Natural Resources 2008).
- The [Michigan Clean Water Corps](#) partnership coordinates three programs that incorporate community scientists with state and local government agencies and non-profit organizations to monitor freshwater habitats:
 - The [Volunteer Stream Monitoring Program](#) supports volunteer stream monitoring groups across the state by providing technical and financial assistance as well as training in standardized data collection protocols for monitoring macroinvertebrates and habitat conditions in wadeable rivers and streams.
 - The [Cooperative Lakes Monitoring Program](#) monitors the water quality of inland lakes with more than 40 years of monitoring data collected by community scientists.
 - The Volunteer Stream Cleanup Program provides funding for local governments to sponsor public litter cleanups in riparian habitats, with an online [inventory of funded cleanup projects](#) since 2005.
- The Michigan DNR Fisheries Division has a statewide Status and Trends monitoring program for inland lakes and streams using standardized protocols to survey key habitat variables and conduct fish community assessments, with an online [Stream Evaluator](#) and [Stream Fish Population Trend Viewer](#).
- Michigan DNR Fisheries Division has survey protocols for monitoring freshwater mussels during construction projects or water level drawdowns to inform regulatory mitigation measures.

D. Action-based I & M State Resources

- The Lower Mississippi Alluvial Valley Joint Venture (LMVJV) Forest Resource Conservation Working Group developed guidance for *Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat*, which describes priority wildlife species and habitat conservation objectives along with recommended forest inventory and breeding bird monitoring indicators for assessing forest habitat condition (LMVJV Forest Resource Conservation Working Group 2007).

- The Michigan DNR Wildlife Division annually conducts [hunter surveys](#) to monitor game species management, with annual reports dating to 1930 available online.
- The [Michigan Fishing Information System](#) centralizes fishing resources information for the public in an online, interactive map viewer that includes an inventory of lakes, rivers and streams, boat access sites, hatcheries, and management regulations.
 - Fish stocking activities are monitored in an online [Fish Stocking Database](#).
 - Monitoring of fishing conditions across the state are provided in a [weekly fishing report](#) to the public.
- Michigan forests can be certified for forestry management standards, with an [inventory of certified forest land](#) managed by the Michigan DNR Forest Resources and Wildlife Divisions. Certified forests are monitored to evaluate state forest plan implementation and forest condition, and [monitoring reports](#) and associated biodiversity and ecological information provided online.

VI. Non-governmental Organization and Community Science I & M Examples

A. Species-based I & M Resources

- [Project FeederWatch](#) uses standardized procedures to annually monitor bird distribution and abundance during the winter months at the continental scale. Sponsors the Cornell Lab of Ornithology, Birds Canada, and Wild Birds Unlimited produce population status and trends reports based on the monitoring project data.
- The [Audubon Christmas Bird Count](#) annually monitors bird populations between December 14 and January 5 at designated locations. Since 1901 the National Audubon Society produces [annual summary reports](#) based on the monitoring data.
- [Global Big Day](#) is an international bird monitoring annual event led by the Cornell Lab of Ornithology that collects bird observations through eBird during 24 hours of a single selected day associated with World Migratory Bird Day.
- The [Great Backyard Bird Count](#) is a global four-day bird monitoring event held annually in February and is sponsored by the Cornell Lab of Ornithology, National Audubon Society, and Birds Canada.
- Partnering with the Cornell Lab of Ornithology and others, the National Audubon Society launched the [Bird Migration Explorer](#) resource in 2022 that aggregates

millions of bird observation data into an interactive map to illustrate the migratory paths and stopover sites for hundreds of bird species.

