Rocky Mountain Herbarium
University of Wyoming
Strategic Plan
2019 - 2022

The mission of the Rocky Mountain Herbarium is to discover and disseminate botanical knowledge, emphasizing the identification, taxonomy and distribution of plant and fungal taxa present in the Rocky Mountain region.

Vision: To enhance scholarship about, and inform stewardship of, the region's biodiversity, by making information about Rocky Mountain plant species available to researchers, land managers, students, and interested citizens.

Executive summary

The Rocky Mountain Herbarium (RM) is a major asset of the University of Wyoming. It contains the world's largest collection of plant specimens from Wyoming and the Rocky Mountain region, as well as specimens from across North America and the rest of the world. With 1.3 million specimens, the RM is the third largest herbarium in the country at a public university; it ranks 15th out of 641 herbaria in the nation, and 75th of 2,962 herbaria in the world (placing it in the top 3% of world herbaria). The RM database contains more than 895,000 databased specimens and 300,000 specimen images, and is available to the global research community through the RM website (www.uwyo.edu/botany/rocky-mountain-herbarium/) and multiple data aggregators, including the Consortium of Southern Rocky Mountain Herbaria, Consortium of North American Lichen Herbaria and Mycology Collections Portal.

This treasure trove of primary information is used extensively by the scientific community, state and federal agencies, and the public. In the last 25 years, the RM has received more than $1,670,000 in mostly federal funding for graduate student education and specimen acquisition, processing, curation, databasing, and imaging. Currently, the RM is a lead partner in a $2.9 million grant from the National Science Foundation to create a comprehensive digital archive of more than 1.7 million plant specimens from the Southern Rocky Mountain region. As the largest herbarium in the region, RM is contributing a significant number of specimens (670,000), and is assisting smaller institutions in their digitizing and imaging efforts. This external funding has allowed RM to employ over 300 undergraduates, many of whom have been in the internship program, and to graduate 52 Master's students from the UW Floristics

program, all of whom have been employed upon graduation. As a single example of the value of floristics, RM studies have vastly increased knowledge of rare plants. Field work completed during the 1990s and 2000's resulted in the inventory of 168,754 mi^2 of the American West, and documented occurrences of 844 species of conservation concern at 3136 sites. This vast increase in knowledge has influenced the removal of many potential or proposed species from the Federal Threatened and Endangered Species List.

This strategic plan, the first for the RM, is intended to highlight the past and present successes of the herbarium and identify the RM's current strengths, to propose measurable goals and objectives that will not only maintain the strengths of the RM, but build upon them to increase the relevance of the collections to society, and to increase the contributions of the RM to the University of Wyoming's mission of research, education and outreach. In writing and sharing this document, we also hope to increase institutional understanding of, and support for, the Rocky Mountain Herbarium. We hope and expect that the conclusions we have drawn will move the RM substantially forward in the next few years.

Most important, and central to all other goals, we need to hire a new director and support staff to support a facility the size and significance of the RM. And, as the value and amount of digitized data, including high resolution images of specimens, continues to grow, we must find creative ways to share the ever-increasing costs of data storage and a new, sustainable networked database and web-based interface, all of which are essential to the functioning of a modern, world-class herbarium.

The RM must maintain excellent management. During this transition, it is imperative that protocols are updated, so that current and future students, volunteers and staff have the benefit of experience. Moreover, we need to develop workforce capacity through the training of student interns to oversee multiple herbarium tasks, and to supervise RM employees and volunteers. Our goal is to maintain the emphasis on research use of the RM specimens. RM is a primary resource for large-scale research projects such as the Flora of North America and regional projects. The RM website and search tool requires updating to be sustainable; in addition, collaboration with global-scale data aggregators, such as the Global Biodiversity Information Facility (GBIF) and Integrated Digitized Biocollections (iDigBio), will increase worldwide visibility and use of RM data and specimens. As new cutting-edge techniques are developed that can utilize specimens, the RM specimens will increase in value; we must continue to make them available.

The RM, through strengthening its ties to elementary, secondary and undergraduate education, can serve as an important resource for the teaching of botany, ecology, and the effects of climate change, while educating the next generation about the need for natural history collection. We have significantly increased the number of K-12 activities and lessons that we provide in the last few years, but would like to reach many more schools beyond south-east Wyoming. Moreover, the RM is an untapped resource for undergraduate and graduate-level classes that focus on analysis of very large data sets.

