

# Department of Animal & Range Sciences

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## 2020 Program Self-Study and Review



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## CHAPTER 1. INTRODUCTION

The Animal and Range Sciences Department has a blend of Teaching, Research, and Extension faculty appointments. Our Department's on-campus instruction offers undergraduate programs of study that prepare students for a complex and rapidly changing world by providing both a scholastic foundation in basic sciences, as well as real-world opportunities to apply knowledge to complex interactions of science and management. Our Department offers four BS degrees: 1) Animal Science, 2) Natural Resources and Rangeland Ecology (NRRE), 3) Ranching Systems ([links 1 and 4](#)), and 4) a multi-department BS degree in Sustainable Foods and Bioenergy Systems. At the graduate level, we offer a MS in Animal and Range Sciences, a PhD in Animal and Range Sciences, and a multi-department PhD degree in Ecology and Environmental Sciences. We also participate in a multi-department PhD degree in Interdisciplinary Studies.

In addition to our multi-department undergraduate and graduate degree programs, Animal and Range Sciences Department courses formally support several undergraduate degree programs offered by other departments within Montana State University. Examples include the BS in Agricultural Education, BS in Biological Sciences, BS in Biotechnology, BS in Environmental Sciences, and BS in Microbiology. On average, 60% of the students enrolled in ANSC 100; Introduction to Animal Science and > 50% of the students in NRSM 101; Natural Resources Conservation and NRSM 102; Montana Range Plants are not Animal Science or NRRE majors ([Teaching 17 and 18](#)). Several other NRRE courses also have significant proportions of their enrollment comprised of students from other departments, including NRSM 240; Natural Resource Ecology (20%), NRSM 330; Fire Ecology and Management (32%), NRSM 455; Riparian Ecology and Management (27%), WILD 355; Wildlife-Livestock Habitat Restoration (33%), WILD 420; Range and Wildlife Policy and Planning (28%), WILD 426; Wildlife Habitat Management (38%), and WILD 438; Wildlife Habitat Ecology (24%). Per graduate education, our Department faculty supported several graduate degree programs in other departments during the review period, including serving as chairs, co-chairs, or members of graduate student committees. These programs included Agricultural Education, American Studies, Biochemistry, Biological Sciences, Education, Entomology, Exercise and Nutrition Sciences, Fish and Wildlife Biology, Health Sciences, History, Immunology and Infectious Disease, Land Rehabilitation, Land Resources and Environmental Sciences, Microbiology and Immunology, Molecular Biosciences, Plant Science, and Statistics. In addition, our Department faculty teach graduate courses in Microbiology and Veterinary Medicine.

Our BS degree in Animal Science includes options in 1) Livestock Management and Industry, 2) Equine Science, and 3) Science. Our BS degree in NRRE includes options in 1) Wildlife Habitat Ecology and Management and 2) Rangeland Ecology and Management. Many undergraduate students in our Department value the integrative nature of our curriculums and elect to double major in Animal Science and NRRE, or they pursue an academic minor in the other. Undergraduate instruction integrates traditional and innovative academic experiences with applied 'hands-on' applications

Our MS degree emphasizes either Animal Science or Range Science, while our PhD degrees emphasize either Animal Science, Range Science, or Ecology and Environmental Sciences ([Link 5](#)). Graduate programs provide exceptional and unique opportunities for advanced academic training and focused independent study through departmental research programs. Graduate education and research programs in Animal Science focus on livestock nutrition (including ruminal/gastrointestinal microbiology), reproductive physiology, genetics, meat science, and livestock production systems. Graduate education and research programs in Range Science focus on rangeland and riparian ecology, livestock grazing management, invasive plants, forages, wildlife habitat ecology and management, and livestock grazing interactions with fish and wildlife.



Off-campus instructional programs (Extension) provide research-based information to farmers and ranchers, other large and small acreage landowners, Extension agents, government agency personnel, youth, and other clientele. Extension specialists in the Department focus their educational efforts on beef cattle, sheep, forages, pesticide safety, wildlife, and rangeland management.

To take full advantage of this program review as a department self-study, we assigned teams that included all faculty (TT and fulltime NTT) and staff to develop first drafts of several chapters: Chapter 2. Undergraduate Education: Animal Science; Chapter 3. Undergraduate Education: NREE; Chapter 4. New Undergraduate Degree: Ranching Systems; Chapter 5. Graduate Education; Chapter 6. Scholarship; Chapter 7. Extension/Outreach/Engagement; and Chapter 8. Service. All data in [Appendix B](#) were made available to the author teams for developing their first drafts. Additional data were collected and/or summarized based upon each team's needs. Over a 5-week period each team shared their draft material and made presentations with Q&A to faculty and staff. Comments received during and after these sessions were incorporated into this final document.

## **Mission and Goals**

The mission of the Animal and Range Sciences Department is to create, evaluate and communicate science-based knowledge to enhance the management of Montana's livestock, rangelands, and related natural resources (e.g., forages and wildlife) in ways that are economically, socially and ecologically sustainable. To accomplish our mission, the Department combines Animal Science disciplines (reproduction, nutrition, genetics, microbiology, meat science and applied animal production) and Range Science disciplines (plant, rangeland, riparian and wildlife habitat ecology and management). Our Animal Science and Range Science programs focus on sustainable livestock production and wildlife habitat on rangelands and pastures. The livestock species foci include cattle, sheep and horses. The Department fosters collaborations with other programs at MSU and in the COA, allied industries, institutions, governmental agencies, non-government organizations (NGOs), private farms and ranches, and foundations. All of these interactions enable us to synthesize research results into comprehensive scientific-based knowledge that is disseminated through formal courses on-campus, off-campus teaching activities (Extension), scientific publications, and outreach publications and media. In particular, the Department's Teaching, Research and Extension activities have practical application to the state's livestock producers, other landowners, and natural resource managers.

The Department's research programs generate new knowledge centered on management of the grazing animal and the natural resources of the region. We provide research results that are useful in their applications to problems and choices facing the agricultural community, natural resource managers, and the scientific community. We disseminate information via academic courses, scientific scholarly products, individual consultations, Extension programs, and media presentations. Research salaries (faculty and staff) and benefits, operations and graduate research assistant (GRA) support and broad program directions are provided by the Montana Agricultural Experiment Station (MAES) which is funded by state and federal sources. In addition, grants and contracts are solicited to support research activities. Research activities are conducted in laboratories (on-campus and off-campus research centers) and on private, state and federal lands. Faculty, undergraduate and graduate students cooperate with MAES research centers located across our state.

All Department faculty participate in outreach and service activities to the general public, agricultural and natural resource clientele including private businesses; local, state, and federal government agencies; and professional scientific societies. University service activities include participation in departmental, college, and university committees and related activities.

Please refer to these links to learn more about our Department's history ([link 2](#)), diverse faculty ([link 1](#)), and facilities ([link 7](#)).

## 2013 Departmental Review

Although not part of the MSU Academic Program Review Guidelines ([Appendix B.](#)), we think it critical to review our progress over the last 7 years in light of our most recent Department review. Listed below are the strengths, weaknesses, opportunities, threats, and strategic directions from the 2013 review. Reviewer comments are either direct or summarized quotes. Our Department's 2020 responses are in italics.

### Strengths

- Excellent job in undergraduate teaching and with student access to faculty
- Student clubs and departmental support for clubs
- Rangeland degree is strong given limited faculty and increasing student numbers
- Equine science option and increasing student numbers
- Department has a positive momentum
- New building with modern labs
- New and expanded hires
- Demonstrated investments in department by university and department stakeholders as indicated by stakeholder financial support for the Animal Bioscience Building (ABB)
- Department is well thought of throughout the state by stakeholders
- Connection that faculty have with stakeholders is a major asset and strength
- Undergraduate and graduate students happy with curriculum and instructors
- Department is doing well in attracting international graduate students and appears to have good gender diversity.
- The undergraduate students entering the workforce appear employable

### Weaknesses

- Animal Science undergraduate students want more rigor and direction related to their required internship and faculty should decide what role the internship requirement plays in the curriculum
  - *The Department has addressed this with the hire of Hannah DelCurto and her leadership and responsibilities for the internship program with specific learning objectives for each internship*
- Large number of undergraduate advisees per faculty member detracts from other duties
  - *COA has instituted "common advising" for incoming freshman helping reduce the load but also creating some issues with mixed messages among advisors in COA and department*
- Preparedness of Incoming students
  - *National issue, no Department response or action*
- Prerequisites are not enforced uniformly at MSU and not within the department
  - *We have implemented "hard wired" prerequisites for all of our courses, meaning students cannot register without the prerequisite*
- Concern for PhD Program and lack of departmental grad courses and resources
  - *This is still a concern. In the last 7 years we have had a large turnover in faculty (11 retirements/resignations and 12 new hires; [Faculty 8](#)). We are attempting to carve out a niche for our PhD program based on the talent we have. We have asked our Extension specialists to consider teaching alternate year 1 credit modules in their area of expertise. We see a national need for applied agricultural and natural resource scientists. This is an area we are well-positioned to serve.*
- Students with BS and MS degrees from the department should NOT be accepted into the department's PhD program

- *We agree and since the 2013 review we've had other examples of failure with accepted BS and MS students into our PhD program.*
- Department and university need to decide if they can afford to maintain quality graduate education and if so, to commit to the investment of sufficient the resources to do so
  - *The Department has limited resources but through new hires and initiatives such as the Bair Ranch Foundation Seminar Series we are working to move our graduate program to a new, more consistent, design. In the Graduate Education section of this report and in the Summary, we address this issue*
- Poor job on course, program, and curriculum mapping and assessment
  - *We have taken assessment seriously as indicated in [Link 3](#). We are one of the few departments on campus that is thorough and up-to-date with assessment.*
- Current appointment FTE's are not consistent.
  - *The COA has a work load policy that gives some direction about this issue. That said we still do not have a consistent FTE appointment among faculty. Part of the issue is not (ex) all 3-credit courses require the same level of input on the part of the faculty member responsible for the course.*
- Research productivity should increase.
  - *This is still a major issue. The data presented in the 2020 review ([Analytics 2-11 Funding 1. – 11, and Publications 1. – Publication 8](#) clearly indicate we are NOT getting our research published in peer reviewed professional journals. This issue is addressed in more detail later in this report in Chapter 6. Scholarship. We have implemented measures to improve our performance. The “carrot” has been mentoring junior faculty and financial support for PhD students. The “stick” is our Department’s new Role and Scope document (2019) which contains quantifiable measures for research productivity and the Provost’s new policy which requires a “meets expectations” in all categories of faculty evaluations in order for faculty performance to be rated satisfactory.*
- Senior faculty should mentor junior faculty in all aspects of their duties with a focus on research productivity
  - *Based on the 2013 review, we implemented a mentor program for junior faculty. Each junior faculty member is assigned one senior faculty member within the Department and another senior faculty member from outside the Department. Dr. Jeff Mosley is doing an excellent job heading up the mentor program.*
- Adequacy of departmental Extension faculty FTE seems to be marginal in its ability to address stakeholder needs across the state, primarily due to the size and scope of the state
  - *We have added a new position in Extension Wildlife. Our current Extension faculty do excellent work but they are stretched. We look forward to completing our Extension Forage Specialist search that was suspended due to COVID-19. The addition of a second Extension range specialist stationed in Miles City would be a welcome addition to our program.*
- Connection between researchers and Extension needs to be enhanced
  - *Difficult to measure but we believe this has improved with new hires and partnerships among faculty that have major research and extension appointments.*
- Department seminars are poorly attended by both faculty and students
  - *We have taken steps to address this issue, in part with our Bair Ranch Foundation sponsored seminar series.*
- There is a weakness in administration due to the high rates of turnover from department head on up the MSU administrative ladder.
  - *This situation has changed for the better. It is the general feeling of our faculty that the Department of Animal and Range Sciences receives good support from upper administration.*

