Montana Natural Heritage Program Scope of Work Progress Report

Report for FY19

This report provides an overview of progress the Montana Natural Heritage Program (MTNHP) has made towards delivery of core service goals outlined in Appendix 1, Scope of Work (SOW) for operation of the MTNHP, under the Contract for Services between the Montana State Library and the University of Montana for state fiscal years 2018 and 2019 (award number 20171019). Core service goals were taken largely from the MTNHP Strategic Plan for 2015-2020 which received review from MTNHP staff, MSL staff, and state, federal, and private partners. The report lists the core service goals outlined in the core contract using a logic model of INPUTS (resources needed) → OUTPUTS (products produced) → OUTCOMES (patron use) → IMPACTS (impact on patrons) and then reports on them for FY19 using a series of metrics and the following color coding:

Green – activity progressing as expected.
Yellow – activity may be delayed but the delays do not necessarily rise to the level of concern
Red – activity is delayed and attention is warranted
Blue – addition or change to the original work plan

Funding for the staff and expertise required for the core service goals in this SOW is composed of Core, Supplemental Core, MSDI Core, and Project funding as defined below:

Funding Source Definitions

- **Core:** This funding represents the $657,419 included in the MSL-UM contract for "Essential Core Services." Examples of essential core services include: fulfilling information requests across all program disciplines, adding new data to program databases, administering and managing all program databases and systems, maintaining species status, maintaining and improving web delivery of information, and program administration.

- **Supplemental Core:** Funding provided by partners that contribute to the support of essential core services and information and may be allocated at the discretion of the Program for those essential core services. This funding is not specified or allocated in the MSL-UM contract and is provided by partners in recognition of inadequate state funding for essential core services. Examples include data compilation, species or community status reviews, data system maintenance, development of web pages and applications, answering user requests, and providing trainings on the use of MTNHP resources.

- **MSDI Core:** Montana Spatial Data Infrastructure (MSDI) funding is from the Montana Land Information Act account in accordance with the latest Montana Land Information Plan and is dedicated to Wetlands and Land Cover MSDI data development and coordination.

- **Project:** Funding that supports the overall mission of the program, but entails specific deliverable products for partners. Project funding does not allow discretionary spending by the Program and does not directly support essential core services. This funding is not specified or allocated in the MSL-UM contact. Examples include: requests for development of new datasets, web resources, or field surveys to address data needs such as assessments of the status of species or communities.

Impact - Partner Feedback

The ultimate impact of the information resources that are compiled and delivered by MTNHP are probably best measured through partner feedback and are provided here at the beginning of this Scope of Work Report. Partners have provided a great deal of positive feedback on the impact of MTNHP to their organizations through our request router survey, directly to staff who have assisted them, or to the Environmental Quality Council, individual Legislators, the Governor, and the State Budget Director in the past year. For mediated requests where patron's submitted a survey describing a their experience: (1) 100% of responses said they got the information they needed or even more information than they expected; (2) 85% or responses said the information would be very difficult to get elsewhere or was only available from the MTNHP; and (3) 100% or responses said they received the information on or before they date they requested it by. Written feedback in the past year includes the following:

- Just wanted to thank you for the information you sent. This is the first time I have requested an Environmental Summary and was not sure what to expect. I was impressed with the information provided. It is easy to interpret and professionally done. I complete wildlife consulting in other states and they provide services similar to this, but with an annual subscription rate and you have to do all the searches.
- An example of how Weyerhaeuser uses the NHP is in our implementation of the Sustainable Forestry Initiative (SFI). SFI is the largest forest environmental certification program in North America, enrolling 250 million acres. Mandatory performance measures within SFI require the use of regional databases on plant and animal distribution in resource management planning. NHP fits this requirement perfectly, providing not only site-specific locations of endangered and threatened species, but also map-based information that can be used to display and evaluate landscape scale implications of forest management programs. Weyerhaeuser recently collaborated with NHP, the Montana Tree Farm Program and others to produce a brochure on bat biology and habitat management for Montana's forest and woodlot owners. In summary, the NHP and NRIS provide valuable services to Montana's citizens, businesses, and landowners. In particular, the information compiled and distributed by NHP positively informs the management of Montana's fish, wildlife, and plant community resources. Weyerhaeuser supports the continued funding of NHP and NRIS to improve Montana's biological resource information.
- We often hear about the inefficiency of government, but I am here to tell you that the Montana State Library, and in particular the Montana Natural Heritage Program is an example of government that works. The data are the best in our region, it is available, easy to access, and the staff are courteous and efficient. In short it is the perfect example of what any business or state agency should aspire to.
- You set the bar high for customer service! Thanks for the help.
- Holy Cow that was fast! Thank you so much for the Environmental Summary Report!
- Thank you very much for the prompt response and data retrieval.
- Thanks for the quick turnaround!
- Thank you as always! That was quick, I'm talking record time….
- You all are always so timely - so appreciated.
- Thank you- I appreciate the thoroughness and quick response!
- Thanks for doing such a fast and thorough job. This is a really nice resource to have available and helps our fisheries management work considerably!
- Thank you for the report. I really like the format and detail that MNHP has incorporated into these now. As always, you guys are fast and extremely thorough!!
- Thank you for the information. As always the MTNHP produced an excellent set of data.
- Really love the Montana Field Guide Website, thank you for doing such good work on it and making it available for everyone.....

- Check it out! A watershed organization using the snapshot tool :-) The Ruby Valley Conservation District has used the Montana Natural Heritage Program's Species Snapshot Tool to create a field guide for the Mammal Species in the Ruby Valley. You can find it here!
- Thank you for getting me these data so quickly! I really appreciate all of your help. I will contact you if I have any additional questions.
- Found the attached document (Montana Bat and White-nose-Syndrome Surveillance Plan) on the internet - just wanted you to know it is HUGELY useful as someone just getting a bit serious about bat calls. Thanks!
- Saved 5 to 10 hours of my time that would have been spent combing through data online.
- I'm not sure of how to put a monetary value on the data, but access to data, like this, is essential to what we do.
- Very detailed and more specific to the area of interest than I could do on my own.
- Some information you have may have been available elsewhere, but time consuming and difficult to track down. Grateful for MTNHP's help on the phone and quick response to my online request!
- First time getting report, so it contained much more information that I had anticipated. Nice job!
- The excel spreadsheet summary is very valuable and helps to assess other areas besides the SOC.
- I expected it to take longer. I was very pleased with the prompt response!
- Was first time ordering an Environmental Summary for a project. Was very happy with amount of information provided. Very detailed, easy to interpret, and professionally done. Thanks!
- MNHP is always fast and thorough.
- This is a very valuable service - thank you!
- The MTNHP continually provide incredibly prompt services to my requests. I greatly appreciate how quickly staff respond and post the Env Summary Reports. Thanks!
- I am thankful for the data and services MTNHP provides. They make my job a little easier.
- I appreciate the quick responses and help from all of you. Keep up the great work!
- Very helpful!
- This service is incredibly valuable to me and to the agencies I work for. The site specific information really helps to focus environmental assessments and planning. Thank you!!
- Very fast friendly service

Sustainable funding is secured to achieve the statutory mission of the program			
Inputs	**Outputs**	**Outcomes**	**Impacts**
Program Coordinator and other staff time to summarize funding needs and mission status.	Communicate state core funding needs through the executive planning process and to the Montana legislature. Communicate supplemental core funding needs to State, local,	Montana's governor and legislature and State, local, federal, and nongovernmental partners recognize the importance of providing adequate core and project funding to maintain program staff, expertise, and information services.	Partners have complete trust and confidence that MTNHP information is comprehensive, up-to-date and authoritative on distribution, status, and general biology of all species and biological communities of the

State, local, federal, and nongovernmental partner input and support.	federal, and non-governmental partners that are dependent on MTNHP services. Empower partners to articulate the value of MTNHP information and data delivery services to help secure adequate funding.	Statutory mission of being "a program of information acquisition, storage, and retrieval for data relating to the flora, fauna, and biological community types of Montana" (MCA 90-15-102) is achieved for all species and biological communities of the state. All core staff positions are funded to work on the core mission of the program. Staff expertise can be recruited, retained, and enhanced.	state and can easily access this information to save time and money, speed environmental reviews, and inform decision making.

