2022 Academic Program Review

SCHOOL OF NATURAL RESOURCES

snr.unl.edu

SNR'S MISSION

At the School of Natural Resources, our mission is to champion the natural world.

We address complex environmental issues through scientific discovery, creativity, and perseverance and we teach future leaders to manage the delicate balance between people and the environment on which we depend.

SNR'S VISION

We are committed to training current and future natural resource and environmental professionals to be critical thinkers prepared to manage, sustain, and renew our natural resources.

Through our teaching, outreach, and research scholarship, we will:

Prepare students for careers in natural resources and the environment.

Collaborate with others to conduct innovative scientific research that informs policy and management decisions.

Provide accessible, objective, science-based information to our stakeholders.

Promote a holistic conservation ethic for the betterment of Nebraska, the nation and the world.

SNR'S VALUES

These core beliefs guide our mission and vision:
Practical: Our science is useful beyond academia.
Trust: We operate with the highest of ethics and integrity.
Respectful: Our workplace is inclusive and respectful.
Diverse: We represent the diversity of our community, country, and world.
Freedom of thought: Our culture fosters freedom of thought and expression.
Generosity: We give of our time and talent to our community.

This document is printed on recycled paper.

2022 Academic Program Review

School of Natural Resources
University of Nebraska–Lincoln

Acknowledgments: Thanks to the students, faculty and staff of the School of Natural Resources for their participation in the production of this document. All images provided by students, faculty and staff of the School of Natural Resources.

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ADMINISTRATION

INTRODUCTION

The School of Natural Resources (SNR) aspires to provide the utmost in interdisciplinary higher education. Since 2003, SNR leadership has identified critical linkages between the diverse physical- and life-science disciplines and missions within SNR. It has long encouraged the integration of disciplines, which is evinced by successes in teaching, research and extension. Nevertheless, the integrative endeavor is challenging, even more so because there is no comparative disciplinary diversity in any other academic unit at UNL. In acknowledging the challenge, we also concede the need for success-focused improvements.

SNR has enjoyed a period of sustained development and growth in research and teaching since the last academic program review (APR) in 2015, and even more so since the preceding APR in 2010. SNR faculty garnered more than $18 million in grants

John Carroll
Director

R.M. (Matt) Joeckel
Senior Associate Director

Jenny Dauer
Associate Director for Undergraduate Education

Trenton Franz
Associate Director for Research and Graduate Education

in 2020-2021 and nearly 400 students are now enrolled in SNR degree programs. Also, SNR's scope of activities has broadened in impactful ways since 2015. The Nebraska State Climate Office was established within SNR. The unique Platte Basin Timelapse program has been embedded in SNR. The director of the new Center for Resilience in Agricultural Working Landscapes, as well as some of its core faculty, have appointments in SNR. SNR Extension has excelled with great efficiency despite the loss of personnel in climate science and wildlife damage.

Nevertheless, there have been some negative offsets to SNR's overwhelmingly positive trajectory. Core tenure-track faculty FTEs have declined by 18% since 2010. Many SNR faculty positions now occupy grant-funded non-tenure-track positions. Moreover, increasing numbers of faculty positions are the outcomes of special hiring decisions (partner hires and positions assigned by higher administration) that do not strictly align with any core missions in SNR. The Nebraska Water Center and the Geography program, which included faculty, were removed from SNR by administrative reorganization after the last APR.

SNR STATE-FUNDED FACULTY FTEs BY FUNDING SOURCE

Year	Total State FTE	CASNR	ARD	EXT
2010				
Total State-Funded Faculty (Non-TT)	9.20	1.69	3.36	2.95
Total State-Funded TT Faculty	44.45	7.48	26.13	3.72
Total State-Funded Faculty in SNR	53.65	9.17	29.49	6.67
SNR Total Faculty FTE	53.65			
2015				
Total State-Funded Faculty (Non-TT)	12.28	6.20	2.78	2.30
Total State-Funded TT Faculty	35.90	12.49	20.59	2.42
Total State-Funded Faculty in SNR	48.18	18.68	23.37	4.72
SNR Total Faculty FTE	49.98			
2021				
Total State-Funded Faculty (Non-TT)	9.08	3.50	4.58	3.00
Total State-Funded TT Faculty	36.00	12.44	20.79	2.02
Total State-Funded Faculty in SNR	45.08	15.94	25.37	5.02
SNR Total Faculty FTE	51.08			

Faculty appointments include Tenure Track (TT), Professor of Practice, Research Professor, Lecturer, Extension Educator, Forester, and Geoscientist at all available grades.

Continuing in the spirit of our long-term byword “integration and identity,” SNR consolidated multiple disciplines into three program areas in 2015. The Applied Ecology program area was created from Fisheries and Wildlife and Regional and Community Forestry. The Environmental Science program area focuses on water science, but it includes other aspects of the Earth sciences. It also attains additional value by intersecting with the Applied Ecology program area. The Applied Climate and Spatial Science program area encompasses the Nebraska State Climate Office, High Plains Regional Climate Center, National Drought Mitigation Center, and Center for Advance Land Management Information Technology. Faculty numbers in all three of these program areas are suboptimal. For example, Applied Climate Science has a total of 4.5 faculty FTE, but 3.0 faculty FTE is devoted to administration within the four aforementioned centers.

Although we have focused on addressing teaching issues since the 2015 APR, our research capacity within our core focus areas remains problematic. We have done more research with fewer faculty and staff and an increasing dependence on soft-money funding for positions. Similarly, engagement with Nebraska Extension has declined since the 2010

APR. One staff position in the Conservation and Survey Division (CSD) was reclassified as a Geoscientist (non-tenure-track faculty) position in 2021 and another such reclassification will be made in 2022. To be sure, CSD Geoscientists and tenure-track faculty undertake extension activities. Nevertheless, their assigned duties and job descriptions in the context of CSD's mission preclude them from functioning as extension specialists or educators.

In spite of constraints such as these, SNR has been flexible in collaborating with the Nebraska Department of Environment and Energy (NDEE) to establish three jointly funded extension educator positions, all of which focus on water-quality issues.

Diversity, Equity, and Inclusion (DEI) initiatives identified as a key priority in 2015 stimulated the establishment of the Natural Resources Diversity Initiative (NRDI). The late SNR faculty member Mary Bomberger-Brown established our membership in Women in Science, which expanded across the university. SNR strives to be at the forefront of DEI engagement since then. SNR faculty have also innovated by focusing attention on neurodiversity.

SNR is committed to being an active partner in the shared success of IANR and UNL. We envision a strong future that will always reflect positively on the Institute and the University.

FIVE-YEAR PLAN

In view of the aforementioned developments, SNR will focus on the following priorities over the next five years:

A. Management
    - Continue to develop the Faculty Advisory Committee as an integral management component in the interest of shared governance.
    - Identify faculty with interests in administrative duties and encourage leadership training.
    - Review the operations and staffing of Nebraska Maps and More. Although a successful operation, there should be a strategic re-evaluation of its primary roles as a support facility for Conservation Survey Division, as a U.S. Geological Survey map repository, as well as its support role in conferences and publishing.
    - Support and encourage Inclusive Excellence in all of SNR's operations.
    - Prepare for the transition to a new Director of SNR when John Carroll vacates the position.

B. Teaching

- Enroll at least 500 students in our degree programs, including at least 150 graduate students.
- Encourage a more even distribution of undergraduates among majors (at least 50 students in each degree program).
- Formally merge the Water Science program into Environmental Science.
- Critically evaluate a potential merger of the Applied Climate & Spatial Science program area into Environmental Science.
- Initiate a process of faculty tuition return modeled on our present policy of returning research facilities and administrative costs (F&A), in accordance with the University's Incentive-Based Budget Model (IBB).

C. Extension

- Align SNR Extension priorities with those of Nebraska Extension.
- Streamline the wildlife-damage program in Extension, which experiences a sustained demand even though it is understaffed.
- Encourage more Nebraska Extension involvement with the Nebraska State Climate Office.

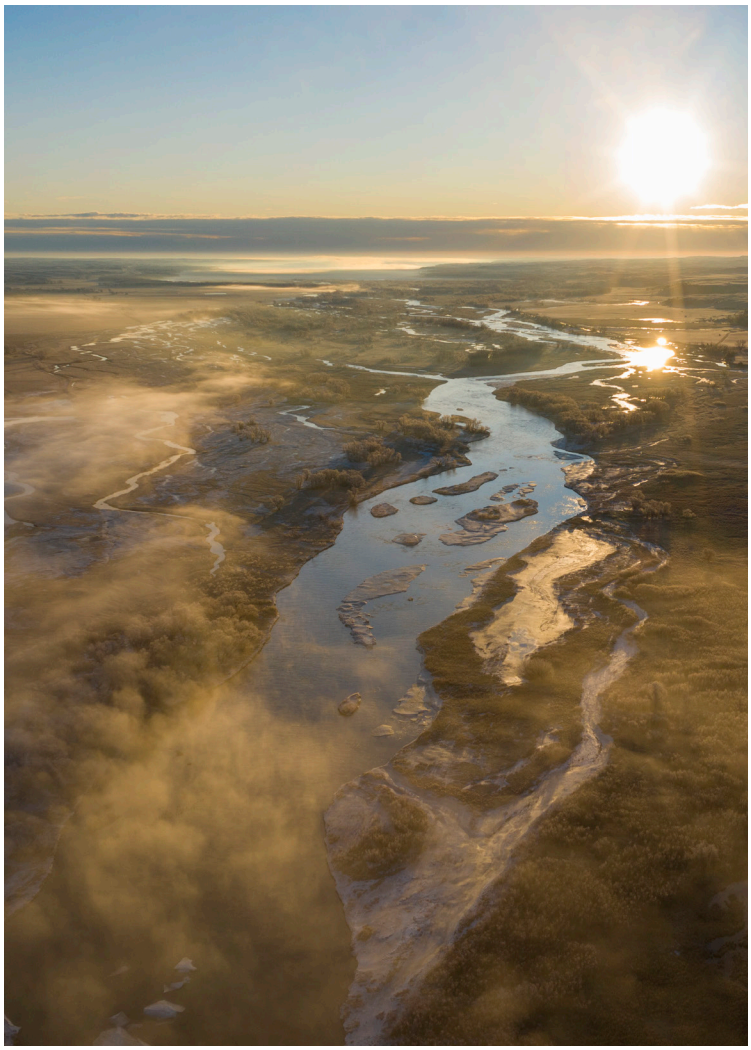
D. Research

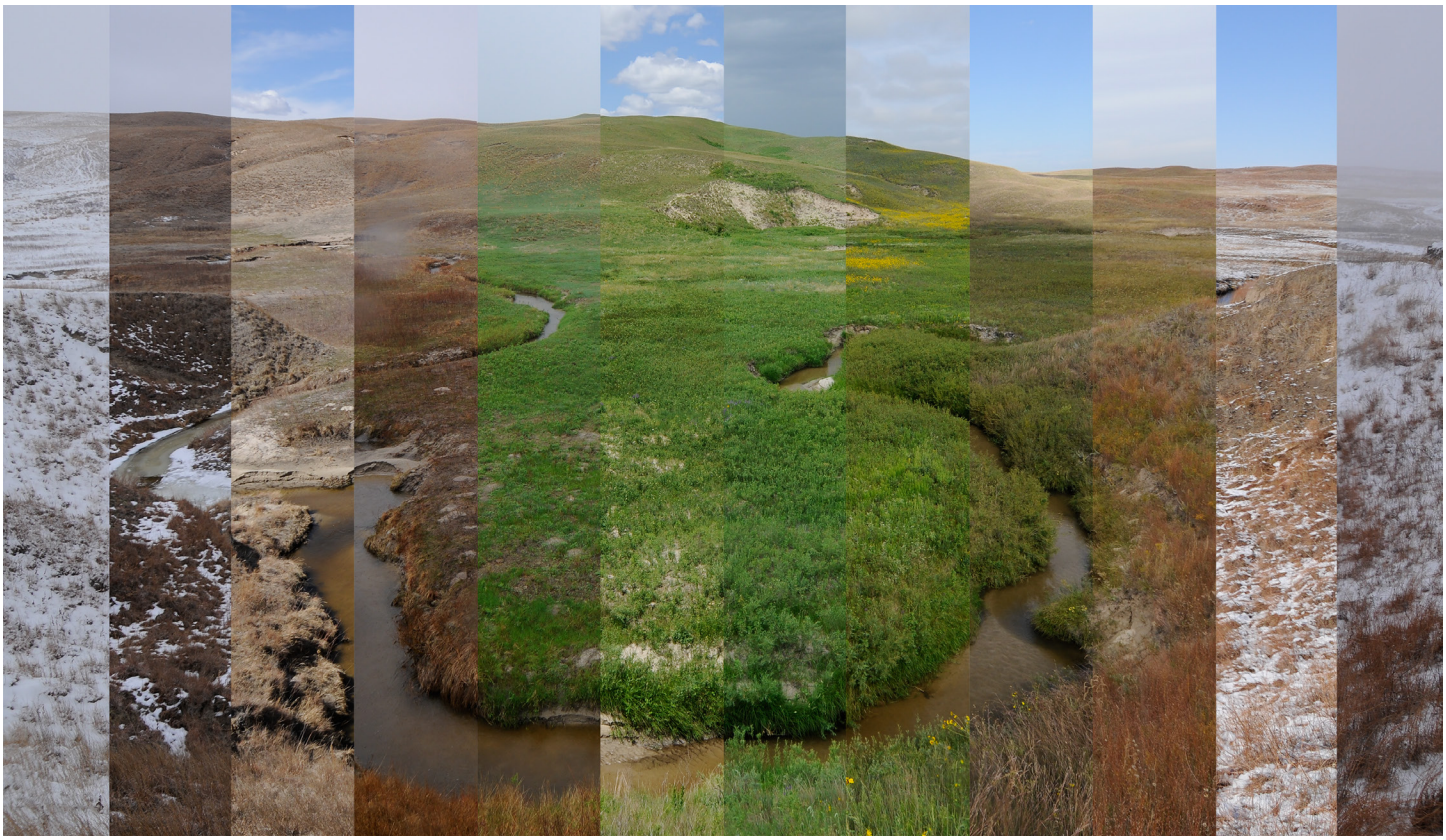
- Continue to support SNR faculty research endeavors through incentives and support of creative and forward-looking programs.
- Support creative collaborations outside SNR.
- Reward grant writing with continued F&A returns to individual faculty.

E. Personnel
    - Prioritize the hiring of additional tenure-track faculty with teaching. appointments in the Environmental Science and Applied Climate and Spatial Science program areas.
    - Develop a demonstrably strategic approach to the hiring of Professors of Practice (PoPs).
    - Establish clear policies for the hiring, duties, and status of state-funded staff that accord with the IBB model.

F. Relations with IANR and across UNL
    - Develop joint faculty positions with other IANR units to maximize impact and efficiency, and to address the University's Grand Challenges and other critical initiatives identified by IANR and University administration.
    - Coordinate productive, cross-campus collaborations between SNR Spatial Sciences and the Geography group in the School for Global Integrated Sciences in the College of Arts and Sciences.

G. Development and External Relations
    - Establish at least one Endowed Professor position by 2024.
    - Actively engage with the UNL fundraising campaign by establishing an SNR Campaign Leadership Group.
    - Reinvigorate working relationships with key state agencies such as Nebraska Department of Environment and Energy, Nebraska Department of Natural Resources, and Nebraska Game and Parks Commission, to facilitate the solution of environmental and societal problems and to leverage external funding.





