Graduate Biennial Program Assessment Report

Program Information: (Modify table as needed)	
Degree/s Assessed	PhD Biological Sciences PhD Fish and Wildlife Biology PhD in Ecology & Environmental Science (intercollege)
	MS Biological Sciences MS Fish and Wildlife Management
College or Administrative Division	College of Letters & Science
Department/School	Ecology
Report Submitted By	Diane Debinski
Date Submitted	
Assessment Period:	Fall 2020—Spring 2022

Graduate assessment reports are to be submitted biennially. The report deadline is October 15th.

1. Program Description:

The full program of study is determined by the graduate committee following the Graduate School degree requirements, usually after the student has completed the oral qualifying exam during the second semester in the program for MS degrees or by the end of the third semester for PhD degrees. Current degree requirements are in the Graduate Catalog. All graduate degrees in Ecology fall under Plan A: Thesis

2. Program Learning Outcomes, Assessment Schedule, and Methods of Assessment

PROGRAM LEARNING OUTCOMES	2020-2021	2021-2022	***Data Source****
Demonstrate a substantive breadth of knowledge of the field and sub-disciplines of ecology	X	X	Qualifying Exam & Foundations of Ecology & Mgmt. Course BIOE554: Comprehensive testing on broad ecological knowledge Oral presentations Literature synthesis
Demonstrate effective written and oral communication of scientific material, both from original and other sources	X	X	Comprehensive Exam and Communications in Ecol. Sciences BIOE 555: Written and oral communications in multiple formats
Conduct substantive original research and produce written and oral reports of the body of work	X	X	Thesis/Dissertation Defense: Ability to conduct original research and produce written and oral reports of the body of work.
Conduct scholarly and professional activities in an ethical manner	X	X	Body of work shows good understanding of ethical conduct of research as determined by grad committee. Federally funded students complete CITI Responsible Conduct or Research Training
PhD students only: Contribute to the development of the field of ecology and/or scientifically based natural resource management	X	X	Refereed publications, poster & oral presentations at national and international meetings

3. Threshold values for program learning outcomes (please include assessment rubrics)

PROGRAM LEARNING OUTCOME	Threshold Value (individual student based)	Results	Data Source
Demonstrate a substantive breadth of knowledge of the field and sub-disciplines of ecology	Passing BIOE 554 (Foundations of Ecology & Mgmt.) and passing Qualifying Exam	For 2020-2021: **14** Ecology grad students took BIOE 554 (Foundations of Ecology & Mgmt.) and passed. **3** MS and **2** PHD took and passed their qualifying exam, no students failed the course or their exams. For 2021-2022: **16** Ecology grad students took BIOE 554 (Foundations of Ecology & Mgmt) and passed. **2** MS and **1** PHD took and passed their qualifying exam and passed, no students failed the course or their exams.	Qualifying Exams, Foundations Course BIOE 554
Demonstrate effective written and oral communication of scientific material, both from original and other sources	Passing BIOE 555 (Communications in Ecol. Sciences) and passing Qualifying Exam and/or Successfully defend Thesis/Dissertation	For 2020-2021: **9** Ecology grad students took BIOE 555 (Communications in Ecol. Sciences) and passed. **3** MS and **2** PHD took and passed their Qualifying Exam, no students failed the course or their exams. **8** MS and **2** PhD students successfully defended their thesis/dissertation For 2021-2022: **6** Ecology grad students took BIOE 555 (Communications in Ecol. Sciences) and passed. **2** MS and **2** PHD took Qualifying Exam and passed, no students failed the course or their exams. **7** MS and **2** PhD students successfully defended their thesis/dissertation	Qualifying Exams, Communications course BIOE 555, Thesis/Dissertation Defense
Conduct substantive original research and produce written and oral reports of the body of work	Passing Comprehensive Exam and/or Successfully defend Thesis/Dissertation	For 2020-2021: **7** MS successfully defended their theses. **2** PhD student successfully defended their dissertation and passed their Comps. For 2021-2022: **7 MS** successfully defended their theses. **2** PhD students successfully defended their dissertation and passed their Comps.	Comprehensive Exams, Thesis/Dissertation Defense
Conduct scholarly and professional activities in an ethical manner	Passing Comprehensive Exam and/or Successfully defend Thesis/Dissertation	For 2020-2021: **9** successfully defended their theses. **2** PhD students successfully defended their dissertation For 2021-2022: **7** MS successfully defended their theses. **2** PhD students successfully defended their dissertation	Comprehensive Exams, Thesis/Dissertation Defense/CITI Course Completion (if required)