Metrics: core, supplemental core, and project funding applications and awards; staff recruitment and retention; partner feedback.

Core Funding

Core funding for the FY18-FY19 biennium was reduced by $230,808 to $657,419 as a result of passage of Senate Bill 261 by the 2019 legislature and a projected revenue shortfall. There has been a 56% reduction in buying power of core funding provided by the Montana legislature since FY08. On its own, core funding is now only able to fully support 3 of the program's 12 core services positions. The recent funding cuts caught the attention of the Environmental Quality Council (EQC). That interim legislative committee conducted a review of the program, explored several options to increase funding, and recommended that the Governor propose an increase in state funding for the program of $600,000 per biennium (EQC meeting archives can be accessed at http://leg.mt.gov/css/Committees/Interim/2017-2018/EQC/default.asp). During the 2019 Legislative Session, Representative's Llew Jones (committee chair), Bradley Hamlett, and other members of the Joint Appropriations Subcommittee on Education expressed a great deal of support for adequate funding of the program and programs of the State Library in general. Representative Hamlett, sponsored House Bill 633 which was passed by the full House and Senate and signed by the Governor. This legislation: (1) creates a special revenue account to fund digital library services at the State Library; (2) appropriates $100 to the account; and (3) directs the Legislative Finance Committee to conduct a study of a funding formula to adequately and fairly distribute the cost of administering and operating the National Resource Information System (including the Montana Natural Heritage Program) and other digital library services among state agencies and private or commercial entities during the 2019-2020 interim. The Education Subcommittee of the Legislative Finance Committee has scheduled the first discussions on this new funding model for September of 2019.

Supplemental Core Funding

MTNHP partners continued to be very supportive of the MTNHP during FY19. Partners provided $281,000 in supplemental core funding in FY19, an 85% match to state funding and within $1,500 of the supplemental core funding provided in FY18. The MTNHP is very grateful to the following partners for their financial support in FY19: Bureau of Land Management ($60,000), UM VP for Research and Creative Scholarship ($50,000), U.S. Forest Service ($45,000), NatureServe ($40,000), Natural Resource Conservation Service ($25,000), Montana Department of Agriculture ($20,000), Montana Department of Transportation ($10,000), Montana Land Information Act ($10,000), The Nature Conservancy ($10,000), Bonneville Power Administration ($6,000), and U.S. Fish and Wildlife Service ($5,000).

Project Funding

Staff have worked with partners to develop meaningful projects that support MTNHP's overall mission of documenting the distribution and conservation status of the plants, animals, and biological communities of Montana and making that information available to partners for environmental planning, review, and permitting efforts. Project funding levels in FY19 have been very consistent with recent years and will likely total around $1,000,000. Staff are currently managing about 45 partner sponsored projects along the lines of those outlined at http://mtnhp.org/about/projects.asp

Staff Recruitment and Retention

Despite the budget cuts imposed by Senate Bill 261, MTNHP has been able to maintain all the staff positions that were present before the cuts and has added a full time Spatial Analysis Lab Director, Jessica Mitchell, to take the lead on the Land Cover layer and assisting partners with their remote sensing and vegetation mapping needs. Unfortunately, as a result of the cuts, a number of the core service positions have had to take on project work that does not directly relate to core services (e.g., creation of a botany database for the state of Utah by our Database Manager or creation of an online field guide for the states of Wyoming, Utah, and California by the Web Programmer). This has created heavier workloads for staff in order to maintain rapid responses to information requests and a growing backlog of core work tasks, both of which are causing a noticeable increase in staff stress which may hinder staff retention in the long run. For example, in the recent departure of our Wetland Mapping Coordinator, he cited the lack of reliable funding for wetland mapping as a key reason for his departure.

Botanical information (vascular plants, non-vascular plants, lichens, fungi, diatoms and other algae) is comprehensive, up-to-date, and authoritative			
Inputs	**Outputs**	**Outcomes**	**Impacts**
Botany and Information Services staff time. Expert input. State, local, federal, and nongovernmental partner input on prioritization.	Comprehensive, up-to-date, and authoritative coverage for: - taxonomic representation - general information - observations/surveys - species occurrence polygons for environmental reviews - predictive distribution models - conservation status ranks	State, local, federal, and nongovernmental partners have complete trust and confidence that MTNHP information is comprehensive, up-to-date and authoritative on distribution, status, and general biology of all botanical species. Botanical information is readily available for MEPA, NEPA, other permitting and planning processes, and responses to natural and human caused disasters (e.g., fires, oil spills).	State, local, federal, and nongovernmental partners make informed decisions from a common information resource in a timely manner, saving time and money, reducing duplication of effort, and avoiding litigation. Stewardship of botanical species is improved. Botanical species listings as a result of lack of information are avoided.

Metrics: statistics on taxonomic representation; photos, descriptions, habitat, references, and other general information added or updated on the Montana Field Guide or other web pages; botanical literature and web links compiled; observations, surveys, species occurrences, predictive models, range polygons, and habitat associations added/created; conservation status ranks reviewed or updated; presentations made; trainings conducted; projects undertaken; reports and publications completed; and partner feedback.

Taxonomic Representation

Vascular Plants – There are currently about 2,927 species, subspecies, or varieties listed in MTNHP database as present, reported with no documentation, or have the potential to invade Montana: 2,327 native, 491 exotic, and 109 of unknown/undetermined origin.

Mosses - There are currently about 541 species, subspecies, or varieties listed as present or reported with no documentation in Montana in the MTNHP database: 520 natives and 2 exotics. Of these taxa, 387 have updated accounts on the Montana Field Guide while 154 are shell accounts with only the taxonomy listed. A new Montana Moss checklist with county distributions has been published on the MTNHP website (see MTNHP botany publications) with county distributions, current nomenclature, is supported by verified specimens, and is reflected on the Moss Field Guide. The History, Biogeography, and Species of Montana Mosses (1880-2018) by Joe Elliott and Andrea Pipp was published in a peer-reviewed Journal, Evansia 26(2): 39-58.

Liverworts/Hornworts – There are currently about 135 species, subspecies, or varieties listed as present or potentially present in Montana in MTNHP databases; 134 natives and 1 of unknown/undetermined origin. Of these taxa, only 5 have any account information beyond a general listing on the Montana Field Guide. The Program Botanist has identified a knowledgeable Bryologist who can update Liverwort field guide account. The Program Botanist has also located where the herbarium collection of Montana Liverworts is housed (Providence College, Great Falls). As time and funding allow the program Botanist will pursue contact with the herbarium.

Algae/Diatoms – In FY19, 1,205 diatoms were added to MTNHP databases and these will be shown on the Montana Field Guide once a new "Microscopic Life Forms" guide is added to the Montana Field Guide. There are now 1,205 native diatom species and 4 algal species (2 native, 2 exotic) represented in MTNHP databases; only *Nitellopsis obtusa* has a fully developed species account in the Montana Field Guide. There are an unknown number of algae known from Montana that are not currently represented in MTNHP databases or on the Montana Field Guide.

Lichens – Montana has 1,045 lichen taxa (species or varieties): 1,044 native and 1 exotic. The first Montana Lichen checklist has been developed based on documented specimens. The new lichen checklist is reflected on the Lichen Field Guide and represents current nomenclature and taxonomy. Lichen Field Guide accounts need to be updated to represent current useful information.

Fungi – True fungi are not well represented in MTNHP databases or on the Montana Field Guide; currently only 9 species of true fungi are represented in MTNHP databases (2 native and 7 exotic). The Program Botanist has identified two mycologists and will pursue future tasks aimed at creating a Montana checklist.

Conservation Status Ranks

A backlog of 258 vascular plant taxa are listed as Status Under Review because their conservation status needs to be reviewed in detail so that they can be properly addressed in project reviews and local and regional planning efforts. Of these 36 plant taxa are currently being assessed and funding has been found to assess another 31 plant taxa in the next fiscal year.