Notes:

1. *The Water Center was part of SNR in FY10; Geography program joined SNR in 2008. Some Geography faculty were salaried in the College of Arts and Sciences.*
2. *In FY2010, SNR had 6 program areas & faculty could select their top three choices. For comparison purposes, this report uses only the primary area.*
3. *State funded positions are those faculty appointments that are paid by state funding, excluding grants from other state entities.*
4. *FTE includes instruction for Environmental Studies, Geography, and the Nebraska Water Center which were part of SNR in FY2010*
5. *FTE for SNR's Coordinators is listed under University Service*
6. *Center Director FTE reported as Admin includes HPRCC, NDMC, CALMIT, CSD; Great Plains Regional Center is included in Research FTE*

CHALLENGES

Each succeeding chapter in this document identifies specific challenges to the success of SNR. Some of these challenges relate directly to perceived needs for additional personnel and resources. Although we seek to address personnel challenges by maximizing the effectiveness of our present workforce, those measures are insufficient

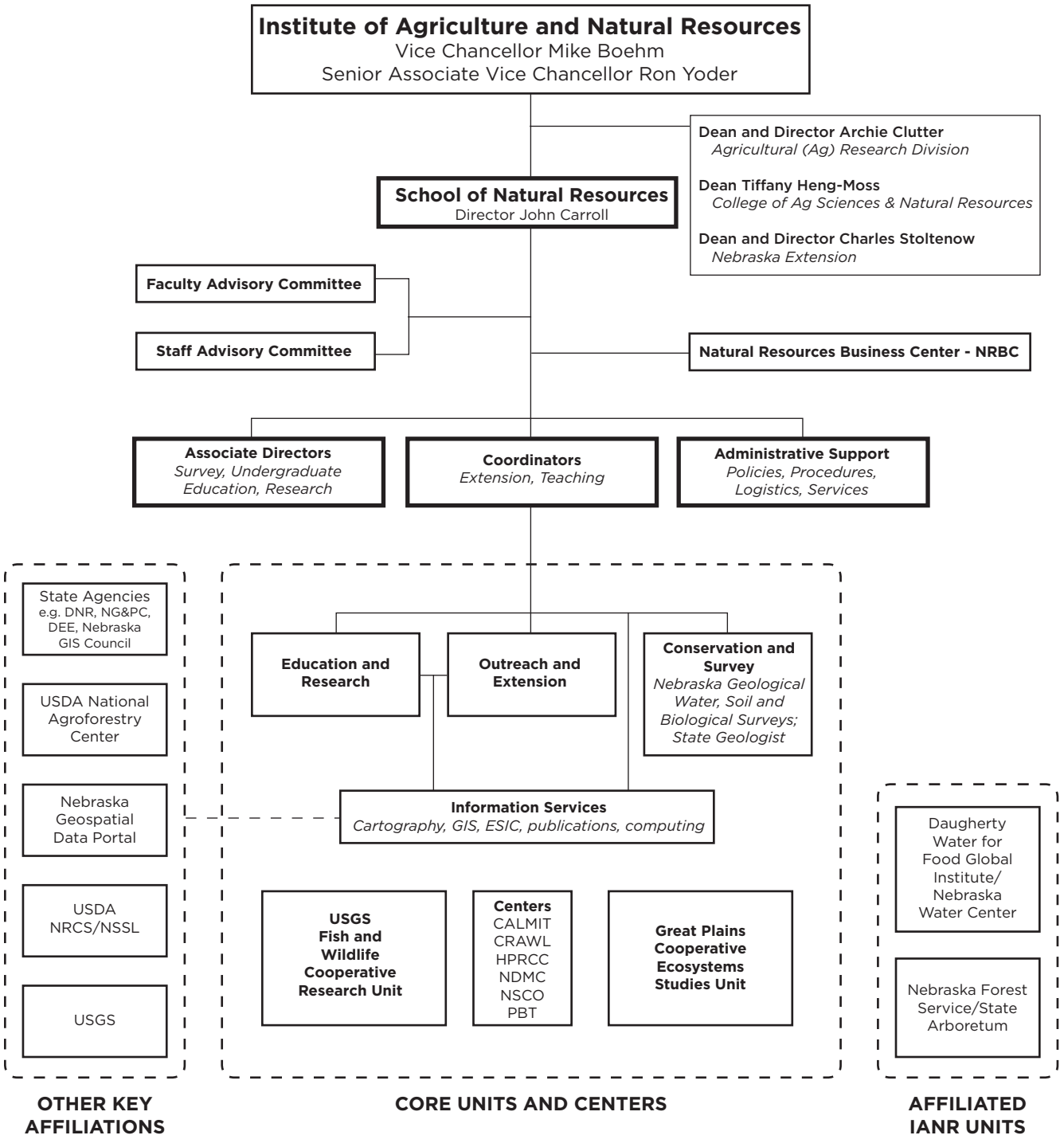
relative to the scope and magnitude of our present mission. Simultaneously we are already identifying and beginning to address many challenges unrelated to personnel and resource constraints. We look forward to cooperatively addressing all of our challenges in the interest of a more impactful IANR.

SUMMARY

SNR has already met with significant success. While it faces challenges, we are adamant that the School has tremendous, unrealized potential in teaching, research and extension. The NU system has recently created an initiative for Grand Challenges facing Nebraska and the world. The Grand Challenges are fundamentally related to natural resources, particularly in terms of climate, water, land use, environmental degradation, and community health and well-being. Thus, SNR can be a vital hub of expertise and resources for addressing those challenges. Indeed, we are committed to that role and we maintain that the Grand Challenges effectively highlight the value of a strong natural resources program within the University of Nebraska.

Wildlife and landscape photos in this chapter by Mariah Lundgren, Ethan Freese, Michael Forsberg/Platte Basin Timelapse

SCHOOL OF NATURAL RESOURCES



Bold box indicates SNR Management Team

Revised 7-11-2022

INSTITUTE OF AGRICULTURE AND NATURAL RESOURCES

Dean and Director, Agricultural (Ag) Research Division
Dean, College of Ag Sciences & Natural Resources

Dean and Director, Nebraska Extension
Dean, College of Arts and Sciences

SCHOOL OF NATURAL RESOURCES

SNR DIRECTOR - JOHN CARROLL

SNR Senior Associate Director and Conservation and Survey Director
Matt Joeckel

SNR Associate Director for Undergraduate Education
Jenny Dauer

SNR Associate Director for Research
Trenton Franz

Assistant to the Director, Academic/Administrative Operations
Christine Steggs

PROGRAM AREA LEADERS
Applied Climate and Spatial Science - *Brian Wardlow*
Applied Ecology - *Chris Chizinski*
Environmental Science - *Paul Hanson*

COORDINATORS
Extension - *Andy Little* Teaching - *Lisa Pennisi*

Administrative Associate
TBA

SNR SUPPORT SERVICES MANAGERS

Administrative Office Services/Logistics
TBA

Communications/Public Relations
R. Cory Matteson-On Call

Computing
Gregg Hutchison

Education, Services, Planning
Christine Steggs

Events and Sales
Jacki Loomis

Field and Drilling Services
Matt Marxsen

GIS/GPS and Cartography
TBA

Lab Safety
Jeremy Hiller

Liaison from SAPDC
Warren Pettee

SNR Website/Database
Mark Mesarch

STUDENT SUCCESS

Graduate
Emma Hazel

Undergraduate
Sara Winn

STANDING COMMITTEE CHAIRS
go.unl.edu/snrcommittees

Faculty Advisory
Mike Hayes

Graduate
Dan Snow

Promotion and Tenure
Dave Wedin

OPERATIONAL COMMITTEE CHAIRS

Community Engagement
Andy Little

Digital First
Mark Mesarch

Diversity and Inclusion
Jessica Corman

Extension
Andy Little

Safety and Facilities
Dennis Ferraro

Seminar
Katie Pekarek

Social
TBA

Staff Advisory
Ian Ratcliffe

Wellness
TBA

Faculty and Staff
go.unl.edu/snrdirectory

Conservation and Survey Division (CSD)
Matt Joeckel, Director and Nebraska State Geologist

Cooperative Ecosystems Studies Unit
Paul Hanson, Director

Center for Advanced Land Management Information Technologies (CALMIT)
Brian Wardlow, Director

High Plains Regional Climate Center (HPRCC)
Rezaul Mahmood, Director

National Drought Mitigation Center (NDMC)
Mark Svoboda, Director

Nebraska Cooperative Fish & Wildlife Research Unit
Kevin Pope, Director

Nebraska State Climate Office (NSCO)
Martha Shulski, Director and Nebraska State Climatologist

AFFILIATED PROGRAMS
Environmental Studies - Dave Gosselin
Forensic Science - Mike Adamowicz
Science Literacy - Joseph Dauer

Revised 7-11-2022

Dean and Director, Agricultural (Ag) Research Division
Dean, College of Ag Sciences & Natural Resources

Dean and Director, Nebraska Extension
Dean, College of Arts and Sciences

SCHOOL OF NATURAL RESOURCES

SNR DIRECTOR - JOHN CARROLL

UNL AFFILIATES

Daugherty Water for Food Global Institute
Peter G. McCornick, Executive Director

- **Nebraska Water Center**
  Chittaranjan Ray, Director
  - **Water Sciences lab**
    Dan Snow, Director

Agronomy and Horticulture
Martha Mamo, Department Head

Animal Science
Clint Krehbiel, Department Head

Biological Systems Engineering
David Jones, Department Head

Center for Resilience in Working Agricultural Landscapes
Craig Allen, Director

Civil & Environmental Engineering
Shannon Bartelt-Hunt, Department Head

Earth and Atmospheric Sciences
Clint Rowe, Department Head

Nebraska Forest Service
John Erixson, Director

Nebraska State Museum
Susan Weller, Director

School of Biological Sciences
Michael Herman, Director

School of Veterinary Medicine and Biomedical Sciences
Bruce Brodersen, Director

NEBRASKA PARTNERS

USDA FS/NRCS National Agroforestry Center
Susan Stein, Director

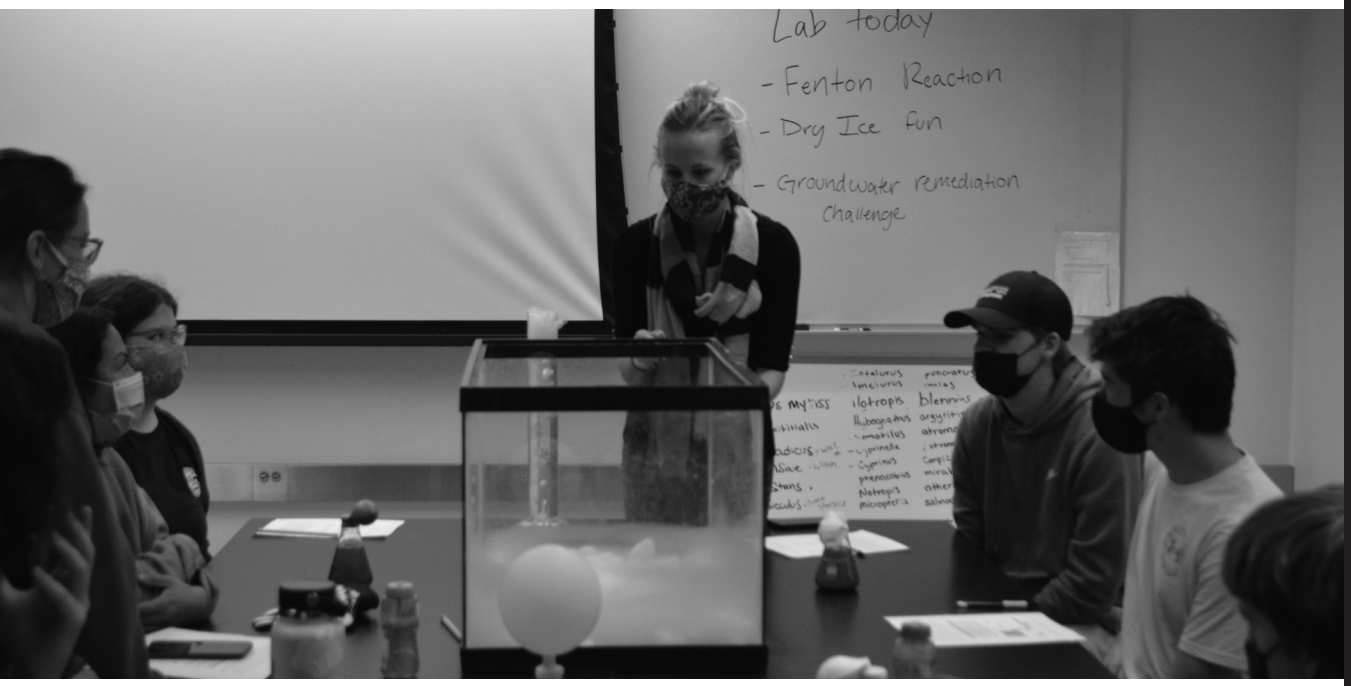
Nebraska Department of Environment & Energy
Jim Macy, Director

Nebraska Department of Natural Resources
Tomas Riley, Dirctor

Nebraska Game & Parks Commission
Tim McCoy, Director

IANR BUSINESS SERVICES
Kyle Bogus and staff

Revised 7-18-2022



UNDERGRADUATE EDUCATION

SCHOOL OF NATURAL RESOURCES

Undergraduate Education
snr.unl.edu/undergrad

UNDERGRADUATE EDUCATION OVERVIEW

We emphasize:

- experiential learning,
- inclusive excellence that encourages diversity, equity, access and inclusion,
- developing career-ready students.

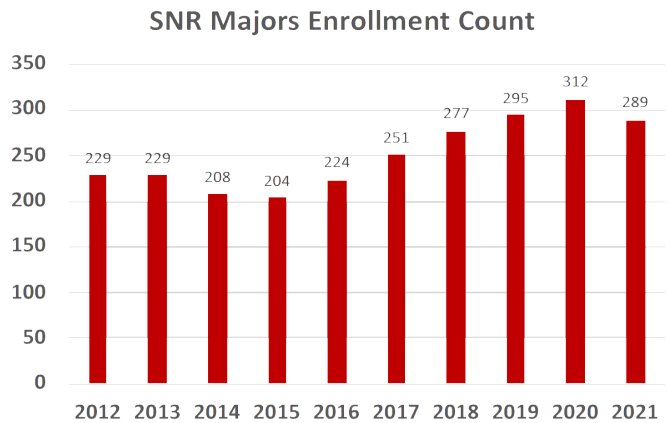
SNR provides an important undergraduate curriculum that meets the educational and technical needs of present and future natural resource managers and scientists. We hold steadfast in our promise to create future leaders to manage the delicate balance between people and the environment on which we depend.

"Doing research and coursework taught me skills I needed to set me up for a successful PhD. I think the most important thing I learned in SNR was how to critically evaluate a problem — whether it was a chemical equation, an instrument causing trouble, or how to find a literature gap. The problem solving skills have really made a difference."