- Graduate students seem confused about graduate education policies and finances both in the department and at the university
  - *We have implemented several measures to address this issue including a new department graduate policy (Link 11).*

### Opportunities

- Consider partnering with other universities on graduate courses
  - *We are looking into this*
- Considering what kinds of positions the PhD graduates are likely to pursue may help define technical disciplinary expertise they need to acquire in their program of study
  - *Our strength lies primarily in the applied science fields and taking advantage of our unique faculty structure and opportunities for involvement in meaningful teaching experiences, Extension teaching, and livestock operations. We will address this in more detail in the Summary.*
- Opportunities for Extension specialists to connect better with county extension faculty
  - *Turnover among Extension agents was greater than normal for several years. The reinstatement of tenure-track positions for Extension agents has brought more stability and enabled our Extension specialists to develop stronger relationships with Extension agents.*
- The addition of a Beef Cattle Extension Specialist stationed in Miles City will be of great benefit to both that program and to the producers and other stakeholders on that side of the state. A similar position in rangeland management extension should also be seriously considered in the future
  - *We added the Extension Beef Cattle Specialist position in Miles City and continue to pursue the addition of an Extension Range Management Specialist position in Miles City.*
- The stakeholders recognized, and appreciated, all of the extension and outreach conducted by the department. They do not know what faculty appointments are, nor do they likely care. They only see the faculty out in the state helping them with their issues. Whomever the department has as its Head, that person must continue to make a concerted effort to interact with stakeholders, agencies, and organizations throughout the state.
  - *Since 2013 our Department Head has made a concerted effort to attend many of the commodity group meetings including Montana Stockgrowers, Montana Wool Growers, Ag Lenders Range School, Montana Farm Bureau, and Montana Organic. We also have a very active departmental advisory committee.*

### Threats

- Serious concern expressed as to the worker safety of working facilities and equipment at the BART farm
  - *We have new leadership at BART. In 2020 we are removing our feed mill, getting rid of unsafe equipment, and we instituted a safety training in conjunction with MSU Safety and Risk.*
- Increased enrollment without an increase in human and other resources will lead to a reduced quality in undergraduate programs
  - *Since 2013 we have received excellent support from the Provost for not only filling vacant positions but also receiving increases in base funding for NTTs and GTAs .*
- The department appears to be significantly understaffed in terms of laboratory assistants/research technicians
  - *We are one of the few departments on campus with a dedicated lab manager resulting in our labs often having the highest safety record on campus. Our livestock operations staff does an excellent job under new leadership supporting teaching and research. Research technicians are the responsibility of PIs to employ with grant funds.*

## Strategic Direction

- Develop and implement a strategic plan to continue the momentum
  - *The university is currently involved in this process*
- The department must create a climate and enthusiasm for research among its entire faculty. This includes the complete research cycle – getting grants, funding graduate students, and publishing the results in appropriate peer-reviewed and refereed outlets
  - *Addressed above*
- Opportunity for undergraduate research
  - *Although we lack data to support this statement, we have increased the number of students involved in undergrad research since our 2013 review*
- Our recommendation that this department schedule a formal retreat with an outside facilitator and defined objectives. A good facilitator will be able to help set up a productive agenda and lead the department to desired outcomes and direction
  - *We have not done this – in part because of the turnover we have had in faculty. However, this is an excellent suggestion that we plan to implement in 2020/2021 once fully staffed.*
- The department has a great opportunity to improve internal communications. Letting all staff know what is going on will help them communicate with faculty, students, and the public
  - *We implemented a quarterly newsletter for external communication that has improved internal communication as well. In addition, we implemented a weekly set of announcements for internal communication (Monday Morning Memo).*
- The Department and especially the faculty involved in the Natural Resources and Rangeland Ecology undergraduate degree should consider having their Rangeland Ecology and Management option accredited by the Society for Range Management
  - *We are currently accredited by SRM and will be reviewed for reaccreditation in 2020-2021.*
- Lastly, and perhaps most importantly, the department needs to take advantage of its uniqueness in terms of being a combined animal and range sciences department.
  - *One very tangible program we have put in place to take advantage of our unique department is the new endowed Ranching Systems Undergraduate Degree Program. This program gives equal weight to coursework in animal and range science along with coursework in business/accounting,*
- While it is commendable that the department was able to garner such private support to build their building, garnering commensurate support to enhance programs, encompassing the teaching, research and Extension missions, and scholarships will be even more important as they move into the future.
  - *The Ranching Systems Program along with the Nancy Cameron Endowed Chair in Range Beef Cattle Management are good examples of outstanding progress in this area.*

## **Faculty and Students**

Faculty data are presented in [Faculty 1-8](#) tables and figures. In 2013 there were 16 TT faculty in our Department: 4 assistant, 2 associate, and 10 full professors, with 5.55 FTE in Teaching, 5.16 FTE in Research, and 2.99 FTE in Extension. In 2013, the average years of service at MSU for our TT faculty was 16.1 years ([Faculty 1](#)). Projecting to August 2020, our Department will have 19 TT faculty: 9 assistant, 4 associate, and 6 full professors, with 6.03 FTE in Teaching, 7.50 FTE in Research, and 2.97 FTE in Extension, and an average years of service at MSU of 11.7 years ([Faculty 3](#)). The net addition of 3 TT faculty from summer 2013 to summer 2020 netted 0.02 less FTE in Extension, 0.52 more FTE in Teaching, and 2.34 more FTE in Research, reflecting greater emphasis on Research moving forward. Seven of the 16 TT faculty who were members of our Department in 2013 are not in the Department in 2020 due to retirements and resignations. Six of these seven TT positions were refilled and

one was converted to NTT and also refilled. In addition, we added 2 new TT faculty positions, we filled one vacant TT faculty position, and we nearly filled one more. The two additions were: 1) the Nancy Cameron Endowed Chair in Range Beef Cattle Production, and 2) a Wildlife Habitat Ecologist. The filled vacancy was an Extension Beef Cattle Specialist, and the nearly filled vacancy was an Extension Forage Specialist (search is currently suspended due to the COVID-19 hiring freeze). Of our 19 TT faculty projected for August 2020, seven were hired very recently (i.e., in 2019 or 2020).

NTT faculty also increased in the Department during the review period. In 2013, there were 4 NTT faculty in our Department, with 1.25 FTE in Teaching, 0 FTE in Research, and 2.0 FTE in Extension (*Faculty 1*). Projecting to August 2020, our Department will have 9 NTT faculty, with 3.65 FTE in Teaching, 0.23 FTE in Research, and 2.67 FTE in Extension (*Faculty 3*). The increase in NTT FTE included: 1) filling the Extension Sheep and Wool Production Specialist position as NTT vs. TT, 2) adding an Applied Animal Science and Livestock Judging Coach, 3) and adding a full-time (50% base funded) Equine Science Instructor. However, past experience has been that in times of economic stress, NTT positions are at risk. Losing NTT positions would severely decrease student success.

The Department's combined totals of TT and NTT faculty FTE projected for August 2020 are 9.68 FTE in Teaching, 7.73 FTE in Research, and 5.64 FTE in Extension.

Key performance indicators (KPI) indicate a consistent increase since 2013 in total faculty instructional expenditure (*Teaching 1*) and FTE (*Teaching 2*), with a relatively stable proportion of tenure-track faculty contribution to instruction (*Teaching 3*). The exception to the latter was in 2019, which likely reflected that several TT faculty retired or left the Department and the resulting increase in NTT instructors for critical (mostly undergraduate) classes. Increases in expenditures per student FTE have been similar to other COA departments (*Teaching 5*). Comparing 2019 vs. 2012, SCH increased 22%, credits taught increased 11%, and student enrollment increased 11%, from 350 students in 2013 to 387 students in 2019 (*ERG 1*). However, the number of students majoring in our Department per Faculty FTE and SCH per faculty FTE both declined during the review period (*Teaching 6 and 10*). This anomaly was caused, in part, by several vacant faculty positions in 2013 which skewed the data. The ratios also reflect the relatively small class sizes of our upper division courses, something in which MSU prides itself (*ERG 2*). The number of majors also is not wholly indicative of our instructional course loads. Large numbers of students in our courses are often majors from other departments (*Teaching 17 and 18*). The percentage of non-majors enrolled in our Department's courses averaged 33% during the review period and increased substantially since 2016 (*ERG 17*).

Retention of Animal and Range Sciences students was 70% in 2016-17 and 2017-18, lower than both projected and MSU overall retention values (*ERG 2*). However, in 2018-2019 Department retention was 82% which was well above both projected and MSU overall retention values (*ERG 2*). There are however, inconsistencies in retention data provided by the MSU Office of Planning and Analysis. For example, *ERG 13* indicates a lower student retention rate in our Department than data presented in *ERG 2*. Overall, it appears that more than 70% of students that change from a major offered in our Department remain at MSU to complete their degree.



## Teaching 1. Enrollment and Graduation Data from Provost Office.

Teaching 1. enrollment and graduation data from Provost Office

DEGREE	MAJOR 1, 2, 2nd DEGREE		CONC	2012	2013	2014	2015	2016	2017	2018	2019
BS	Animal Science	Equine Science	ASEQ	84	87	83	91	91	87	87	77
BS	Animal Science	Livestock Mgmt & Industry	ASLV	71	90	90	101	103	87	83	96
BS	Animal Science	Science	ASSE	71	68	69	73	99	83	103	107
BS	Natural Resources & Rangeland Ecol	Rangeland Ecology & Mgmt	RGEM	53	42	33	37	41	38	33	35
BS	Natural Resources & Rangeland Ecol	Wildlife Habitat Ecology & Mgmt	WHEM	47	37	43	52	45	38	35	46
BS	Ranching Systems		RSMG								1
BS	Sustainable Food and Bioenergy	Sustainable Livestock Production	SFLP	3	3	3	4	5	5	6	3
<b>TOTAL UNDERGRADUATE ENROLLMENT:</b>				<b>329</b>	<b>327</b>	<b>321</b>	<b>358</b>	<b>384</b>	<b>338</b>	<b>347</b>	<b>365</b>
MS	Animal and Range Sciences	Animal and Range Sciences	ANRS	18	11	14	18	20	15	14	15
PHD	Animal and Range Sciences	Animal and Range Sciences	ANRS	3	5	5	5	6	7	6	3
PHD	Ecology & Environmental Sciences	Ecology & Environmental Sciences	ESEC				1	3	2	4	4
<b>TOTAL GRADUATE ENROLLMENT:</b>				<b>21</b>	<b>16</b>	<b>19</b>	<b>24</b>	<b>29</b>	<b>24</b>	<b>24</b>	<b>22</b>
<b>TOTAL ENROLLED:</b>				<b>350</b>	<b>343</b>	<b>340</b>	<b>382</b>	<b>413</b>	<b>362</b>	<b>371</b>	<b>387</b>