Additional Program Learning Outcomes for PhD students:			
Contribute to the development of the field of ecology and/or scientifically based natural resource management	Acceptance of manuscript for publication, Presentation at Scientific Meeting, Outreach to Professional Practitioners	All PhD candidates are evaluated by their committee for scholarly works. Ecology graduate students (both M.S. and Ph.D.) are successfully publishing the results of their research, as summarized in Appendix 1. In 2020 ecology graduate students were authors or co-authors on 30 publications, with 35 publications in 2021 and 12 thus far for 2022.	Publication in Scientific Literature, Presentation at Scientific Meeting, Outreach to Professional Practitioners

4. What Was Done

a) Was the completed assessment consistent with the plan provided? YES_X__ NO_____
If no, please explain why the plan was altered.

b) Please provide a rubric that demonstrates how your data was evaluated.

Example: BIOE55 Communication in Ecological Sciences– Requirements from Syllabus and Rubric for Student Presentations

Presentation Descriptions (all presentations need to have an ecological theme)**:**

• 15-minute professional paper presentation (~23 minutes total; 15 for presentation, 5 for questions, 3 for audience to complete evaluation form)

This presentation represents the introduction of your thesis or dissertation and provides the foundation for your 15-minute presentation without slides (see below). For this presentation, you will select journal articles that are central to your introduction and overall research question. You will use the articles to explain the background to the research need, demonstrate how your research fits into the body of knowledge on the subject, and convince the audience that your research is important. Your presentation should explain the article(s) such that the audience can understand the foundational research that has led to your research. Your presentation should end with a "so what" that can be used as a segue to your 15-minute presentation without slides (see below).

THIS PRESENTATION SHOULD BE DATA RICH AND JARGON IS APPROPRIATE.
YOU MUST INCLUDE AT LEAST TWO FIGURES AND ONE TABLE IN YOUR PRESENTATION. That is, reproducing tables and figures from the articles is appropriate, but remember to use the guidelines for making good slides. Be careful when directly copying tables and figures from manuscripts because they often are not suitable for presentations because they typically contain too much detail. Furthermore, scanned images from journal articles can be pixelated in a PowerPoint presentation.

• 15-minute presentation without slides (~23 minutes total; 15 for presentation, 5 for questions, 3 for audience to complete evaluation form)

For this presentation, you will present your thesis or dissertation topic without using PowerPoint (or any similar software). You can bring in visual aids such as tags, traps, or mounts—be creative in your presentation style. The presentation should be a continuation of your 15-minute presentation with slides

(see above) and focus on the research need (i.e., remind the audience how this research will benefit the species, ecosystem, and/or society), your research hypotheses, predictions, methods, and results (results are not required because many of you will be in the early stage of your program). You can also include any conclusions, but we expect this will be rare given where you are in your graduate education timeline. You can use this presentation to obtain feedback from the audience on your proposed research. We encourage engaging the audience in this presentation.

• 6-minutes of Science presentation

For this presentation, you will follow a style similar to the PechaKucha format, but the number of slides is your choice and slides will not automatically advance. This presentation will be formatted for the lay audience and could be on a topic that you are familiar with, but not directly related to your thesis or dissertation topic.

• Podcast interview

You will be interviewed (by Chris Guy or Andrea Litt) for the podcast titled Today's Voices of Conservation Science, and we will use interviews of students in this class to populate many of the podcast episodes. The podcast interviews should be fun, low-key, relaxed, informative, and focused on communicating your science and passion to the lay audience. The podcast will be ~20-minutes long, but the interview process will be about 45 minutes to an hour. To prepare for the podcast please respond to these questions prior to the podcast via an e-mail to Chris—this will allow us to prepare for the conversation. The responses can be a couple of sentences for each question and then we will fill in the details during the interview:

• Introduction and biographical information (50-70 words)
• What compelled you to pursue a career in conservation?
• Who or what was instrumental in getting you interested in conservation and nature?
• What hurdles did you personally face and how did you overcome them to get where you are today?
• Tell me about your research?
• Why is your research important?
• What is the best thing you could discover?
• What is your favorite animal, plant, or both?