Observations

521,680 observation records for native species (496,547 vascular plant, 492 algal, 3365 moss, 49 liverwort, and 2,059 lichen records) were added to the MTNHP observation database in FY19. Additionally, 67,625 native species observation records (67,552 vascular plant, 58 moss, 3 liverwort, 12 lichen records) had spatial or tabular information updated to improve the records in FY19. The Program Botanist collaborated with the University of Montana Herbarium on a grant that if funded would geo-reference about 2,500 observations. At least 150,000 records of diatom observations are awaiting screening for inclusion into MTNHP databases when staff funding and time allows for it.

Species of Concern Occurrence Records for Environmental Reviews

A total of 304 Species of Concern Occurrence records for 145 species were added to the MTNHP database in FY19 and are now available for use in environmental reviews and permitting processes as follows (298 occurrences for 139 vascular plant species, 2 occurrences for 2 moss species, and 4 occurrences for 4 lichen species). Cleanup on the mapping of older Species Occurrences is ongoing to bring this important information layer fully up to current standards; this effort is approximately 50% complete.

Range Polygons

In FY19 range maps were created for 264 vascular plant species and these are now showing on the Montana Field Guide and Map Viewer web applications.

Predicted Habitat Suitability Models and Range Maps

In FY19, predicted habitat suitability models were created for 41 vascular plant Species of Concern and finalized for 29; reports are posted at http://mtnhp.org/models/ Predicted habitat suitability output can be viewed in the Map Viewer web application under the Single Species Overview and Environmental Summary tasks.

Field Guide Species Accounts

In FY19, Field Guide species accounts were newly created for 36 noxious weed species and 5 aquatic invasive species and updated for 33 vascular plant species.
Current representation for general descriptions and habitat use summaries for botanical taxa on the Montana Field Guide is as follows:
Vascular Plants – 2,672 of 2,927 species have general descriptions and 2,617 of 2,927 species have habitat needs summarized in species accounts on the Montana Field Guide. Other fields in Montana Field Guide Species Accounts for vascular plants need additional work to bring them up to the latest standards.
Mosses – 385 of 541 species have general descriptions and 383 of 541 species have habitat needs summarized in species accounts on the Montana Field Guide.
Liverworts/Hornworts – 5 of 135 species have general descriptions and habitat needs summarized in species accounts on the Montana Field Guide.
Algae/Diatoms – 3 of the 1,209 taxa have general descriptions and habitat needs summarized in species accounts on the Montana Field Guide.
Lichens – 35 of 1,045 species have general descriptions and 39 of 1,045 species have habitat needs summarized in species accounts on the Montana Field Guide.
Fungi – 3 of 9 species have general descriptions and habitat needs summarized in species accounts in the Montana Field Guide.

Photos

A total of 24,056 photos of botanical taxa have been added to the MTNHP database in FY19 and 10,584 of these were attributed for display on the Montana Field Guide. Current photo representation on the Montana Field Guide is as follows:
Vascular Plants – 2,505 of 2,927 species have images showing on the Montana Field Guide.
Mosses – 135 of 541 species have images showing on the Montana Field Guide.
Liverworts/Hornworts – 5 of 135 species have images showing on the Montana Field Guide.
Algae/Diatoms – 4 of the 1,209 taxa currently represented have images showing on the Montana Field Guide.
Lichens – 93 of the 1,045 species currently represented have images showing on the Montana Field Guide.
Fungi – 7 of the 9 species currently represented have images showing on the Montana Field Guide.

Botanical Literature and Website Links

77 botanical literature references have been added to the MTNHP reference management database allowing 133 reference listings to be added to species accounts in the Montana Field Guide in FY19.

The Botany related website links page was reviewed and broken links were fixed. Additionally, 2 website links were added to the Class Links in the Montana Field Guide.

Habitat associations added/created

No associations between ecological systems and individual botanical species were created in FY19.

Presentations and Trainings

The following presentations or trainings were given in FY19:

- "What is the Montana Natural Heritage Botany Program", Botany 320 Class, University of Montana, Missoula, MT. September 14, 2018.
- "Interactive Botany Databasing Lab", Botany 320 Class, University of Montana, Missoula, MT. September 14, 2008.
- Conducting the First Non-vascular Surveys in Mussellshell County, Montana. Northwest Scientific Association conference, Lewiston, Idaho. March 28, 2019.
- Montana Rare Plant Conservation Strategy Kick-off Meeting, Helena, MT. April 26, 2019. Hosted, presented talks, and facilitated discussions among 19 folks representing 20 partnering affiliations (Federal, State, Academia, and Non-Governmental Organizations). This work was done in conjunction with a Steering Committee represented by USFS, BLM, Montana Native Plant Society, and MTNHP.
- Population Updates on select Spalding' Catchfly Species Occurrences on the Flathead Indian Reservation. *Silene spaldingii* Technical Team Meeting, Spokane, WA. April 30-May 1, 2019.
- Ground Layer Indicator for Rangelands training to MTNHP Ecology field crew, Helena, MT. May 15, 2019
- Co-Lead on Lichen and Vascular Plant Hikes in the Cypress Hills Inter-Provincial Park for the Montana & Saskatchewan Native Plant Societies. Saskatchewan, Canada. June 21-23, 2019.

Projects

The Botany Program worked on the following projects in FY19:

- Supporting Weed Management with Plant Status Reviews, 2017 – Montana Department of Agriculture, Noxious Weed Trust Fund Grant
- Supporting Weed Management with Plant Status Reviews, 2018 – Montana Department of Agriculture, Noxious Weed Trust Fund Grant
- Developing a Montana Rare Plant Conservation Strategy – Montana Native Plant Society grant
- Spalding's Catchfly (*Silene spaldingii*) Population Monitoring at Two Key Conservation Areas – U.S. Fish and Wildlife Service Section 6 grant
- Species Accounts and Taxonomy Management for Non-native Species – Montana Department of Natural Resources and Conservation
- Databasing and georeferencing the University of Montana moss collection – Institute of Museum and Library Services
- Wetland and Riparian Plant Surveys on the Milton Ranch - Montana/Dakotas Bureau of Land Management
- Butte and Greer Radio Station Vegetation Surveys – Bonneville Power Administration

Reports/Publications

The following reports were finalized in FY19 and are available on the MTNHP Botany Publications web page :

Pipp, Andrea. 2018. An Exploratory Study Using the Ground Layer Indicator Method for Montana Rangelands – Montana/Dakotas Bureau of Land Management. October 23rd.

Pipp, Andrea. 2019. *Three-Year Baseline Monitoring Studies for Silene spaldingii on the Flathead Indian Reservation: Year 2018*. Prepared for the Confederated Salish & Kootenai Tribes, Flathead Indian Reservation, Pablo, MT and U.S. Fish and Wildlife Service, Montana Ecological Services Field Office, 31 pp.

Pipp, Andrea. 2019. Spalding's Catchfly (*Silene spaldingii*) Species Occurrence Re-visits on the Flathead Indian Reservation. Memorandum to the Confederated Salish & Kootenai Tribes and U.S. Fish and Wildlife Serve. May 2nd. 14 pp.

Elliott, Joe and Andrea Pipp. 2019. A Checklist of Montana Mosses (1880-2018). Updated May 5th. Montana Natural Heritage Program, Helena, MT. 73 pp.

Elliott, Joe and Andrea Pipp. 2019. History, Biogeography, and Species of Montana Mosses (1880-2018). Evansia 26(2).

Ecological information (terrestrial and aquatic biological communities, land cover mapping, wetland and riparian mapping) ***is comprehensive, up-to-date, and authoritative***			
Inputs	**Outputs**	**Outcomes**	**Impacts**
Ecology and Information Services staff time. Expert input. State, local, federal, and nongovernmental partner input on prioritization.	Comprehensive, up-to-date, and authoritative coverage for: - distribution, status, and general information for terrestrial communities - distribution, status, and general information for wetland and aquatic communities - land cover mapping - wetland and riparian mapping	State, local, federal, and nongovernmental partners have complete trust and confidence that MTNHP information is comprehensive, up-to-date and authoritative on distribution, status, composition, structure, and dynamic processes for Montana's terrestrial and aquatic biological communities. Terrestrial and aquatic biological community information is readily available for MEPA, NEPA, other permitting and planning processes, and responses to natural and human caused disasters (e.g., fires, oil spills).	State, local, federal, and nongovernmental partners make informed decisions from a common information resource in a timely manner, saving time and money, reducing duplication of effort, and avoiding litigation. Stewardship of terrestrial and aquatic biological communities is improved and species listings are avoided as a result.