AWARDED DEGREES												
DEGREE	MAJOR	OPTION	CONC	AY12	AY13	AY14	AY15	AY16	AY17	AY18	AY19	
BS	Animal Science	Equine Science	ASEQ	16	7	13	14	12	5	10	13	
BS	Animal Science	Livestock Mgmt & Industry	ASLV	15	21	16	19	20	28	25	20	
BS	Animal Science	Science	ASSE	15	9	25	23	12	21	16	17	
BS	Natural Resources & Rangeland Ecol	Rangeland Ecology & Mgmt	RGEM	5	10	14	6	10	6	11	4	
BS	Natural Resources & Rangeland Ecol	Wildlife Habitat Ecology & Mgmt	WHEM	8	14	6	8	4	12	9	12	
BS	Sustainable Food and Bioenergy	Sustainable Livestock Production	SFLP		1	1	2				1	
MS	Animal and Range Sciences	Animal and Range Sciences	ANRS	12	10	5	6	5	7	10	3	
PHD	Animal and Range Sciences	Animal and Range Sciences	ANRS				1			1	1	
PHD	Ecology & Environmental Sciences	Ecology & Environmental Sciences	ESEC								1	
<b>TOTAL DEGREES AWARDED:</b>				<b>71</b>	<b>72</b>	<b>80</b>	<b>79</b>	<b>63</b>	<b>79</b>	<b>82</b>	<b>72</b>	

AWARDED MINORS												
	MINOR DESCRIPTION		CONC	2012	2013	2014	2015	2016	2017	2018	AY20	
	Animal Science		ANS	5	5	8	5	1	3	2	2	
	Genetics		GNTC	1	1	6	4	7	4	11	17	
	Natural Resources & Rangeland Ecol		NRRE		4	1		2	1	2		
<b>TOTAL MINORS AWARDED:</b>				<b>6</b>	<b>10</b>	<b>15</b>	<b>9</b>	<b>10</b>	<b>8</b>	<b>15</b>	<b>19</b>	

## CHAPTER 2. UNDERGRADUATE EDUCATION: ANIMAL SCIENCE

Undergraduate enrollment in Animal Science has been relatively stable [average of 264 students per year across all Animal Science degree options ([ERG 1 and 12](#))]. During the review period, 397 students graduated with their BS degree in Animal Science ([ERG 1 and ERG 12](#)). Enrollment in the Genetics minor increased since 2012, while Animal Science declined in popularity as a concentration area for minors ([ERG 11](#)).

The Strategic Plan for the College of Agriculture identifies a focus area goal of: *developing competent life-long learners and leaders who excel in their chosen career and life experiences*. Most courses taught in the Department incorporate advanced learning techniques that challenge students to collect information, critically analyze it and use it to solve practical problems. Both the College of Agriculture and the University seek to incorporate more high-impact teaching practices. In alignment with this goal, our faculty has made a concerted effort to incorporate more writing intensive projects, group work, and oral presentations into our courses. Faculty research is frequently incorporated into courses including guest lectures from MAES personnel. Extension faculty are often invited to discuss current issues and research needs in animal agriculture. The majority of upper division undergraduate Animal Science courses are writing intensive and utilize collaborative assignments and projects to help students develop their communication and teamwork capabilities. Undergraduate research is integrated into many courses and degree options. Global learning is incorporated in species-specific courses (beef cattle, sheep, and horses) that address the world livestock industry and the impacts of worldwide production and marketing trends. Numerous courses also embrace community-based learning by bringing in members of the livestock industry, while the beef and sheep practicum courses (ANSC 232 and ANSC 234) engage students in calving and lambing as a service learning opportunity. Finally, all Animal Science majors are required to complete an internship for credit, and capstone management plan projects are required in several upper division courses. For a detailed list of how specific high-impact teaching practices are used in individual courses, please see [Teaching 14](#).

Retention within Animal Science majors ranged from 52% (Equine Science Option) to 59.5% (Livestock Management and Industry Option; [ERG 14](#)). Our assessment data indicate that some students leave because they are not adequately prepared for college. As courses become more challenging, non-retention becomes an issue. This is especially true when students are challenged to complete prerequisite classes and spend more semesters in leveling courses for math and chemistry. The sooner students can get into courses they perceive as being relevant to their major, the more likely they are to continue in our program. Twenty-six to 35% of students who leave the Animal Science major leave MSU ([ERG 14](#)). DFW (grades of D or F, or withdrawal from the course) are presented in [Teaching 11 and 12](#). As expected, freshman-level courses have the highest DFW percentage. Although there is extensive mentoring in our ANSC 100 course, there is also a level of rigor appropriate for a University Freshman-level course. DFW percentages drop to less than 3% in Junior- and Senior-level courses ([Teaching 11 and 12](#)). For more information on our mission and dedication to students please see [link 1](#).

### Learning Outcomes

Learning Outcomes were developed collectively by all Animal Science teaching faculty based on the expertise necessary for graduates to be successful in animal agriculture and the skills taught in individual courses. Students earning their BS in Animal Science at MSU will have demonstrated the ability to:

1. Design and evaluate animal management systems by synthesizing and applying knowledge of biological processes related to animals and the rangeland plants that support them. [*Knowledge*]
2. Identify and critically evaluate scientific or technical animal science content to make informed decisions providing a foundation for lifelong learning. [*Critical Thinking*]

3. Demonstrate effective oral and written communication to a range of audiences and within collaborative environments. [*Communication and Collaboration*]
4. Use scientific principles to formulate questions, explore solutions, and solve real-world problems and advocate based on science. [*Problem Solving*]
5. Actively engage in discussions of complex ethical issues in their profession. [*Ethics*]
6. Demonstrate animal husbandry and plant identification skills. [*Skills*]

Animal Science students with senior standing were assessed in 2017 and 2018 ([Link 3](#)). On the selected assignments in 2017, 89% of the students achieved an acceptable rating for knowledge, and 90% of students were rated acceptable for their critical thinking skills. In both cases, students were rated above our minimum standard of 80%. We identified some common mistakes related to our students' skills:

1. Students did not identify and completely respond to specific assignment requirements.
2. Students did not properly cite sources.
3. Students were unable to identify credible sources of information.
4. Students were unfamiliar with journal manuscript style or format.
5. Students were unable to put research information into their own words.

In 2018, all students met expectations for oral communication skills with a range of scores from 3.6 to 4.5 on a 5-point scale. However, written communication skills were rated almost a full point lower on a 5-point scale than scores for oral communication skills. Use of references, as in number or validity, still challenge the students. This could be a result of poor communication of the expectations by the instructor, but may also be a result of student procrastination and last-minute efforts diminishing the quality of the written work. The majority of upper division Animal Science courses are "writing intensive" courses to address the identified shortcomings.

To improve students' attainment of our desired Learning Outcomes, we also added several courses since the last program review in 2013. These include ANSC 202 Livestock Feeding, ANSC 436 Professional Development in Beef Production Systems, ANSC 437 Professional Development in Beef Feedlot Systems, EQUUS 206 Equine Ethology: Understanding Horse Behavior, and EQUH 133 Horse: Ground Level. ANSC 202 was added to allow more time for *critical thinking* and *problem solving* in ANSC 320 Animal Nutrition. ANSC 436 and 437 together follow animals from weaning through harvest. The classes utilize a hands-on approach allowing students to hone their animal handling *skills*, identify when animals need to be treated or harvested, and learn different approaches to finishing animals. EQUUS 206 was added to ensure equine students have a comprehensive *knowledge* of equine behavior before they enter upper division, hands-on classes with horses.

## Evaluations from Students and Student Successes

Teaching evaluations indicate that most students ranked their Animal Science undergraduate instructors Very Good to Excellent ([Student Survey 7](#)). For advising, each student has their own faculty advisor who they can approach for curriculum questions and career advice. Student ratings of their advisor verify that advisors are positive, encouraging, and help students avoid or solve problems in their academic planning ([Student Survey 1, 3, 5, and 8](#)). Students consistently responded that their advisors were more responsible and took more initiative toward their academic success than the students did themselves when it came to initiating meetings and fully understanding the curriculum ([Student Survey 1 and 3](#)). In an anonymous survey of three undergraduate classes, 86% of students gave advisors a grade of A-B for advising skills out of a possible A, B, C or D ([Student Survey 9](#)). Most comments indicated faculty were friendly and supportive, however, several respondents did

not find their faculty advisor helpful or personable. Several students expressed displeasure with the College of Agriculture common advising for freshmen.

Three undergraduate classes were anonymously surveyed (*Student Survey 9*) to determine their perceptions of the Animal Science Undergraduate Program. Based on 137 respondents (25 Equine Science Option majors, 54 Livestock Management and Industry Option majors, and 60 Science Option majors), 97% of Animal Science undergraduates believed their BS in Animal Science degree, once earned, would support their chosen career paths, and 96 % were happy to have chosen to pursue their degree through the Department. Most students (98%) indicated faculty of the Department were very knowledgeable about their subject concentration and 93% indicated the faculty and staff of the Department care about their success.

Senior Exit Interviews (*Student Survey 5*) further support the quality of the program through the following results:

- In general graduating seniors were happy with their major and agreed that the curriculum is well-structured, challenging, provided ample opportunity for hands on learning, and was committed to science-based learning.
- Graduates also appreciated the interaction with faculty and found the advisor's helpful.
- The one area graduates indicated needed improvement was lab equipment and animal handling facilities.

Students graduating with a BS in Animal Science degree go on to a variety of professional positions and careers. Most commonly, students either return to the family agricultural enterprise, gain employment with an agriculture related industry, attend veterinary school, or enroll in graduate school (*Student Survey 10*). Although only a limited "snap shot", *Student Survey 10* provides specific examples of professional employment achieved by students after completing their BS in Animal Science.

Undergraduate Animal Science students have the opportunity to participate in the Academic Quadrathlon, a competition that consists of a comprehensive written exam, impromptu oral presentation, hands-on lab practicum and a double-elimination quiz bowl tournament. Our Department has had a team compete at the regional level every year between 2012 and 2019, and our students placed first in 2013 and advanced to the national competition. Students also can represent our Department at national contests by earning a spot on the Livestock Judging Team or the Wool Judging Team. During the review period, student successes have included top awards for MSU Collegiate Cattle Women, numerous team wins at the National Collegiate Beef Quiz Bowl, multiple wins by our Colt starting classes in the Top of The West Colt Starting Competition, and national awards for our MSU Equestrian Team.

## **Strengths, Weaknesses, Opportunities, and Threats**

### Strengths

- Internships are available with a variety of ranches, businesses, and agencies associated with livestock and natural resource management.
- Faculty regularly engage with off-campus groups, landowners, agencies (local, state and federal) and MSU Extension for field trips, research, and other experiences that are incorporated into the classroom.
- Proximity of teaching and research facilities at the Bozeman Agricultural Research and Teaching Center (BART), the Red Bluff Research Ranch, and the Fort Ellis Research Farm provide students opportunity for hands-on learning within a normal class schedule.
- Animal Science teaching faculty is diverse and representative of the Animal Science student body.

- Faculty regularly incorporate hands-on approaches, high-impact educational practices; case studies and collaborative assignments in teaching.

#### Weaknesses

- Limited use of common intellectual experiences (i.e., continuing projects from one class to another) across courses within the Department.
- Problems with pre-requisite enforcement leads to perceptions by students that they can take classes out of order.
- Vacant faculty positions staying open for long periods and frequent faculty turnover. Short-term instructors affect continuity and establishment of effective learning communities.

