

## Graduate Biennial Program Assessment Report

|                                    |  |
|------------------------------------|--|
| <b>Program Information:</b>        |  |
| Degrees Assessed                   | Thesis-based LRES MS, Thesis-based Land Rehabilitation MS, Professional Paper-based LRES MS, Entomology MS, ESEC PhD |
| College or Administrative Division | Agriculture  |
| Department/School                  | LRES   |
| Report Submitted By                | Graduate Committee   |
| Date Submitted                     | 15-SEP-2020  |
| Assessment Period:                 | 1-JUL-2018 through 30-JUN-2020   |

**Graduate assessment reports are to be submitted biennially. The report deadline is September 15<sup>th</sup>. The use of this template is optional, however, any assessment report submitted must contain the required information provided in template.**

### **Common Program Learning Outcomes (Where both Masters and Doctoral outcomes are the same).**

1. Successful demonstration of disciplinary expertise through completion of coursework appropriate to the individual student's master or doctoral program.
2. Successful completion of the required course, Seminar, LRES 594. The course is taken during the student's first year and is where the student's graduate research proposal is presented. The course addresses competencies such as oral and written communication and presentation skills, problem solving skills, critical thinking, and quantitative reasoning.
3. Successful demonstration of oral and written communication and presentation skills.
4. Successful demonstration of problem solving skills and critical thinking.
5. Successful demonstration of data collection abilities, quantitative reasoning, analytical synthesis, and decision making.
6. Successful demonstration of teaching experience. This addresses competencies such as leadership, conflict resolution, self-confidence, time management, and mentorship.
7. Publication of theses in peer-reviewed scientific/professional journals and/or professional presentations.

### **Unique Masters Learning Outcomes:**

A. Thesis option: The student will be trained to be a practicing scientist. On completion of the program, the student will be able to plan, conduct, analyze, and communicate their own scientific studies and will be able to assess the scientific merits of other studies.

B. Non-thesis option: Professional Masters: The student will be trained to critically assess and analyze scientific information. On completion of the program, the student will be able to analyze, assess, synthesize, and communicate scientific information in the environmental sciences.

## Unique Doctoral Learning Outcomes

C. Doctoral: The student will develop expertise in a scientific discipline or sub-discipline. On completion of the program, the student will be an expert in their disciplinary topic.

### 1. What Was Done (Assessment Methods)

a. List the courses or instruments used to assess each outcome.

| <b>Student category</b>   | <b>Learning Outcomes</b> |          |          |          |          |          |          |          |          |
|---|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>Masters Students</b>   | <b>1</b>                 | <b>2</b> | <b>3</b> | <b>4</b> | <b>5</b> | <b>6</b> | <b>7</b> | <b>A</b> | <b>B</b> |
| LRES 594 (Graduate seminar)   | X                        | X        | X        | X        | X        |          |          | X        | N/A      |
| Passing grades as indicated on the student's program of study                                 | X                        | X        | X        | X        | X        |          |          | X        | X        |
| Successful defense and completion of the thesis, as indicated by appropriate signatures       | X                        | N/A      | X        | X        | X        |          |          | X        | N/A      |
| Teaching Experience   | N/A                      | N/A      | X        | X        | X        | X        |          | X        | N/A      |
| Professional placement as appropriate to the student's disciplinary area                      | X                        | N/A      | X        | X        | X        |          |          | X        | X        |
| Professional presentation and or peer-review publication(s)                                   |                          |          |          |          |          |          | X        | X        | X        |
| <b>Doctoral Students</b>  | <b>1</b>                 | <b>2</b> | <b>3</b> | <b>4</b> | <b>5</b> | <b>6</b> | <b>7</b> | <b>C</b> |          |
| LRES 594 (Graduate seminar)   | X                        | X        | X        | X        | N/A      |          |          | X        |          |
| Passing grades as indicated on the student's program of study                                 | X                        | X        | X        | X        | X        |          |          | X        |          |
| Successful completion of the written comprehensive exam                                       | N/A                      | N/A      | X        | X        | X        |          |          | X        |          |
| Successful completion of the oral comprehensive exam  | X                        | N/A      | X        | X        | X        |          |          | X        |          |
| Successful defense and completion of the dissertation, as indicated by appropriate signatures | N/A                      | N/A      | X        | X        | X        |          |          | X        |          |
| Teaching Experience   | N/A                      | N/A      | X        | X        | X        | X        |          | X        |          |
| Professional placement as appropriate to the student's disciplinary area                      | X                        | N/A      | X        | X        | X        |          |          | X        |          |
| Professional presentation and or peer-review publication(s)                                   |                          |          |          |          |          |          | X        |          |          |

b. What benchmark is used to demonstrate whether the outcome has been satisfactorily met? Describe any changes to the benchmark since last reporting cycle.