Metrics: statistics on status of statewide wetland and riparian mapping; status of land cover mapping; photos and text added or updated on the Montana Field Guide or other web pages; field surveys and assessments of key ecological community types; ecological literature and web links compiled; conservation status ranks for ecological systems reviewed or updated; presentations made; trainings conducted; projects undertaken; reports and publications completed; and partner feedback.

Wetland and Riparian Mapping

In FY19, modern wetland and riparian mapping was completed in 24 1:24,000 scale U.S. Geological Survey quadrangle maps. A total of 2,448 quads have now been mapped (86% of Montana) with a total of 3,183,018 acres; 2,515,459 acres of wetlands and 667,559 acres of riparian. The wetland and riparian mapping effort is described at http://mtnhp.org/nwi/ During recent meetings, partners have expressed appreciation for the benefits they get from having modern wetland and riparian mapping in place and interest in having it completed for the entire state. However, funding for wetland and riparian mapping has dwindled, especially for mapping quads that are dominated by private lands. Partners have provided funding for mapping another 91 quads in FY20 and beyond.

Land Cover Mapping

The land cover layer was not updated in FY19. However, Jessica Mitchell, has begun working on a partnership-driven plan for creating and systematically updating the land cover layer and associated metadata to utilize the latest Landfire data, better integrate it with other MSDI layers such as hydrography and wetland and riparian mapping, and provide more ready access to information on the classification accuracy of individual land cover types. This effort will also assess partner interest in the development of new land cover products such as lidar derived vegetation mapping products, assessment of changes in land cover over time, continuous percent cover products instead of categories, and incorporation of georeferenced photographs that document current and historic land use. While partners like the NRCS have expressed interest in contributing funding to these efforts, they may be hampered to some extent by the lack of Montana Land Information Act funding that is available to support this work. Current and historic MSDI layers have been reorganized into a single geodatabase

with metadata for individual layers. This updated geodatabase is available for download through the MSL website. Updated text for the Land Cover home page has been drafted and will be finalized in coordination with Erin Fashoway.

Conservation Status Ranks for Ecological Systems

Core and supplemental core funding is not adequate to systematically assess conservation status ranks for ecological systems.

Field Guide Accounts for Ecological Systems

No updates were made to ecological system accounts in the Montana Field Guide in FY19, but no updates were really needed.

Field Surveys and Assessments of Key Ecological Community Types

In FY19, field crews conducted the following surveys of key ecological community types:

- Forest surveys of the Flathead National Forest beginning in 2018.
- Ecological assessments of slope wetlands in Southwest Montana.
- Ecological assessments of wetlands to add to our statewide wetland reference network.
- Identification and baseline ecological surveys of fire-affected wetlands.
- Identification and baseline ecological surveys of "sentinel wetlands" to track change over time.
- Ecological assessments of rangeland and aquatic condition for the BLM's Assessment Inventory and Monitoring program in 2019.
- Collaborated with federal and non-profit partners to run a Beaver Restoration Assessment Tool to identify optimal sites for installation of beaver analog structures. This model will be rerun in Fall of 2019 with new inputs and a new script.
- Ground and remote surveys of invasive grass species in UL Bend and Willow Creek areas of the Charles M Russell National Wildlife Refuge.
- Remote surveys of invasive grass in the Centennial Valley.
- Collaborated with Bureau of Land Management to identify existing and historic surveys of "wooded draws and ravines" in eastern Montana. The information will be used to support comprehensive updates to the MSDI Land Cover theme.

Photos

A total of 1,540 wetland, riparian, and terrestrial habitat assessment photos were added to the MTNHP database in FY19. These photos will eventually be added to the georeferenced photos section of the Map Viewer web application to serve as visual documentation of habitat status at a point in time and to guide mappers and modelers at MTNHP and other agencies in land cover and habitat mapping and modeling.

Ecological Literature and Website Links

No ecological literature references were added to the MTNHP reference management database in FY19.

The Ecology related website links page was reviewed and broken links were fixed, and 8 website links were added.

Presentations and Trainings

The following presentations/trainings were given in FY19:

- Poster, Baseline Data Collection at Fire-Affected Wetlands, 11th National Monitoring Conference, Denver, CO, March 27, 2019.

- Presentation, Wetlands and Fire: Reframing the Questions, 11th National Monitoring Conference, Denver, CO, March 26, 2019
- Meeting: Indicators of Wetland Change: Lessons from the Field. Montana Wetland Council, March 21, 2019. Meeting organized and sponsored by the MTNHP Ecology Program.
- Meeting: Spatial Analysis Lab Introductions, Governor's Montana Land Information Advisory Council Meeting, August 8th, 2018, Helena MT
- Presentation: Remote Sensing for Heritage Program Applications, The 2018 Natural Heritage West Conference, Lake Tahoe, CA, October 30th, 2018 - November 1st, 2018
- Presentation: Spatial Analysis Lab Introductions, Department of Geography Colloquium, Missoula, MT, November 13th, 2018
- Presentation, Big Sky GeoCon, April 1st-4th, 2019, Butte, MT
- Presentation: Assessing Functional Diversity in a Dryland Ecosystem using Full Waveform Lidar and a bit more …, American Geophysical Union Fall Meeting, Washington, D.C., December 10th-14th, 2018
- Presentation: Spatial Analysis Lab Introductions, Systems Ecology Seminar Series, Missoula, MT, April 18th, 2019
- Poster: Research Outreach: Leveraging NEON Data to Investigate Remote Sensing of Biodiversity Variables, NSF Macrosystems Biology PI Meeting, Boulder, CO, May 15th – 17th, 2019 (Jessica Mitchell, co-author but not presenter)
- Presentation: Macroscale Ecology in the Classroom: An EREN Partnership Using NEON Data. The Northeast Natural History Conference, Springfield, Massachusetts, April 12th-14th, 2019 (Jessica Mitchell, co-author but not presenter)
- Presentation: Applying the Beaver Restoration Assessment Tool in Montana, Montana Chapter of American Fisheries Society Annual Meeting, Billings, MT, January 29th – February 1st

Projects

Ecology Program staff worked on the following projects in FY19:

- Rangeland Health Assessments, Bureau of Land Management
- Aquatic Health Assessments, Bureau of Land Management
- Monitoring Tools for Decision Makers: US EPA
- Species Accounts and Taxonomy Management for Non-native Species – Montana Department of Natural Resources and Conservation
- Forest data collection and mapping, Flathead National Forest—United States Forest Service
- Crown of the Continent habitat mapping – The Wildlife Society
- Geospatial data development – Bureau of Land Management
- Value-added mapping, monitoring and outreach for Montana –U.S. EPA
- Developing wetland assessment and monitoring tools, capacity-building datasets, professional development and other resources for Montana–U.S. EPA
- Biodiversity mapping using NEON data – National Science Foundation, Macrosystems Biology
- Mapping mariana fruit bats in Guam – University of Montana Math Department
- Predicting arthropod distributions – Montana Fish Wildlife and Parks
- Invasive grass species mapping on the Charles M Russell National Wildlife Refuge - USFW
- Cheatgrass mapping in the Centennial Valley – USFWS
- Ventenata mapping on the National Bison Range - USFWS

Reports/Publications

The following reports/publications were finalized in FY19:

Dashti, H., Glenn, N.F., Ustin, S., **Mitchell, J.J.,** Qi, Y., Ilangakoon, N.T., Flores, A.N., Silván-Cárdenas, J.L., Zhao, K., Spaete, L.P. and de Graaff, M.A., 2019. Empirical Methods for Remote Sensing of Nitrogen in Drylands May Lead to Unreliable Interpretation of Ecosystem Function. *IEEE Transactions on Geoscience and Remote Sensing*, *57*(6), pp.3993-4004.