#### Opportunities

- As part of this internal review, we selected 5 different universities (Angelo State (TX), North Dakota State, South Dakota State, Oregon State and New Mexico State) with similar programs to compare our current curriculum. In general, we have comparable classes with most of the 300 and 400 hundred classes being similar (nutrition, reproduction, genetics, meat science). There are, however, three classes missing from our program: large animal anatomy and physiology, livestock behavior other than equine, and a freshmen/sophomore seminar. This presents an opportunity that could address some weaknesses identified by the faculty and students.
- Connecting students to career development opportunities and full-time jobs is one of the ways to increase student success after graduation. To this end, it would benefit students if the Department created a real-time job board for students, similar to one maintained by the Department of Ecology - <http://www.montana.edu/ecology/jobboard/index.html>.
- Another opportunity is to develop “concentration certificates” within the Livestock Management and Industry option. Colorado State University has 4 of these in its Animal Science option. The certificate contains 13–14 credits specific to animal nutrition, beef feedlot management, beef production systems or meat science. Each certificate requires an internship in the area of concentration.
- Additional ideas from faculty were:
  - a. Merge or co-convene EQUH 133 Horses: Ground Level and EQUH 206 Equine Behavior
  - b. Seedstock Development Class

#### Threats

- In the previous departmental review (2013) faculty expressed concern with the preparedness of incoming students and this continues to be a challenge. The lack of student preparation in basic skills puts pressure on the Animal Science undergraduate teaching faculty when students are challenged to complete prerequisite classes, such as chemistry. Many Animal Science upper division courses are only offered once a year, and difficulty passing the prerequisites can result in substantially longer time to graduation, challenging retention in the Department.
- A lack of understanding of University structure and organization by stakeholders within the livestock and ranching communities can lead to poor perception of the Department’s response to educational needs or preparation of students. Unfortunately, this confusion by stakeholders can lead to misunderstanding and displeasure regarding the activities, funding sources and relationships with other entities in the state.
- Changing culture and economics of Bozeman may challenge BART Farm existence.

## Strategic Directions for the Future

The continued need for an undergraduate animal science program is demonstrated by the demand for graduates by the animal agriculture industry. The Department regularly receives more requests for interns than we have students. In 2015, a USDA survey (<https://nifa.usda.gov/press-release/one-best-fields-new-college-graduates-agriculture>) concluded there was a need for well educated people in agriculture with an estimated 60,000 jobs available that require higher education with only 40,000 of those filled (USDA Employment Opportunities for College Grads in Food, Ag, Natural Resources (<https://www.purdue.edu/usda/employment/>)). The general consensus among stakeholder groups, such as the Montana Stockgrowers Association and Montana Farm Bureau Federation, is that there is a shortage in skilled farm and ranch labor. The average age of farmers and ranchers is increasing, and with growing world population and environmental and social challenges, the need for highly-trained agricultural professionals to implement cutting edge technology on farms and ranches will continue to increase. To meet this need, we will:

- Continue to engage in high-impact teaching practices and maintain close contact with industry.
- Create and institute courses to fill gaps in the current Animal Science degree program revealed during degree assessment in Spring Semester 2020.
- Design a process for tracking students post-graduation to collect information pertaining to job preparedness as a result of their MSU Animal Science degree and then use this information to assess areas of concern in our Animal Science degree program every 5 years.
- Expand faculty mentoring efforts to enhance undergraduate teaching.
- Utilize new equine tenure track hire to expand and strengthen equine research opportunities for Animal Science undergraduates.



## CHAPTER 3. UNDERGRADUATE EDUCATION: NRRE

In 2006, we modernized the name of our degree program from a B.S. in Range Science to a B.S. in Natural Resources and Rangeland Ecology (NRRE). Undergraduate enrollment in NRRE has been relatively stable from 2012 to 2019 (range 68–92, average = 81; *Teaching 1*). On average, 17.3 students have graduated with a BS in NRRE each year from 2012 to 2019 (range 14-24, *Teaching 1*). Enrollment in NRSM 101 and NRSM 102 has averaged about 220 students since 2012, with peak enrollments of 254 students in 2016 and 266 students in 2019. An additional lecture section (NRSM 101) and several lab sections (NRSM 102) were added in 2016 and 2019, respectively, to meet this demand.

At a recent (2/19/2020) Range Program Leaders meeting at the annual Society for Range Management meeting, most leaders described declining enrollment in their programs (B. Olson, pers. comm.), despite plentiful career opportunities for recent graduates. Students continuing to seek the NRRE degree at MSU indicate a strong desire by young people to be associated with natural resources and range science and that our Department is viewed as having a quality program. Our undergraduate program has one of the highest enrollments of rangeland ecology and management programs accredited by the Society for Range Management (*Teaching 16*).

The Strategic Plan for the College of Agriculture identifies a focus area goal of: *developing competent life-long learners and leaders who excel in their chosen career and life experiences*. Most courses taught in the Department incorporate advanced learning techniques that challenge students to collect, critically analyze, and use information to solve practical problems. Faculty research is frequently incorporated into classroom lectures, within context. In selected courses, students meet with ranchers and natural resource professionals, including individuals from MT FWP, USFS, NRCS, BLM and others in the classroom and in the field. For example, in separate sessions, two federal agency individuals (USFS, NRCS) and an environmental consultant present real-world scenarios to students in NRSM 453 Habitat Inventory and Analysis at the end of the semester. Graduate students from Dr. McNew's Wildlife Habitat lab deliver 2- 3 guest lectures to WILD 355, Livestock and Wildlife Habitat Restoration. Dr. John Fisher, Sociology and Anthropology Department (MSU), mentors NRRE students as they reconstruct pre-development landscapes for the Rosebud Battlefield State Park. Senior students in NRSM 455, Riparian Ecology and Management, evaluate riparian process and function with help from Dr. Thomas Keck, Custer-Gallatin National Forest Soil Scientist.

One defining feature of our NRRE curriculum is that it is purposely structured so that Freshman- and Sophomore-NRRE majors are enrolled in range science courses taught by our faculty. This approach differs from many other university range curricula in which range majors do not enroll in range-specific courses until their junior year. Our freshman- and sophomore-level coursework also purposely includes substantial field time outdoors in rangeland environments. This two-pronged approach helps lower-division students establish strong ties with our major and our faculty. Our approach also aids student recruitment because prospective students realize they will have the opportunity to decide relatively early in their course of study whether NRRE is the right choice for them.

The freshmen cohort of the NRRE Rangeland Ecology and Management Option had the greatest retention (Fall 1 to Fall 2: 72.41%) among the six options in our Department, which includes three Animal Science options (52% to 59%), the Sustainable Livestock Production Option (40%), and the Wildlife Habitat Ecology and Management Option (52%; *ERG 14*). Average retention is 51.5% across the College of Agriculture. The 72.41% retention rate for Rangeland Ecology and Management Option students may benefit from required enrollment in NRSM 101; Natural Resource Conservation and NRSM 102; Montana Range Plants Lab during their Freshmen-year. NRSM 102 includes hands-on opportunities in the field.

In the NRRE program, the DFW rate exceeds 20% in two courses (NRSM 101 and NRSM 102; [Teaching 13](#)). This DFW rate has been fairly consistent across the review period. Students often comment on the rigor of these two introductory courses. Some may not be ready for this rigor during their first semester at a university, which may partly explain the relatively high DFW rate in those courses. All other NRRE and WILD courses have DFW rates less than 11%.

## Learning Outcomes

Learning Outcomes were developed from a meeting among NRRE faculty, whereby we agreed on the expertise necessary for graduates to succeed in natural resource management and rangeland ecology, based on skills taught in individual courses. Our Learning Outcomes are related to specific courses ([Link 3](#)). [Link 3](#) also includes the curriculum map for NRRE majors. Faculty indicated which classes address each Learning Outcome and whether the course content introduces (I), develops skills (D), or requires mastery (M) of each Learning Outcome. Learning Outcomes for NRRE graduates are to:

1. Demonstrate the ability to develop sustainable management and habitat restoration plans by synthesizing and applying knowledge of rangeland and wildlife ecology, soils, and vegetation. [*Knowledge*]
2. Critically review and evaluate information to make decisions regarding the management of renewable resources to achieve conservation and management goals. [*Critical Thinking*]
3. Demonstrate effective written and oral communication skills and facilitate communication within collaborative environments. [*Communication and Collaboration*]
4. Use scientific principles to formulate questions, explore solutions and solve problems in their chosen profession [*Problem Solving*], and
5. Practice ethical conduct appropriate to their profession (*Ethics*)

Assessments of skills by upper division undergraduate students in NRRE were completed in 2017 (Outcomes 1 and 2), 2018 (Outcomes 3 and 4), and 2019 (Outcome 5). In 2017, 83% of students achieved an acceptable rating for knowledge, but only 75% of students were rated acceptable for their critical thinking skills. Our minimum standard was 80%. In 2018, 100% of students were rated as acceptable for their oral communication skills, while 89% of students were rated as acceptable for their written communication skills. In 2018, 81% of students were rated acceptable for their problem-solving skills. In 2019, we assessed the fifth Learning Outcome, Ethics, and 94% of students were rated acceptable.

High-impact teaching practices are utilized in many NRRE courses ([Teaching 15](#)). The goal of these high-impact teaching practices is to heighten those critical skills of oral and written communication along with understanding global perspectives and research. With a new hire in 2014 (Dr. Lance McNew), we were able to add a course, WILD 420 Range and Wildlife Policy and Planning. This course met one of the requirements for our NRRE program to become accredited by the Society for Range Management in 2016. Dr. McNew stresses written and oral communication skills in his course, one of our five learning outcomes. Other examples of high-impact practices in NRRE courses include:

- WILD 325 Livestock-Wildlife Nutrition: uses a flipped classroom. Students work in groups to solve problems on worksheets. The course is also integrated with Montana Department of Fish, Wildlife and Parks' management of the Bridger Mountains' mule deer herd.
- NRSM 353 Grazing Ecology and Management takes two field trips to ranches. This course also has several writing assignments and half of the semester incorporates collaborative learning and flipped methods.

Internships for credit are not required for NRRE majors. However, the NRRE curriculum provides numerous opportunities for hands-on experiences via field trips (*Teaching 15*), and faculty advisors strongly encourage students to seek seasonal employment from a plethora of opportunities. All seasonal- and career employment opportunities received by faculty are immediately posted on a listserv for current and former students.

## Evaluations from Students and Student Successes

Teaching evaluations for our undergraduate NREE courses (NRSM and WILD) averaged 4.5 on a 5-point scale during the review period (*Student Survey 7*). For advising, NRRE undergraduates rated their faculty advisors an average 3.75 on a 4-point (*Student Survey 2 and 4*). Surprisingly, students evaluated themselves with an average score of 3.45, suggesting faculty were more prepared for advising sessions than the students. In our Department, all students are advised by a faculty member, not a staff member as is common in some departments at MSU and other universities.

Three undergraduate classes were anonymously surveyed to determine their perceptions of the NRRE program. Based on 47 respondents (28 from NRSM 101, 6 from NRSM 240, 13 from NRSM 455), 94% of students believed their NRRE degree, once earned, would support their chosen career paths, and 96% were pleased to have chosen to pursue their degree at MSU (*Student Survey Data 11*). All students (100%) indicated NRRE faculty were knowledgeable about their subject concentration, and 98% of students indicated that NRRE faculty and staff care about their success.

Senior Exit Interviews from 2016-2018 further support the quality of our NRRE program (*Student Survey 6*). On a 3-point scale, with 1 being “strongly agree” and 3 being “strongly disagree”, students most strongly agreed with: “Happy with major” (1.21), “Meaningful interaction between faculty and students” (1.21), and “Ample opportunity for hands-on learning” (1.31). The “lowest” scores, trending toward “strongly disagree” were: “Animal handling facilities are excellent” (2.00), “Little trouble getting into required classes” (2.17), and “Program allowed pursuit of personal interests” (2.07). Note, a score of “2” was “agree” on this scale. Exit interviews with graduating seniors also indicate that students are happy with their choice of major and most are actively engaged in careers in NRRE (*Student Survey 5*). Most NRRE graduates have pursued successful careers in federal and state agencies, environmental consulting firms, or entered graduate school, while some have returned to the family ranch. NRRE faculty are often told that our students, whether as seasonal employees, young career professionals or graduate students, are well prepared compared with individuals from other natural resource/range programs.