- Valerie Schoepfer

ENROLLMENT

- Average of 8.8% annual growth between 2015 and 2020
- Student diversity is increasing
- Approximately 7,100 student credit hours generated in 2020-2021
- >175 different courses yearly, including 5 field courses



Numbers reflect student's first reported major

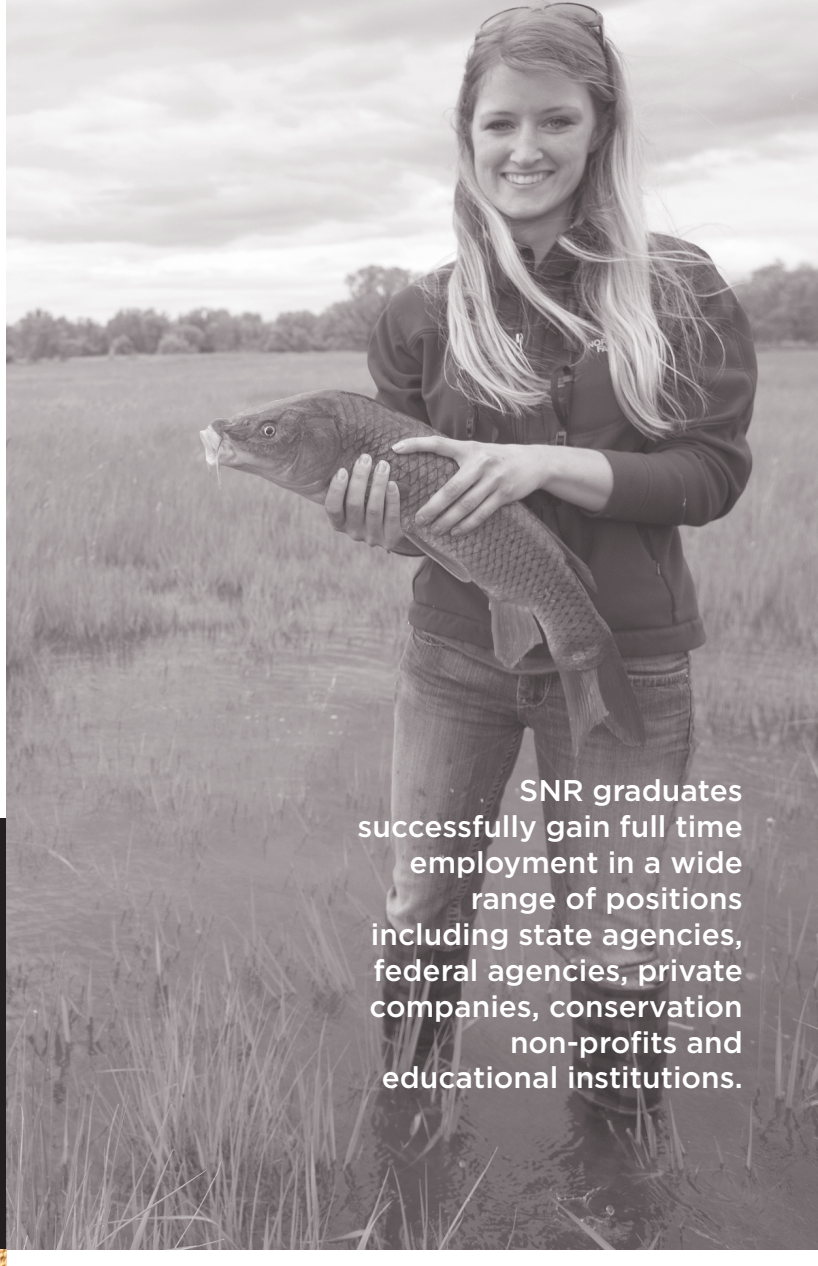
SNR STUDENT SUCCESS HUB

The SNR Student Success Hub is a vital part of undergraduate recruitment and retention for the School of Natural Resources. The Student Success Specialist and the Student Success Coordinator create a place for undergraduate SNR students to find support and direction. They provide:

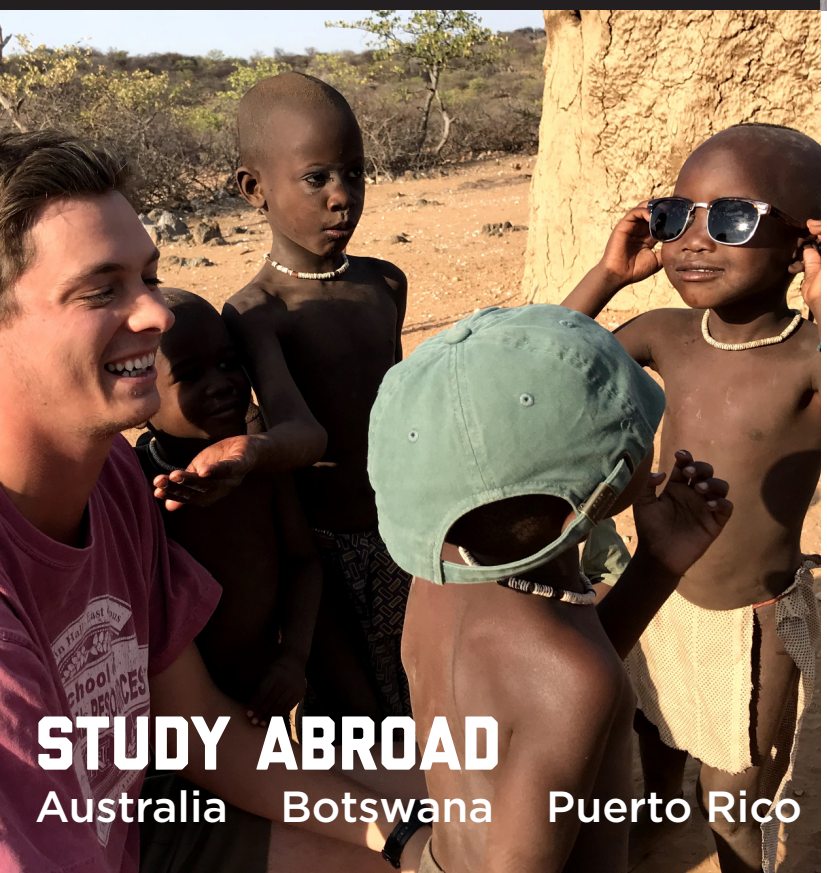
- Advising - Academic advising and liaisons with wellness and resilience campus partners
- Career preparation - Resume labs, career information day, employer in residence
- Recruitment - Prospective student visits, large group and K-12 visits, admitted student events
- Student Support - Scholarship and application essay reviews, student workshops, study zone

"My SNR education prepared me well. I deal with a variety of fish and wildlife management issues. The many fisheries and wildlife classes that SNR offers allowed me to gain valuable experience and knowledge that helped me become a successful conservation law enforcement officer."

- Travis Shepler



SNR graduates successfully gain full time employment in a wide range of positions including state agencies, federal agencies, private companies, conservation non-profits and educational institutions.



STUDY ABROAD

Australia Botswana Puerto Rico

FUTURE EMPLOYMENT

- Fisheries Technician
- Highway Environmental Biologist
- Sea Turtle Protection Intern
- Forest Products Program Leader
- Environmental Scientist
- Big Cat Keeper
- Integrated Water Management Planner
- Ecologist
- Many others

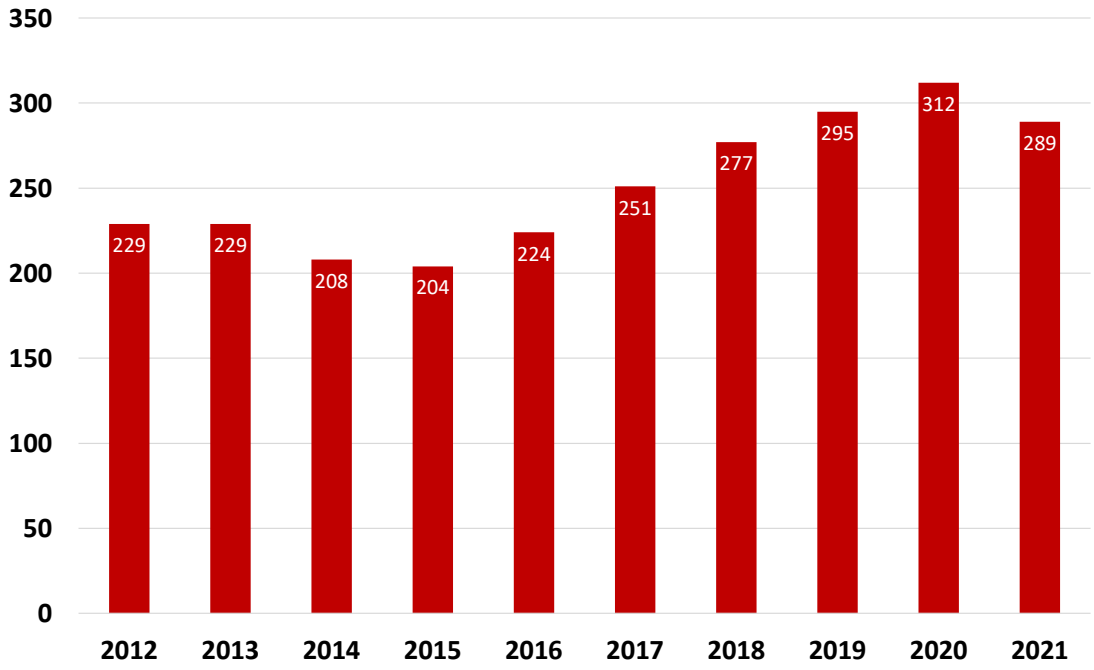
There are many employment opportunities for SNR graduates in Nebraska and beyond. The natural resources job sector is growing faster than the national average for job growth.

UNDERGRADUATE EDUCATION

INTRODUCTION

The School of Natural Resources (SNR) is home to several strong undergraduate programs with an estimated combined enrollment of 321 students in Fall 2021. SNR has the second-highest undergraduate enrollment in the College of Agricultural Sciences and Natural Resources (CASNR) of the Institute of Agriculture and Natural Resources (IANR). Our total undergraduate enrollment is growing, registering 8.8% average annual growth between 2015 and 2020.

TOTAL ENROLLMENTS IN SNR MAJORS, 2012-2021



Note: These numbers count only student's 1st reported major. Actual enrollment was calculated to be 10% higher in 2021 when 2nd and 3rd reported majors were included.

In 2020–2021, SNR generated approximately 9,841 student credit hours, 85% of which were for undergraduates. Institutional data suggest that SNR generates 11–13% of the undergraduate student credit hours within CASNR. Thus, SNR also ranks second in undergraduate credit-hour production within CASNR. SNR has five undergraduate majors and six minors that provide professional training and general preparation for careers in the natural resources. These programs are: Applied Climate Science (APCS) Major & Minor, the Regional and Community Forestry (RECF) Major & Urban Forestry Minor, the Environmental Education Minor, the Environmental Sciences (ENVS) Major & Minor, the Fisheries and Wildlife (FWL) Major & Minor, and the Water Science (WATR) Major & Minor. SNR also shares in the Grassland Systems Major and the Environmental Studies Major

with other units. Furthermore, SNR has recently proposed several new undergraduate programs. As SNR's programs mature, we seek intelligent and sustainable pathways for growing enrollment while continuing to focus on student success through retention, matriculation, and degrees awarded.

SNR has a highly effective undergraduate curriculum that meets the educational and technical needs of natural resource managers and scientists. We provide a strong educational foundation in organismal biology, ecology, environmental sciences, and conservation social science. A large proportion of our courses include experiential components with authentic growth opportunities that prepare our students for their careers. To enhance student learning, we focus on: (1) experiential learning opportunities that provide hands-on learning and/or connections with communities; (2) inclusive excellence that encourages diversity, equity, access, and inclusion; and (3) enhanced cross-disciplinary programming through participation in IANR communities and initiatives.

SNR is uniquely important because it prepares students for the growing number of natural-resource career opportunities in Nebraska and beyond. According to a 2019 external labor market analysis conducted on behalf of CASNR, water, environment, and climate jobs show strong potential, with jobs expected to increase by 10–12% between 2016 and 2026; faster than the overall rate of increase in the United States. Likewise, jobs related to animal systems, such as wildlife biology and zoology, are expected to see an 8% increase in jobs between 2016 and 2026. SNR graduates have gained full-time employment in a wide range of positions including state and federal agencies (e.g., Nebraska Game and Parks Commission, USDA, National Park Service), private companies (e.g., consulting firms, tree services, landscaping and nurseries), conservation nonprofits, and educational institutions (e.g., zoos, universities).

Undergraduate education programming within SNR is complex for many reasons. SNR has many programs, including shared and related programs. SNR's majors and minors do not align one-to-one with SNR's program areas of Applied Ecology, Environmental Science, and Applied Climate and Spatial Sciences. The

expertise of SNR instructors often extends across more than one program area, and many courses overlap multiple majors and minors. Teaching appointments vary considerably among SNR instructors, and many SNR faculty do not have teaching appointments at all. In 2021, 61% of our undergraduate student credit hours were produced by tenure-track faculty, 12% by non-tenure track faculty such as Professors of Practice, 21% by non-tenure track employees with short-term status (such as post-docs and temporary instructors), and 5% by other non-tenure track faculty and staff.

It is commonly the case that only a single faculty member has sufficient expertise to teach particular courses in SNR. Therefore, it can be difficult to ensure that a course is taught when illness, abrupt separation, and other unanticipated changes remove key faculty from the classroom. SNR frequently hires short-term instructors to remediate these situations; hence, the high (21%) contribution to our teaching by non-tenure track and short-term employees. In the spring 2022 semester alone, SNR employed nine part-time or full-time temporary instructors. Also, because single faculty are committed to particular courses they have less time to develop new courses, improve curricula, and engage in other programming. Temporary faculty are not expected to perform these activities and, indeed, their doing so would be inefficient and largely ineffective.

Another major challenge to undergraduate teaching in SNR is the limited number of graduate student teaching assistantships (GTAs) available each year. Funding for many GTAs was lost during a budget reduction in 2019 and a diversion of funds to pay for temporary instructors. The availability of GTAs is expected to decrease even more as the University transitions to the Incentive-Based Budget Model and eliminates tuition remission for state-funded GTAs. The decrease in GTAs threatens our ability to maintain courses with experiential components and authentic assessments.

SNR seeks to be inclusive and welcoming in our undergraduate programs. We have made good progress, but much remains to be done to ensure that our programs are welcoming and lack barriers for the success of all students. Over the past two years SNR has examined our own student-equity data, sought to educate ourselves, and to closely examine our policy, practices, and structures. SNR faculty recently read and discussed *Black Faces, White Spaces* by Carolyn Finney, which examines the experiences of People of Color in nature, and then they participated in inclusive teaching workshops. SNR is creating extra support and networking opportunities for undergraduate students (e.g., Latins for Natural Resources, a club that recently joined Minorities in Agriculture, Natural Resources and Relates Sciences). We are also improving our physical spaces (e.g., creating mother's rooms and gender-neutral restrooms). Furthermore, we are carefully considering the content in our courses. As SNR strives for inclusion, we recognize that diversity among our faculty and staff is a top concern and priority for developing an inclusive culture for our undergraduate programs.

SNR STUDENT SUCCESS HUB

The SNR Student Success Hub is vital to undergraduate recruitment and retention for the School of Natural Resources. Currently housing two staff members, the Student Success Specialist and the Student Success Coordinator, the hub is a place for undergraduate students to find support and direction during their time at the University. The Student Success Hub staff roles include:

- academic advising and liaisons with wellness and resilience campus partners,
- career preparation (resume labs, career information day, employer in residence),
- recruitment (prospective student visits, large-group and K-12 visits, admitted student events),
- student support (scholarship and application essay reviews, student workshops, study zone), and
- curriculum advisement (timing of courses, course capacity, student interest, service on the SNR Curriculum Committee, etc.).

FIVE-YEAR PLAN

Recently, UNL laid out aggressive targets in its N2025 goals. These goals include a four-year graduation rate increase from 46.9% to 55%, a 6-year graduation rate increase from 67.8% to 72%, a first- to second-year retention rate of 88%, and the equity gap in degree completion reduced from 14.4% to 7%. To reach these goals, many initiatives and programmatic elements must be amplified or developed. Some of these initiatives and elements include:

- Engage more K-12 students in classrooms through recruitment and outreach that highlights our programming.
- Create peer mentoring and study support groups to help retention. One

approach would be having advanced undergraduates and graduate students assist with leading study groups for our more difficult subjects.
- Develop a sophomore seminar to support first-year retention and career development. This seminar would include information on finding internships, summer positions, research opportunities, and other information.
- Provide additional career-development support, including a senior seminar offering a resume review, interview practice, job searching, or workshops on topics specific to natural resources fields. In the latter case, topics might include graduate school, state and federal jobs, and professional certification processes.
- Implement a formal faculty-student mentoring program.
- Forge stronger connections with employers and formal internship opportunities and develop opportunities for nationally recognized certification opportunities for undergraduates.
- Enhance the effectiveness of SNR clubs so that they augment the classroom experience and provide leadership training.
- Schedule more social events involving students and faculty.

CHALLENGES

- The Hub is extremely staff- and time-limited, especially given increased enrollment in parallel with greater expectations and needs for student support services.

MAJORS AND MINORS

A. APPLIED CLIMATE SCIENCE MAJOR AND MINOR

Climate science is increasingly at the forefront of the challenges facing global society. UNL's Climate Resilience is also one of seven Grand Challenges the University will emphasize through 2025, and beyond. The focus of the Applied Climate Science program (APCS) is on climate resilience. The APCS major and minor should be leading educational efforts in this area at UNL. Nevertheless, we have encountered difficulties in distinguishing the APCS degree from the Meteorology and Climatology major, which is housed in the Department of Earth and Atmospheric Sciences in the College of Arts and Sciences. These difficulties are clearly surmountable because the APCS major is unique. Uniquely, APCS provides students the opportunity to investigate climate resilience and its links with natural resources, agriculture, water, spatial science, and yet other disciplines and programs within IANR.