In addition, we would like to broaden the audience that accesses the RM database and feels comfortable using the herbarium facilities and staff to increase personal knowledge. In collaboration with UW Extension and other UW and non-UW partners, we have participated in a variety of community education events and workshops, and we have initiated a series of RM speakers and open houses. But again, we need to reach beyond our local community. Changes

to the website that will make it friendlier, such as the use of common names and inclusion of photos, could greatly increase our reach and audience.

Overview

The Rocky Mountain Herbarium is the largest facility of its kind between Saint Louis and the West Coast. Rich in material from throughout US, Canada, and northern Europe, it is the largest collection of Wyoming and Rocky Mountain plants in the world and reflects the region's biological diversity and natural history. It has been a leader in collections databasing and imaging; with >895,000 databased specimens and >300,000 images, it is second only to the New York Botanic Garden in the number of specimens that are available online to the global community of researchers.

The RM was established in 1893 by Aven Nelson, a charter member of the UW faculty, who served as president of the American Society of Plant Taxonomists and Botanical Society of America, and as president of the University of Wyoming (1918-1922). Over the past 45 years, under the supervision of Curator Dr. Ronald Hartman, the RM has been enriched by an unparalleled inventory program involving 50 floristics graduate students, as well as Herculean collecting feats by Curator Hartman and Manager, now Curator, Burrell "Ernie" Nelson.

In 1982 the US Forest Service National Herbarium (USFS), established in Washington, D.C. in 1911, and containing 120,000 specimens, was transferred to the RM on indefinite loan. The W. G. Solheim Mycological Herbarium (RMS; established in the 1930's by Dr. Solheim, distinguished UW teacher, researcher, and administrator) contains 48,000 specimens, principally parasitic fungi; also all of the major groups of fungi. It is based on Dr. Solheim's own formal collection of approximately 1,800 species as well as specimens from many other states, Canada, the Farlow Herbarium at Harvard, and several European herbaria. The RM collection, including USFS and RMS, now exceeds 1.3 million specimens.

The RM website can be found at:
https://www.uwyo.edu/botany/rocky-mountain-herbarium/.

The RM's Index Herbariorum entries are:
http://sweetgum.nybg.org/science/ih/herbarium-details/?irn=126907 (RM/USFS), and
http://sweetgum.nybg.org/science/ih/herbarium-details/?irn=126908 (RMS).

The purpose of this strategic plan is to set priorities and goals that will guide the RM into the next decade, maximizing the potential of the current staff, departmental resources and funding model. Our ultimate goal is to maintain the excellence of the RM until such time as a new Director is able to take leadership and set priorities.

Strategic Planning Partners: This team is the same as the Herbarium Management Team, which consists of Dr. Greg Brown (Associate Dean of A & S and Interim Director, RM Herbarium), Mr. Burrell "Ernie" Nelson (Curator, RM Herbarium), Ms. Bonnie Heidel (Lead Botanist, Wyoming Natural Diversity Database), Dr. Kristina Hufford (Associate Professor, Department of Ecosystem Science and Management), Mr. Lawrence Schmidt (Research Support Librarian, UW Libraries), and Dr. Dorothy Tuthill (Associate Director, UW Biodiversity Institute).

Organization

Organizational Circumstances of the Herbarium: The RM is part of the Department of Botany, University of Wyoming, and occupies one-third of the Aven Nelson Building, the building allocated to the department. The Interim Director, in consultation with the Curator, and other members of the RM Management Team, makes budget decisions for the herbarium. The RM has no annual operating budget, receiving only as-needed, ad hoc, fiscal support from the department; the basic operations budget is supported by an endowment and external grants.

Herbarium Staff: in addition to the Curator, there is a management team of five people. Currently, there are six undergraduate students working on a NSF data basing and imaging grant, two work/study undergraduates, 3 part time undergraduates, and six volunteers from the community.