The NRRE undergraduate program strongly supports the participation of two academic teams, Undergraduate Range Management Exam (coached by Ms. Merrita Fraker-Marble, NTT) and Plant Identification (coached by Dr. Craig Carr, TT), that compete at the annual Society for Range Management meetings. These teams compete with 20+ teams (180+ individuals) from the U.S., Mexico and Canada. Students also compete in the Society for Range Management Undergraduate Extemporaneous Public Speaking Contest. We consider the results of these competitions to be indirect measures of the mentoring and teaching that students receive in the NRRE program, and our undergraduate students have a strong record of achievement in these competitions during the past 7 years. In the Undergraduate Range Management Exam, our team placed 3<sup>rd</sup> in 2014, 5<sup>th</sup> in 2017, 2<sup>nd</sup> in 2018, 4<sup>th</sup> in 2019, and 3<sup>rd</sup> in 2020. We had one student place 3<sup>rd</sup> overall in 2014, and another student placed 2<sup>nd</sup> overall in 2017 and 1<sup>st</sup> overall in 2018. In the Plant Identification Exam, our team placed 4<sup>th</sup> in 2018, 2019, and 2020, and was the only U.S. team in the top five in 2020. In Extemporaneous Speaking, our students placed 3<sup>rd</sup> in 2012, 2<sup>nd</sup> and 4<sup>th</sup> in 2014, and 1<sup>st</sup> place in both 2015 and 2018. In 2018, our students won the Collegiate Trail Boss Award, the composite award for all undergraduate student competitions that year.

## **Strengths, Weaknesses, Opportunities, and Threats**

### Strengths

- Six research/teaching professors provide a strong, critical mass, cover the diversity of specialty areas in range management, e.g. rangeland ecology, grazing management, fire and riparian management, wildlife habitat, natural resource inventory and assessment, “Forages” is vacant – search in progress.
- Added Wildlife Habitat Ecologist position (2014).
- Judicious use of adjuncts.
- Numerous field labs/activities.
- Close working relationship with NGOs, state and federal natural resource managers, and the ranching community.
- Close proximity to rangeland, related natural resources, and ranches.
- Accredited by the Society for Range Management (2016).
- Students are competitive on standardized exams (URME, Plant ID).
- Added Extension Wildlife Specialist who will have partial teaching appointment (2020).
- Retention rate of majors in Rangeland Ecology and Management Option well above college and university averages.
- Integration of animal science and range science—a perfect fit for Montana.

### Weaknesses

- With the recent departure of Dr. Emily Meccage, the NREE teaching faculty is less diverse (1 female, 7 males), although the NRRE teaching faculty is complemented by the Animal Science teaching faculty which is comprised of 8 females and 5 males.
- Curriculum lacks sufficient exposure to human dimensions, such as conflict resolution and collaborative conservation.

### Opportunities

- Upcoming retirements = new hires, could bring social scientist and second modeling specialist.
- Access to large scale landscapes, facilities and working livestock for field laboratories and research.
- Good relations with federal and state agencies.
- Numerous seasonal employment opportunities for students.
- Multi-day field trip to Pryor Mountains where several range biomes merge.

### Threats

- University Core Curriculum prevents adding courses in natural resource law, conflict resolution and societal influence on natural resource conservation and management.
- Limited or non-existent funding for extended laboratory travel, e.g. Pryor Mountain Biomes tour.
- With field labs, liability exposure with many student drivers.

## **Strategic Directions for the Future**

The continued need for an undergraduate NRRE program is demonstrated by the demand for graduates by federal and state agencies, and consulting firms. For example, the USDA Natural Resources Conservation Service (USDA-NRCS) announced in April 2020 that it will fill 1,200 professional resource management positions across the nation. In Arizona, USDA-NRCS has about 140 range-related positions and 40 are currently vacant because of a lack of qualified applicants (L. Smith, pers. com.). On a broader scale, a USDA survey (2015) projected that by 2020, agriculture would have 60,000 jobs requiring well-educated people, with only 40,000 of those filled. Some of the job demand is due to pending retirements by large numbers of natural resource scientists and managers in federal and state agencies. This should ensure a steady stream of entry-level positions for our

graduates, thus we project a stable and possible slight increase in enrollment in the NRRE undergraduate program during the next review period.

Pending retirements also will affect the NRRE faculty during the next review period. We anticipate that 3 of the 5 NRRE TT teaching faculty (Drs. Marlow, Olson, and Sowell) and one of the 2 NRRE NTT teaching faculty (Dr. Mike Frisina) will retire within the next 7 years. Our newest hire, Dr. Jared Beaver, is poised to assume Dr. Frisina's teaching responsibilities when Dr. Frisina retires, but the other 3 TT faculty positions will need to be refilled. MSU administration strongly supported filling TT vacancies in Animal Science during the last review period. Hopefully this support will continue for NRRE faculty during the next 7 years. In addition, a search to refill the Extension Forage Specialist position with a minor teaching appointment (AGSC 342 Forages, 3 credits) was suspended in April 2020 due to COVID-19 but will hopefully resume soon.

Our strategic directions for the future include:

- Expanding student recruitment beyond our traditional recruiting areas of Montana, Wyoming, and California.
- Expanding recruitment of Native American students.
- Maintaining faculty lines.
- Incorporating more social science skills (e.g., conflict resolution) into curriculum.
- Creating an endowment fund to cover student travel costs to range ecosystems outside Montana and northern Wyoming.

## CHAPTER 4. NEW UNDERGRADUATE DEGREE: RANCHING SYSTEMS

The Animal and Range Sciences Department added the BS in Ranching Systems degree in 2019. The purpose of this new 4-year undergraduate degree is to prepare graduates with the diverse set of skills needed to meet the variety of challenges facing the ranching industry. The BS in Ranching Systems degree is the mainstay of our Department's new Dan Scott Ranch Management Program which seeks to strengthen the ecological, financial, and social sustainability of the ranching industry, focused on the Northern Great Plains and Rocky Mountain West regions.

The BS in Ranching Systems degree is a limited enrollment program after the sophomore year. The degree opened for student enrollment in July 2019, and 3 students are currently majoring in Ranching Systems. One student was admitted to the upper level of the degree in December 2019 with an anticipated graduation date of December 2021. The curriculum is comprised of courses in Animal Science, NRRE, Agricultural Economics, and Business ([Link 4](#)). Six new Ranching Systems courses were developed by the Dan Scott Ranch Management Program Leader (Dr. Rachel Frost) and are currently being reviewed through the CiM process:

1. RS 306; Livestock Management and Human Resources in Ranching Systems
2. RS 316; Forage Management and Natural Resource Stewardship in Ranching Systems
3. RS 398; Livestock and Forage Management in Ranching Systems – Work and Learn Internship
4. RS 406; Finance and Decision Making in Ranching Systems
5. RS 416; Systems Thinking For Ranches
6. RS 498; Finances and Decision Making in Ranching Systems – Work and Learn Internship

### Learning Outcomes

Learning Outcomes were developed with input from faculty and members of the Dan Scott Ranch Management Program's Ranch Management Industry Advisory Council. Students earning their BS in Ranching Systems at MSU will have demonstrated the ability to:

1. Design and evaluate sustainable ranching systems by synthesizing and applying knowledge of livestock production, business and economic aspects of Ranching Systems, and rangeland ecology and management to a systems-level approach to Ranching Systems. [*Knowledge*]
2. Critically review and evaluate information to make decisions regarding the management of the whole ranching enterprise in order to achieve management goals. [*Critical Thinking*]
3. Demonstrate effective oral and written communication to a variety of audiences, as well as within collaborative environments. [*Communication and Collaboration*]
4. Use scientific principles to formulate questions, explore solutions, and solve real-world problems based on scientific principles. [*Problem Solving*]
5. Demonstrate knowledge of complex ethical issues in their profession. [*Ethics*]



## CHAPTER 5. GRADUATE EDUCATION

During the review period, the Department of Animal and Range Sciences had relatively stable graduate enrollment, averaging 15.6 MS students per year (range 11 – 20) and 7.8 PhD students per year (range 3 – 10; *Teaching 1*). For MS candidates, which make up the bulk of our graduate program, this could be viewed as a positive given the overall reduction in MS enrollment across Montana State University during this period. We awarded 58 MS and 4 PhD degrees during the review period at a consistent rate among years (*ERG 8 - 10*). Our graduate student enrollment in the PhD degree in Ecology and Environmental Sciences progressively increased since our Department joined the multi-department program in 2015. Last year we awarded our first PhD in Ecology and Environmental Sciences, with conferment of additional degrees anticipated over the next few years. The data do not suggest that our PhD degree in Ecology and Environmental Sciences is limiting recruitment or retention of students in our PhD degree in Animal and Range Sciences. We have several students scheduled to complete their MS and PhD degrees in 2020. While not reflected in current data, these students reflect our Department's recent efforts to expand and improve our graduate (particularly PhD) programs, and enhance retention and graduation rates.

Graduate enrollment data reported for our Department during the review period exclude six graduate students whose committees are/have been chaired by Animal and Range Sciences faculty, but the students pursued degrees in other departments, including the Department of Ecology, Department of Education, Department of Land Resources and Environmental Sciences, and the Department of Microbiology and Immunology. Graduate enrollment data for our Department during the review period also exclude one of our graduate students who is seeking their PhD degree in Interdisciplinary Studies.

The Strategic Plan for the College of Agriculture identifies focus area goals to: *1) advance innovative research to enhance local and global impact; and 2) develop competent life-long learners and leaders who excel in their chosen career and life experiences*. Both the College of Agriculture and the University seek to incorporate more high-impact teaching practices. In alignment with this goal, graduate teaching in our Department utilizes several high-impact practices, including seminars, writing-intensive courses, collaborative assignments, and service and community-based learning. For example, all of our graduate students are required to participate in ARNR 594; Research Seminar in which they attend two weekly seminars by leading national and regional animal science and range science researchers. After each seminar students can engage the speakers during informal catered sessions provided by our Department. Via ARNR 507; Research Methods and ARNR 594; Research Seminar, all of our graduate students are required to prepare formal written research proposals, research posters, oral presentations, and research manuscripts. Efforts are currently underway to further integrate both Extension and MAES faculty into our graduate courses. Our ARNR 525; Muscle Growth and Biology course requires students to develop a research proposal for the next steps based on the questions raised in a refereed journal article, and students in ARNR 544; Advanced Grazing Ecology and Management engage in service learning when landowners or other land managers provide real-world management problems that require students to analyze the problem, propose a solution, make an oral presentation, and prepare a written report.

Retention rates appear reasonable with a less than 11 % attrition rate in our MS and less than 15% attrition in our PhD programs, as compared with 14–16 % (MS) and 15–22% (PhD) attrition among graduate candidates at MSU after year 2 (*ERG 15 and 16*). Time to degree could be improved with just 35% of our MS candidates graduating after 3 years although graduation rates increase sharply thereafter, reaching 62% after 4 years, and 73 % after 5 years. Similarly, just 44% of our PhD candidates graduate after 5 years, and 57% graduate after 6 and 7 years. Graduation rates for both MS and PhD degrees in our Department do not reach 80% until after 8 years. Overall, these numbers are comparable for MS and better for PhD than the university averages wherein only 28 % of MS candidates graduate after 3 years and 18 % of PhD candidates after 5 years. After 8 years just 49 % of PhD candidates have graduated at MSU, while 84% of MS candidates have graduated by year 5 (*ERG 15*

*and 16*). Graduation rates for PhD candidates in our Department versus the MSU average are difficult to compare because we currently require students to have an MS degree before they may enter our PhD program and some other university programs do not.