J. J. Mitchell, N. F. Glenn, K. M. Dahlin, N. T. Ilangakoon, H. Dashti, and M. C. Maloney*, "Integrating Hyperspectral and LiDAR Data in the Study of Vegetation.," *in* Hyperspectral Remote Sensing of Vegetation (Volume I), II Ed., P. S. Thenkabail, J. G. Lyon, and A. Huete, Eds. London, Ney York: CRC Press- Taylor and Francis group, 2018, p. 449.

Ilangakoon, N.T., Glenn, N.F., Dashti, H., Painter, T.H., Mikesell, T.D., Spaete, L.P., **Mitchell, J.J.** and Shannon, K., 2018. Constraining plant functional types in a semi-arid ecosystem with waveform lidar. *Remote Sensing of Environment*, 209, pp.497-509.

Spatial Analysis Lab Website Development and Maintenance

A website was created for the Spatial Analysis Lab http://www.umt.edu/spatial-analysis-lab The site can be accessed from the Montana Natural Heritage Program home page and is scheduled to be accessible from University of Montana Department of Geography and Department of Ecosystems and Conservation Sciences websites, as well as MontanaView.

Zoological information (vertebrates and invertebrates) is comprehensive, up-to-date, and authoritative			
Inputs	**Outputs**	**Outcomes**	**Impacts**
Zoology and Information Services staff time. Expert input. State, local, federal, and nongovernmental partner input on prioritization.	Comprehensive, up-to-date, and authoritative coverage for: - taxonomic representation - general information - observations/surveys - species occurrence polygons for environmental reviews - predictive distribution models - conservation status ranks	State, local, federal, and nongovernmental partners have complete trust and confidence that MTNHP information is comprehensive, up-to-date and authoritative on distribution, status, and general biology of all animal species. Animal information is readily available for MEPA, NEPA, other permitting and planning processes, and responses to natural and human caused disasters (e.g., fires, oil spills).	State, local, federal, and nongovernmental partners make informed decisions from a common information resource in a timely manner, saving time and money, reducing duplication of effort, and avoiding litigation. Stewardship of animal species is improved. Animal species listings as a result of lack of information are avoided.

Metrics: statistics on taxonomic representation; photos, descriptions, habitat, references, and other general information added or updated on the Montana Field Guide or other web pages; zoological literature and websites compiled; observations, surveys, species occurrences, predictive models, range polygons, and habitat associations added/created; conservation status ranks reviewed or updated; presentations made; trainings conducted; projects undertaken; reports and publications completed; and partner feedback.

Taxonomic Representation

Vertebrates – There are currently 699 vertebrate species or subspecies listed as present, potentially present, present on an accidental/nonregular basis, or having the potential to invade Montana in MTNHP databases; 632 natives and 67 exotics. These taxa are fully represented in the MTNHP database and on the Montana Field Guide representing the following taxonomic groups: 101 fish, 15 amphibians, 20 reptiles, 448 birds, and 115 mammals.

Invertebrates - There are currently 4,452 **(41% increase from FY18)** invertebrate species or subspecies listed as present, potentially present, present on an accidental/nonregular basis, or having the potential to invade Montana in MTNHP databases that are currently showing on the Montana Field Guide; 4,168 natives and 284 exotics. We know that there are likely more than 10,000 additional invertebrates that occur in Montana or have the potential to invade Montana that are not currently represented in MTNHP databases, but we lack sufficient resources to quickly incorporate that information. The invertebrate taxa that are currently represented in MTNHP databases include: 2 freshwater sponges, 2 myxozoan, 37 bivalves, 1 turbellarian, 24 fairy/tadpole shrimp, 2 copepods, 21 crayfish/shrimp/amphipods/isopods, 97 round worms, 2 tapeworms, 6 leeches, 23 earthworms, 27 millipedes, 1 springtail, 157 slugs/snails, 354 spiders, 1 cockroach, 391 beetles, 97 flies and mosquitos, 136 mayflies, 1 rock crawler, 44 true bugs, 326 bees/wasps, 2,071 butterflies/moths, 3 mantis, 2 alderflies, 1 lacewing, 99 dragonflies/damselflies, 131 grasshoppers/crickets, 126 stoneflies, 2 thrips, 265 caddisflies. Of the invertebrates represented on the Montana Field Guide, accounts are reasonably well developed for only 544 (12%) while 88% are only shell accounts that lack general descriptions or information on habitat use.

Conservation Status Ranks

State conservation status ranks were reviewed and updated for 15 vertebrate and 1 invertebrate species in FY19 in coordination with FWP (the Montana Animal Species of Concern Committee is jointly composed of 3 FWP staff and 3 MTNHP staff). Rank scoring is now posted on species accounts on the Montana Field Guide to allow agency partners and the public direct access to ranking information. An example can be seen under the State Rank Reason section of the Snapping Turtle species account at: http://fieldguide.mt.gov/speciesDetail.aspx?elcode=ARAAB01010

Conservation status ranks have not been reviewed since before 2002 for 86 (60%) of Montana's Invertebrate Species of Concern and 181 (33%) of Montana's vertebrate non-SOC. Furthermore, 3,750 (87%) of Montana's invertebrate non-SOC have never had their conservation status ranks reviewed in detail. Ideally, conservation status ranks for all species in MTNHP databases would be reviewed in detail every 10 years so that species can be properly addressed in project reviews and local and regional planning efforts.

Observations

26,280 observation records for native species (24,032 vertebrate and 2,248 invertebrate records) were added to the MTNHP observation database in FY19. Additionally, 16,670 previously existing native species observation records (16,665 vertebrate and 5 invertebrate records) had spatial or tabular information updated to improve the record in FY19. A growing backlog of observation records were not able to be entered into MTNHP databases in FY19 as a result of recent budget cuts. These records have been stored and will be entered as time and resources allow.

Structured Survey Locations

73,227 structured survey locations where 37 specific protocols were used to detect animal species were added to the MTNHP database in FY19. In addition, 145 structured survey locations were updated to improve Raptor Nest Survey locations. A growing backlog of structured survey location records were not able to be entered into MTNHP databases in FY19 as a result of recent budget cuts. These records have been stored and will be entered as time and resources allow.

Species of Concern Occurrence Records for Environmental Reviews

A total of 144 Species of Concern Occurrence records for 80 species (140 occurrences for 76 vertebrate species and 4 occurrences for 4 invertebrate species) were added to the MTNHP database in FY19 and are now available for use in environmental reviews and permitting processes.

Range Polygons

Range maps were updated or added for 133 species (112 vertebrates and 21 invertebrates) to account for new observations and/or other improvements in our understanding of their known geographic distribution and these are now showing on the Montana Field Guide and Map Viewer web applications.

Predicted Habitat Suitability Models

Predicted habitat suitability models were created and reports were finalized for 7 vertebrate species and 6 invertebrate species (3 Species of Concern, 2 Potential Species of Concern, and 8 non-Species of Concern of management interest in FY19; reports are posted at http://mtnhp.org/models/ Predicted habitat suitability output can be viewed in the Map Viewer web application under the Single Species Overview and Environmental Summary tasks.

Field Guide Species Accounts

General descriptions and habitat needs summaries were added for 19 species accounts (4 vertebrates and 15 invertebrates) in the Montana Field Guide in FY19. Current representation of this information on the Montana Field Guide is as follows:

Fish – 101 of 101 species have general descriptions and 98 of 101 species have habitat needs summarized in species accounts on the Montana Field Guide.

Amphibians – 14 of 15 species have general descriptions and 15 of 15 species have habitat needs summarized in species accounts on the Montana Field Guide.

Reptiles – 17 of 20 species have general descriptions and 17 of 20 species have habitat needs summarized in species accounts on the Montana Field Guide.

Birds – 405 of 448 species have general descriptions and 292 of 448 species have habitat needs summarized in species accounts on the Montana Field Guide.

Mammals – 92 of 115 species have general descriptions and 110 of 115 species have habitat needs summarized in species accounts on the Montana Field Guide.

Invertebrates – Only 663 (15%) of the 4,452 species that are showing on the Montana Field Guide have general descriptions and only 683 (15%) have habitat needs summarized.