**Direct measures**

- Passing grade ( $\geq$ B) for Seminar, LRES 594.
- Passing grades ( $\geq$ B) as indicated on the student's program of study.
- Successful completion and appropriate signatures on thesis or dissertation.
- Successful completion and appropriate signatures on forms for written and oral comprehensive exams for PhD students.

**Indirect measures**

- Average range of start/end date.
- Professional placement as appropriate to the student's disciplinary area.

**Additional assessment metrics added to this reporting cycle**

- Student professional presentations (e.g., conference, field days, etc.)
- Professional papers and or peer-reviewed publications

c. What was the process for evaluation (how were data collected and by whom)?

Data were collected by the student coordinators of LRES/LREO and checked for successful completion. The data were then forwarded to the Chair of the LRES Graduate Committee for evaluation and refinement in consultation with the LRES Graduate Curriculum Committee. Data collected were from 1-JUL-2018 to 30-JUN-2020.

d. Has this assessment method changed since the last reporting cycle? Yes or No. Explain any changes.

Yes. LRES has incorporated student professional papers and peer-reviewed publications data since the last reporting cycle.

## 2. What Data Were Collected

What was collected to assess learning outcomes listed above?

**Direct measures:**

- Passing grades for coursework;
- Successful completion of master's defense of thesis for LRES, Land Rehabilitation, and Entomology; successful completion of professional paper
- Presentation of professional paper for LRES MS (LREO); successful completion of written
- Comprehensive exam, oral comprehensive exam, and doctoral defense for ESEC PhD.
- \*Public presentations of thesis research \*
- \*Publication of thesis research\*

\* Please refer to summary data in Performance Assessment, Table 1

**Indirect measures:** Student placement data and average range of start/end date.

## 4. What Was Learned: Results

a. What was revealed from analyzing learning outcome data regarding student learning? Describe any result, pattern, or trends that you identify as meaningful.

- Completion rates, professional presentations, peer-reviewed publications for all LRES graduate programs in the evaluation period were extremely impressive.
- LRES graduate student job placement is excellent. [Please refer to Supplemental Tables 1 and 2.](#)

b. Describe how the above results were communicated to the department and used to discuss potential other plans for improvement.

[Presented at August/September faculty meetings.](#)

#### 4. How We Responded

a. Based on assessment, describe any changes (content, pedagogical, structural, etc.) that are an outgrowth of the current year's assessment of this outcome. Include timelines.

[LRES faculty continue to discuss annual reviews of graduate student progress separate from major advisor and/or committee progress meetings with the student.](#)

b. When will the changes be next assessed?

[Assessments are ongoing and annual.](#)

#### 5. Closing the Loop

If there have been changes in program/curriculum to reflect concerns from previous assessments, what impact have the changes had (if any) on achieving the desired level of student learning outcomes?

[Not applicable.](#)

### SUPPLEMENTAL INFORMATION

#### A. Additional Metrics

During the 2019-2020 biennial period:

1. LRES graduated:

- 44 Professional Masters
- 16 MS Plan A students
- 6 PhD students

→ **Demonstrates a robust graduate program.**

2. LRES graduate students presented 77 conference papers/posters and/or contributed to (co-authored) an additional 22 other conference presentations

→ **Illustrates success at conducting substantive original research.**

3. LRES graduate students first-authored or co-authored 7 peer-reviewed publications. (Student names in **bold**, directly below).

→ **Indicates highest quality science**

## B. PEER-REVIEWED PUBLICATIONS

**Bode, E.**, Lawrence, R., Powell, S., Savage, S., Trowbridge, A. M. (2018). A time-series approach for mapping mountain pine beetle infestation extent and severity in the U.S. Central Rocky Mountains. *Journal of Applied Remote Sensing*, 12, 15.