The APCS major is a relatively new program within CASNR, dating to Fall 2016. By Fall 2021, six students were enrolled in the APCS major, placing it among the ten smallest

of 28 CASNR majors. Three APCS majors graduated in Spring 2022, the largest number to date. Between 2015 and 2021, the total teaching FTE for permanent APCS faculty fell from 1.55 to 1.10, hampering course delivery and recruitment at a critical time.

The APCS major and minor and the new Remote Sensing Minor benefit from the five climate-, remote-sensing, and resilience-related centers in SNR (National Drought Mitigation Center, High Plains Regional Climate Center, Nebraska State Climate Office, Center for Advance Land Management and Information Technologies (CALMIT), and the Center for Resilience in Agricultural Working Landscapes. In fact, no comparable degree program in the United States can equal this combination of unique experiential opportunities for students. Graduates with both climate-related and spatial science skills are increasingly valuable in emerging natural resources, energy, green industry, agriculture, national security, and public health fields.

FIVE-YEAR PLAN

- Build the undergraduate focus for the university's Climate Resilience Grand Challenge by expanding the visibility and opportunity of the Applied Climate Science major and minor.
- Increase new student enrollment in the APCS major/minor and Remote Sensing minor by working with UNL, IANR, and SNR recruitment specialists.
- Offer experiential learning opportunities for students in courses and in the major and minors, especially with the five aforementioned SNR Centers.
- Embed multiple APCS courses and remote sensing/spatial science courses within other relevant majors and minors, including Environmental Science, Fisheries and Wildlife, Regional and Community Forester majors, and other programs.
- Develop "roadmaps" of 4-year course plans for potential APCS majors so they can visualize how an APCS major may link with remote sensing, GIS, agronomy, environmental science, applied ecology, national security, etc.
- Increase recruitment using a strategy that rebrands programs to make clear where students interested in climate resilience at UNL should enroll.
- Determine how Applied Climate and Spatial Sciences courses, and particularly the Spatial Science courses, service other programs/majors/minors. In other words, many of the Spatial Science courses are required courses for other majors. While this situation demonstrates need, it also challenges the Spatial Science instructors to provide courses on a regular basis.
- Investigate credentialing, badges, certificates, and other innovative course packaging.
- Initiate remote delivery of APCS courses, particularly Remote Sensing courses, across Nebraska. UNL is the sole provider of many such courses in Nebraska.
- Incorporate the APCS and Remote Sensing curricula under Environmental Science.

CHALLENGES

- APCS was partially supported by the work of a tenured faculty member who retired in June 2020, leaving a single faculty member responsible for maintaining the program.
- Student recruitment must be increased for both APCS and Remote Sensing.
- Both APCS and the Remote Sensing minor would benefit from a core faculty position focusing on undergraduate teaching, particularly at the 100- and 200-levels. Climate Literacy (NRES 208), an important gateway course, needs a dedicated instructor.

B. REGIONAL AND COMMUNITY FORESTRY (RECF) MAJOR AND URBAN FORESTRY MINOR

The RECF program began in 2020. As of Fall 2021, ten students are enrolled in the major. The Urban Forestry minor started in 2019 and it enrolled 17 students by Fall 2021. The program focuses on urban forestry, rather than traditional forestry, capitalizing on a regional need for expertise. RECF aspires to produce career-ready professionals.

The faculty member who founded the program was hired in 2018. He developed a wide range of courses that also serve other natural resources degrees. His departure from the University in 2020 created a void in leadership and teaching. Lord Ameyaw, a faculty Forester/Agroforester attached to the Nebraska Forest Service and USDA-NRCS, is the new lead of the RECF. He will begin a full-time appointment in SNR in Fall 2022 as an Assistant Professor.

FIVE-YEAR PLAN

- Increase new student enrollment in the major by working with UNL, IANR, and SNR recruitment specialists. Also, secure assistance in marketing and advising.
- Recruit new students from Nebraska, the Great Plains, and the intermountain states.
- Offer students experiential learning opportunities with partners.
- Determine the feasibility of establishing the former three-week Agroforestry course as a regular, one-semester course with an enrollment of at least 15 students.
- Reactivate the promotional TreeHusker newsletter and social media accounts.
- Hire new faculty.

CHALLENGES

- There was no forestry degree at UNL until RECF was initiated by a Forest Service grant. Thus, it was just beginning to gain momentum when the program founder and lead instructor departed in Fall 2020.
- Circumstance have dictated that SNR employ a temporary lecturer

to teach many of the required courses. This situation will remain problematic until a new faculty member is hired in fulfillment of the 2017 U.S. Forest Service agreement.

C. ENVIRONMENTAL EDUCATION MINOR

In 2020, the Environmental Education minor was revised and moved from Environmental Studies to SNR, making it a stand-alone minor with a current total of 14 students. This move enhances the visibility of the program on the SNR and CASNR websites. There should be significant growth in the minor if advertising is increased. SNR's two experientially taught undergraduate Environmental Education courses provide hundreds of hours of community service each fall. Environmental Education Curricula (NRES 322) guides student teaching at Title I schools for six weeks. Environmental Education and Interpretation (NRES 434/834) students conduct 20 hours of service per student at local schools, nonprofits, and state agencies. These have special considerations.

FIVE-YEAR PLAN

- Increase new student enrollment in the minor.
- Increase GTA capacity for courses and experiential learning opportunities.
- Strengthen experiential learning opportunities with partners for students in courses and in the minor.
- Collaborate with the MAS in Environmental Education graduate students to evaluate undergraduate programs and learning.
- Acquire trainer certifications for instructor so that they can offer two newly created national certification courses.
- Update the curriculum to reflect the revisions to the minor; include a diversity, equity, and inclusion unit in NRES 434/834.

CHALLENGES

- Five courses for the minor are taught by a single non-tenure-track faculty member.
- Environmental Education Curricula (NRES 322) is an experientially taught course that requires students to teach at Title I after-school programs in the Lincoln Public School Community Learning Centers for six weeks. This course needs GTA support because the instructor cannot carry out all of these visits singlehandedly.
- Environmental Communication Skills (NRES 301) is an ACE 2 course, meaning that it provides instruction in oral and visual communication. NRES 301 is required for the minor, but it is also recommended for the Environmental Studies program and for other SNR majors and minors. Oral,

visual, and written communication are vital in professional environmental educators. Projects are emphasized in this skills-building. The large amount of time required for grading them justifies GTA support.

D. ENVIRONMENTAL SCIENCES MAJOR AND MINOR

The Environmental Science (ENVS) major is experiencing significant interest. This new program name resulted from a two-year effort to change the less-recognizable name "Environmental Restoration Science." The number of students admitted to the major rose sharply following the name change in 2020. In Fall 2021, UNL admitted 50 freshmen into ENVS. During Fall 2021, ENVS had 43 enrolled in the major and one student enrolled in the minor, making it a mid-sized program among CASNR's 28 majors. Eighty ENVS majors had been admitted for Fall 2022 at the time this document was written. Although the ENVS program attracts considerable interest from out-of-state students, its high qualifications and scholarship offers from other programs temper enrollment. Therefore, a concerted effort to contact admitted ENVS students and encourage their enrollment will be critical for success.

We exercised foresight by developing an introductory, four-credit-hour environmental science course (NRES 115). This course was taught for the first time with a laboratory in Fall 2021. The goal of this course is to introduce ENVS majors to the exciting topics covered in the ENVS curriculum at large. In the future, one or more faculty members will coordinate NRES 115, and other faculty will provide lectures highlighting subdisciplines such as soil science, limnology, hydrology, and geology. Environmental science faculty without formal teaching appointments may also contribute by leading a NRES 115 laboratory exercise such as collecting soil samples, drilling a borehole, or conducting surface-water or groundwater sampling.

We anticipate that students will hone their specific interests as ENVS enrollments increase. Therefore, it is likely that parallel growth will occur in the lagging Water Science major. Relative to other SNR majors, our ENVS and Water Science (WATR) undergraduates are more urban, and include more out of state students, necessitating increased recruitment efforts to those prospective students. In ENVS, 36% of all undergraduates are from outside of Nebraska and 36% of in-state undergraduates are from large cities. In WATR, 27% are from outside of Nebraska

and 54% of the in-state students are from large cities. We also have the potential to increase the number of female undergraduate majors, considering that 33 of 50 students admitted to Environmental Science in Fall 2021 were female.

FIVE-YEAR PLAN

- Incorporate Water Sciences under ENVS.
- Increase teaching capacity in anticipation of growth in both ENVS and WATR. Secure new faculty positions with teaching FTEs of 0.4 to 0.5.
- New state-funded GTAs will be needed for the laboratory sections of two large-enrollment classes: Introduction to Environmental Science (NRES 115) and a planned 200-level Advanced Environmental Science course.
- Stabilize ENVS and WATR curricula by requiring all environmental science faculty with teaching appointments to teach the required courses on a routine basis.
- Attract students from within and outside of SNR with the new Introduction to Environmental Science (NRES 115) starting in Fall 2021. We will advertise widely.
- Determine which faculty will be teaching particular ENVS and WATR courses in the next three to five years. Identify future teaching FTE needs, particularly relative to anticipated retirements. Capitalize on recent and forthcoming hires. A 1.0 teaching FTE hired in Spring 2022 is presently assisting with undergraduate courses. A Soil Health faculty position (0.2 FTE teaching in SNR) has recently been interviewed by SNR and Agronomy and Horticulture. The successful candidate can contribute to ENVS and WATR by teaching a 200 to 300- level course in soil biology, ecology, and/or microbiology.

CHALLENGES

- Twenty-one faculty, with appointments dominated by research FTE, are now included in the Environmental Sciences Program Area. Thirteen of these faculty have tenure-track appointments. Nevertheless, the total teaching FTE in permanent positions is only 2.45. The two senior faculty in the program have been teaching at double their assigned teaching FTEs for more than five years. Furthermore, one of them has just left UNL and the other will be retiring within three years. Many of the other Environmental Sciences faculty have designated research, extension, and administrative duties within the various centers in SNR. Thus, new hires with significant teaching FTEs are essential if the ENVS program is to succeed.
- Notwithstanding, we did not receive a requested core Assistant Professor of Environmental Science under IANR's Phase V initiative in 2021. This position would have had a 0.7 teaching FTE, making it an essential component in the future success of the program.

E. FISHERIES AND WILDLIFE MAJOR AND MINOR

The Fisheries and Wildlife major (FWL) was one of the original majors formed during the School of Natural Resources merger. It continues to serve as SNR's flagship major. FWL has seven options that emphasize skills and training for several fish- and wildlife-oriented careers. These seven options are: fisheries ecology and management, wildlife ecology and management, conservation biology, zoo animal care, habitat management, law enforcement, and nature-based entrepreneurship. FWL maintains steady growth in enrollment, attracting a diverse student body. During Fall 2021, FWL had approximately 271 students enrolled, making it the third-largest program among the 28 CASNR majors.

FIVE-YEAR PLAN

- Evaluate the current curriculum to ensure it continues to: (1) appeal to our diverse student populations and (2) maintain faculty-led, hands-on, and field-oriented education.
- Assemble a faculty committee to evaluate and refine the FWL curriculum. This committee will identify potential changes to ameliorate capacity constraints and to improve the coordination of large-enrollment core classes.
- Schedule teaching assignments several years in advance. We will use this long-term schedule to improve the effectiveness of our teaching appointments.

- Implement a team-teaching schedule for some of our large-enrollment core classes such as Ecology (NRES 220), and its associated laboratory course (NRES 222). This effort will standardize subject material and streamline the commitments of individual faculty and teaching assistants.

CHALLENGES

- Increased enrollments have revealed capacity constraints in certain core classes with lab sections. More students are interested in enrolling, but we had to deny them because our classrooms are at capacity.
- It has proven difficult to coordinate the instruction of certain large-enrollment core courses because of increases in the number of course sections needed to fulfill demand.
- Most faculty in Applied Ecology are performing at or beyond their teaching FTE. Therefore, we cannot expand the number of classes taught per instructor. Incorporating curriculum refinements, team teaching, and graduate-student and postdoc instructors will partially alleviate this problem.

F. WATER SCIENCE MAJOR AND MINOR

Our Water Science (WATR) major is designed to prepare students to address complex issues surrounding water management and conservation. Sustainable management of water quantity, quality, and other ecosystems services derived from aquatic ecosystems requires interdisciplinary knowledge that spans social sciences, mathematics, chemistry, hydrogeology, and ecology. The WATR major is designed to expose students to each of these fields while providing more detailed training in specialization areas such as aquatic ecology, hydrology, water law and policy, water quality, and watershed management.

UNL is the only Big Ten University to offer an undergraduate Water Science major and one of only a few universities in the nation to do so. The program is known for getting students into the field early in their degree programs. It develops well-

rounded students by requiring classes in communications, decision making, policy, and technology. Unfortunately, the Water Science major has not attained steady enrollment levels. Enrollment in the major has ranged from three to twenty-five students since its inception. Student numbers increased initially (17 in 2016 and 20 in 2017) in the program's first five years, but enrollment fell to three students in Fall 2021. This precipitous drop may be due, in part, to enrollment increases accompanying the renaming of the Environmental Science program. Accordingly, we intend to transform the Water Science major to a Water Science specialization option under the new Environmental Science major. We will maintain the Water Science minor, however, because it has exhibited higher participation over the last five years, enrolling 29 minors in 2021. Doing so will improve water science education at UNL by exposing more students to our water science courses.

FIVE-YEAR PLAN

- Attract more students and to streamline administrative efforts, we will merge the Water Science major with Environmental Science major and develop a unique Water Science specialization within the major.
- Explore development of a non-thesis 3:2 program in which enrolled students would receive a BS in Environmental Science and a Master's of Applied Science (MAS) degree in Water Science.
- Work with the CASNR Dean's office to move the Water Science major under the new Environmental Science major.
- We have already begun organizing course requirements for the new ENVS specialization and we will propose ENVS specialization in the summer or fall of 2022.
- Move the administration of the Water Science minor to the Environmental Science curriculum committee.

CHALLENGES

- There is a conspicuous lack of instructors to teach the full complement of water science courses. Faculty in permanent positions in SNR with water expertise and teaching appointments comprise only 1.15 FTE. Our recent hiring of a lecturer, Dr. Keeley MacNeill, only partially addressed this problem. Elevating that position to a tenure-track line could improve matters.
- Identifying a committed SNR faculty member to lead the Water Science specialization remains a high priority. We maintain that the lack of a dedicated leader contributed to insufficient enrollment in the Water Science major.

G. SHARED PROGRAMS, RELATED PROGRAMS AND PROPOSED MINORS

GRASSLANDS SYSTEMS MAJOR (SHARED)

Grasslands, which cover more than half of Nebraska's land area, have critical importance in our agricultural economy, biodiversity, and soil and water resources. UNL has a long history of research, and outreach in range management, prairie conservation, and grassland ecology. The Grassland Systems major is a new (2020) major that combines the former Grassland Ecology and Management and Grazing Livestock Systems programs under the coordination of the Center for Grassland Studies (CGS). CGS also recently assumed leadership in managing several of IANR's grassland properties, including Nine-Mile Prairie, a 235-acre tallgrass prairie preserve. Nine-Mile Prairie is heavily used by SNR for teaching, including SNR-led instruction in prescribed burning.

There are no faculty with teaching FTEs in CGS. Therefore, the teaching, advising, mentoring, and curriculum development needed to sustain and build the Grassland Systems major depends on participating faculty and staff based in other CASNR units. Currently, faculty and staff from five units serve on the Grassland Systems

Curriculum Committee (SNR, Agronomy and Horticulture, Animal Science, Agricultural Economics, and CGS). In 2021–2022, three SNR faculty taught courses serving the Grassland Systems Major (Gwendwr Meredith, Dan Uden, and David Wedin). The SNR Student Services Specialist (Sara Winn) also serves on the GSCC and is the primary advisor for the major. Additionally, Agronomy and Horticulture rebranded their degree to Plant Biology with a Plant Ecology track. This new name creates some confusion about where students should be enrolling for their degree.

FIVE-YEAR PLAN

- Increase enrollment of both urban and rural students. A video produced by CGS and SNR's Platte Basin Timelapse can be employed, as well as the CGS website, social media, and recruiting events.
- Revise the curriculum, which includes courses housed in both SNR and Agronomy and Horticulture. Capitalize on new faculty and fill gaps left by the retirements of key personnel..
- Develop new research and internship opportunities with CGS partners in conservation NGOs, state and federal agencies, and the ranching and seed industries.