Photos

A total of 3,239 photos of animal species have been added to the MTNHP database in FY19 and 415 of these were attributed for display on the Montana Field Guide for 241 species (205 vertebrates and 36 invertebrates). Current photo representation on the Montana Field Guide is as follows:

Fish – 101 of 101 species have images showing on the Montana Field Guide.

Amphibians – 15 of 15 species have images showing on the Montana Field Guide.

Reptiles – 20 of 20 species have images showing on the Montana Field Guide.

Birds – 447 of the 448 species have images showing on the Montana Field Guide.

Mammals – 107 of the 115 have images showing on the Montana Field Guide.

Invertebrates – Only 1,824 (41%) of the 4,452 species currently represented on the Montana Field Guide have images showing.

Zoological Literature and Website Links

127 zoological literature references have been added to the MTNHP reference management database allowing 3,817 reference listings to be added to species accounts in the Montana Field Guide in FY18; the majority of these were for butterflies.

The Zoological related website links page was reviewed, broken links were fixed, and 3 website links were added. Additionally, 7 website links were added to the Class Links in the Montana Field Guide.

Habitat associations added/created

No associations between ecological systems and individual animal species were created or updated in FY19.

Presentations and Trainings

The following presentations/trainings were given in FY19:

- Bat ecology and management training to state and federal partners. Helena, MT. July 23 – 25, 2018.
- Use of Caves by bats in Montana. National Speleological Society Conference, Helena MT. August 2, 2018
- Bats of the Montana. Workshop at the National Speleological Society Conference, Helena, MT. August 1, 2018
- Bat acoustic and roost monitoring in Montana. Natural Heritage West Conference. October 30, 2018.

- Update on Zoology Projects and Future Work, Montana Natural Heritage Program Annual Partners Meeting, December 6, 2018.
- Northern Myotis Status and Distribution in Montana. Mountain-Prairie Region WNS Coordination Call. December 19, 2018
- Montana Bat Working Group Meeting. Montana Chapter of the Wildlife Society Annual Conference, Helena, MT. February 26, 2018.
- Digital Tools for Wildlife Data Collection. Workshop at the Montana Chapter The Wildlife Society Annual Conference. February 27, 2018.
- Establishing Range of Montana's Rarest Bat Species the Northern Myotis. Presentation at the Montana Chapter The Wildlife Society Annual Conference. February 29, 2018.
- Biology of Lick Creek Cave. Presentation at Lick Creek Cave Management Meeting. Helena, Mt. April 29, 2019
- Update on the Use of Montana's Caves by Bats. Annual Meeting of the Northern Rocky Mountain Grotto, Lewis and Clark Caverns. April 6, 2019

Projects

The Zoology Program worked on the following projects in FY19:

- Northern Myotis Range Surveys- US Fish and Wildlife Service Grant
- Surveys for Cave Roosting Bats – Bureau of Land Management and US Forest Service Grants
- Establishing Statewide Baseline Distribution and Activity Levels for Bats– Bureau of Land Management and US Forest Service Grants
- White-Nose Syndrome/ Pd Surveillance at hibernacula – Conducted in collaboration with Montana Fish Wildlife and Parks, Bureau of Land Management and US Forest Service
- NABat Monitoring in USFS Region 1- US Forest Service Grant
- Bat species monitoring at Coal Mines in Central Montana – Montana Department of Environmental Quality Grant
- Identification of Bat Roosts in Bridges across Northern Montana – Montana Fish Wildlife and Parks Agreement
- Conservation Status Review for Native Species – Nature Serve Agreement

Reports/Publications

The following reports and posters were finalized in FY19:

Bachen, D.A. et al. Produced 93 reports summarizing bat species presence and activity for data from our long-term acoustic monitoring sites.

Stagliano, D.M. 2019. Freshwater Mussels of Montana (revised). Helena, Montana. 21 pp.

Stagliano, D.M., B.M. Maxell, and D.A. Bachen. Freshwater Mussels of Montana Poster. Helena, Montana.

Bachen, D.A. and B.M. Maxell. Turtles and Lizards of Montana Poster. Helena, Montana.

Bachen, D.A. 2018. **Update on Northern Myotis (Myotis septentrionalis A.K.A Northern Long-eared Bat) Surveys in Eastern Montana**. Report to the US Fish and Wildlife Service. Montana Natural Heritage Program, Helena, Montana. 10 pp. plus appendices.

Bachen, D.A. 2019. ***Roost features used by bats in the Northern Rocky Mountains and Great Plains***. Report to Montana Department of Environmental Quality. Montana Natural Heritage Program. Helena, MT.

Information on Montana's species and biological communities is readily available to State, local, federal, and nongovernmental partners through mediated requests and MTNHP web applications, web pages, and web services			
Inputs	**Outputs**	**Outcomes**	**Impacts**
Web Projects Manager and Information Services, Botany, Ecology, and Zoology staff time. State, local, federal, and nongovernmental partner feedback.	The following web applications and web pages are fully integrated with MTNHP's data management systems, use the latest coding standards, and are easy to use and reliable: - Field Guide - Species Snapshot - Map Viewer - Species of Concern - Information requests - Data Submissions - Related Websites - Program, Botany, Ecology, and Zoology information pages - Announcements and general program information	State, local, federal, and nongovernmental partners have common easy access to MTNHP information resources. Government partners are able to self-serve information and reports from MTNHP web applications and web pages that they can use directly in their MEPA, NEPA, permitting, and other planning processes. Partners heavily use MTNHP web applications and web pages as a gateway to other information sources on plants, animals, and biological communities that assist them in their planning and management efforts.	State, local, federal, and nongovernmental partners make informed decisions from a common information resource in a timely manner, saving time and money, and improving the stewardship of Montana's plants, animals, and biological communities.

Metrics: mediated request statistics; web application and web page use statistics; web code development and maintenance efforts; partner feedback from surveys and annual partners meeting.

Mediated Requests

In FY19, total mediated requests for Environmental Summary Reports and/or geodatabases of MTNHP information was reduced to 411 (37% reduction from FY18) as a result of developing the Environmental Summary Report task in Map Viewer and training agency personnel to self-service their information needs using this tool. Most agency personnel are now self-servicing their information needs with Map Viewer and remaining requests are mostly from private consultants or are geodatabase related.

Additionally, Botany, Ecology, Zoology, and Information Services staff collectively answer 5-10 requests on the average work day related to accessing MTNHP information resources or requiring specific botanical, ecological, or zoological expertise (e.g., how to conduct a survey for a rare plant or animal).

Self-Serve Downloads

Environmental Summary Report

In FY19, there were 1,508 downloads of MTNHP Environmental Summary Reports (133% increase) by agency-level users of the Map Viewer website. Trainings to agency resource managers and biologists on the MTNHP Environmental Summary Report continued throughout FY18 and FY19 and feedback gathered during these trainings has continued to be used to improve this web application.

Custom Field Guide PDF Downloads

In FY19, there were 7,277 downloads of custom field guides (11.6% increase from FY18) from the Montana Field Guide (3,918 - 10.7% decrease), Species Snapshot (169 – 21.4% decrease), and Map Viewer Environmental Summary Report (3,190 – 50.5% increase) web pages. It appears that in FY19 users are primarily having their custom field guide download needs met through the field guides included in the Environmental Summary Report package rather than having to do secondary downloads from the Montana Field Guide or Species Snapshot after receiving a list of species included in the Environmental Summary Report as in earlier years when agency personnel were not fully trained on the Environmental Summary Report.

Excel Downloads

In FY19, there were 2,519 (12% decline) Excel downloads of species and habitat reports for particular geographic areas from the Map Viewer (2,441 – 6% decline) and Species Snapshot (78 – 48% decline) websites. These statistics are reflective of more heavy use of the Environmental Summary Report tool in FY19. The Environmental Summary Report tool includes one Excel file that contains summaries of Species of Concern, species observed, structured surveys, land cover, wetland and riparian mapping and land management. So, rather than downloading 6 different Excel files from different tasks within Map Viewer, users are preferentially downloading a single Excel file from the Environmental Summary Report task. There was a 133% increase in download of Environmental Summary Reports in FY19 so overall, much more information was shared in FY19 in a more efficient manner for our users as compared to FY18 when the Environmental Summary Report was new.