Podcast interviews will occur in the evening (starting at 5:15 p.m.) to keep the background noise to a minimum. Please contact Dr. Guy to schedule a podcast interview on a Monday or Wednesday during the semester. Again, this should be enjoyable and casual. You can check out the podcast here http://conservationscience.buzzsprout.com or on iTunes or Stitcher.

15-Minute Professional Paper Presentation

Name of Presenter:

Instructor: _____

Category	Needs Improvement (4 pts)	Good (4.5 pts)	Excellent (5 pts)	Comments
Introduction caught your attention				
Dynamic speaking with voice inflection				
Confident speaker				
Spoke from points and didn't read text				
Made good eye contact with the entire audience (i.e., talked to all of the audience)				
Synthesized literature and provided well thought-out research need				
Slides were well designed (such as complementary colors and minimal text)				
Graphs were well designed and easy to interpret				
Table(s) were well designed and easy to interpret				
Emphasized 'So what?' of the topic; why this is important to understand				
Addressed questions appropriately and with poise				

Additional Comments:

15-Minute Presentation (without PowerPoint) on Thesis or Dissertation Research

Name:

Instructor: _____

Category	Needs Improvement (4 pts)	Good (4.5 pts)	Excellent (5 pts)	Comments
Introduction caught your attention				
Dynamic speaking with voice inflection				
Confident speaker				
Provided clear well thought-out research hypotheses/objectives				
Made good eye contact with the entire audience (i.e., talked to all of the audience)				
If she/he engaged the audience it was carefully thought-out and appropriate				
Used the whiteboard and it was coherent, carefully thought-out, and organized				
Moved enough to maintain a dynamic presentation				
Emphasized 'So what?' of the research; why this is important to the scientific community and/or general public				
Held your interest for the entire time				
Addressed questions appropriately and with poise				

Additional Comments:

Example: BIOE554 Foundations of Ecology and Management – Rubric for Student Presentations

Evaluation of Presentation

Name of Presenter _____ Total Score_____

Speaking Skills					
Loudness	Too quiet			Just right	
	2	4	6	8	10
Enthusiasm	low			Just right	
	2	4	6	8	10
Eye contact with audience	None			Just right	
	2	4	6	8	10
Confidence	None			Just right	
	2	4	6	8	10

Presentation					
Timing	Too short or too long			Just Right	
	2	4	6	8	10
Format of Slides	Needed improvement			Highly polished	
(font size, words/slide, etc.)	2	4	6	8	10
References	Did not have references			Several references	
(embedded in talk)	2	4	6	8	10
Visual aids	Poor Quality			High Quality	
	2	4	6	8	10

Content					
Cohesiveness of presentation	Low				High
	2	4	6	8	10
Creativity in linking to class	Low				High
material	2	4	6	8	10

Comments:

5. What Was Learned: Results

Please include who received the analyzed assessment data, and how it was used by program faculty for program improvement (s).

As we noted in the 2020 report, in 2012-2014, the pass rates on graduate exams and defenses were noted to be reasonable, but the faculty believed that students did not express as broad an understanding of the discipline as desired, and were rather narrow and focused on just their research and some struggled to express themselves verbally. The new curriculum initiated in 2012 for the MS students requires them to take two specific courses: BIOE 554 Foundations of Ecology and Management and BIOE 555 Communication in Ecological Sciences. These classes provide an opportunity for a cohort of graduate students to interact, regardless of their subdiscipline in Ecology, which promotes "cross-pollination" within the Ecology Department across graduate majors. Enrollment from 2020-2022 in both courses has been has been very strong: Foundations Fall 2020 (**14**), and 2021 (**16**) and Communications Spring 2021 (**9**) and 2022(**6**). The Foundations class provides background with regard to key ecological and management topics, including classic historical literature as well as some of the newest advances in Ecology. Both classes emphasize communication skills that are essential for a career in ecology. The outcome has been especially noteworthy. Faculty have observed that students bring a broader understanding of the literature to their research, and have improved in their ability to express themselves.