ENVIRONMENTAL STUDIES MAJOR AND MINOR (RELATED)

The Environmental Studies (ENVR) program offers an undergraduate degree jointly administered by the College of Arts and Sciences (CAS) and the College of Agricultural Sciences and Natural Resources (CASNR). The program employs a student-centered, experiential approach to provide a comprehensive education. This approach prepares students to make informed judgments about contemporary environmental issues using sustainability as a framework to connect humans to the living and physical environment. The program generates over 1000 student credit hours annually and supports over 140 majors and minors (the latter as Environmental Studies or Sustainability Studies).

Dr. David Gosselin, the part-time director of the program, is an SNR faculty member. He has a 0.2 FTE administrative appointment to direct the program and he is the only tenure-rack faculty appointment assigned to the unit. His 0.6 teaching FTE is jointly funded by CAS and CASNR. Other SNR faculty directly support the program by serving as advisors for ENVR senior theses and indirectly through teaching the SNR classes required by the major.

REMOTE SENSING MINOR (APPROVED)

A 15-credit hour Remote Sensing Minor was recently developed to provide students with a credentialing option that requires more in-depth training. This minor consists of four courses offered in SNR that should appeal broadly to students across UNL since remote sensing is used in many academic fields. The targeted start date is Fall 2022.

CONSERVATION STORYTELLING MINOR (APPROVED)

We have developed a Conservation Storytelling minor with the Platte Basin Time Lapse Group. This minor will partner with Environmental Education. It should attract students from across the university and beyond who wish to use photography and video to communicate conservation stories to a wide audience. Our approved Conservation Storytelling minor entails 15 credit hours. The newly created Conservation Photography course (NRES 260), to be taught for the first time in Fall 2022, will be incorporated into the minor.

HUMAN DIMENSIONS MINOR (PROPOSED)

We are developing an undergraduate minor in Human Dimensions of Natural Resource Management. This minor will align SNR with successful peer institutions of repute. Schools with a major in Human Dimensions of Natural Resources include Colorado State, Utah State, Cornell, Missouri, Wisconsin-Stevens Point, and Virginia Tech. Four other Big Ten Universities already offer a minor in Human Dimensions or have a very similar program. The proposed Human Dimensions minor will enhance other SNR and CASNR majors by increasing course offerings and academic and career aspirations. The minor will provide a strong social science knowledge base relevant to many SNR and CASNR majors.

SUMMARY

SNR undergraduate education programs are well positioned to increase enrollment in existing programs and to expand to new audiences through proposed new programs, badging and credentialing, and online education. As our programs grow, SNR will remain focused on offering high-quality instruction, particularly through experiential education, and on inclusive excellence.

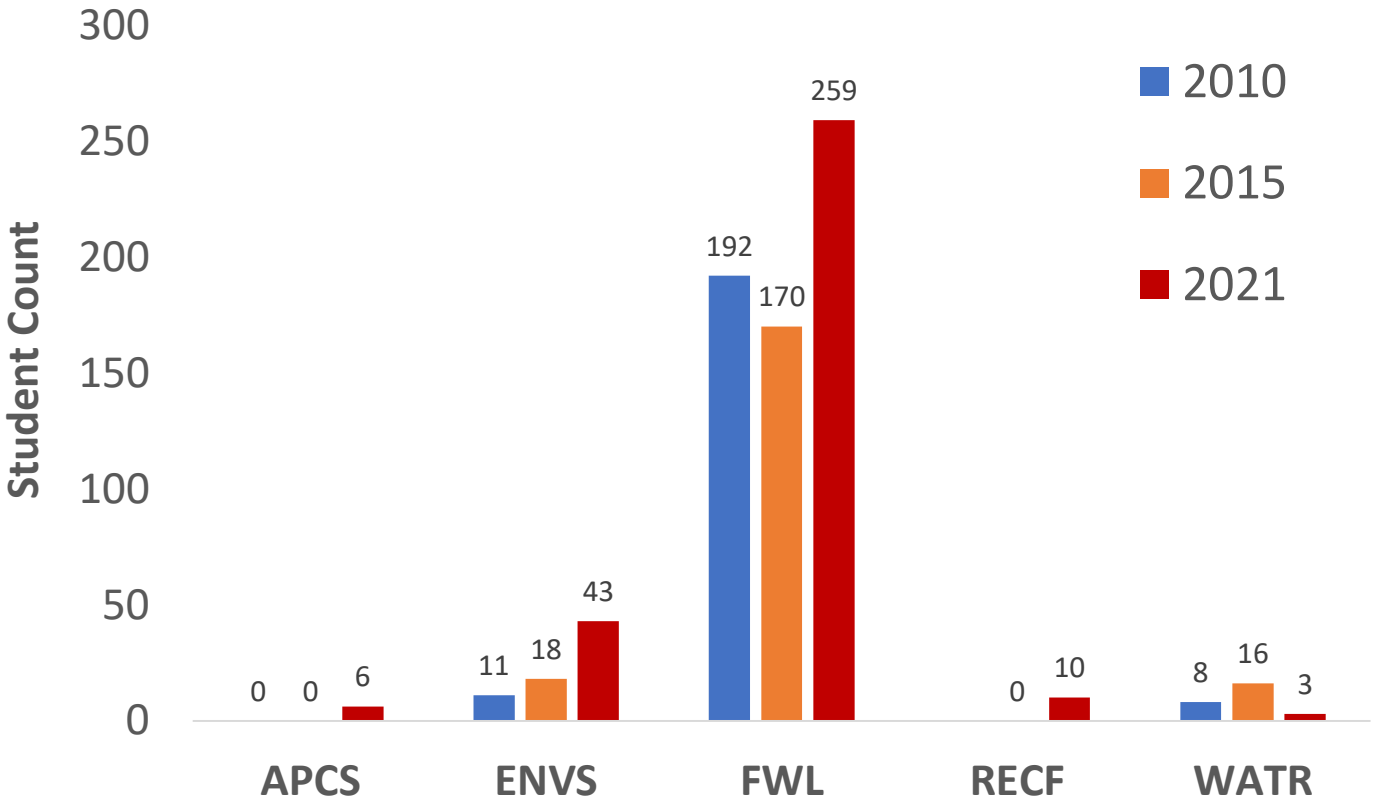
SNR programs are at risk because of a general lack of duplication of instructor expertise and conspicuously low teaching FTEs in climate, water, forestry, environmental sciences, and other areas. We recommend increasing SNR's teaching capacity by as much as 3.0 FTEs through new hires at different levels. These additional FTEs would allow us to

reduce the high percentage of instruction that is currently done by temporary instructors. A commitment to new faculty appointments should include sufficient teaching apportionments to significantly reduce our dependence on temporary instructors. Furthermore, we hope to hire new instructors that increase diversity within SNR and foster a culture of belonging among our underrepresented undergraduate students.

SNR will continue to make a strong contribution to CASNR's undergraduate offerings as a core unit with popular majors and minors. SNR has highly dedicated instructors and staff who truly believe in the power of their work. We hold steadfast in our promise to create future leaders to manage the delicate balance between people and the environment on which we all depend.

SNR STUDENT DATA

ENROLLMENTS IN FIVE SNR MAJORS, 2010-2021



Enrollment of each SNR Major, Applied Climate Science (APCS), Environmental Science (ENVS), Fisheries and Wildlife (FWL), Regional and Community Forestry (RECF), and Water Science (WATR).

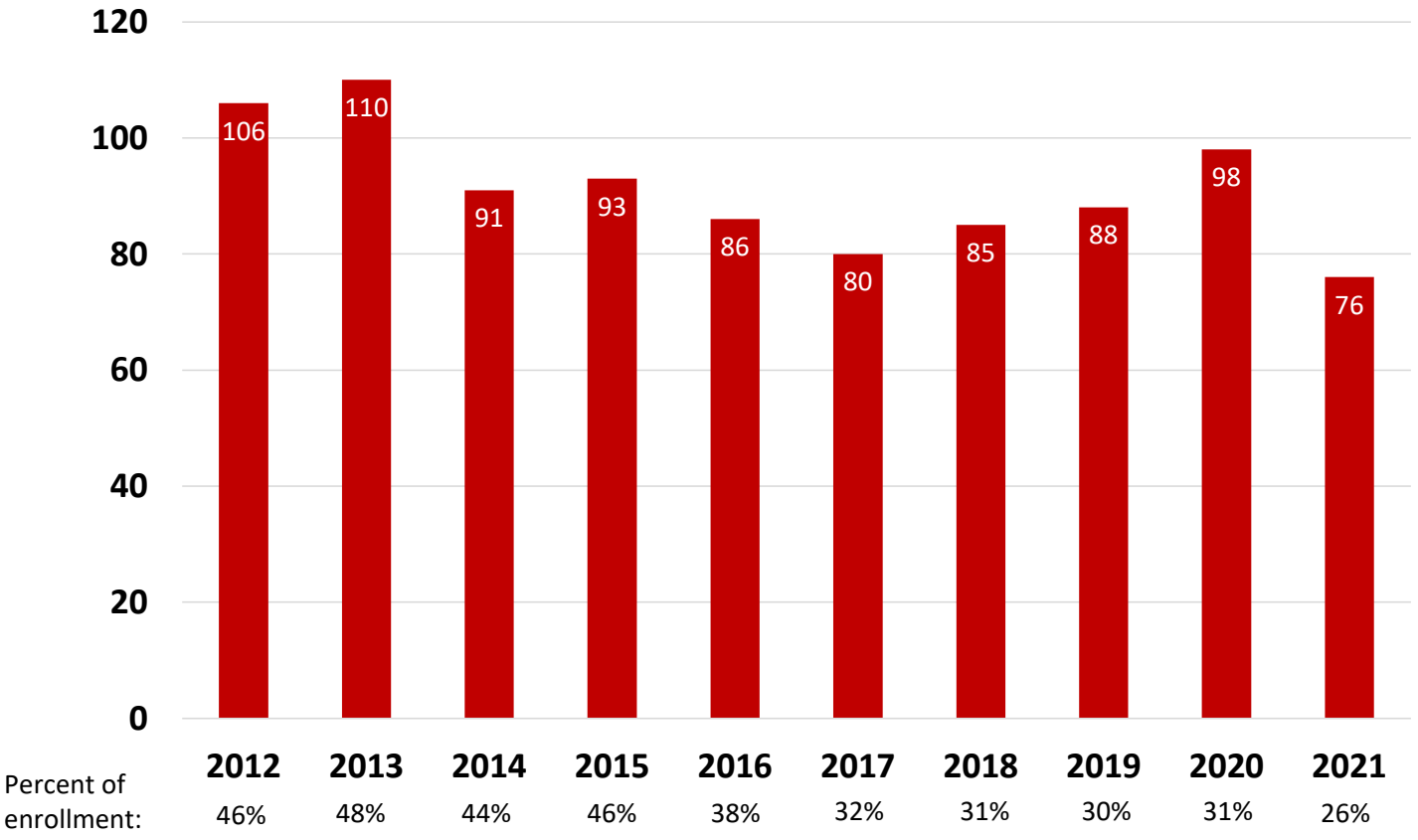
The 2021 data account for students' 2nd and 3rd majors. 2015 and 2010 data may be as much as 10% higher. In Fall 2021, there were 27 additional students in the Fisheries & Wildlife Minor, 29 additional students in the Water Science Minor, 1 student in the Applied Climate Minor, and 1 student in the Environmental Science Minor.

STUDENT DEMOGRAPHICS IN 2010, 2015, AND 2021

	Male	Female	White	Asian	Hispanic	Black or African American	Native Hawaiian or Other Pacific Islander	Two or more	Non-resident alien	Unknown
2010	65%	35%	90.1%	0.5%	2.4%	0.0%	0.0%	1.9%	0.5%	4.7%
2015	58%	42%	87.0%	0.0%	6.3%	1.0%	0.0%	1.0%	2.4%	2.4%
2021	42%	58%	82.4%	1.0%	9.3%	2.1%	0.3%	4.2%	0.3%	0.3%

Approximate demographics of students with an SNR Major in 2021, 2015, and 2010 indicating a trend toward more female students and fewer white students.

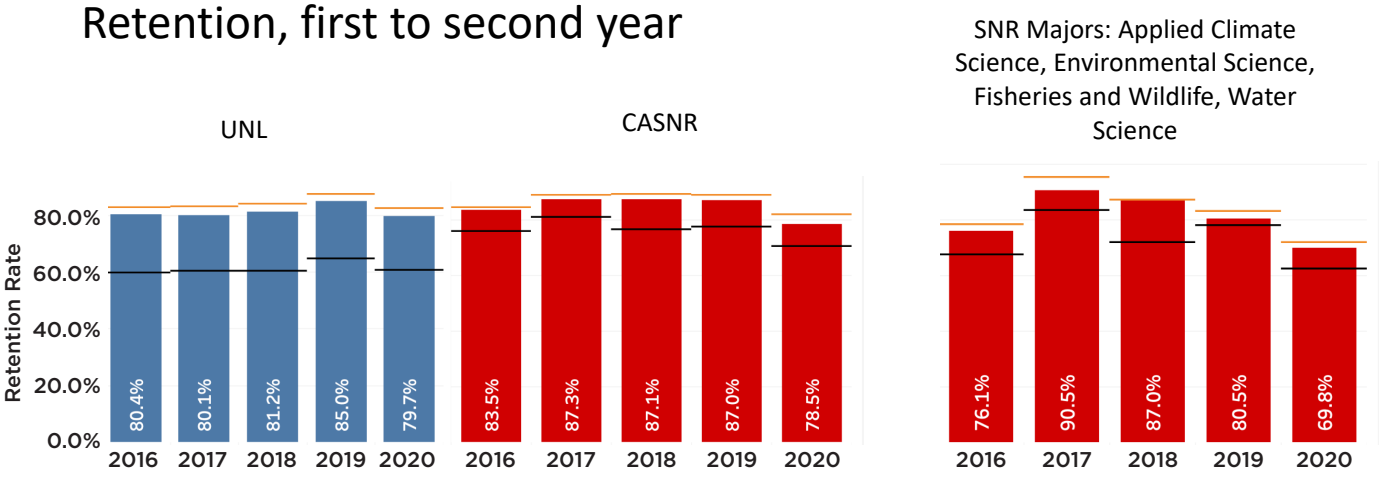
TOTAL FALL ENROLLMENTS OF FIRST-GENERATION STUDENTS IN SNR



Estimate of the proportion of first-generation status of fall enrolled students with an SNR Major, indicating a trend toward fewer first-generation students.