## Learning Outcomes

We have developed separate Learning Outcomes for MS students and PhD students. Students earning their graduate degrees in our Department will have the demonstrated ability to:

### MS Students

1. Conduct research resulting in an original thesis.
2. Demonstrate mastery of subject content knowledge and research/critical inquiry methodology.
3. Demonstrate effective written communication of substantive content.
4. Demonstrate effective oral communication of substantive content.
5. Be able to conduct scholarly or professional activities in an ethical manner.

### PhD Students

1. Produce and defend an original significant contribution to knowledge.
2. Demonstrate mastery of subject content knowledge and research/critical inquiry methodology.
3. Demonstrate excellence in written communication of substantive content.
4. Demonstrate excellence in oral communication of substantive content.
5. Be able to conduct scholarly and professional activities in an ethical manner.
6. Demonstrate professionalization into the field of study as demonstrated through publications, presentations, funded fellowships, professional association activities, professional experience, etc.

Based on assessment of our graduate program Learning Outcomes, our curriculum and teaching are largely effective ([Link 3](#)):

- All students who attempted to graduate from our program during the most recent period of assessment (2017 – 2019) successfully defended their MS and PhD theses or dissertations describing original research.
- 91% of our MS graduates and 100 % of our PhD graduates demonstrated mastery of their subject content knowledge and research/critical inquiry methodology.
- 80 % of MS candidates, 100% of PhD candidates, 73% of MS graduates, and 100% of PhD graduates demonstrated effective written communication.
- All MS candidates and MS graduates, and all PhD candidates and PhD graduates demonstrated effective oral communication of substantive content.
- All MS and all PhD graduates demonstrated an ability to conduct scholarly or professional activities in an ethical manner.

Our graduate Learning Outcomes also aim for our PhD students to demonstrate professionalization into the field of study as demonstrated through publications, presentations, funded fellowships, professional association activities, professional experience, etc. Two PhD graduates were assessed during the review period and were determined to have published an average of 6 papers each, they each presented 4 scientific papers at professional and scientific meetings, and between them they received 2 grants for conducting research in their field of study. Both students also had demonstrable participation in professional societies.

To improve students' attainment of our desired Learning Outcomes, we made two major changes to the graduate curriculum since our last program review in 2013. First, we created the Bair Ranch Foundation Seminar series and integrated it with a new course, ARNR 594; Research Seminar. This change better enables ARNR 507; Research Methods to focus on the needs of beginning graduate students, while ARNR 594; Research

Seminar ensures that continuing graduate students can advance their skills in written and oral communication and critical thinking. In addition, we now offer ARNR 507 and ARNR 594 via live WebEx broadcasting to provide access for off-campus students. Our second major curriculum change replaced ARNR 521; Advanced Ruminant Nutrition with two new courses (ARNR 505; Ruminant Microbiology and ARNR 527; Livestock Mineral Nutrition) to provide students more depth in these subjects than could be covered previously in only one course.

## **Evaluations from Students and Student Successes**

Graduate students in our Department were anonymously surveyed to determine their perceptions of our graduate program (n = 18 respondents, 11 MS students and 7 PhD students). All graduate students indicated their graduate degree, once earned, would support their chosen career paths, and 89% of graduate students were happy to have chosen to pursue their graduate degree through our Department. Nearly all graduate students (94%) indicated faculty in our Department were very knowledgeable about their subject concentration, and 83% of graduate students indicated the faculty and staff of the Department care about their success. Among areas requiring improvement (assessed as < 80% satisfaction), only 72 % of students indicated there were enough classes presently available to support their degree program, and only 72% indicated their major advisor provided sufficient guidance on all parts of their graduate program. In response to this identified need for improvement, our Department has already committed to participating in a 'Train-the-Trainer' workshop in Fall 2020 to be presented by the Center for Improving Mentored Experiences in Research in partnership with the MSU Center for Faculty Excellence and the Graduate School.

Our graduate students have received numerous prestigious awards. Examples during the review period include Erin Nix (MS, 2012, Western Section of American Society of Animal Science Applied Research Award; and Kate Sharon (MS, 2013), Western Section of American Society of Animal Science Young Scholar Award. Similarly, graduates of our MS and PhD degree programs have regularly become successfully employed in leading academic, industry, and government positions. Notable examples during the review period include:

- Dr. Omolola Betiku (PhD, 2017) Assistant Professor of Animal Sciences at Florida Agriculture and Mechanical University
- Katie (Tierney) Brown (MS, 2013) Senior Environmental Scientist, Althouse and Meade, Inc.
- Dr. Megan Millegan (PhD, 2019) Research Scientist, US Geological Survey
- Jarrett Payne (MS, 2019) Riparian Ecologist, Montana Fish, Wildlife & Parks
- Devon Ragen (MS, 2012) MSU Research Associate and former Montana Wool Lab Manager
- Torrey Ritter (MS, 2018) Non-game Wildlife Biologist, Montana Fish, Wildlife & Parks
- Jeffrey Swartz (MS, 2014) Director of Nutrition, Homestead Nutrition, Inc.
- Skyler Vold (MS, 2018) Research Scientist, Wisconsin Department of Natural Resources
- Smith Wells (MS, 2017) GIS Specialist, Montana Fish, Wildlife & Parks

## **Strengths, Weaknesses, Opportunities, and Threats**

### Strengths

- Our applied programs and our working relationships with the Montana and regional livestock, range, and forage industries.
- Smaller size of our Department relative to other institutions and the multi-disciplinary nature of Animal and Range sciences, which collectively results in our faculty being just 'one deep' in any major discipline and necessitates a culture of working across departments, colleges, universities, industry and other government agencies both research ARS and management USFS, BLM, NRCS, NCAT etc. for faculty to succeed and be effective in our mission
- National demand for our MS and PhD graduates in our applied disciplines is greater than the national supply of recent graduates. This is a niche that our Department is well-positioned to serve and we are working to increase our PhD student numbers and increase support for our outstanding faculty mentors.

## Weaknesses

- One major weakness is the lack of growth and limited number of MS and especially PhD students in our graduate program. This is probably reflective of limited internal and external funding opportunities to fund additional graduate students.
- Another related issue is our inability to offer stipends that are both competitive and reflective of the higher cost of living in the Bozeman area. This latter issue is further compounded by limited graduate housing availability on campus, although as indicated recently by the Graduate School Dean, new undergraduate housing is suggested to free up graduate housing opportunities by reducing the number of undergraduates utilizing graduate housing.
- Although stipends are largely limited by external funding and funder-adopted policies on stipend maxima, exploration of alternative strategies for GTA and GRA distributions (as per the COA strategic plan focus area 2 that balance 'topping-up' stipends with availing opportunities for additional graduate students) are underway and a renegotiation of stipend maxima, particularly among private- and industry sponsors should be attempted. Nevertheless, the limited number of GTA and GRA appointments available limit their potential efficacy as a tool.
- One final weakness, as indicated in the previous Departmental review and as implied from student perceptions of our program is the limited number of graduate classes we have available in our curriculum. Our examination of relatable graduate programs at New Mexico State, South Dakota State, North Dakota State, Oklahoma State, University of Wyoming, Colorado State, and University of Idaho have identified non-ruminant (monogastric) nutrition, livestock behavior, brain (hypothalamo-hypophyseal-pineal) endocrinology, cardiovascular and neural physiology, habitat restoration, and water shed-focused graduate classes as common but missing in our curriculum. Courses focused on topics including environmental physiology, companion animals, and wool are rarer potential opportunities. Many of these same universities offer dedicated techniques-focused (animal physiology, laboratory, range nutrition) courses and courses that cover more specialized topics that we currently teach within our curriculum but the topics are embedded within more broadly focused classes. Although it is recognized that growth in our program is largely limited by the size of our graduate enrollment and number of faculty, opportunities to integrate multi-institutional on-line endeavors, such as Ag-Idea may expand the number of classes we can offer and broaden the appeal of our program to additional students.

## Opportunities

- Allowing self-funded MS and PhD degrees, potentially to include professional degrees.
- Expanding our graduate program to include professional (non-thesis) degrees to serve non-research professions, including Extension agents.
- Increasing access to our classes for offsite students (e.g., at research centers) through tools such as WebEx and making more classes available on-line. These endeavors may require some reconfiguration of class structures that include hands-on practical aspects, such as intensifying these components over shorter periods of time or dividing these components into separate intensive class listings.
- Participation in, and integration of, Ag-Idea online course selection into our curriculum.
- Eliminating the requirement for students to have an earned MS degree before entering our PhD program.
- Strategic targeting of Higher-Education grants to improve opportunities for student funding. This could include current USDA opportunities focused on under-served communities such as American Indian populations.

## Threats

- The doctoral prioritization process identified the PhD program of the Department of Animal and Range Sciences as ‘needing improvement’, predominantly due to the numbers of students and degrees conferred ([Link 10](#)).

## Strategic Directions for the Future

Findings by the Committee on Considerations for the Future of Animal Science Research indicate the number of MS and PhD students with degrees in Animal Agriculture is decreasing nationally (<https://www.ncbi.nlm.nih.gov/books/NBK285711/>). However, there remains a recognized need for graduate programs in animal and range sciences. As noted by the USDA (<https://nifa.usda.gov/press-release/one-best-fields-new-college-graduates-agriculture> and <https://www.purdue.edu/usda/employment/>), there are nearly 60,000 high-skill agriculture job openings annually, but only 35,000 graduates available to fill them. This will limit future hiring both in industry and academia. While we believe that our Department is well-positioned to contribute to this deficit, our graduate student numbers are stable and our PhD numbers are low, indicating a need for creative ways to fund more students and more research.

We expect additional graduate courses will be created during the next few years by our new Animal Science teaching faculty, including Drs. Rodrigo Marques (Ruminant Nutritionist), Sarah McCoski (Reproductive Physiologist), , and Christian Posbergh (Sheep Production). We also anticipate that Dr. Carla Sanford (our new Extension Beef Cattle Specialist) and perhaps our new Extension Forage Specialist may also offer new graduate courses during the next review period. In addition to new graduate courses, our strategic future directions in Graduate Education should include:

- Distributing GTAs and GRAs more strategically.
- Coordinated efforts to better target higher-education and other federal funding opportunities.
- Relaxing restrictions on entry to our graduate program, including consideration of allowing students to enter our PhD program with only a BS degree, allowing self-funded MS and/or PhD programs, and expanding our graduate program to include options for professional (non-thesis) degrees.
- Expanding access to our graduate courses to enable students located at research centers to seek graduate degrees in our Department through development of online graduate courses and broadcasting technologies (e.g., WebEx).
- Expanding our participation in multi-institutional online course curricula, such as Ag-Idea to increase the breadth of our graduate program and keep it competitive with our peer universities.
- Reemphasizing expectations of faculty to mentor graduate students.
- Emphasizing writing in our graduate curricula to ensure our students are meeting expectations and are well-prepared to succeed.
- New Graduate Student Policy ([Link 11](#)).