Stakeholders:

- RM staff
- Global community of botanists, ecologists and biodiversity researchers
- Federal agencies (BLM, NPS, USFS, NRCS, USFWS)
- State and County agencies
- UW entities (College of Agriculture, Extension, College of Arts & Sciences, Department of Botany, Wyoming Natural Diversity Database, Office of Research and Economic Development, UW Libraries, IT)
- Data aggregators (SoRo group, Seinet, iDigBio, GBIF, etc.)
- UW graduate students, undergraduate students, and student employees
- Wyoming citizens

Audience:

- RM Director, Curator and management team
- Key stakeholders (above)
- Botany department head and faculty
- Dean of the College Arts & Sciences and other UW administrators
- UW Board of Trustees
- Wyoming Governor and State Legislature
- Federal Agencies
- Potential donors

Strategies, goals and objectives

Strategy Statement:
The Rocky Mountain Herbarium will leverage its status as the best herbarium in the region to promote use of collections for research, biodiversity conservation, and outreach to support a constituency including UW administrators, faculty and students; regional educators; and researchers, managers and citizens of Wyoming and across the globe.

Specific Goals & Objectives

Goal # 1. Direct more University of Wyoming resources to RM.

- Hire director and support staff.
- Institutionalize digital storage costs.
- Provide support for integrated database and web system, and digital archiving.

Goal # 2. Maintain excellence in management.

- Maintain curatorial excellence with training, updated protocols and stringent quality control.
- Develop an undergraduate internship program.
- Process and store the specimen backlog.
- Make plans for RM expansion
- Rebuild volunteer program.

Goal # 3. Maintain emphasis on research excellence, recognizing the intrinsic value of specimens.

- Reinstate a strong graduate program.
- Maintain collecting and accessioning activities.
- Expand on-line identification services by posting reference collections online.
- Collate list of research articles that have resulted from RM/USFS specimens.
- Update and improve website.
- Promote the use of specimens in innovative research.
- Provide access to RM Herbarium specimen records for increased exposure through data aggregators, including GBIF.

Goal # 4. Strengthen ties to Wyoming K-16.

- Increase connections between RM and UW and Wyoming community college undergraduate courses.
- Work directly with middle and high school educators to develop materials to meet classroom science standards and place-based education goals.

Goal # 5. Broaden audience for dissemination.

- Provide educational opportunities for community members (e.g., plant walks, workshops, lectures, citizen science programs).
- Improve public accessibility of RM search portal;
    - Explore options for including common names.
    - Explore options for incorporating photo gallery.
- Use social media to promote RM activities and research.
- Maintain in-house plant identification service.
- Novel outreach activities.

Assessment and evaluation

In order to make regular and measurable progress towards our identified goals, we are developing a logic model that identifies inputs, activities, and output and outcome metrics, benchmarks and milestones. The model is expected to change over time, as we achieve (or do not achieve) our benchmarks within the anticipated timeframe.

The logic model is attached as appendix A; the living version is available from Dorothy Tuthill, dtuthill@uwyo.edu.

Environmental scan

SWOT Analysis:

Strengths

- The largest herbarium in the Rocky Mountain region.
- Known nationally as one of the premier herbaria in the west.
- Significant portion of the Wyoming and regional collections are databased and imaged and work is continuing.
- Strong partnerships with other herbaria and land management agencies.
- In the “age of big data” the collections are becoming more relevant now than in the past.
- Routine use by state, regional, and national botanists.
- Public outreach has increased local recognition and volunteerism.

Weaknesses

- The lack of adequate space.
- The lack of adequate staffing.
- Lack of sustainable funding model.
- Next generation not being trained (maybe a lack of interest).

Opportunities

- Acquiring additional space within the Aven Nelson Building.

- Outreach to schools and the community.
- Promote the use of the RM for research uses of specimens and data.
- Collaboration with UW Libraries on archival storage and other IT costs.
- Additional partnerships for funding.
- New Research Office support for a "biodiversity center" will bring together and provide support for campus natural history collections, including the RM.

Threats

- Support from the University that is disproportionate to the size and significance of the RM.
- The cost of data storage.
- Staff and associates are close to retirement (no young people being trained or recruited for staff positions).
- Current lack of sustainable networked database and web-based interface.
- Large backlog of unmounted specimens stored in boxes.
- Insects or other building/maintenance damage.