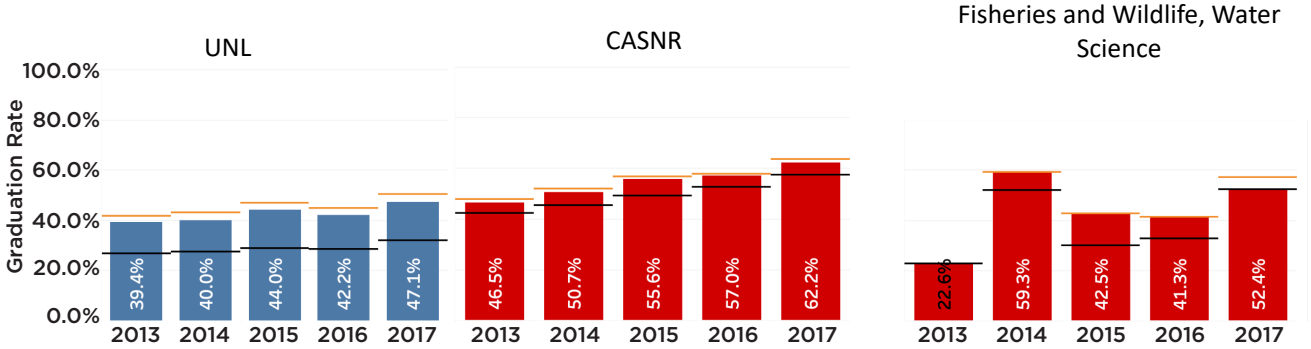
RETENTION AND GRADUATION RATES

Retention, first to second year

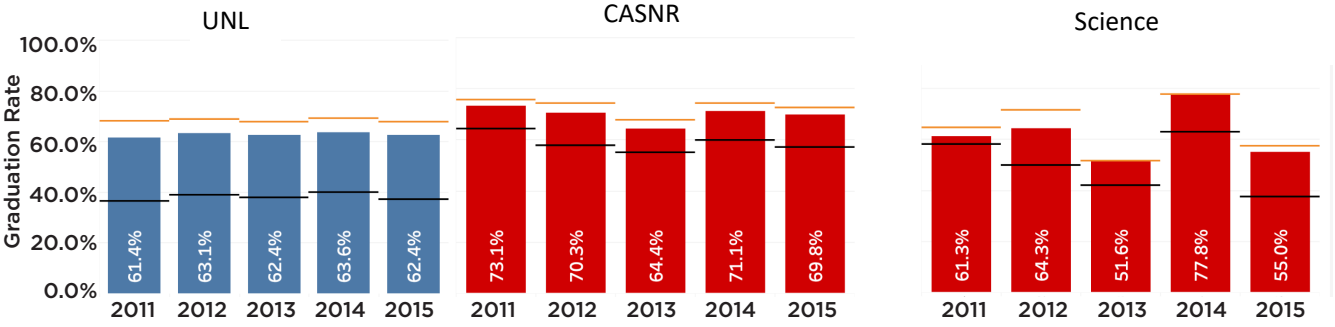


Retention of first-year students across UNL, CASNR, and SNR.
Orange line signifies retention within the NU system, the bar signifies retention at UNL, the black line signifies retention in the college.

4-year Graduation Rate



6-year Graduation Rate



Graduation rates for students across UNL, CASNR, and SNR.
Orange line signifies graduation from the NU system, the bar signifies graduation from UNL, the black line signifies graduation in the college.

DIVERSITY, EQUITY, AND INCLUSION INDICATORS

First-year retention rates

	Overall		White		URM		Pell-eligible		First-gen	
Fall Cohort	**CASNR**	**SNR**	**CASNR**	**SNR**	**CASNR**	**SNR**	**CASNR**	**SNR**	**CASNR**	**SNR**
2020	78.5% (314/400)	69.8% (37/53)	80.1% (273/341)	72.7% (32.44)	67.6% (23/24)	50.0% (3/6)	78.3% (94/120)	71.4% (10/14)	71.4% (75/105)	77.8% (14/18)
2019	87.0% (434/499)	80.5% (33/41)	86.0% (338/393)	76.5% (26/34)	82.1% (32/39)	100.0% (6/6)	79.0% (98/124)	87.5% (7/8)	82.1% (96/117)	75.0% (6/8)
2018	87.1% (386/443)	87.0% (40/46)	86.0% (296/344)	83.3% (30/36)	79.3% (23/29)	100% (7/7)	82.9% (102/123)	73.3% (11/15)	82.6% (100/121)	63.6% (7/11)
2017	87.3% (428/490)	90.5% (38/42)	86.5% (333/385)	90.9% (30/33)	82.4% (28/34)	75% (3/4)	81.9% (118/144)	84.6% (11/13)	85.0% (119/140)	87.5% (14/16)
2016	83.5% (400/479)	76.1% (35/46)	84.5% (326/386)	76.7% (33/34)	59.1% (12/22)	100% (1/1)	79.2% (95/120)	85.7% (12/14)	78.6% (125/159)	58.3% (7/12)

First-to-second year retention rates for students in SNR majors as compared to CASNR (URM = under-represented minorities).

Four-year graduation rates

	Overall		White		URM		Pell-eligible		First-gen	
Fall Cohort	**CASNR**	**SNR**	**CASNR**	**SNR**	**CASNR**	**SNR**	**CASNR**	**SNR**	**CASNR**	**SNR**
2017	62.2% (305/470)	52.4% (22/42)	62.1% (239/385)	54% (18/33)	26.5% (9/34)	25.0% (1/4)	45.8% (66/144)	46.2% (6/13)	53.6% (75/140)	56.3% (9/16)
2016	57.0% (273/479)	41.3% (19/46)	57.0% (220/386)	44.2% (19/43)	27.3% (6/22)	Null	46.7% (56/120)	42.9% (6/14)	54.7% (87/159)	33.3% (4/12)
2015	55.6% (254/457)	42.5% (17/40)	58.2% (228/392)	38.2% (16/26)	25.8% (8/31)	66.7% (4/6)	47.1% (56/119)	20.0% (3/15)	48.5% (66/136)	31.3% (5/16)
2014	50.7% (226/446)	59.3% (16/27)	52.0% (206/396)	61.5% (16/26)	35.0% (7/20)	Null	43.8% (49/112)	16.7% (1/6)	46.2% (66/143)	33.3% (2/6)
2013	46.5% (201/432)	22.6% (7/31)	49.3% (184/373)	20.0% (5/25)	25.0% (9/36)	66.7% (2/3)	32.2% (38/118)	28.6% (4/14)	45.0% (77/171)	29.4% (5/17)

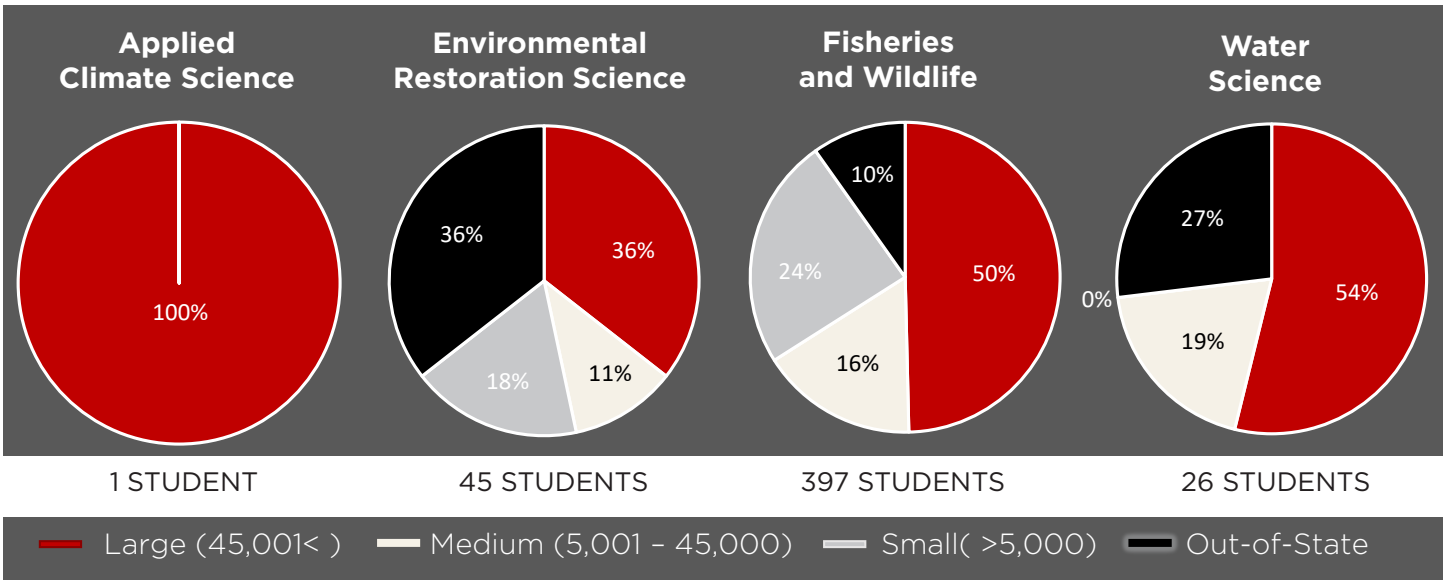
Four-year graduate rates for students in SNR majors as compared to CASNR (URM = under-represented minorities).

FROM WHERE DO OUR STUDENTS COME?

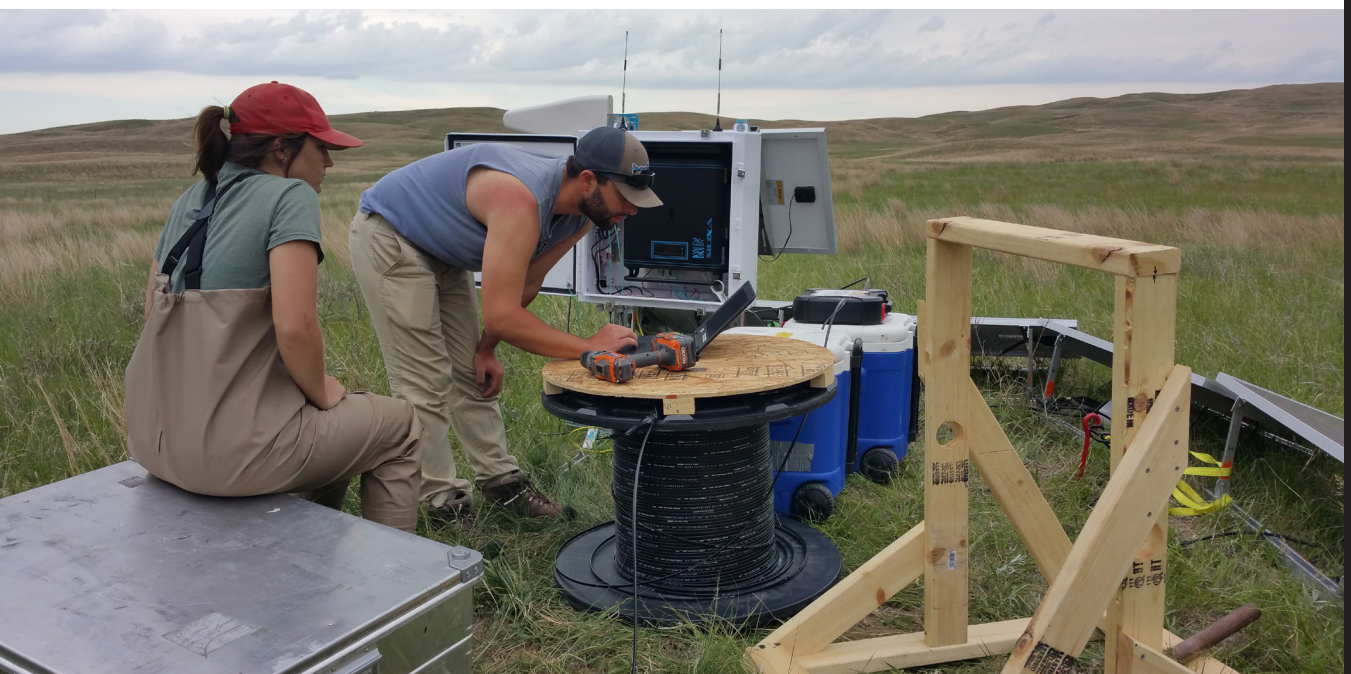
In a 2017 analysis, most CASNR students came from hometowns with populations under 5,000. The majority of SNR students came from hometowns with populations over 45,000*. CASNR must continue to assist SNR in recruitment from these demographic settings.

HOMETOWN SIZE OF SNR STUDENTS

ADMITTED STUDENT DATA BY MAJOR
JAN 2015-AUG-2019



*Credit: Elyse Watson and *Larkin Powell, 2017, NACTA Journal, 61(2), 121-126.*



GRADUATE EDUCATION

SCHOOL OF NATURAL RESOURCES

Graduate Education
snr.unl.edu/gradstudent

GRADUATE EDUCATION OVERVIEW

The School of Natural Resources is subdivided into three program areas: Applied Climate and Spatial Science (ACSS), Applied Ecology (AE), and Environmental Science (ES). The programs develop and help administer graduate curriculum. SNR offers two graduate education tracks – a graduate degree in Natural Resources with six specialties for a PhD (Adaptive Management, Applied Ecology, Bio-Atmospheric Interactions, Climate Assessment and Impacts, Human Dimensions, Hydrological Sciences) and eight for an MS (Geographical Information Systems, Remote Sensing, in addition to the other six).

GOALS OF GRADUATE EDUCATION

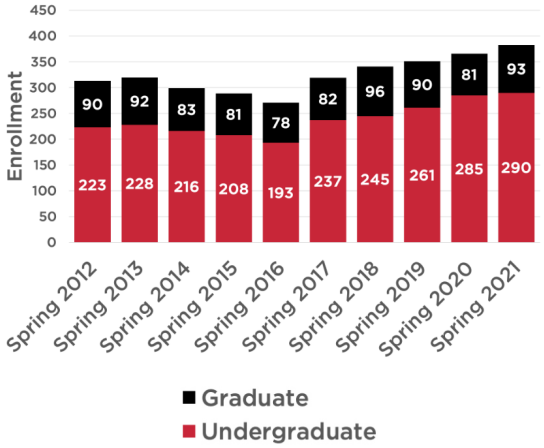
The goal of the MS and PhD degree programs are to train students for careers in academia, government service, and private industry. SNR also offers a Master of Applied Science (MAS) with two specializations in Conservation Agriculture and Environmental Education. The goal of the MAS program is to provide coordinated professional training for students who need post-baccalaureate work in natural resources for their career that does not require a thesis.

IMPROVING & SUPPORTING

DIVERSITY & INCLUSION

Natural Resources Diversity and Inclusion committee expects each program area to engage and support activities that build a diverse and inclusive community within SNR, free of discrimination, harassment, and retaliation, where all can succeed.

SNR ENROLLMENT



	Graduate Students			Funding Source		
Year	GTA (# of)	GRA (# of)	Total (# of)	State (%)	Grant (%)	Other (%)
2010	4	75	79	16	63	21
2015	6	65	71	12	59	29
2021–2022	4	78	82	19	63	18

Number of students and source of funding over time

	M.S. Minimum Payscale				Ph.D. Minimum Payscale				Post-docs	
Policy Established	2010	2015	2021	2025	2010	2015	2021	2025	2020	2025
Year 1	$16,000	$18,000	$24,000	$27,000	$18,000	$20,000	$24,000	$30,000	$50,000	$56,000
Year 2	$16,500	$18,500	$24,500	$27,500	$18,500	$20,500	$24,500	$30,500		
Year 3					$19,000	$21,000	$25,000	$31,000		

Minimum 12-month salaries for M.S. and Ph.D. graduate assistantships and postdocs in SNR.

FUTURE GOALS FOR PROGRAM AREAS

APPLIED CLIMATE AND SPATIAL SCIENCE:

Continue to expand graduate program and look for opportunities to teach courses as hybrid/online, particularly for Remote Sensing courses, which are not provided by any other higher educational unit in the state.

APPLIED ECOLOGY:

Provide a robust education to our graduate students that is centered on applied-research activities, and graduate education that is designed to be flexible to reflect the diverse nature of applied ecology.

ENVIRONMENTAL SCIENCE:

Increase graduate program enrollment significantly in relation to re-emphasis of this program in Environmental Science (successfully renamed in 2020) and the addition of new faculty in this area.

HUMAN DIMENSIONS

Update graduate specialization to better train students in social science theory and methodology; and prepare students for interdisciplinary collaboration in natural resources.

GRADUATE EDUCATION

INTRODUCTION

The School of Natural Resources (SNR) combines interdisciplinary approaches and disciplinary excellence to foster an integrated, systems approach to address complex natural resource, environmental, and human issues. We provide quality academic experiences for students to develop innovative approaches toward fundamental research in natural resource systems. Furthermore, we promote a comprehensive conservation ethic for the effective and appropriate management of natural resources.

SNR is subdivided into three program areas: (1) Applied Climate and Spatial Science (ACSS), (2) Applied Ecology (AE), and (3) Environmental Science (ES). Each program area is responsible for developing and helping to administer graduate curricula. SNR offers two graduate education tracks: the M.S. and Ph.D. in Natural Resources, and the Masters of Applied Science (MAS). The goal of the M.S. and Ph.D. degree programs is to train students for careers in academia, government service, and private industry. The MAS program, in contrast, provides coordinated professional training for students who need non-thesis, career-oriented post-baccalaureate study.