a) Areas of strength – Ecology graduate students are developing a broad set of communication skills via the Communication in Ecological Sciences course. We have cultivated a departmental culture of participating in this course, where the student presentations constitute our departmental Spring Seminar. The Foundations of Ecology and Management introduces the students to some of the more classic foundational and contemporary applications papers from a broad array of subdisciplines within Ecology and Management. This course has become relatively popular and had some of its highest enrollments in 2020 and 2021. The students in this class learn both from their peers and from the faculty how to articulate thoughtful and sophisticated scientific questions evaluating the literature.

Ecology graduate students are also very successfully publishing the results of their research, as summarized in Appendix 1. In 2020 Ecology graduate students (both M.S. and Ph.D.) were authors or co-authors on 30 publications, with 35 publications in 2021 and 12 thus far for 2022. Our graduate students are publishing their work prior to completion of their degrees in many cases, and they are publishing in high impact journals. Publication of new science is the gold standard for success in STEM fields and they are achieving that goal.

b) Areas that need improvement – Some of our graduate students are taking the CITI Responsible Conduct or Research Training because it is a requirement for students who are supported by NSF Graduate Research Fellowship Program (GRFP). However, it may be valuable for a larger number of our graduate students to be involved in such programs. We will investigate options for this and other types of professional training in the next few years.

c) Observations - Over the past 2-3 years, which included the COVID pandemic, several things have occurred that affected our graduate program. From the faculty perspective, 3 Ecology full professors retired out of a total of ~15 faculty, our undergraduate population continued to increase (now close to 600 students), and graduate student recruitment declined slightly. These changes are not

surprising, but they are worth reflecting on in the context of impacts on our graduate program during coming years. COVID resulted in higher retirement rates nationally. The combination of having fewer tenure-track faculty in the context of a burgeoning undergraduate population put stress on our faculty's recruitment of new graduate students, and that is shown the Fall 2022 graduate student numbers, which are lower than usual. In AY 22-23 we have two new tenure-track faculty starting positions, and we will be conducting two additional searches during this academic year. However, it will take a few more years for our new faculty to ramp up to recruit their own graduate students.

The second major shift related to COVID that affects our graduate program was a response from the student perspective. Several graduate students who were in the midst of doing a M.S. degree either finished the degree and went on to a Ph.D. in our program or switched from a M.S. to a Ph.D. degree within our program. Whereas prior to COVID, M.S. students were commonly encouraged to move to a different institution after completing their degree, during COVID, the level of uncertainty increased for many aspects of graduate school (impacts on health of students and their family and friends, impacts on graduate student's ability to conduct field research, etc.). This affected our recruitment of Ph.D. students internally in a positive way. Faculty were more likely to encourage strong M.S. students to move into our Ph.D. programs. The ratio of M.S. to Ph.D. students in Ecology has been on the order of 3:1 historically. It will be interesting to see if it shifts slightly towards more Ph.D. students in coming years as a result of this internal recruitment of Ph.D. students.

6. How We Responded

a) Based on the faculty responses, will there any curricular or assessment changes (such as plans for measurable improvements, or realignment of learning outcomes)?

YES_____ NO____X___

If yes, when will these changes be implemented?

Please include which outcome is targeted, and how changes will be measured for improvement. If other criteria is used to recommend program changes, please explain how the responses are driving department, or program decisions.

b) When will the changes be next assessed? Fall 2024

7. Closing the Loop

a. 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?

We did not have any major concerns that were identified in 2022. Our graduate program is strong, there is strong support for graduate students in our department, and students are completing their degrees with a high level of success. For future reviews, we will include data on numbers of federally funded students who complete CITI Responsible Conduct or Research Training".

NOTE: Student names must not be included in data collection. Dialog on successful completions, manner of assessment (publications, thesis/dissertation, or qualifying exam) may be presented in table format if they apply to learning outcomes. In programs where numbers are very small and individual identification can be made, focus should be on programmatic improvements rather than student success. Data should be collected through the year on an annual basis.