Sustainability

Maintaining Strengths

The RM is the largest herbarium in the Rocky Mountain region. It is a leader in collections databasing and imaging; with >895,000 databased specimens and >300,000 images. The RM is second only to the New York Botanic Garden in number of specimens that are available online to the global community of researchers. The collection also includes >5,900 type specimens, nearly all scanned at very high resolution. The online search site and the physical specimens themselves are used routinely by state, regional and national botanists. Currently, the RM is a leading partner in a $2.9 million award from the National Science Foundation to create a digital archive of more than 1.7 million specimens native to the Southern Rocky Mountain region. The grant has significantly increased the proportion of Wyoming and regional collections that are databased, imaged and available on-line. In the "age of big data," these digital resources have become more relevant than ever. In addition, RM has an active group of volunteers who assist RM staff and student employees, and who have been invaluable help in ongoing specimen processing.

Addressing Weaknesses

The RM's greatest weaknesses are the lack of a permanent director, and inadequate specimen storage space. Although the RM is able to employ a number of students, it is understaffed at higher levels, most notably lacking a permanent director for the past four years. This has left the curator, who is nearing retirement, as the only full-time employee. Fortunately, the Botany Department recognizes the value of the RM, and has consistently placed the hiring of a new director as its number one priority. We are hopeful that removal of bottlenecks at the university level will allow progress soon. The RM may be able to acquire substantially more space in a few years, when a new Science Initiative building is completed in 2022. Most

occupants of the Aven Nelson Building are expected to move to the new building, potentially freeing up space for the RM. The RM management team is currently preparing a proposal to the UW Facilities Council, requesting a doubling of floor space and storage capacity for the RM within the Aven Nelson Building.

Capitalizing on Opportunities

UW currently has two major science-related initiatives that are providing new resources to biological sciences. The RM is not directly affiliated with either, but can benefit from both. As mentioned above, the new Science Initiative building on campus will relieve space pressure in the Aven Nelson building, enabling the RM to expand in its current facility. In addition, the Science Initiative has programs to support research by undergraduate students, who are also expected to speak publicly about their research. Tapping into such programs could spotlight herbarium research and the RM for a broad audience of constituents across the state. Furthermore, the creation of a new "Biodiversity Research Enterprise" (BRE) will increase opportunities to support the RM and other UW collections. The UW Office of Research and Economic Development, through the BRE, has already committed financial support to a cross-promotional effort that includes all UW natural history collections. The intended purpose of the effort is to increase awareness and appreciation of the research and educational values of the collections, and to direct more university resources their way. We hope to make the institutionalization of digital storage costs a piece of this support, which would create a significant savings for the RM. We also continue to investigate opportunities for collaboration on campus, including working with UW Libraries on archival storage. On a smaller scale, we plan to investigate the possibility of hiring undergraduate interns to take over some of the tasks of the curator, e.g., training and support of student employees and volunteers, and to build opportunities to use RM resources in undergraduate and K-12 education. The RM also has an opportunity to re-invigorate the volunteer program, and a student intern could be especially helpful in that capacity.

Mitigating Threats

Our priority must be to educate and work with the UW administration and RM stakeholders to increase institutional support for a permanent director, appropriate support staff, affordable data storage, and financial support for a new, sustainable networked database and web-based interface. Towards that end, we plan to collaborate with the new Biodiversity Research Enterprise to increase awareness of collections broadly, and the RM specifically, and to increase our own outreach efforts to promote the RM as a center of botanical excellence available to students, researchers, land managers and citizens of Wyoming and beyond.

Acknowledgements

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We also thank members of the RM Management Team, and members of the Department of Botany, especially Drs. David Williams and Brent Ewers. In addition, we thank the employees and volunteers of the Rocky Mountain Herbarium, and the long line of graduate students, Directors, and Curators, who have made the Rocky Mountain Herbarium into the world-class facility that it is today.

Question and comments about the RM strategic plan should be addressed to:

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Appendix A: Assessment and Evaluation Logic Model