- The [Urban Wildlife Information Network](#) aims to make cities better for humans and wildlife through an alliance of urban wildlife scientists in communities across the US and Canada. The Network shares research and monitoring information to improve the understanding of urban wildlife and the relationships people have with them. Resources developed by the Network include standardized monitoring protocols, training tools, and educational programming for all ages.
- [Fish Watchers](#) is a public project by the International Game Fish Association to create a national fish biodiversity database for the United States (called [FishBase](#)) by allowing the public to submit records of fish that have been seen or caught.
- The North American Butterfly Association's [Butterfly Count](#) annually collects butterfly observations across more than 450 count circles across North America, with monitoring data available from 1993 to the present.
- Journey North enlists volunteers to track the spring and fall migrations of Monarch, Monarch reproduction, and the presence of milkweed using survey protocols as part of their [Monarch Migration & Milkweed Phenology Project](#).
- The [Monarch Watch Tagging Program](#) led by Monarch Watch annually monitors the fall migration of Monarch through mark and recapture monitoring by community scientists across North America.
- The [Nebraska Monarch and Regal Fritillary Survey](#) annually tracks both species across Nebraska with community scientists using a survey protocol.
- The Xerces Society offers numerous [identification and monitoring guides](#) for citizen scientists to monitor bees, Lepidoptera, dragonflies, freshwater mussels, aquatic macroinvertebrates, and pollinator plants. Conservation biologists with the Xerces Society developed [survey protocols and guidance](#) for public agencies to facilitate monitoring of at-risk invertebrate species and their habitats on public lands; monitor the effectiveness of pollinator habitat restoration projects; and provide training to agency staff and citizen scientists on pollinator identification and monitoring.
- The [Migratory Dragonfly Partnership](#) is a citizen-science project supported by the Xerces Society, US Forest Service, and other partners to engage the public in documenting observations of migratory dragonflies in the US, Canada, and Mexico. A data collection protocol, standardized datasheet, and field guide are provided to interested participants.

- The [Lost Ladybug Project](#) is a citizen science-based project to monitor the distribution of native and non-native ladybug species across North America, with more than 39,000 observations collected as of September 2024.

B. Habitat-based I & M Resources

- The [Resilient Land Mapping Tool](#) developed by The Nature Conservancy is an inventory of representative climate-resilient locations to sustain biodiversity across the conterminous US. Datasets include terrestrial habitat resilience, recognized biodiversity values, Indigenous lands, habitat connectivity and networks, climate flow, landscape fragmenting features, geophysical settings, secured lands for conservation, forest and soil carbon, and land cover.
- The [Resilient River Explorer](#) is an inventory of freshwater habitat condition and resiliency for rivers, streams, and lakes across the conterminous US. Developed by The Nature Conservancy, the online resource includes a spatial inventory of dams, functionally connected stream networks, freshwater resilience assessments at the HUC12 scale, freshwater and riparian biodiversity assessments, and more. Users can define dam removal scenarios to evaluate resiliency impacts.
- The [Karst Waters Institute](#) is dedicated to improving the understanding of karst water systems through scientific research and education. As part of that mission, the organization provides access to [multiple datasets](#) (e.g., updated lists of terrestrial cave-obligate species), [databases](#) (e.g., a digital map of karst areas in the US, subterranean species diversity maps for cave dwelling species), and publications (e.g., techniques for monitoring groundwater in karst terrains). The [Karst Information Portal](#) is an open-access digital library.
- The [National Cave and Karst Research Institute](#) is a non-profit organization created by the US Congress to support cave and karst research, management, and data sharing. As part of this effort, the Institute is developing standards for characterizing, monitoring, and protecting karst and pseudo-karst resources. The organization maintains a [National Cave Sample Archive](#) and provides open, online access to cave and karst research materials and publications.
- The [Lake Observations by Citizen Scientists and Satellites \(LOCSS\)](#) project asks citizen scientists to submit lake water level measurements to ground-truth satellite measurements, allowing for a better understanding of how the quantity of water in lakes changes over time at the global scale. Monitored lakes include several in Illinois and Ohio.

- Since 1992 community scientists have participated in monitoring lake habitats in Missouri as part of the [Lakes of Missouri Volunteer Program](#).

C. Threat-based I & M Resources

- The [Global Learning and Observations to Benefit the Environment \(GLOBE\) Program](#), an international citizen science initiative sponsored by the National Aeronautics and Space Administration, engages the public in numerous environmental monitoring projects:
 - The [GLOBE Observer: Trees](#) project engages the public to measure tree heights and circumferences using a smartphone app to document changes in forest biomass.
 - The [GLOBE Observer: Land Cover](#) project recruits the public to “adopt a pixel” to photograph and identify land cover to ground-truth remote sensing imagery, including grass, trees, pavement, outcrops, or bare soil.
 - The [GLOBE Observer: Hydrosphere](#) project focuses on community science monitoring of surface waters with water quality and freshwater macroinvertebrate observations and measurements.
- The [Global Lake Ecological Observatory Network \(GLEON\)](#) monitors the water quality of Lakes worldwide as well as the rivers and streams connected to them. Using the Lake Observer mobile app, research and citizen scientists record geo-referenced data on weather, water quality, ice cover and aquatic vegetation. As of September 2024, Lake Observer observations are being collected in Minnesota, Wisconsin, Michigan, and Ohio in the Midwest region.
- The North American Lake Management Society conducts an annual Secchi Dip-In event when volunteers can gather data on lake water quality and submit it to the [Secchi Dip-In Online Database](#).
- The [Big Microplastic Survey](#) is a global project to gather information on plastic pollution along the shorelines of lakes, rivers and coastal areas. Citizen scientists use standardized methods to document the presence and abundance of plastic within five small sample sites within one 25-meter length of shoreline.
- [Great Lakes Worm Watch](#) involves the public in monitoring the distributions of exotic earthworms and their impacts to forest ecosystems in the Great Lakes region.