Submit report to programassessment@montana.edu

Appendix 1: Ecology Publications with Graduate Student Authors

2022 Graduate Publications:

(* Denotes Graduate Student from the Department of Ecology; ** denotes Affiliate of the Department of Ecology)

Albertson, L.K.**,**Briggs*, M.A.**,**Maguire*, Z.**,**Swart, S., Cross, W.F.**,**Twining, C. W.,Wesner, J.S.,Baxter, C.V., andWalters, D.M.. 2022. "Dietary Composition and Fatty Acid Content of Giant Salmonflies (Pteronarcys Californica) in Two Rocky Mountain Rivers."*Ecosphere*13(1): e3904. https://doi.org/10.1002/ecs2.3904

Djokic*, M. A., Heishman, J., Kappenman, K. M., Gaylord, T. G., & **Verhille, C. E**. (2022). A microwave energy meter to estimate energetic reserves in juvenile sturgeon. *Journal of Applied Ichthyology*, 38, 149-156. https://doi.org/10.1111/jai.14311

Fay, R., Authier, M., Hamel, S., Jenouvrier, S., van de Pol, M., Cam, E., Gaillard, J.-M., Yoccoz, N. G., Acker, P., Allen, A., Aubry, L. M., Bonenfant, C., Caswell, H., Coste, C. F. D., Larue, B., Le Coeur, C., Gamelon, M., **Macdonald*, K. R**., Moiron, M., **Rotella, J.**, … Sæther, B.-E. (2022). Quantifying fixed individual heterogeneity in demographic parameters: Performance of correlated random effects for Bernoulli variables. *Methods in Ecology and Evolution*, 13, 91– 104. https://doi.org/10.1111/2041-210X.13728

Flesch*, E., Graves, T., Thomson, J., Proffitt**, K., and Garrott, R.. 2022. " Average Kinship Within Bighorn Sheep Populations is Associated with Connectivity, Augmentation, and Bottlenecks." *Ecosphere* 13(3): e3972. https://doi.org/10.1002/ecs2.3972

Glassic*, H.C.; Guy, C.S.; Koel, T.M., 2021. Diets and Stable Isotope Signatures of Native and Nonnative Leucisid Fishes Advances Our Understanding of the Yellowstone Lake Food Web. ***Fishes***, ***6***, 51. https://doi.org/10.3390/fishes6040051

Goodheart, B*., Creel, S., Vinks, M.A., **Banda, K.***, **Reyes De Merkle, J.*,** Kusler, A., Dean, K., Dart, C., Banda, K., Becker, M.S., Indala, P., Simukonda, C., Kaluka, A. 2022. African wild dog movements show contrasting responses to long and short term rish of encountering lions: analysis using dynamic Brownian bridge movement models. ***Movement Ecology***. 10:16. https://doi.org/10.1186/s40462-022-00316-7

Lunn, T. J., Peel, A. J., Eby, P., Brooks, R., Plowright, R. K., Kessler, M. K.*, & McCallum, H.; 2022. Counterintuitive scaling between population abundance and local density: Implications for modelling transmission of infectious diseases in bat populations. *Journal of Animal Ecology*, 91, 916– 932. https://doi.org/10.1111/1365-2656.13634

Martinez, M.T., Calle*, L**.** Romañach, S.S., and Gawlik, D.E.. 2022. " Evaluating Temporal and Spatial Transferability of a Tidal Inundation Model for Foraging Waterbirds." *Ecosphere* 13(4): e4030. https://doi.org/10.1002/ecs2.4030

Miller, J.M., Campbell, E.O., **Rotella, J.J.** *,* **MacDonald*, K.R.,** ***et al.*** ***(2022)*** Evaluation of novel genomic markers for pedigree construction in an isolated population of Weddell Seals (*Leptonychotes weddellii*) at White Island, Antarctica. *Conservation Genet Resour* **14**, 69–8. https://doi.org/10.1007/s12686-021-01237-0