Goal/objective	Input	Activities	Output	Output metric	Output benchmark	Output milestone	Outcome short-term	Outcome long-term	Outcome metric	Outcome benchmark	Outcome milestone
Goal # 1. Direct more University of Wyoming resources to RM.											
Hire director and support staff											
Institutionalize digital storage costs											
Provide support for integrated database and web system, and digital archiving.											
Goal #2. Maintain excellence in management											
Maintain curatorial excellence	Time	Update protocols Write protocol for destructive sampling Train staff, students, and volunteers in protocols	Updated and new protocols	# updated or new protocols				All employees and volunteers maintain excellence in all aspects of curation			
Develop undergraduate intern program	time graphic artist for poster	Find out if BOT has intern program Make posters Determine tasks & learning schedule for interns	Undergrad students knowledgeable in herbarium tasks	# of interns # of hours			Curator relieved of student employee training responsibilities Increased activities (processing, outreach, etc.)	Continuous stream of curatorial assistants Increased activities at RM Workforce development	# hours of curator's time "saved" # and quality of new programs & activities # interns through program Employment/education outcome for interns		
Process and store backlog	Time Student employees Interns Volunteers	Mounting Databasing Imaging Filing	Processed specimens	# specimens mounted # specimens databased # specimens imaged		1,000,00th specimen!	Additional specimens available online	All specimens processed and available online	Decrease in number of backlogged specimens		
Make plan for RM expansion	Time	Assessment of needs Writing	Proposal for space committee		Proposal submitted to space committee			Much more space for specimen processing and storage			

Adopted: July 16, 2019

Rebuild volunteer program	Student intern	Develop programs to attract and retain volunteers Provide daily support and oversight of volunteers	Processed specimens	# volunteers # of hours contributed by volunteers # of specimens processed	40 hours/week donated by volunteers			Intellectually satisfied volunteer workforce Stakeholders	# years per volunteer		
Goal # 3. Maintain emphasis on research, recognizing the intrinsic value of specimens.											
Reinstate a strong graduate program	Time Funding (through agency grants)	Write proposals Recruit top students	Trained graduates Reports for funders Specimens	# proposals funded # students enrolled		1 student funded and recruited		Workforce development Status as an actively collecting herbarium	# graduate students # specimens added per student # specimens added as a result of program		
Maintain collecting and accessioning activities		Develop collections priority list									
Expand on-line identification services by posting reference collection online											
Collate list of research articles that have resulted from RM/USFS specimens											
Update and improve website											
Promote the use of specimens in innovative research											
Publish RM to more data aggregators, including GBIF											
Goal #4. Strengthen ties to K-16											
Increase connections between RM and undergrad classes	Time	Collaborate with LIFE program and BOT to develop activities	Lesson/lab plans that meet class learning goals	# lessons # courses # students	1 course engaged per semester		Undergrad students familiar with collections' data Increased awareness among faculty of collections resources on	Citizens familiar with natural history collections and their data UW resources directed to RM to support undergrad education	# students and faculty engaged with RM $ directed to RM for education		Part-time person supported to develop & deliver undergrad education resources Students

							campus				using RM for self-directed research
Work directly with middle and high school educators to develop materials to meet classroom science standards and place-based education goals.	Time Graphic artist Materials and supplies for classroom use Web person Cost of shipping trunk(s) to schools	Work with educators to determine their needs Design and gather appropriate materials Grant writing Develop guidelines for use of trunks	Lesson plans Trunk of educational materials Student-friendly website	# teachers engaged # students using the materials	One teacher per semester requesting trunk	Second trunk needed!	Improve educational experiences for students and teachers	Knowledge of Wyoming's natural heritage increased among students and educators Environmental literacy increased in population RM recognized for support of public education Resources directed to RM to support public education			
Goal #5. Broaden audience for dissemination of botanical information											

Provide educational opportunities for community members	Time
	Classroom space
	Microscopes
	Graphic artist
	$ to bring speakers
	$ for receptions
		Collaborate with Extension and BI to develop activities and educational materials	Plant walks
			Plant ID workshops
			Educational materials Visiting speakers Citizen science opportunities
				# activities
				# participants
					Three events per year in at least two communities	Five events per year in at least three communities	RM recognized as valuable educational resource across state	Knowledge of Wyoming's natural heritage increased among public
								Environmental literacy increased in population
									# participants
									# communities visited
									$ directed to RM for education		

Improve lay accessibility to search portal	Time Web person Programmer	Explore options for including common names Explore options for incorporating photo gallery	User-friendly search portal with increased input and output options	# website hits per month Duration of visits # downloads			RM website a go-to place for interested public, as well as professional botanists	RM website recognized nationally as model for herbarium outreach			
Use social media to promote RM activities and research	Undergrad intern	Gather interesting stories to share on social media, and distribute		# friends, visits, etc.							
Maintain in-house plant identification services											
Novel outreach activities											