**Gaffke, A. M.**, Sing, S. E., Dudley, T. L., Bean, D., Russak, J., Grieco, P., Peterson, R., Weaver, D. (2018). Semiochemicals to enhance herbivory by *Diorhabda carinulata* aggregations in saltcedar (*Tamarix* spp.) infestations. *Pest Management Science*, 74(6), 1494 - 1503.

**Gaffke, A. M.**, Sing, S. E., Dudley, T. L., Bean, D. W., Russak, J. A., Mafra-Neto, A., Peterson, R. K. D., Weaver, D. K. (2019). Field demonstration of a semiochemical treatment that enhances *Diorhabda carinulata* biological control of *Tamarix* spp. *Nature Scientific Reports*, 9(13501), 1-9.

Wang, Q., Kang, Y.-S., **Alowaifeer, A.**, Shi, K., Fan, X., Wang, L., Jetter, J., Bothner, B., Wang, G., McDermott, T. (2018). Phosphate Starvation Response Controls Genes Required to Synthesize the Phosphate Analog Arsenate. *Environmental Microbiology*, 20(5), 1782-1793.

Jackson-Smith, D., Ewing, S., Jones, C., **Sigler, W.**, Armstrong, A. (2018). The road less traveled: Assessing the impacts of farmer and stakeholder participation in groundwater nitrate pollution research. *Journal of Soil and Water Conservation*, 73, 610-622.

**Sigler, W.**, Ewing, S., Jones, C., Payn, R., Brookshire, E., Klassen, J., Jackson-Smith, D., Weissmann, G. (2018). Connections among soil, ground, and surface water chemistries characterize nitrogen loss from an agricultural landscape in the upper Missouri River Basin. *Journal of Hydrology*, 556, 247-261.

Varella, A. C., Talbert, L., **Achhami, B. B.**, Blake, N. K., Hofland, M. L., Sherman, J., Lamb, P., Reddy, G., Weaver, D. (2018). Characterization of resistance to *Cephus cinctus* Norton (Hymenoptera: Cephidae) in barley germplasm. *Journal of Economic Entomology*, 111(2), 923-930.

**SUMMARY:** Collectively, the above data clearly speaks to the excellence of the LRES graduate program and its students; i.e. effective written and oral communication of scientific material, both from original and other sources.

## C. LRES GRADUATE STUDENT AWARDS

- Ethan Wologo (MS) received the NACTA Graduate Student Teaching Award of Merit.
- Sam Carlson (PhD) received the NACTA Teaching Award of Merit for Graduate Students.
- Shealyn Malone (MS) received a travel grant from MSU's Graduate School to attend the Plant- Herbivore Interaction Gordon Research Conference in Ventura, California.

- Miranda Margetts (PhD) received a travel grant from MSU's Graduate School to conduct research at Assurity Labs in Las Vegas, Nevada.
- Miranda Margetts (PhD) was awarded the Montana Water Center Graduate Student Research Fellowship.
- Briana Whitehead (MS) was awarded The Montana Range Days Scholarship
- Briana Whitehead (MS) was awarded The Nielsen Pedology Graduate Research Fellowship.
- Brianna Whitehead (MS) received The Graduate School's Dean Advancement Grant for Fall 2019.
- Rekha Bhandari (MS) was awarded funding from the MSU Foundation Endowed Fund for M.S. student in Entomology.
- Rekha Bhandari (MS) was awarded a Professional Advancement Grant from The Graduate School.
- Achhami, Buddhi won the Megha Parajulee SONE Award, National: 2019 winner of this annual award, issued among Nepalese graduate students in the US.
- Miranda Margetts - Montana State University's Graduate Award in Teaching Excellence
- Sam Carlson - Montana State University's Graduate Award in Teaching Excellence

#### D. LRES MS AND PHD GRADUATE STUDENT EMPLOYMENT TRACKING

Supplemental Table 1. Job and career placement of LRES MSc and PhD grauate students.