Paterson*, J. T.**,** Proffitt**, K. M.**, and** Rotella, J. J.. 2022. Incorporating vital rates and harvest into stochastic population models to forecast elk population dynamics. *Journal of Wildlife Management* 86:e22189. https://doi.org/10.1002/jwmg.22189

Reinert*, J.H., Albertson, L.K., and Junker, J.R.. 2022. "Influence of Biomimicry Structures on Ecosystem Function in a Rocky Mountain Incised Stream." *Ecosphere* 13(1): e3897. https://doi.org/10.1002/ecs2.3897

Rogers*, W., Brandell, E. E. & Cross**, P. C. (2022). Epidemiological differences between sexes affect management efficacy in simulated chronic wasting disease systems. *Journal of Applied Ecology*, 59, 1122– 1133. https://doi.org/10.1111/1365-2664.14125

2021 Graduate Publications:

Albertson, **L. K.**, M. J. MacDonald, **B. B. Tumolo***, **M. A. Briggs***, **Z. Maguire***, S. Quinn, **J. A. Sanchez-Ruiz***, **J. Veneros*** and **L. A. Burkle**. 2021. Uncovering patterns of freshwater positive interactions using meta-analysis: Identifying the roles of common participants, invasive species, and environmental context. ***Ecology Letters*** 24:594-607. https://doi.org/10.1111/ele.13664

Bowersock, N. R.*, Litt, A.R., Merkle, J. A.*, K. A. Gunther, and F. T. van Manen. 2021. Responses of American
black bears to spring resources. ***Ecosphere*** 12(11):e03773. 10.1002/ecs2.3773

Briggs*, M. A., **L. K. Albertson**, D. R. Lujan, L. M. Tronstad, **H. C. Glassic***, **C. S. Guy**, and T. M. Koel. 2021. Carcass deposition to suppress invasive lake trout causes differential mortality of two common benthic invertebrates in Yellowstone Lake, Wyoming. ***Fundamental and Applied Limnology*** 194 (4):285-295. DOI:10.1127/fal/2020/1352

Brusa*, J.L., J.J. Rotella, K.M. Banner, and P.R. Hutchings. 2021. Challenges and opportunities for comparative studies of survival rates: An example with male pinnipeds. ***Ecology and Evolution*** 11:7980–7999. https://doi.org/10.1002/ece3.7627

Brusa*, J.L., J.J. Rotella, and **R.A. Garrott.** 2021. Influence of age and individual identity in the use of breeding colony habitat by male Weddell seals in Erebus Bay, Antarctica. ***Marine Mammal Science*** - published online April 4, 2021 https://doi.org/10.1111/mms.12812

Burkle, L.A., **L.J. Heil***, R.T. Belote. 2021. Salvage logging management affects species' roles in connecting plant–pollinator interaction networks across post-wildfire landscapes. ***Journal of Applied Ecology.*** doi.org/10.1111/1365-2664.13928

Carroll*, K.A., R.M. Inman, **A.J. Hansen**, R.L. Lawrence, K. Barnett. 2021. A framework for collaborative wolverine connectivity conservation. iscience, v. 24:8 https://doi.org/10.1016/j.isci.2021.102840

Clute, T.*, Martin, J.*, Looker, N. *et al.* 2021. Hydraulic traits of co-existing conifers do not correlate with local hydroclimate condition: a case study in the northern Rocky Mountains, U.S.A. *Oecologia* **197,** 1049–1062. https://doi.org/10.1007/s00442-020-04772-z

Cutting*, K.A., J.J. Rotella, J.A. Waxe, A. O'Harra, S.R.Schroff, L. Berkeley, M. Szczypinski, **A.R. Litt**, and B.F. Sowell. 2021.Resource allocation effects on the timing of reproduction in an avian habitat specialist. ***Ecosphere*** 12 (8):e03700. https://doi.org/10.1002/ecs2.3700

Cutting, K.A.*, J.J. Rotella, E. Grusing, J.A.*, Waxe, E. Nunlist, & B.F. Sowell.2021.Nutrient sources for offspring formation: diet–mother and mother–offspring isotope discrimination in domesticated gallinaceous birds.***Isotopes in Environmental and Health Studies***, 57:6, 553-562, DOI: 10.1080/10256016.2021.1984905