D. Action-based I & M Resources

- The Nature Conservancy developed the (non-public) [Seeds of Resilience](#) tool in 2020 to aggregate data on the locations of native prairie plants and seed sources across Minnesota, North Dakota, and South Dakota to assist in prairie restoration projects.
- The [Chronolog Environmental Monitoring Project](#) at Indiana Dunes State and National Parks invites visitors to the parks to crowdsource time lapse photographic imagery at five stations to inform restoration of designated ecosystems.

Citizen and community science project directories are available at citizenscience.gov, scistarter.org and anecdata.org. Table 1 lists species databases currently available from non-governmental, academic, and citizen science inventoring and monitoring programs and projects, modified from TCI and NEFWDTC (2023).

Table 1. Numerous non-governmental and citizen science databases are publicly available online that contain inventory, monitoring, and status information on fish and wildlife resources of the Midwest, modified from TCI and NEFWDC (2023).

Informational Database	Location and Description
Discover Life	<p>https://www.discoverlife.org/</p> <p>International database and encyclopedia of plant and animal species observations and profiles for more than 1.4 million species with 822,000+ known distribution maps.</p>
FishBase	<p>https://www.fishbase.se/search.php</p> <p>International database of 35,000+ fish species profiles with taxonomy, location, conservation status, habitat, biological use, protection status, trophic ecology, life history, identification keys, citations, and imagery.</p>
Global Biodiversity Information Facility (GBIF)	<p>https://www.gbif.us/</p> <p>National species database for animals, plants, and fossils in the US and its Territories. More than 825 million observation records with taxonomy, occurrence status, location, date, issues and flags, source dataset, and publisher (e.g., USGS, NatureServe, NOAA). Previously known as the Biodiversity Information Serving Our Nation (BISON) database.</p>
Global Invasive Species Database	<p>http://www.iucngisd.org/gisd/</p> <p>International database of invasive species with species profiles that include taxonomy, species description, native distribution, alien distribution, impacts, life cycle stages, reproduction, spread pathways, management techniques, references, and photographs.</p>

Informational Database	Location and Description
iNaturalist	<p>https://www.inaturalist.org/</p> <p>Public observations of animal and plant species across the world, which are searchable by name or location with information on the seasonality, number, life stage, and sex of observations. Includes more than 411,000 species and 125 million observations contributed by 5.9 million people.</p>
Invasive and Exotic Species of North America	<p>https://invasive.org</p> <p>Database of invasive and exotic species profiles that include taxonomy, origin, life cycle, distribution, imagery, and invasive listing sources. Includes plants, insects, pathogens, and other species.</p>
ITIS	<p>https://www.itis.gov/</p> <p>Integrated Taxonomic Information System (ITIS) is the authoritative taxonomic information source on animals, plants, fungi, and microbes of North America and the world and is the taxonomic reference standard for RSGCN and the national SGCN database maintained by the USGS.</p>
IUCN Red List of Threatened Species	<p>https://www.iucnredlist.org/</p> <p>International Union for Conservation of Nature (IUCN) maintains a Red List of Threatened Species with comprehensive information on the global extinction risk status of animal, fungus, and plant species. Information on more than 153,000 species includes taxonomy, conservation status, status assessments, geographic range, population trends, habitat and ecology, threats, use and trade, and needed conservation actions.</p>