Our graduate track in Natural Resources has eight specializations for an M.S.: Geographical Information Systems, Remote Sensing, Adaptive Management, Applied Ecology, Bio-Atmospheric Interactions, Climate Assessment and Impacts, Human Dimensions, and Hydrological Science. There are six specializations for a PhD.: Adaptive Management, Applied Ecology, Bio-Atmospheric Interactions, Climate Assessment and Impacts, Human Dimensions, and Hydrological Sciences. The MAS has two specializations: Conservation Agriculture and Environmental Education.

As might be expected the publication portfolio of our faculty spans our broad range of disciplines. We have national and global reputation as a result of publications in fisheries and wildlife, water quality research, hydrology, climate risk, and remote sensing.

FIVE-YEAR PLAN

The ACSS, AE, and ES program areas will assume more independent authority in the development of graduate education and research. Nevertheless, Human Dimensions (HD), Natural Resources Diversity and Inclusion (NRDI), and Science Literacy (SL), will supply guidance for decision making in each program area.

- The ACSS program area will further expand its graduate program and look for opportunities to teach courses in hybrid and online formats. These formats are

particularly important for Remote Sensing courses because no other institution in Nebraska offers them.

- The AE program area will provide a robust education to our graduate students that is centered on applied-research activities. Graduate education will continue to be flexible so that it reflects the diverse nature of teaching and research in the program area. Therefore, there will be few required classes in forthcoming years and, instead, the student's adviser and committee will suggest coursework that address any deficiencies.
- The ES program area expects graduate enrollments to increase significantly given the re-emphasis of this program and the proposed hiring of new faculty.
- HD will update its graduate specialization to better train students in social science theory and methodology, and to prepare students for interdisciplinary collaboration in natural resources.
- NRDI expects each program area to engage and support activities that build a diverse and inclusive community within SNR, free of discrimination, harassment, and retaliation, in which all can succeed.

- SL will foster a scientifically literate society which evaluates and makes decisions associated with natural resource issues based on a sound understanding of scientific findings and principles.

Furthermore, the following objectives have been identified as essential for success over the next five years:

- Each of the three program areas will develop four-year schedules for graduate courses. They will also identify course prerequisites and instructors so that there is clear guidance for faculty, staff, and students.
- Each program area will identify gaps in skills useful to SNR graduate students relative to existing curricula. They will then identify faculty members who may be able to teach courses that inculcate those skills. Any such gaps that cannot be filled with current faculty members will provide a strong rationale for future faculty searches. Future job descriptions for faculty will emphasize graduate courses to be taught and participation in the development of graduate curricula.
- Future hiring will minimize bias. To this end, we recommend: intercultural competence training for administration and supervisors; training opportunities that promote working in more inclusive and diverse teams; incorporating Diversity, Equity and Inclusion approaches in the classroom; and the development of teaching resources that address diversity and inclusive practices.

- Each program area will investigate opportunities for the remote delivery of courses that are not provided by any other higher educational unit in Nebraska.
- Prepare students in SNR for successful careers and enable them to make informed decisions about natural resources. Science Literacy education is needed to engage citizens in the conservation and management of natural resources. Thus, we encourage sustainability and equitability in meeting future demands for food, fuel, water, and landscapes.

CHALLENGES

The following critical resources have been identified to meet the expected growing enrollment and research productivity across the three program areas. All program areas have identified the need for new faculty hires, albeit with an emphasis on teaching.

- Existing graduate teaching FTEs are insufficient. Each of ACSS, AE, and ENVS identifies a need for two (2) faculty positions with 0.4/0.6 FTE or 0.5/0.5 FTE Teaching/Research apportionments. Thus, as many as six (6) new faculty positions would be optimal.
- There is a persistent need for teaching and research assistantships, both to augment instruction and to facilitate the recruitment of graduate students.
- We need training opportunities and resources for students, staff, and faculty on intercultural competence, working in more inclusive and diverse teams, incorporating Diversity, Equity and Inclusion approaches in the classroom, and development of teaching resources that address diversity and inclusive practices.

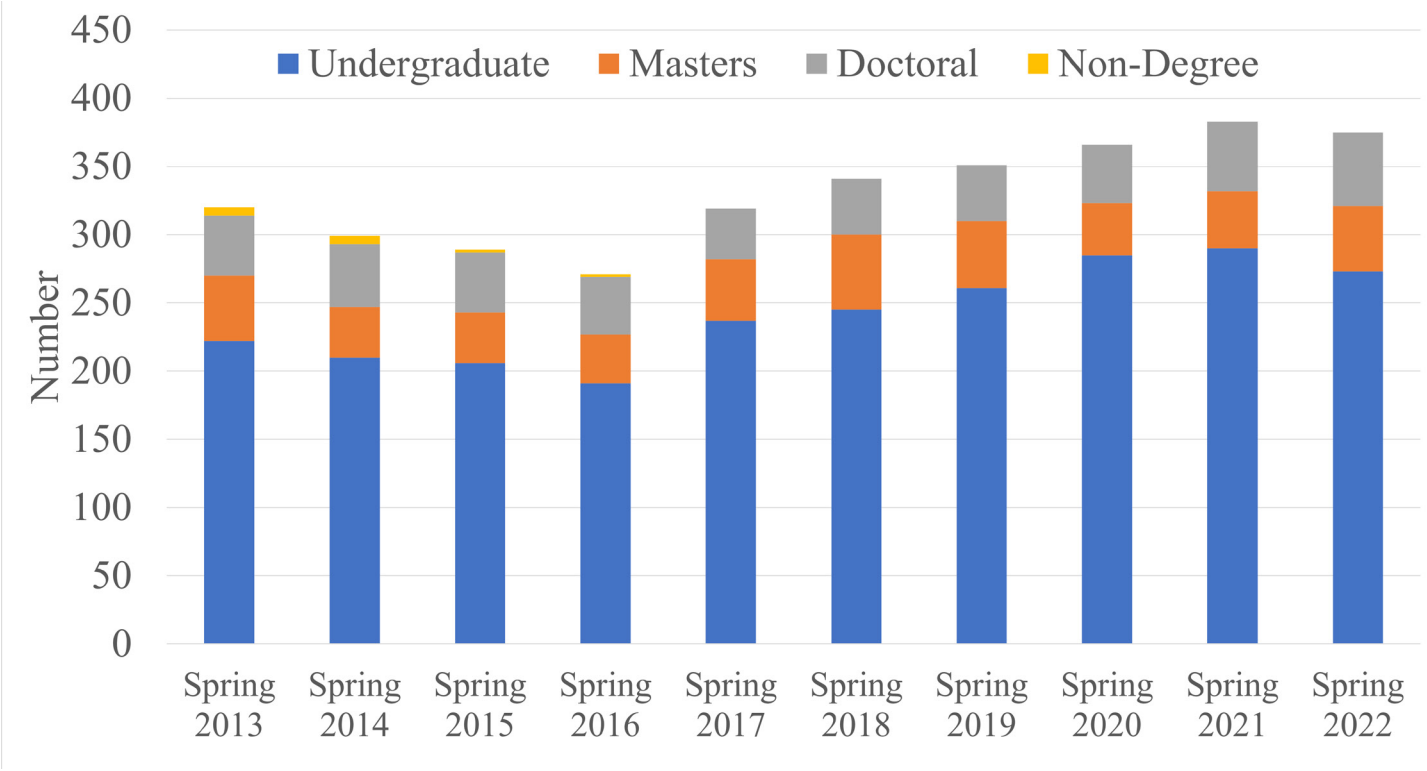
SUMMARY

Graduate education is a vital part of SNR's academic profile. We continue to emphasize both as aspects of our core mission. Moreover, because graduate education extends across the entire Land Grant mission, we are emphasizing that all faculty need to embrace graduate mentorship. We will continue to diversify our funding portfolio and encourage broader collaboration both within SNR and outside of our program.

Our overarching goals in these endeavors are:

- To provide interdisciplinary approaches and disciplinary excellence to foster an integrated, systems approach that will address complex natural resource, environmental, and human issues.
- To foster a scientifically literate society which evaluates and makes decisions about natural resource issues using a sound scientific understanding.
- To engage in and support activities that build a diverse and inclusive community within SNR, free of discrimination, harassment, and retaliation, in which all can succeed.

SNR ENROLLMENT BY DEGREE TYPE



SNR GRADUATE STUDENT NUMBERS AND FUNDING SOURCES, 2010-2021

	Graduate Students			Funding Source		
Year	GTA (# of)	GRA (# of)	Total (# of)	State (%)	Grant (%)	Other(%)
2010	4	75	79	16	63	21
2015	6	65	71	12	59	29
2021/2022	4	78	82	19	63	18

SNR GRADUATE STUDENT PAYSCALE, 2010-2021

	Masters Minimum Payscale				Doctoral Minimum Payscale				Postdocs	
Policy Established	**2010**	**2015**	**2021**	**2025**	**2010**	**2015**	**2021**	**2025**	**2020**	**2025**
Year 1	$ 16,000.00	$ 18,000.00	$ 24,000.00	$ 27,000.00	$ 18,000.00	$ 20,000.00	$ 24,000.00	$ 30,000.00	$ 50,000.00	$ 56,000.00
Year 2	$ 16,500.00	$ 18,500.00	$ 24,500.00	$ 27,500.00	$ 18,500.00	$ 20,500.00	$ 24,500.00	$ 30,500.00		
Year 3					$ 19,000.00	$ 21,000.00	$ 25,000.00	$ 31,000.00		

Minimum 12-month salaries for M.S. and Ph.D. graduate assistantships and postdocs in SNR.

RESEARCH

SCHOOL OF NATURAL RESOURCES

Research
snr.unl.edu/research

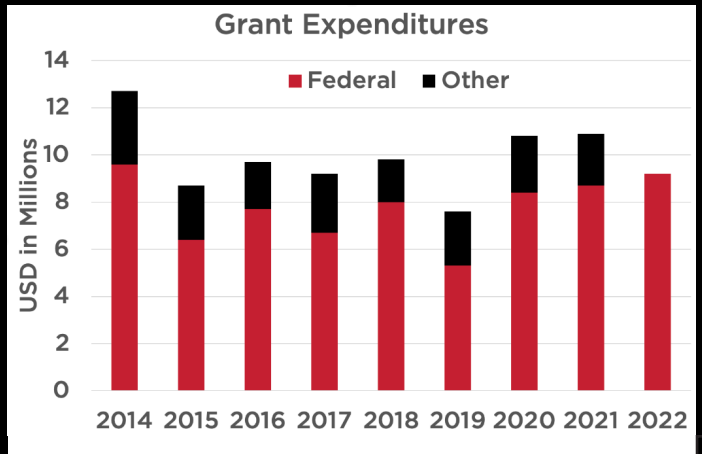
DIVERSE RESEARCH
STRONG IMPACTS

The scope and impact of research in SNR reflects the diversity of our eclectic group of scientific disciplines. SNR is extremely diverse in comparison with other self-identified Natural Resources programs in the USA, but therein lies its strength as an academic unit.

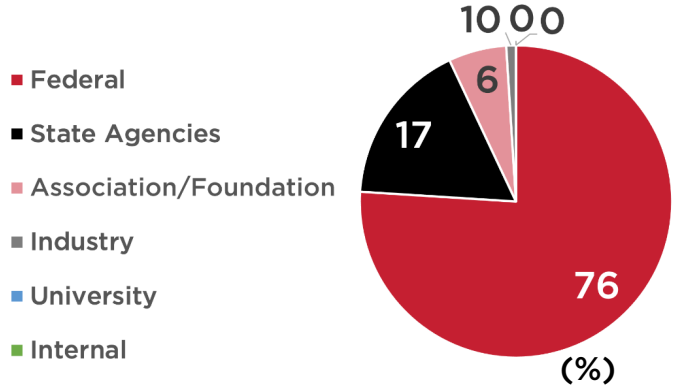
> **"An apt metaphor for SNR research, relative to UNL at large, is that of a wheel. Collectively SNR researchers are the hub, but they are also the spokes."**
>
> - R. M. Joeckel, Sr. Associate Director

FINANCIAL SUPPORT

During the past decade our yearly grant input has been more than $10 million annually, coming from a wide range of sources.

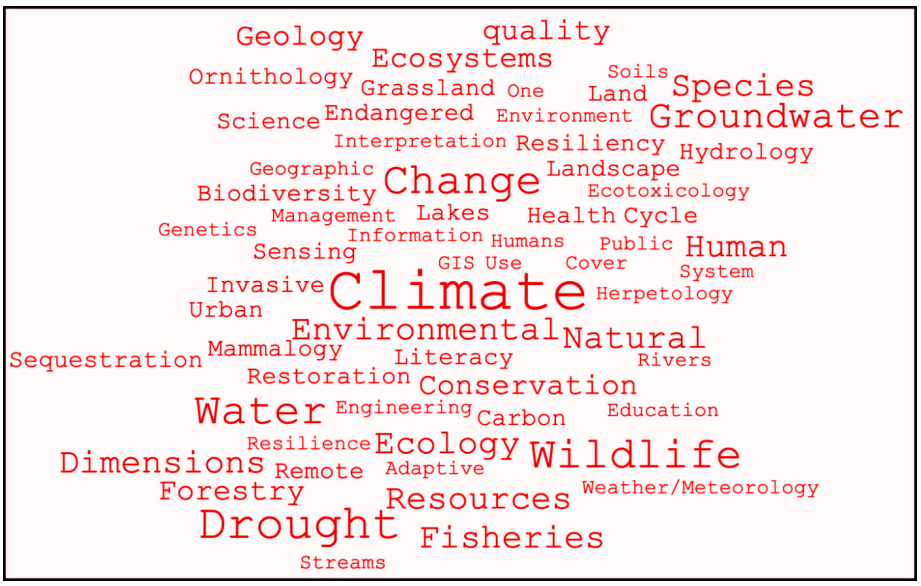


FY 2021 RESEARCH FUNDING SOURCES



	Submitted	Awarded
Internal 2021	$ 714,845.00	$ 179,679.00
External 2021	$ 34,599,616.00	$ 16,946,290.00
External 2020	$ 28,754,909.00	$ 12,524,968.00

INTEGRATED DISCIPLINES

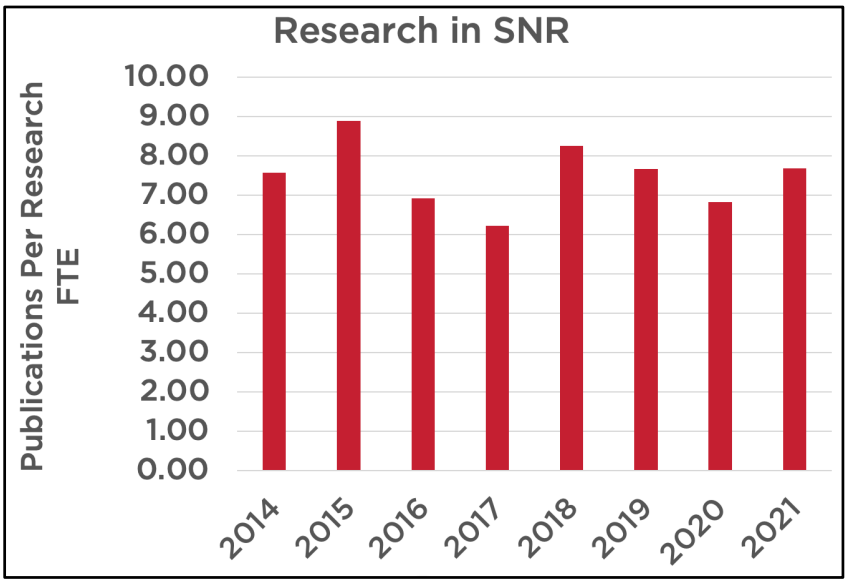


Our research expertise is encapsulated by a word cloud, incorporated in the accompanying infographic, that the terms by which our faculty and research staff described their expertise.

IMPACTFUL RESEARCH PUBLICATIONS

Most of our faculty have strong publication records in terms of peer-reviewed scientific journal articles. Nevertheless, some SNR faculty and centers have mission responsibilities that are not tied to traditional peer-reviewed publications. For example, CSD has published the annual Nebraska Statewide Groundwater-Level Monitoring Report for several decades. An enormous undertaking, this document is used widely by stakeholders. Similar publications include the National Drought Monitor, Platte Basin Timelapse camera system, Nebraska Climate Mesonet, and geologic maps produced every year by CSD under the U.S. Geological Survey's STATEMAP Cooperative Geologic Mapping Program.