Web Use:

Home Page Use in FY19 (change compared to FY18) was:

Users = 26,612 (28% increase)
Sessions = 47,476 (14.7% increase)
Average Session Duration = 3 minutes, 1 second (15.8% decline)
Page Views = 120,658 (0.5% increase)
Average Use Per Work Day = 9.2 hours (3.1% decline)

Field Guide Use in FY19 (change compared to FY18) was:

Users = 353,243 (17.5% increase)
Sessions = 469,114 (14.5% increase)
Average Session Duration = 2 minutes, 10 seconds (3% decline)
Page Views = 1,445,485 (5.9% increase)
Average Use Per Work Day = 65.4 hours (11.8% increase)

Map Viewer

In FY19 there were 2,047 (5.6% increase over FY18) total individuals with accounts with 1,237 (6.3% increase) with agency-level access and 810 (4.6% increase) with general public access.
Total Users in FY19 based on a combination of User Key and IP Address = 929 (7.6 % increase)
Total Hours of Use for all sessions less than 3 hours of duration in FY19 = 1,462 hours (not tracked in same way in earlier years)

FY19 Number of User Sessions by Agency
Conservation District/Weed District = 125
Department of Agriculture = 17
Department of Environmental Quality = 321
Department of Fish, Wildlife, and Parks = 424
Department of Natural Resources = 200
Department of Transportation = 33
Montana Natural Heritage Program = 1853
University System = 36
Unidentified State Agency = 685
Army Corps of Engineers = 304
Bureau of Land Management = 507
Bureau of Reclamation = 7
Federal Emergency Management Agency = 112
Federal Highways Administration = 7
National Park Service = 23
Natural Resource Conservation Service = 107
Tribal = 4
U.S. Fish and Wildlife Service = 237
U.S. Forest Service = 704
U.S. Geological Survey = 2
Unidentified Federal Agency = 56
Consultants and General Public Users = 558

Web Development and Maintenance

Home Page

We have had plans to update the MTNHP home page to simplify it and make it more compatible with use on mobile devices for over 2 and a half years now. However, we do not have adequate funding/staffing to undertake this task for the foreseeable future.

Field Guide

The code base that runs the live version of the Montana Field Guide is becoming more and more out-of-date and we do not have adequate funding/staffing to modernize this website using core and supplemental core funding. However, the Wyoming Natural Diversity Database, Utah Conservation Data Center, and California Natural Diversity Database all provided project funding in FY19 to create online field guides for those NatureServe Network member programs. Early versions of these guides can be seen at http://fieldguide.wyndd.org/ for Wyoming and http://fieldguide.mt.gov/utah/ for Utah. These efforts have allowed us to develop a more modern code base for portions of a future Montana Field Guide and with support from other NatureServe network member programs, we have a vision for creating a field guide platform using Amazon Web Services that any NatureServe network program across the Western Hemisphere can use to create an online field guide. A common platform along these lines would expose a great deal of network information (most importantly from states and provinces adjacent to Montana so that our agency partners have a better context for the overall status and distribution of Montana species) that is currently only available in behind-the-scenes databases and documents and it will allow programming expertise to be shared across the network into the future to support all programs. Early versions of the Montana, Utah, Wyoming, and NatureServe field guides are now running in the Amazon Web Services environment and a number of other NatureServe Network programs have expressed interest in launching field guides under this common field guide platform; Oregon and Washington are likely to be the next guides launched after California's.

Species Snapshot

No updates were made to the Species Snapshot web application in FY19. Google Analytics usage statistics on the Species Snapshot indicate that it is not well utilized relative to the Montana Field Guide. Because of this and because this web application primarily provides species list and field guides for particular locations, we plan to integrate the filters of this site into the Field Guide and eventually eliminate Species Snapshot.

Map Viewer

Trainings to agency resource managers and biologists on Map Viewer, and the Environmental Summary Report in particular, continued throughout FY19 and feedback gathered during these trainings was used to continue to refine this web application. In FY19, no major updates were made to the outward appearance of Map Viewer, but behind the scenes a variety of code was refined, consolidated, and modularized in order to make the website run more efficiently and allow future updates to be made and deployed more easily across the 10 major tasks that agency-level users can see in Map Viewer.

Mobile Data Collection Applications

In FY19, code was developed and deployed using Survey123 for ArcGIS to add the following data collection applications:

- Bat Surveys 1.0 for gathering data during Cave/Mine, Building, Bridge, and Mistnet surveys; a bat identification key is included that walks users through the identification of bat species based on morphology and geographic location.

In FY19, code was refined and deployed using Survey123 for ArcGIS to update the following data collection applications:

- Heritage Obs Collector 2019 for collection of a variety of plant and animal data as well as structured surveys for animals by all MTNHP partners. Agency biologists on an approved list have animal data appended directly to MTNHP databases upon upload so that it is viewable on MTNHP web sites the following day.
- Chimney Swift 1.0 to facilitate collection of survey data for Chimney Swift by FWP.
- Lentic Herp Survey to facilitate collection of data on amphibians and aquatic reptiles at surveys of standing water bodies by the USFS.
- Long-billed Curlew Survey 1.1 to facilitate collection of survey data for Long-billed Curlew by FWP.
- Nocturnal Calling Survey 1.0 to facilitate the collection of survey data for nocturnal calling amphibians and birds by all MTNHP partners.

State, local, federal, and nongovernmental partners are aware of MTNHP information resources and services and are trained in their appropriate use			
Inputs	**Outputs**	**Outcomes**	**Impacts**
Program Coordinator, Botanist, Ecologist, and Zoologist time. MSL Training and Development Specialist and State GIS Coordinator assistance. State, local, federal, and nongovernmental partner feedback.	Regular trainings are conducted for state, local, federal, and nongovernmental partners that can make use of MTNHP information resources. User guides are made readily available on MTNHP web applications and web pages. Staff respond in a timely manner to mediated requests for MTNHP information and staff expertise. Announcements of new and improved MTNHP resources are posted on MTNHP's homepage and social media accounts.	State, local, federal, and nongovernmental partners have individual and institutional knowledge of the information resources provided by MTNHP and how to easily access those information resources by self-servicing on MTNHP websites or through the assistance and expertise of MTNHP staff. State, local, federal, and nongovernmental partners provide feedback on how MTNHP information resources can be improved and, where possible, those suggestions are implemented.	State, local, federal, and nongovernmental partners make informed decisions from a common information resource in a timely manner, saving time and money, and improving the stewardship of Montana's plants, animals, and biological communities.

Metrics: Numbers of agency personnel with Map Viewer accounts; trainings held; presentations made; user guides developed; partner feedback from surveys and annual partners meeting.

Map Viewer Accounts

In FY19, 151 individuals created new Map Viewer accounts; 111 with agency-level access and 40 with general public access. With closures of some accounts associated with retirements or departures, the total number of individuals with Map Viewer accounts is currently 2,047 (5.6% increase over FY18); 1,237 with agency-level access (6.3% increase over FY18) and 810 with general public access (4.6% increase over FY18).

Trainings/Presentations

Twenty-six presentations/trainings/posters were given in FY19 by the MTNHP Program Coordinator as follows:

- Resource materials for State Prison inmates to Montana State Prison Librarian. Helena, MT. July 16, 2018.
- MTNHP and general library resources at a booth at the Lewis and Clark County Fair. Helena, MT. July 28, 2018
- Common Field Guide presentation to NatureServe Network member programs across the United States. Webinar. August 16, 2018
- Overview of the Biology and Ecology of Bats and Research on Montana Bats. Lewis and Clark Caverns State Park. August 17, 2018
- MTNHP information overview to Montana Fish, Wildlife, and Parks Region 1 staff. Kalispell, MT. September 11, 2018.