## CHAPTER 6. SCHOLARSHIP

The Strategic Plan for Montana State University, *Choosing Promise*, was adopted in 2019 and guides University research priorities through 2024. Intentional Focus 2 is related to scholarship, creative activity, and research. The Strategic Plan directs the University to dedicate time and effort to: 1) *Enhancing the significance and impact of scholarship*; 2) *Expanding interdisciplinary scholarship*; 3) *Strengthening institutional reputation in scholarship*; and 4) *Evaluating expectations for scholarship*. The College of Agriculture updated its Strategic Plan in 2019. In research, the College goal is to *advance innovative research to enhance local and global impact*. More specifically, the College seeks to: 1) *Facilitate interdepartmental and interdisciplinary collaboration*; 2) *Develop research that is relevant to Montana but is scalable nationally*; and 3) *Enhance the reputation of MSU through scholarly activity*.

Our researchers collaborate with several University institutes and centers at Montana State University. For example, we mentor undergraduate students through the Undergraduate Scholars Program, and we often collaborate with MAES Research Centers across our state. Several of our faculty belong to the Montana Institute on Ecosystems and work with the Montana Water Center. Our scientists also collaborate with researchers and natural resource managers in numerous federal and state agencies including the US Forest Service, National Park Service, Bureau of Land Management, US Fish and Wildlife Service, Natural Resources Conservation Service, Montana Department of Fish, Wildlife and Parks, Montana Department of Military Affairs, and the Montana Department of Natural Resources Conservation. We also conduct research in cooperation with several Tribal Nations, NGOs, and livestock industry organizations including the American Angus Association, Montana Angus Association, Red Angus Association of America, American Sheep Industry Association, and National Sheep Industry Improvement Center.

### Grants

Our review of the 195 OSP grants received by our Department from 2012 to 2019 demonstrate that > 95% of our research is directly related to the strategic goals of the University, College, and our Department. Furthermore, 64 of these grants (32%) included collaborators outside our Department. This would be a very conservative estimate of our interdisciplinary grants, since many other grant authors from other departments and disciplines are not included in this measure. Fourteen percent or 27/195 grants were obtained from research centers at Montana State University.

Our Department received between 30 and 60 research grants per year as recorded by the Office of Sponsored Programs (*Funding 4*). We peaked at 60 grants in 2017 and had 42 grants in 2019. We currently average 2.8 grants per faculty, which has declined slightly from a peak of 3.2 in 2017 (*Funding 5*). The mean number of grants/year/research TT FTE was 8.7 from 2012 to 2019 (*Funding 6*). Grant dollars per year per TT research FTE as compiled by the Office of Sponsored Programs has declined from \$250,000 in 2015 to \$100,000 in 2019 (*Funding 7*). Not all expenditures through OSP are research-related, and OSP does not capture all expenditures related to research (*Funding 11*). We suspect that some of the decline from 2015 to 2019 in grant dollars per year per research FTE can be attributed to the conversion of one of our top researchers to an administrative position and the loss of faculty members to retirement or resignations.

Grant activity compiled by Academic Analytics is another method used to gauge departmental productivity. During the review period our Department averaged 6 grants per faculty per year (*Academic Analytics 9*). This ranks our Department at 6/16 compared to other similar departments (*Academic Analytics 9*). Our total number of grants per faculty (0.4) ranks 7<sup>th</sup> out of 16 when compared to other institutions (*Academic Analytics 8*). The Department averaged \$137,000 per grant (*Academic Analytics 7*), which ranks us 11/16 compared to other peer departments. Federal grants are usually compared across institutions because they represent some of the most competitive types of grants available. Our faculty ranks 11/16 for dollars per federal grant (\$55,000) (*Academic*



*Analytics 6*). Our Department is in the 65<sup>th</sup> percentile group for all institutions in federal grants per faculty, percentage of faculty with a federal grant, and total federal grants (*Academic Analytics 11*). Academic Analytics, which places all of its emphasis on federal grants, ranks our faculty in the 54<sup>th</sup> percentile for all grant-related measures. Our faculty also receive grants from state and federal agencies and private sources that do not appear in these totals. When viewed in total, our research grant productivity would be above average.

## **Publications**

From 2012 to 2019, our Department faculty published 167 peer-reviewed scientific journal, averaging 21 publications per year articles (*Publications 1*). Faculty FTE dedicated to Research during this time period averaged 4.93, resulting in an average of 4.3 refereed journal articles per Faculty FTE per year. Our recently approved Role and Scope document has set the standard that a 1.0 FTE should average four scientific peer-reviewed journal articles per year. By this standard, we have produced more scholarly products than expected. However, calculations by Academic Analytics (*Academic Analytics 2*) indicate that our Department averaged 6.3 articles per faculty during the reporting period, which is near the bottom of our peer institutions, and we averaged 7.3 articles per author (*Academic Analytics 3*), which ranks fifth from the bottom of our peer institutions. Our publication output ranked in the 70<sup>th</sup> percentile nationally for percentage of faculty with articles, articles per faculty, and articles per author (*Academic Analytics 11*). These measures indicate that our Department has not produced the quantity of scholarly products expected.

The quality of our publications is higher than average when compared with our peer institutions. One measure of the quality of scientific publications is how often they are cited by other scientists. Our department is ranked in the top third of our peer institutions for Citations per Faculty (*Academic Analytics 5*). Our percentage of authors with citations and citations per publication are near the top of all the institutions reporting in Academic Analytics (*Academic Analytics 11*). However, the percentage of faculty with citations is below 50% (*Academic Analytics 11*), and we rank in the 75<sup>th</sup> percentile nationally for citations per faculty member (*Academic Analytics 11*). Averaging all of the measures used by Academic Analytics (*Academic Analytics 11*), our research quality and productivity ranks in the 70<sup>th</sup> percentile group nationally for all institutions included in this database. When compared with 14 Animal Science departments in the western US, our scholarly research rank was tied for last (*Academic Analytics 10*). When compared with 61 similar departments in the entire US, our composite Scholarly Research Index (SRI) score ranks 56<sup>th</sup> or in the 11<sup>th</sup> percentile.

## **Strengths, Weaknesses, Opportunities, and Threats**

### Strengths

- Our strengths in Scholarly and Creative Activities (Research) would include the hiring of 10 new faculty positions between the 2015 and summer 2020 that have some level of research appointment. Four of these positions are primarily research appointments.
- The NTT faculty continue to contribute to the research effort.
- Our department has the animals and facilities to conduct research and we also have the ability to renew research ties with ARS Fort Keogh Range and Livestock Research Center and the U.S. Sheep Experiment Station.
- We continue to be funded by Federal and State Agencies as well as NGOs and agricultural companies which desire that our department provide research on topics areas relevant to Montana.

### Weaknesses

- While some faculty have met or exceeded expectations for publishing refereed journal articles, other faculty have not published sufficient numbers per their FTE assignment in Research.

### Opportunities

- The addition of our recent hires should result in improvements to our research output.

- Our department structure is designed to assist new faculty with facilities and research.
- Our faculty expertise is diverse and offers opportunities for inter-disciplinary research. Our administration is very supportive of collaborative research.
- Montana Agricultural Experiment Station research facilities offer unique opportunities to develop long-term collaborative research.

#### Threats

- Our department has not published the results of our research at the expected levels.
- Loss of faculty to other institutions with higher salaries and lower costs of living.

#### **Strategic Directions for the Future**

We have recently filled several positions that have large scholarship appointments, and our annual evaluations now include an emphasis on the number and quality of scientific, peer-reviewed journal-quality articles. The structure is in place to advance our Department's research productivity. To meet this challenge, we will:

- More fully capitalize on our livestock and land resources.
- Increase long-term, applied research efforts.
- More fully capitalize on our strengths in applied sciences, our integrative faculty structure, and our connections with the agriculture and natural resource communities.

## CHAPTER 7. Extension/Outreach/Engagement

The Department of Animal and Range Sciences has a long history of exceptional contributions in Extension/Outreach/Engagement. The current strategic plan for Montana State University, *Choosing Promise*, was adopted in 2019 and identifies the University's Extension/Outreach/Engagement priorities through 2024. Intentional Focus 3, Expanding Engagement, seeks to “*Expand mutually beneficial and responsive engagement for the advancement of Montana*” and seeks to 1) *Increase mutually beneficial collaborations with Tribal nations and partners*; and 2) *Grow mutually beneficial partnerships across Montana*. The current strategic plan for the College of Agriculture also was adopted in 2019. Its priorities for Extension/Outreach/Engagement through 2025 are to: 1) *Promote community-based partnerships and share knowledge to improve life and society*; and 2) *Build and maintain enduring partnerships to advance the land-grant mission*. One of the many ways that our Department accomplishes its mission and helps achieve the Extension/Outreach/Engagement goals of the University and College is through the expansive efforts of the MSU Extension Specialists and Associate Specialists in our Department.

Our Department includes more Extension faculty FTE than any other academic department within Montana State University. This strength uniquely positions our Department to fully exemplify the University's tripartite land-grant mission that includes teaching (both academic teaching and outreach teaching), scholarship, and service. When our suspended search to refill the vacant Extension Forage Specialist position concludes successfully, Extension faculty FTE in our department will total 5.64 (*Faculty 3*). These FTE will include 5 TT Extension Specialists and 3 NTT Associate Specialists. Proportional assignments in Extension vary from 50–100% among our 8 Extension faculty members, but Extension purposely comprises the largest proportion of every Extension faculty appointment within our Department. Additional proportions assigned in scholarship, academic teaching, and service complete the responsibilities of faculty with < 100% Extension appointments, thereby enabling individual Extension faculty to exemplify the integrative land-grant mission.

Rangelands, pasture, and hayland comprise 75% of Montana's 93 million acres, and these lands provide much of what makes Montana such a special place, including clean air and water, scenic open spaces, and abundant wildlife. In addition, range livestock agriculture is the state's dominant land use, occurring statewide in every county and every reservation, and it contributes more to the state's economy than tourism, mining, oil and gas, or forest products. Accordingly, the Extension/Outreach/Engagement Program in the Department of Animal and Range Sciences matters to large numbers of people, and our Extension/Outreach/Engagement Program is a primary portal through which the University and College enrich the lives, livelihoods, and landscapes of Montanans throughout our state, including our state's Tribal Nations.

Effective Extension teaching depends entirely upon trust and credibility. Therefore, effective Extension teaching demands spending time and effort developing and sustaining personal relationships. The Extension/Outreach/Engagement Program in our Department works closely with numerous individuals and organizations across Montana and beyond. We strive to establish and maintain positive relationships and partnerships with county and reservation Extension agents, government agencies, and nongovernment associations, among others. A partial list of current external partners includes:

### Nongovernment Associations

- Montana Agri-Business Association
- Montana Association of State Grazing Districts
- Montana Feed Association
- Montana Grain Growers Association
- Montana Public Lands Council
- Montana Stockgrowers Association

- Montana Weed Control Association
- Montana Wool Growers Association

#### State of Montana Agencies

- Montana Department of Agriculture
- Montana Department of Disaster and Emergency Services
- Montana Department of Environmental Quality
- Montana Department of Livestock
- Montana Department of Natural Resources and Conservation
- Montana Department of Public Health and Human Services
- Montana Department of Revenue
- Montana Fish, Wildlife & Parks

#### Federal Agencies

- Animal and Plant Health Inspection Service
- Bureau of Land Management
- Environmental Protection Agency
- Natural Resources Conservation Service
- U.S. Fish and Wildlife Service
- U.S. Forest Service

Extension faculty in our department address 7 primary programming areas: Beef Cattle Production, Forage Crop Production and Utilization, Livestock Environmental Sustainability, Pesticide Use and Safety, Rangeland Management, Sheep and Wool Production, and Wildlife Management. Extension teaching and engagement efforts in these areas respond to immediate needs but also proactively anticipate future challenges and opportunities at local, state, regional, and national levels. Educational programs are based on the latest research information and strive to maintain the highest standards of objectivity and professional credibility. Seven major audiences are targeted: 1) county/reservation Extension agents, 2) livestock and forage producers, 3) government agency personnel, 4) smaller acreage landowners, 5) sportsmen and other wildlife enthusiasts, 6) farm and ranch pesticide applicators, and 7) youth and the urban public.