| LASTNAME    | FIRSTNAME | DEGREE | CURRIC | DATE GRAD | Career Category       | Position                | Specific Employer                          | City                    | State |
|-------------|-----------|--------|--------|-----------|-----------------------|-------------------------|--|-------------------------|-------|
| AY19        |           |        |        |           |                       |                         |  |                         |       |
| Miller      | Florence  | MS     | LRES   | 18 Fall   | Environmental Science | Environmental Scientist | C & Engineering                            | Bozeman                 | MT    |
| Bode        | Emma      | MS     | LRES   | 18 Fall   | Non-profit            | Director                | Forward MT                                 | Bozeman                 | MT    |
| Gaffke      | Alex      | PhD    | ESEC   | 18 Fall   | Govt Agency           | Postdoc                 | USDA-ARS                                   | Gainesville             | FL    |
| Cook        | Adam      | MS     | LRES   | 19 Spr    | Industry              | Technician              |  |                         |       |
| Donahoo     | Claire    | MS     | ENTO   | 19 Spr    | University            | PhD Candidate           | Oregon St. Univ.                           | Corvallis               | OR    |
| Fischer     | Benjamin  | MS     | ENTO   | 19 Spr    | Self-employed         | Farmer                  |  |                         | OR    |
| Harvey      | Audrey    | MS     | LRES   | 19 Spr    | University            | PhD Candidate           | University Northern AZ                     | Flagstaff               | AZ    |
| Roush       | Kimberly  | MS     | LRES   | 19 Spr    | Teaching              | HS Teacher              |  | Pocatello               | ID    |
| Alowaifeer  | Abdullah  | PhD    | ESEC   | 19 Smr    | Govt Agency           | Senior Scientist        | Saudi Federal Drug and Food Administration | Saudi Arabia            |       |
| Three Irons | Emery     | MS     | LRES   | 19 Smr    | Govt Agency           | GIS Specialist          | Crow Nation                                | Crow Indian Reservation | MT    |
| Wologo      | Ethan     | MS     | LRES   | 19 Smr    | ?                     | Environmental Scientist | Enviromin Inc.                             | Bozeman                 | MT    |

**Supplemental Table 1. Continued**

| LASTNAME    | FIRSTNAME | DEGREE | CURRIC | DATE GRAD | Career Category      | Position             | Specific Employer | City      | State |
|-------------|-----------|--------|--------|-----------|----------------------|----------------------|-------------------|-----------|-------|
| <b>AY20</b> |           |        |        |           |                      |                      |                   |           |       |
| Blanchette  | Gabrielle | MS     | ENTO   | 19 Fall   | Private Sector       | Manager              | Genuine Ice Cream | Bozeman   | MT    |
| Dillard     | Shannon   | MS     | LAND   | 19 Fall   | University           | PhD Candidate        | U Wisconsin       | Madison   | WI    |
| Carlson     | Samuel    | PhD    | ESEC   | 20 Spr    | ?                    |                      |                   |           |       |
| Malone      | Shaelyn   | MS     | LAND   | 20 Spr    | University           | PhD Candidate        | U Wisconsin       | Madison   | WI    |
| Margetts    | Miranda   | PhD    | ESEC   | 20 Spr    | University Teaching  | Instructor           | MSU               | Bozeman   | MT    |
| Sigler      | William   | PhD    | ESEC   | 20 Spr    | University Extension | Associate Specialist | MSU               | Bozeman   | MT    |
| Whitehead   | Briana    | MS     | LRES   | 20 Spr    | Govt Agency          | Technician           | NRCS              | Sandpoint | ID    |
| Bhandari    | Rekha     | MS     | ENTO   | 20 Spr    | University           | PhD Candidate        | Cornell U         | Ithaca    | NY    |
| Acchami     | Buddhi    | PhD    | ESEC   | 20 Smr    | University           | Postdoc              | MSU               | Bozeman   | MT    |
| Majeski     | Michelle  | MS     | LAND   | 20 Smr    | Environmental Sci.   | Research Assistant   | MSU               | Bozeman   | MT    |
| Nixon       | Madison   | MS     | LRES   | 20 Smr    | Agriculture          | Ranch Technician     |                   | Bozeman   | MT    |