Informational Database	Location and Description
NatureServe Explorer	<p>https://www.natureserve.org/</p> <p>NatureServe Explorer includes detailed information on the taxonomy, distribution, conservation status, ecology, life history, population, management and monitoring needs, threats, habitat, and biological research needs of more than 100,000 species of plants, animals, and ecosystems.</p>
AmphibiaWeb	<p>https://amphibiaweb.org/</p> <p>AmphibiaWeb includes nearly 8600 amphibian species profiles from around the world that are searchable by species, location, taxa, or photograph. Species profiles in the database include taxonomy, distribution, reasons for decline, and conservation status.</p>
Amphibian Disease Portal	<p>https://amphibiandisease.org/</p> <p>International database monitoring the distribution of amphibian pathogens <i>Batrachochytrium dendrobatidis</i> (Bd) and <i>B. salamandrivorans</i> (Bsal).</p>
Birds of the World	<p>https://birdsoftheworld.org/bow/home</p> <p>International database of birds across the world with comprehensive life history profiles searchable by species or family. Includes identification, taxonomy, systematics, distribution, habitat, movements and migration, diet and foraging, sounds and vocal behavior, behavior, breeding, demography and populations, conservation and management, priorities for future research, and photographs. Integrated with eBird database.</p>

Informational Database	Location and Description
eBird	<p>https://ebird.org</p> <p>Public observations of bird species across the world, which are searchable by species name or location in a database that includes species maps, photographs, and sounds.</p>
Botanical Information and Ecology Network (BIEN)	<p>https://bien.nceas.ucsb.edu/bien/</p> <p>International database of georeferenced plant locations, plot inventories and surveys, species geographic distribution maps, plant traits, species-level phylogeny, and cross-continent, continent, and country-level species lists with more than 464,000 species.</p>
BugGuide	<p>https://bugguide.net/node/view/15740</p> <p>Database of insects, spiders, and related species with identification keys, imagery, taxonomy, and species profiles with information on range, habitat, season, food, and citations.</p>
Bumble Bee Watch	<p>https://www.bumblebeewatch.org/</p> <p>Database of 122,000+ observations of bumble bees and their nests across North America with verified identification of species, location, conservation status, observation date, and related information.</p>
Butterflies and Moths of North America (BAMONA)	<p>https://www.butterfliesandmoths.org/</p> <p>International database of Lepidoptera observations across North America with regional species checklists, taxonomy, and species profiles for more than 7000 species with distribution maps, identification, life history, flight, caterpillar hosts, adult food, habitat, conservation status, management needs, verified sightings, and imagery.</p>

Informational Database	Location and Description
eButterfly	https://www.e-butterfly.org/#/ Database of butterfly 491,000+ observations across North and Central America for 1,250+ species with species profiles including weekly frequency of observations, taxonomy, distribution, imagery, and citations.
Atlas of Common Freshwater Macroinvertebrates of Eastern North America	https://www.macroinvertebrates.org/#/ Database of freshwater macroinvertebrate species for eastern North America with identification keys, diagnostic characteristics, high resolution imagery, genus overview, habitat, pollution tolerance, feeding habits, movements, and distribution. Integrated with the PocketMacros app.
Mayfly Central	https://www.entm.purdue.edu/mayfly/ Database of Ephemeroptera (mayfly) species across North America, including records for 573 species in the US organized by taxonomy.
Ephemeroptera Galactica	https://www.ephemeroptera-galactica.com/index.php Catalog of Ephemeroptera (mayfly) resources including publications, checklists, specimen and collection lists, figure and photograph collections, and materials from the Permanent Committee of the International Conferences on Ephemeroptera.
Plecoptera Species File	https://plecoptera.speciesfile.org/ Database of Plecoptera (stonefly) species across the world, with annotated data on the taxonomy, distribution, specimen data, sounds, images, and bibliographic information for 8223 species.

Informational Database	Location and Description
Trichoptera Nearctica	https://trichoptera.org/ Database of Trichoptera (caddisfly) species in the US and Canada, with a distributional checklist, taxonomy, and a Trichoptera literature database.
Freshwater Mussel Host Database	https://mollusk.inhs.illinois.edu/57-2/ Database of more than 2700 known host interdependent relationships for freshwater mussels searchable by mussel or host species or family with location, data source, and natural or lab evidence for the relationship.
Nature's Notebook	https://www.usanpn.org/natures_notebook National database of 500,000+ phenology records for plants and animals tracking seasonal changes, with featured campaigns to track nectar sources for pollinators, the emergence of mayflies, flowers for bats, insect pests, and non-native invasive plants.
Odonata Central	https://www.odonatacentral.org/#/ Database of Odonata (dragonflies and damselflies) observations in the Western Hemisphere including species, location, date, level of confidence in identification, and imagery with more than 300,000 records.

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