Garcia, L., Castro, F.A., Hernandes-Amasifuen, A.D., Corazon-Guivin, M.A., Vasquez, J.A., Guerrero-Abad, J.C., Arellanos, E., **Veneros*, J**., et al. 2021. Global Studies of cadmium in relation to theobroma cacao: A bibliometric analysis from Scopus (1996-2020). ***Scientific Agropecuaria***. 12:4, https://doi.org/10.17268/sci.agropecu.2021.065

Goodheart* B, **Creel S**, Becker MS, **Vinks* M**, Schuette P, **Banda* K**, Sanguinetti C, Rosenblatt E, Dart C, Kusler A, Young-Overton K, Stevens X, Mwanza A, Simukonda C. 2021. Low apex carnivore density does not release a subordinate competitor when driven by prey depletion. ***Biological Conservation***, online early.

Hansen, **A.J.**, Noble, B.P., **Veneros*, J**., **East***, **A**., Goetz, S.J., Supples, C., Watson, J.E.M., Jantz, P.A., Pillay, R., Jetz, W., Ferrier, S., Grantham, H.S., Evans, T.D., Ervin, J., Venter, O. & Virnig, A.L.S. 2021. Towards monitoring ecosystem integrity within the Post-2020 Global Biodiversity Framework. Conservation. Letters; e12822. https://doi.org/10.1111/conl.12822.

Hansen, **A. J., A. East***, R. E. Keane, M. Lavin, K. Legg, Z. Holden, C. Toney, and F. Alongi. 2021. Is whitebark pine less sensitive to climate warming when climate tolerances of juveniles are considered? Forest Ecology and Management 493:119221.

Hinderer*, R. K.,A. R. Litt, and M. McCaffery. 2021.Habitat selection by a threatened desert amphibian. Ecology and Evolution 11: 536-546. https://doi.org/10.1002/ece3.7074

Jones, J.D., **Proffitt, K.M.**, Paterson, J.T.***, Almberg, E.S., Cunningham, J.A. and Loveless, K.M. (2021), Elk Responses to Management Hunting and Hazing. Jour. Wild. Mgmt., 85: 1721-1738. https://doi.org/10.1002/jwmg.22113

Junker, J.R.*, **Cross, W.F.**, Benstead, J.P. *et al.* Flow is more Important than Temperature in Driving Patterns of Organic Matter Storage and Stoichiometry in Stream Ecosystems. *Ecosystems* **24,** 1317–1331 (2021). https://doi.org/10.1007/s10021-020-00585-6

Kanive*, P.E., J.J. Rotella, T.K. Chapple, S.D. Anderson, T.D. White, B.A. Block, S.J. Jorgensen. 2021. Estimates of regional annual abundance and population growth rates of white sharks off central California. ***Biological Conservation*** 257: article 109104. https://doi.org/10.1016/j.biocon.2021.109104

Levandowski, M.L.*, A.R. Litt, M.F. McKenna, S. Burson, K.L. Legg. 2021. Multi-method biodiversity assessments from wetlands in Grand Teton National Park, ***Ecological Indicators***, v.131, 108205. https://doi.org/10.1016/j.ecolind.2021.108205

Lowrey, B.*, DeVoe, J. D.*, Proffitt, K. M.**, and Garrott, R. A.. 2021. Behavior-specific habitat models as a tool to inform ungulate restoration. *Ecosphere* 12(8):e03687. 10.1002/ecs2.3687

Lujan, D.R., Tronstad, L.M., **Briggs, M.A.*, Albertson, L.K., Glassic, H.C.*, Guy, C.S.**, Koel, T.M. 1921. Response of nutrient limitation to invasive fish suppression: How carcasses and analog pellets alter periphyton. ***Freshwater Science***, 41:1, https://doi.org/10.1086/718647

Lunn, T. J., Eby, P., Brooks, R., McCallum, H., Plowright, R. K., Kessler, M. K.*, & Peel, A. J. (2021). Conventional wisdom on roosting behavior of Australian flying-foxes—A critical review, and evaluation using new data. *Ecology and Evolution*, 11, 13532– 13558. https://doi.org/10.1002/ece3.8079

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