**E. LRES PROFESSIONAL MS GRADUATE STUDENT EMPLOYMENT TRACKING**

**Supplemental Table 2. Job and career placement of LRES Professional Masters Graduate students.**

| Student                | Term   | Completion Year | Category         | Career Category       | Position  | Specific Employer  | City            | State         |
|------------------------|--------|-----------------|------------------|-----------------------|---|--|-----------------|---------------|
| Trum, Eric             | Spring | 2018            | water            | Govt Agency           | Environmental Science Specialist                        | Montana Dept of Environmental Quality; Water Quality Division    | Helena          | Montana       |
| Cimino, Hillary        | Spring | 2018            | grazing          | University Technician | Research Assistant 3                                    | University of Montana  | Missoula        | Montana       |
| Rottinghaus, Dan       | Spring | 2018            | remote sensing   | HS Teacher            | High School Science Teacher                             | Pueblo School District   | Pueblo          | Colorado      |
| Shackford, Blair       | Spring | 2018            | pollution        | Industry              | Program Manager   | Stan Tech, LLC   | Oklahoma City   | Oklahoma      |
| Stukas, Heather        | Spring | 2018            | water            | Govt Agency           | Contractor Fisheries Technician                         | Maine Department of Marine Resources                             | Lewiston        | Maine         |
| Hosley, Rebecca        | Spring | 2018            | remote sensing   | Non-Profit            | Blog Contributor  | Hike it Baby   | Bremerton       | Washington    |
| Hammond, Molly         | Spring | 2018            | invasive species | University Extension  | Extension Agent   | Montana State University   | Hardin          | Montana       |
| Dalton, Kelly          | Spring | 2018            | water            | Govt Agency           | Associate Engineer                                      | City of Costa Mesa   | Costa Mesa      | California    |
| Langston, Carson       | Spring | 2018            | water            | Non-Profit            | Stream Restoration Specialist                           | Canaan Valley Institute  | Abingdon        | Virginia      |
| Malavasi, Jennifer     | Summer | 2018            | risk assessment  | Industry              | Project Manager   | SWCA Environmental Consultants                                   | Casper          | Wyoming       |
| Oakley, Leewood        | Summer | 2018            | invasive species | Industry              | Environmental Consultant                                | SWCA Environmental Consultants                                   | Casper          | Wyoming       |
| van der Hiele, Tona    | Summer | 2018            | animal habitat   | Govt Agency           | Lecturer - Water Management                             | HZ University of Applied Sciences                                | Vlissingen      | Netherlands   |
| Sapp, Cameron          | Summer | 2018            | animal habitat   | Industry              | Environmental Scientist                                 | Terracon   | Billings        | Montana       |
| Watrud, Amy            | Summer | 2018            | animal habitat   | Industry              | Environmental Compliance & Strategy Associate           | Invenergy LLC  | Denver          | Colorado      |
| Benge Bromley, Alexis  | Summer | 2018            | invasive species | Industry              | Regulatory Manager                                      | Ultra Petroleum Corporation (UPL)                                | Birmingham      | Alabama       |
| Newman, Bradley        | Fall   | 2018            | water            | Industry              | Project Environmental Engineer                          | KC Harvey Environmental, LLC                                     | Parkersburg     | West Virginia |
| Martin, Eric           | Fall   | 2018            | remote sensing   | Self-employed         | Consultant/Owner  | Martin Land Services   | Butte           | Montana       |
| Ulven, Andrew          | Fall   | 2018            | water            | Govt Agency           | Environmental Science Specialist                        | Montana Department of Environmental Quality                      | Helena          | Montana       |
| Caron, Chris           | Spring | 2019            | IPM              | University Technician | Research Associate                                      | Montana State University   | Bozeman         | Montana       |
| Hull, Jessica          | Spring | 2019            | disturbance      | Industry              | Utility Forester  | Vegetation Management West LP                                    | Cedaredge       | Colorado      |
| Morford-Graziano, Dawn | Spring | 2019            | biodiversity     | HS Teacher            | High School Science Teacher and Adjunct Science Faculty | Phoenix Union High School District and Gateway Community College | Phoenix         | Arizona       |
| Peppel, Landon         | Spring | 2019            | restoration      | Non-Profit            | Natural Resources Director                              | The Wildlands Conservancy  | Bakersfield     | California    |
| Rodenberg, Taylor      | Spring | 2019            | water            | Industry              | Project Assessor  | Partner Engineering and Science, Inc.                            | Belmar          | New Jersey    |
| Thatcher, Hannah       | Spring | 2019            | water            | Govt Agency           | Senior Environmental Engineer in Charge                 | Washington Department of Transportation                          | Seattle         | Washington    |
| Byrne, Charles         | Summer | 2019            | remote sensing   | HS Teacher            | Substitute Teacher                                      | The Urban School   | San Francisco   | California    |
| Dalby, Caitlin         | Summer | 2019            | biodiversity     | HS Teacher            | High School Science Teacher                             | Chico Unified School District                                    | Forest Ranch    | California    |
| Carroll, Sean          | Summer | 2019            | water            | University Extension  | Community Environmental Educator                        | Cornell Cooperative Extension Dutchess County                    | Pleasant Valley | New York      |
| Jerin, Borrego         | Summer | 2019            | pesticides       | Govt Agency           | Pesticide Registration Specialist                       | Montana Department of Agriculture                                | Helena          | Montana       |