- MTNHP information overview packet for Environmental Quality Council Interim Legislative Committee. Helena, MT. September 12-13, 2018.
- MTNHP information overview to Montana Fish, Wildlife, and Parks Region 2 staff. Missoula, MT. September 17, 2018.
- Rapid Response Tool for Invasive Mussels to Montana Fish, Wildlife, and Parks and Department of Natural Resources staff. Webinar. Sept 21, 2018.
- Biocontrol species models available in Map overview to International Biocontrol Conference. Whitefish, MT. October 9, 2018.
- Mussel StoryMap presentation to Montana Fish, Wildlife, and Parks and Department of Natural Resources staff. Helena, MT. October 15, 2018.
- Great EO Debate a more complete data framework for the NatureServe Network. Natural Heritage West Conference. Fallen Leaf Lake, CA. Oct. 30, 2019.
- Common Field Guide Platform for NatureServe Network. Natural Heritage West Conference. Fallen Leaf Lake, CA. Fallen Leaf Lake, CA. Oct. 30, 2019.
- Partners Meetings for NatureServe Network Programs. Natural Heritage West Conference. Fallen Leaf Lake, CA. Fallen Leaf Lake, CA. Oct. 31, 2019.
- Poster on table on How Natural Resource Managers can Access Information on Invasive Species. Governor's Invasive Species Summit. Helena, MT. November 15-16, 2018.
- Environmental Summary Report training for Montana Weed Coordinators. Webinar. November 19, 2018.
- Pollinator Information Resources at MTNHP. Montana Pollinator Working Group. Helena, MT. December 14, 2018.
- Invasive Species Information to Support Weed Control Efforts. Montana Weed Control Association Annual Meeting. Great Falls, MT. Jan 9, 2019.
- MTNHP information table at Watershed Day in the Montana State Capital Rotunda. Helena, MT. January 28, 2019.
- MTNHP information overview to Montana Watershed Coordination Council. Helena, MT. January 29, 2019.
- Common Field Guide Platform for NatureServe Network. NatureServe Canada and Canadian Conservation Data Centres. Webinar. Feb 13, 2019.
- MTNHP information overview to Montana Fish, Wildlife, and Parks Region 5 staff and BLM and USFS employees. Billings, MT. February 20, 2019
- MTNHP information overview to Montana Fish, Wildlife, and Parks Region 6 staff and BLM employees. Glasgow, MT. February 21, 2019
- MTNHP information overview to Montana Fish, Wildlife, and Parks Region 7 staff and BLM employees. Miles City, MT. February 22, 2019.
- Invasive Species Information at the Montana Natural Heritage Program. Montana Chapter of the Wildlife Society Meetings. Helena, MT. March 1, 2019.
- MTNHP information resources and invasive species data. Weed Trust Fund Grant Application Hearing. Helena, MT. March 5, 2019.
- MTNHP information resources for Big Sky Watershed Corps members. Bozeman, MT. May 3, 2019.

User Guides and other Self-Serve Training Materials Developed

- The How To Use Guide was updated for the Environmental Summary Report task in Map Viewer in order to allow agency biologists and resource managers to self-service their needs for environmental reviews and permitting processes. The updated guide is posted within the question mark link for this task within the Map Viewer application.
- An updated handout was made for MTNHP Survey123 data collector applications to guide agency personnel in downloading Survey123 and the survey applications of interest to them.

Invasive species information is fully integrated into MTNHP data management systems and is readily available to State, local, federal, and nongovernmental partners through MTNHP web applications, web pages, and web services			
Inputs	**Outputs**	**Outcomes**	**Impacts**
Botany, Ecology, Zoology, and Information Services staff time. State, local, federal, and nongovernmental partner input.	Comprehensive, up-to-date, and authoritative coverage for: - Aquatic invasive species - Noxious weeds - Forest pests - Agricultural pests - Biocontrols - Other exotic species	State, local, federal, and nongovernmental partners have complete trust and confidence that MTNHP information is comprehensive, up-to-date and authoritative on current and potential distribution, invasiveness, general biology, and effective management and control efforts for aquatic invasive species, noxious weeds, forest pests, agricultural pests, biocontrols, and other exotic species. Invasive species information is readily available for MEPA, NEPA, other permitting and planning processes, and responses to natural and human caused disasters (e.g., fires) in association with information on native Species of Concern.	State, local, federal, and nongovernmental partners make informed decisions from a common information resource in a timely manner, saving time and money, reducing duplication of effort, and avoiding litigation. Control efforts on invasive species are improved and more easily prioritized. Invasive species management efforts can be more easily considered during MEPA, NEPA, and other permitting and planning processes.

Metrics: statistics on numbers of aquatic invasive, noxious weed, forest pest, agricultural pest, biocontrol, and other exotic species represented in MTNHP data management systems; photos, descriptions, habitat, references, and other general information added or updated on the Montana Field Guide or other web pages; observations, surveys, predictive models, range polygons, and habitat associations added/created; presentations made and trainings conducted; projects undertaken; statistics on information downloads; and partner feedback.

Species Representation in MTNHP Databases

In both FY18 and FY19, a major effort was made to add invasive species information to MTNHP databases with project funding from the DNRC Aquatic Invasive Species Grant Program. Species accounts are now showing on the Montana Field Guide for 851 non-native species that are either present or have the potential to become established; this includes 32 species that are deemed Aquatic Invasive Species, 45 state-listed noxious weeds, 44 county-listed noxious weeds in 43 counties, 13 forest pest species, 23 agricultural pest species, 63 Biocontrol Species, and 635 additional non-native species not listed with any official designation. This is the first major emphasis that MTNHP has been able to make on management of information on exotic/invasive species throughout the program's history and partners have responded that they very much appreciate having this information available in conjunction with information on native species.

Observations and Structured Survey Locations

349,004 observations were added to the MTNHP observation database for 521 invasive species in FY19 as follows:

Status	Total Number of Species	Total Number of Observations
Aquatic Invasive Species	9	4122
Noxious Weeds 1a	3	105
Noxious Weeds 1b	6	838
Noxious Weeds 2a	10	18,664
Noxious Weeds 2b	16	257,589
Regulated Weeds	2	8,361
Agricultural Pest Species	6	120
Forest Pest Species	4	105
Biocontrol Species	14	144
Other Non-native Species	451	58,956

21,692 structured survey locations were added to the MTNHP data system in FY19 for the following survey protocols for invasive species:

Protocol_Name	Total Number of Survey Locations
Artificial Substrate for Invasive Mussels	30
Japanese Beetle Trapping Surveys	110
eDNA for Invasive Mussels	296
Plankton tows for veligers of Invasive Mussels	1828
Noxious Weed Road-based Visual Surveys	1380
Rake tows/pulls for Eurasian Water-milfoil	3738
Visual Encounter Surveys for Aquatic Invasives on Shorelines or Underwater	8888
Eastern Heath Snail Survey	4087
Kicknet Collection Survey for Invasive Mussels and Snails	1335

Range Polygons

Range maps were created or updated for 297 non-native species in FY19 and these are now showing on the Montana Field Guide and Map Viewer web applications.

Predicted Habitat Suitability Models

Predicted habitat suitability models were created for 42 species and finalized with complete write ups and made available on MTNHP websites for 29 species in FY19. Predicted habitat suitability output can be viewed in the Map Viewer web application under the Single Species Overview and Environmental Summary tasks.

Montana Field Guide Species Accounts

In FY19 species accounts in the Montana Field Guide were fully developed for the following invasive species:

- 11 Aquatic Invasive Species; fully developed accounts are now available for all Aquatic invasive species
- 36 State-listed Noxious Weeds; fully developed accounts are now available for all State-listed Noxious Weeds
- 13 Forest Pest Species

Photos

A total of 2,142 photos of non-native species have been added to the MTNHP database in FY19 and 1,874 of these were deemed appropriate for display on the Montana Field Guide. Current photo representation on the Montana Field Guide is as follows:

Status	Total Number of Photos
Aquatic Invasive Species	106
Noxious Weeds 1a	12
Noxious Weeds 1b	19
Noxious Weeds 2a	42
Noxious Weeds 2b	128
Regulated Weeds	33
Agricultural Pest Species	83
Forest Pest Species	46
Biocontrol Species	208
Other Non-native Species	1,833

Literature and Website Links

267 literature references for non-native species have been added to the MTNHP reference management database allowing 328 reference listings to be added to species accounts in the Montana Field Guide in FY19.

3 additional resource management links were added to individual species accounts for all Aquatic Invasive Species, Noxious Weeds, and Biocontrol species.