Off-campus seminars, workshops, and farm/ranch site visits, combined with personal consultations over the phone, via email, or office visits, are the primary methods that we use to deliver Extension teaching. We also have begun teaching via webinars more frequently. During the 6 years from 2014–2019 (data from earlier years are incomplete), Extension faculty in the Department of Animal and Range Sciences delivered, on average, 193 non-academic instructional events per year (i.e., seminars, workshops and farm/ranch site visits; excludes phone calls, emails, and office visits) that averaged 9,047 participants annually (*Extension/Outreach/Engagement 1*). During the same 6-year period, academic teaching faculty in our Department contributed, on average, 13 non-academic instructional events per year that averaged 481 participants annually. Altogether during 2014–2019, the Extension/Outreach/Engagement Program in our Department delivered 1,235 non-academic instructional events that reached 57,167 participants.

Our Department's productivity standard is that a 1.0 Extension FTE should average 30 non-academic instructional events per year that reach  $\geq 625$  participants. During the 6-year period from 2014–2019, Extension faculty in our Department exceeded these standards. Extension faculty members averaged 35 non-academic instructional events per 1.0 Extension FTE that reached, on average, 1,600 participants per 1.0 Extension FTE (*Extension/Outreach/Engagement 1*).

Examples of Extension/Outreach/Engagement publications and other scholarly products include Extension fact sheets, Extension bulletins, research summaries, newspaper or magazine articles, newsletter articles, news releases, websites, videos, and television or radio programs. During 2012–2019, all faculty in our Department combined to create 753 Extension/Outreach/Engagement scholarly products, averaging 94 annually (*Publications Tables 3, 4, 5, 6, and 7*).

## **Strengths, Weaknesses, Opportunities, and Threats**

### Strengths

- Current Extension faculty is diverse (age, gender, education, expertise), dedicated, responsive, and productive Extension faculty that translates science into everyday solutions to help Montanans solve their problems and improve their lives.
- Extension faculty generate significant extramural funding for Extension teaching and scholarship, and Extension faculty collaborations with research faculty enable the department to compete strongly for integrated research-Extension grants.
- Faculty possess a strong network of relationships and partnerships with the range livestock industry, natural resource conservation groups, government agencies, and nongovernment organizations.

### Weaknesses

- Extension faculty members are spread too thin, unable to fulfill the demands for their expertise. This creates frustrations among the Extension faculty members and the clientele they are striving to serve.
- Insufficient web presence, including an insufficient quantity of Extension fact sheets (i.e., MontGuides) and other scholarly products due, in part, to recent changes in ADA compliance.
- Insufficient base operating funds to adequately cover substantial in-state travel and vehicle costs.

### Opportunities

- Organize and deliver more team-taught seminars and workshops that integrate our department's Extension faculty. Also, should capitalize on opportunities to collaborate with the recently created Dan Scott Ranch Management Program.
- Utilize more distance-based teaching technologies (e.g., webinars, podcasts, videos) to increase efficient use of time and money, while making certain we sustain strong interpersonal relationships with clientele.
- Better communicate the research needs of our clientele to MSU faculty who hold full or partial research appointments.

### Threats

- Our clientele increasingly views consultants, salespersons, and other service providers as unbiased educators, despite numerous instances when these “educators” disseminated inaccurate, unreliable information. Clientele also increasingly receive misinformation via the internet and social media. MSU faculty, staff, and administrators need to work together to ensure that Montanans continue to value research-based information and continue to value MSU Extension as a trusted source of up-to-date, research-based information. We also should strive to reach new clientele, but we need to do so without alienating our current clientele.

- Difficulty filling future Extension faculty vacancies because fewer scientists and educators are attracted to Extension and even fewer possess adequate practical field experience to fill Extension Specialist and Associate Specialist positions.

## **Strategic Directions for the Future**

- The most recently completed departmental review (report dated October 22, 2013) concluded that Extension faculty FTE in the department was *“marginal in its ability to address stakeholder needs across the state, primarily due to the size and scope of the state.”* The review report specifically suggested that the department seriously consider adding an additional Extension Range Management Specialist to be stationed in Miles City. This new position would complement the Extension Beef Cattle Specialist stationed there and enhance the department’s ability to serve stakeholders in eastern Montana. An additional Extension Range Management Specialist was not added since the last review, yet the need remains.

Extension FTE in equine (0.20 FTE) and veterinary entomology (0.54 FTE) were eliminated since the last review but these positions were recently supplanted with 0.50 Extension FTE in Wildlife Management. Also, the Department, College, MSU Extension, and the Provost should seriously consider converting Associate Specialist positions to tenure-track when incumbent faculty complete their PhD degrees. One of our 3 Associate Specialists earned their PhD since the last review, while another Associate Specialist is currently pursuing their PhD. Converting these positions to Extension Specialists with minority assignments in scholarship would likely increase graduate student numbers and research productivity in the department.

- Extension faculty in our Department have recently agreed to create a new integrated team to deliver collaborative Extension programming that encompasses the 7 Extension program areas within our Department. This team also will collaborate closely with the Dan Scott Ranch Management Program.
- Extension faculty in our Department will collaborate with other departmental faculty to actively create more opportunities for graduate students to gain experiences with Extension teaching.
- Extension faculty in our Department will work closely with the new administrative associate assigned to the Extension Specialists and Associate Specialists to increase our digital presence via websites and social media, and to create and disseminate more Extension/Outreach/Engagement publications.

## CHAPTER 8. SERVICE

Department, College, and University service is summarized in [Service 1 and 2](#). All faculty ([Service 2](#).) contribute to at least one element of Department, College, or University service.

Faculty participation in professional and public service was at its highest in 2015 ([Service 1](#)). In 2019 faculty were involved in 32 professional service and 13 public service activities ([Service 1](#)). These totals do not include community outreach and engagement activities presented in [Extension/Outreach/Engagement 1](#).

### Integration

Integration is the creation of synergistic relationships among the Teaching, Scholarship, and Service contributions of faculty. Examples include bringing new discoveries into the classroom, fostering student learning in the lab and in the field, engaging the wider community with scholarly products or innovations in teaching, or fostering engagement to address community needs. Integration of Teaching, Scholarship, and Service is valued within our Department because it reflects our commitment to the land-grant mission of our University. Integration leads to synergism which, in turn, creates more effective ways for us to help people manage their livestock, rangelands, and related natural resources. As stated in Chapter 7: Extension/Outreach/Engagement, our Department includes more Extension faculty FTE than any other academic department within our University. This strength uniquely positions our Department to fully exemplify the University's tripartite land-grant mission that includes Teaching (both Academic Teaching and Outreach Teaching), Scholarship, and Service. Engagement is a defining characteristic of our Extension program as well as the interactions between on-campus Teaching and Research faculty and our partners and clientele within the agriculture industry and the natural resource community in Montana and the region. We achieve Integration in two ways. The first is by faculty appointment. In 2013 with TT and NTT faculty combined, we had 6.80 FTE in Teaching, 5.16 FTE in Research, and 4.99 FTE in Extension ([Faculty 1](#)). Projected for August 2020 with TT and NTT combined, we will have 9.68 FTE in Teaching, 7.73 FTE in Research, and 5.64 FTE in Extension ([Faculty 3](#)). The second way we achieve Integration is via faculty commitment to all aspects of our Department's mission. Our faculty strive to incorporate research results into our academic courses, seminars, workshops, and Extension, outreach and engagement activities. In addition, all of our faculty collaborate in scholarly activities with students, on-campus and off-campus partners, and clientele. We provide scientific consultation to community foundations and government agencies, and we contribute research expertise through service on grant review panels and editorial boards.



## CHAPTER 9. SUMMARY

In this departmental self-evaluation process, we analyzed **Strengths, Weaknesses, Opportunities, and Threats** and **Strategic Directions for the Future** separately for Undergraduate Education, Graduate Education, Scholarship, and Extension/Outreach/Engagement. In this Summary, we reiterate some of the more important items identified in the earlier chapters, and we list a few more items that cut across all elements of our departmental mission.

### **Strengths, Weaknesses, Opportunities, and Threats**

#### Strengths

- Truly integrated faculty with appointments in Teaching, Research, Extension, and Service.
- Collegiality and collaboration among faculty.
- Our research is applicable to Montana livestock producers and natural resource managers.
- Continue to be closely engaged with Montana agriculture, land management and natural resource communities.
- Our Animal Science and Range Science curricula are among the few remaining degree programs that introduce and enhance practical skills.
- Credibility of faculty with Montana clientele groups.
- Lab, land, and animal resources.
- Self-funded undergraduate experiential learning opportunities such as livestock judging and Steer-a-Year.
- Extramural-funded Extension programs.

#### Weaknesses

- A Department culture that has resulted in low productivity in terms of peer-reviewed journal publications.
- Although most faculty have respect and value all elements of our tripartite mission, this is not always evident either by attitude or commitment to all elements of their respective appointment and the full mission of the Department.
- Inefficient accounting procedures (i.e., Chrome River) reduce productivity because faculty must be part-time bookkeepers. This burden especially affects Extension faculty due to the large volume of off-campus Extension-related travel expenses.
- Inefficient IT support via Shared Services impedes IT purchases and receiving technical assistance.
- Inefficient HR support via Shared Services impedes faculty and staff position searches. For example, HR via Shared Services required meeting with 5 Shared Services finance specialists to get 5 to 6 approvals to hire a short-term employee. The previous process with College of Agriculture HR and finance specialists was easier, simpler, more rapid, and more efficient.

#### Opportunities

- A fresh renewal with new faculty hires.
- Outcome-based graduate education taking advantage of opportunities in Research, Teaching, Extension, and livestock operations.
- Expand recruiting efforts to increase numbers of Native American students.

#### Threats

- Our Department’s poor publication record may jeopardize other important elements of our departmental mission when it comes to filling faculty positions.
- Low salaries and high housing costs in Bozeman area make it difficult to recruit faculty and staff, threatening our ability to fulfill every element of our departmental mission.
- Inadequate funding to support experiential student learning (labs, field trips, attending industry and professional meetings).

## Strategic Directions for the Future

Value and build upon our expertise and commitment to applied research and student learning, taking advantage of all elements of our tripartite mission and the faculty that serve this mission.

- Reward outstanding work by faculty and staff in all areas of our mission.
- Change the culture within the department that has allowed low research productivity.
- Build upon our faculty expertise, strong undergraduate program, and land and livestock expertise to develop an outcome-based graduate program that capitalizes on:
  - The need identified by USDA for well-educated people in agriculture. (<https://nifa.usda.gov/press-release/one-best-fields-new-college-graduates-agriculture>)
  - Although our graduate program is small, our graduates have gone on to outstanding careers in areas of livestock and natural resource management, disciplines that are underserved by many U.S. universities.
  - Our ability and commitment to train graduate students (MS and PhD) in a manner not common in most U.S. universities. The conceptual model below illustrates the 4-point graduate program that trains graduate students to analyze and conduct research but also includes meaningful academic teaching responsibilities, active engagement with outreach and Extension teaching, and involvement in MSU livestock and land resource operations and management.