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Supplemental Table 2. CONTINUED

| Student            | Term   | Completion Year | Category                | Career Category      | Position  | Specific Employer                              | City          | State          |
|--------------------|--------|-----------------|-------------------------|----------------------|---|--|---------------|----------------|
| Willis, Madelyne   | Summer | 2019            | cryosphere              | Unknown              |   |  |               |                |
| Davis, Stephanie   | Fall   | 2019            | forests                 | Teacher              | Facilitator/Tutor/Middle School Science Teacher | Chatham County Middle School                   | Raleigh       | North Carolina |
| Douglas, James     | Fall   | 2019            | remote sensing          | Govt Agency          | Denton Conservation Coordinator                 | City of Denton, Texas                          | Denton        | Texas          |
| Massey, John Gant  | Fall   | 2019            | restoration             | Govt Agency          | Assistant District Manager of Resources         | Bureau of Land Management                      | Brandon       | Mississippi    |
| McGunagle, Patrick | Fall   | 2019            | disturbance             | Govt Agency          | Smokejumper                                     | United States Forest Service                   | Whitehall     | Montana        |
| Schnee, Mark       | Fall   | 2019            | disturbance             | Govt Agency          | Fisheries Conservation Technician               | Montana Fish Wildlife and Parks                | Kalispell     | Montana        |
| Smith, Kelsey      | Fall   | 2019            | biodiversity            | University Teaching  | Assistant Professor of Aerospace Studies        | Embry-Riddle Aeronautical University           | Prescott      | Arizona        |
| Sovner, Nick       | Fall   | 2019            | restoration             | Industry             | Environmental Consultant                        | Tetra Tech                                     | Helena        | Montana        |
| Binger, David      | Spring | 2020            | disturbance/restoration | Industry             | Project Geologist and GIS Specialist            | Bennett and Williams Environmental Consultants | Columbus      | Ohio           |
| Gupta, Kyla        | Spring | 2020            | disturbance             | HS Teacher           | Part time teacher                               |  | Washington DC | Maryland       |
| Hauptman, Ben      | Spring | 2020            | IPM                     | University Extension | Granite County Extension Agent                  | Montana State University                       | Drummond      | Montana        |
| Lenehan, Tim       | Spring | 2020            | biodiversity            | Industry             | Senior Director                                 | Biogen   | Boston        | Massachusetts  |
| Sees, Mark         | Spring | 2020            | water/restoration       | Govt Agency          | Wetlands Manager                                | City of Orlando                                | Orlando       | Florida        |
| Williams, Amanda   | Spring | 2020            | IPM/biodiversity        | Govt Agency          | Weed and Vegetation Management Specialist       | Teton County, Idaho                            | Victor        | Idaho          |
| Avila, Iris        | Summer | 2020            | water/disturbance       | Industry             | Senior Scientist                                | Terracon Consultants                           | Atlanta       | Georgia        |
| Supplee, Heather   | Summer | 2020            | biodiversity            | HS Teacher           | Teacher's Aid                                   | Gallatin County School District                | Gallatin      | Pennsylvania   |