Our faculty publish at highly variable rates, but most of them have strong publication records and some of our faculty rank very well among the impact indices for scientific publication. Several of our senior faculty have published what are considered landmark papers in their disciplines and we regularly have papers published in *Science*, *Nature*, and other scientific journals of repute.



RESEARCH

INTRODUCTION

The scope and impact of research in SNR reflects the diversity of our eclectic group of scientific disciplines. SNR is extremely diverse in comparison with other self-identified Natural Resources programs in the USA, but therein lies its strength as an academic unit. Put simply, the School encompass the totality of natural resources more comprehensively than any other program in the nation. This realization is nothing short of an epiphany. It is tantamount to understanding the unit's great value to IANR and the University.

We sometimes employ the analogy of a wagon wheel to describe the significance of SNR in research at the University. Previously, we have focused on the concept of SNR as the hub of that metaphorical wheel. The hub of a metaphorical wheel, however, is only useful if there are spokes that connect it to the rim, which represents the external world of research. Indeed, however, SNR researchers are both the hub *and* the spokes: they *transfer* knowledge inward toward a multidisciplinary synthesis, but they also *translate* knowledge outward toward specific disciplines elsewhere in the University and around the world (the rim). Thus, we do not undertake research in isolation, but collectively and with a diversity of partners.

Our research expertise is encapsulated by a word cloud, incorporated in the accompanying infographic, that the terms by which our faculty and research staff described their expertise. The most frequently used descriptors are climate, groundwater, wildlife, drought, water, fisheries, and geology. It is notable that this collection of terms overlaps with descriptors that would be found among almost all IANR units and many departments in other colleges at UNL.

Our vibrant research portfolio includes very deep engagement with our graduate program. It also encompasses creative work by our undergraduates.

Research Funding

SNR, like most academic units, depends heavily on federal grant funding for research, although by no means exclusively. Our funding sources are impressively diverse. Moreover, while many Units in IANR depend heavily on the U.S. Department of Agriculture (USDA) for funding, SNR depends far less on USDA and much more on the National Science Foundation and federal flow-through funding from our agency partners. Additionally, most of our faculty do participate in Hatch formula programs, although several depend on McIntire-Stennis funds. During the past decade SNR's average yearly grant total has been more than $10 million.

Publications and Other Products

Most of our faculty have strong publication records. Some of them also rank very well among the impact indices for scientific publication. Peer-reviewed publications per research FTE within SNR averaged 7.5 from 2014 to 2021 (see the included table for yearly details). We concede that there are several, more elaborate metrics for presenting research productivity related to scientific publications. Most of these metrics do not truly represent the investment and/or value of many types of creative engagement. Therefore, we have restricted our discussion to the simple metric of peer-reviewed publications per research FTE. We also observe that many of our senior faculty have published what are considered landmark papers in their disciplines and we regularly have papers published in *Science*, *Nature*, and other scientific journals of international repute.

Some SNR faculty and centers have mission responsibilities that are not tied to traditional peer-reviewed publications. For example, CSD has published the annual Nebraska Statewide Groundwater-Level Monitoring Report for several decades. An enormous undertaking, this document is used widely by stakeholders. Similar publications include the National Drought Monitor, Platte Basin Timelapse camera system, Nebraska Climate Mesonet, and geologic maps produced every year by CSD under the U.S. Geological Survey's STATEMAP Cooperative Geologic Mapping Program. These mission-fulfilling products have great impact, are widely valued, and contribute significantly to SNR's research portfolio.

SNR PEER-REVIEWED PUBLICATIONS PER RESEARCH FTE

Year	Sum of Research FTE	Sum of Peer-Reviewed Publications	Publications/ Research FTE
2014	18.74	142	7.58
2015	21.70	193	8.89
2016	21.70	150	6.91
2017	21.70	135	6.22
2018	21.70	179	8.25
2019	22.20	170	7.66
2020	21.55	147	6.82
2021	20.95	161	7.68
Total/Average	170.24	1277	7.50

Data are from 47 faculty and research staff with significant research FTE who publish in peer-reviewed journals

Major Research Grants

We highlight but a few examples of recent grant funding in the list below. These examples evince our commitment to environmental research centered on Nebraska, but they also indicate our nationally and international impacts.

- *Cyber Physical Systems Program.* $900k, Trenton Franz (Co-PI with colleague from University of Illinois and Princeton University), U.S. Department of Agriculture and National Science Foundation, 2019-2022, $900,000.

  This project proposes to build a decision-support Cyber-Physical System (CPS) for Nebraska to provide real-time monitoring and forecast for field-level crop irrigation requirements for row-crop producers based on center-pivot systems (i.e., timing and amount of irrigation), with a cyber infrastructure that can disseminate decision-making information online with alerts by email and/or text messages to users. The ambitious goal will be achieved through a novel use of multi-source data fusion (i.e., satellite data, weather station network and forecasts, in-situ sensors) and process-based modeling under a data-model fusion framework. The conclusion of this project will lead to a tool at farmers' fingertips to know when and how much to irrigate their field from their mobile phones or tablets.

- *RII Track 2 FEC: From Ecosystem to Evolution: Harnessing Elemental Data to Detect Stoichiometric Control-Points and their Consequences for Organismal Evolution.* Jessica Corman, National Science Foundation, 9/1/21–12/31-24, $2,095,226.

  This project combines growing environmental datasets from national efforts with ongoing and historical studies at smaller scales to produce a publicly available database containing information on both the elemental composition of organisms and the elemental composition of those organisms' environments. The effort will focus on stream, lake, and other inland water ecosystems, providing the opportunity to also address eutrophication issues found within each jurisdiction. The project team will engage in workforce development through professional training opportunities, develop database activities that expose graduate and undergraduate students to ecological questions, engage with artists to better communicate findings to general audiences, and promote diversity, equity, and inclusivity through professional partnerships, e.g., the Society for Freshwater Science's Instars and Emerge program.

- *RII Track-2 FEC: Resilience Informatics for the Convergence of Critical Capacities to Address Regional-Scale Environmental Change.* Craig Allen (CRAWL), National Science Foundation, 9/7/21–7/31/23, $996,501.

  This project is directly related to the preceding grant in the list.

- *Pallid Sturgeon Biology in the Platte River and its Tributaries.* Mark Pegg, Headwaters Corp. 7/1/21–12/31/26, $1,201,000.

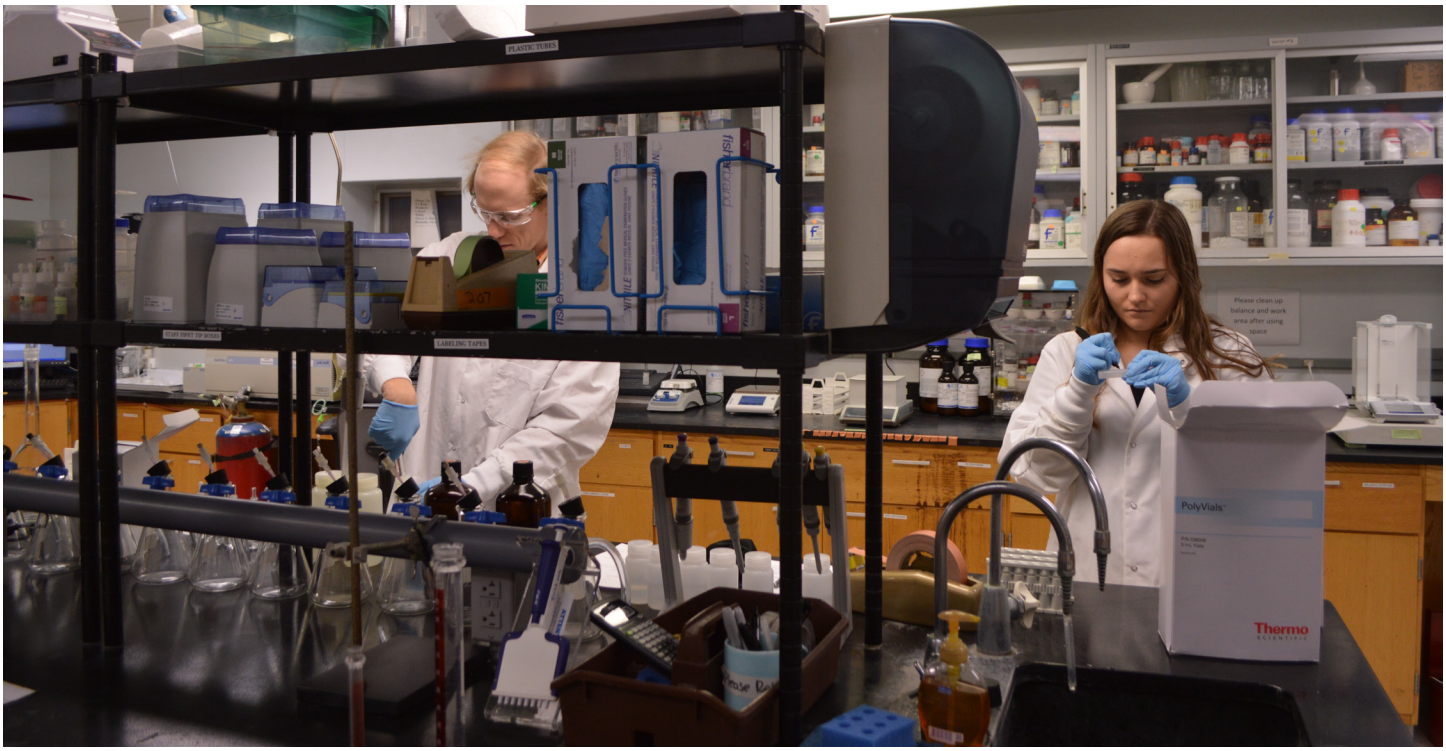
  This project fills knowledge gaps about Platte River contributions to Pallid Sturgeon spawning habitat, reproduction and recruitment, and population dynamics. Our specific objectives are to: (1) identify relations among environmental conditions that facilitate proper timing and extent of Pallid Sturgeon movement into and within the lower Platte River; 2) identify Pallid Sturgeon spawning habitat in the lower Platte River and its tributaries; and 3) verify successful spawning by Pallid Sturgeon in the Platte River and/or its tributaries.

- *Elk Resources Selection, Movement, Survival, and Population Dynamics in Western Nebraska.* John Benson, Nebraska Game and Parks Commission, 8/1/21–6/30/28, $831,942.

  This project evaluates fine-scale movement decisions by elk and creates predictive surfaces of relative probability of use of different landscapes across the state. Additionally, the study will provide seasonal elk space use patterns within the natural habitat/cropland interface allowing biologists to better manage population levels in and around these areas. We will combine data on survival and reproduction from radio-collared animals, abundance estimates, and existing age-at-harvest data in an Integrated Population Model that managers can use to set informed harvest quotas that balance the needs and goals of landowners and hunters in Nebraska.

- *USDA Support for Enhancements to the US Drought Monitor.* Brian Fuchs (NDMC), U.S. Department of Agriculture-OCE, 9/30/21–9/30/22, $1,275,000.

  This cooperative agreement will produce: (1) economic projects related to agriculture and water used for agriculture; (2) research associated with improving information for livestock producers and forage production; and (3) enhancements related to the products and data associated with the United States Drought Monitor (USDM).



FIVE-YEAR PLAN

Over the next five years, we will work with IANR administration to maintain or rebuild faculty numbers in our areas of research strength. Climate science, water science focusing on quality issues, and remote sensing are disciplinary areas in particular need of additional faculty research FTEs.

CHALLENGES

SNR has too few faculty in many disciplines. We still need to work on developing critical mass in Applied Ecology, Environmental Science, and Applied Climate and Spatial Science.

SUMMARY

SNR has a highly successful and diverse research portfolio. Like most interdisciplinary programs we face balancing research breadth versus depth (i.e., total research faculty FTE). We have a long history of both internal and external partnerships, but those take significant effort in leveraging the efforts of our faculty. In addition, faculty turnover often results in a greater relative loss of capacity in our core academic areas. We have worked diligently to provide our team with the resources they need to undertake their own research programs but at the same time feel confident that they can be members of teams of researchers to help tackle the great natural-resources challenges faced by our state, nation, and world.

CENTERS

CENTERS

INTRODUCTION

The eight centers in the School of Natural Resources (SNR) have a rich and vital history at the University of Nebraska-Lincoln. One SNR center's origins as Nebraska's geological survey date back nearly 150 years, yet another center was founded as recently as 2020 to address a changing agricultural and global health landscape. SNR's centers have tremendously diverse expertise in climatology, geology, ecology, remote sensing, agricultural practices, and several other disciplines.

The SNR centers are:

Center for Advanced Land Management Information Technologies (CALMIT)

Center for Resilience in Agricultural Working Landscapes (CRAWL)

Conservation and Survey Division (CSD)

Great Plains Cooperative Ecosystem Studies Unit (GP CESU)

High Plains Regional Climate Center (HPRCC)

National Drought Mitigation Center (NDMC)

Nebraska Cooperative Fish and Wildlife Research Unit (NECFWRU)

Nebraska State Climate Office (NSCO)

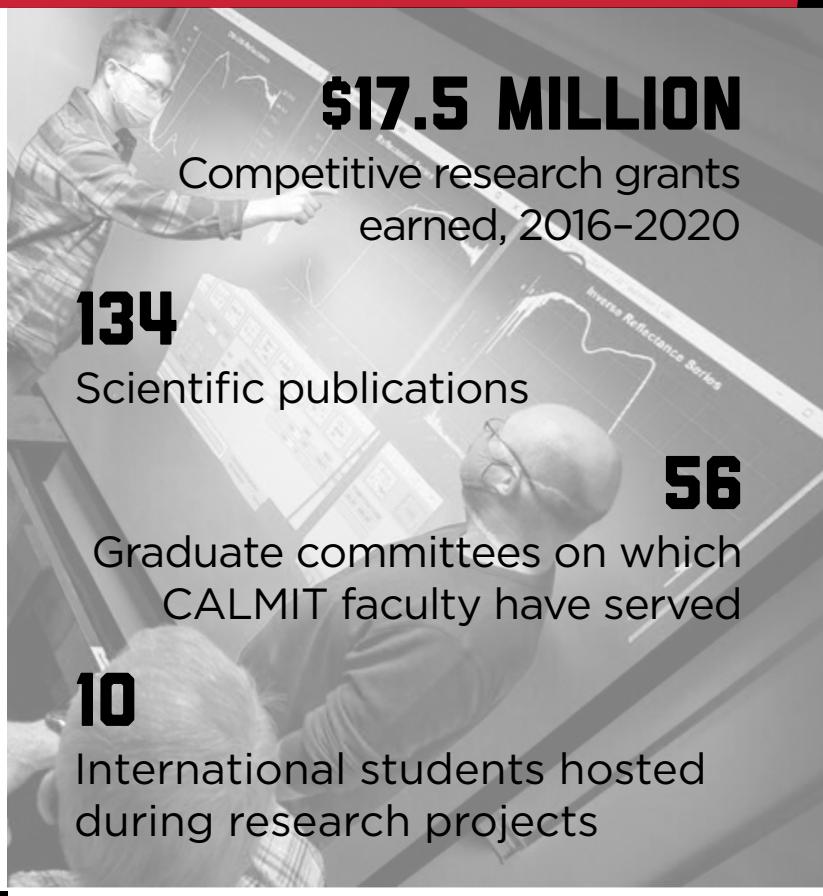
The ultimate goal of all of these centers is to use the scientific expertise of the School of Natural Resources to address state, regional and global challenges.

SCHOOL OF NATURAL RESOURCES

CENTER FOR ADVANCED LAND MANAGEMENT INFORMATION TECHNOLOGIES
calmit.unl.edu

SKY'S THE LIMIT

The Center for Advanced Land Management Information Technologies (CALMIT) has been a global leader in application and advancement of remote sensing in natural resources and agriculture since 1972. CALMIT's mission is to develop and apply novel remote sensing technologies to Earth observation, with the goal of assessing the health and function of natural and managed ecosystems. Key themes include the productivity, diversity, and resilience of natural systems in the face of changing climate and ongoing human activities. We examine these themes through satellite, aircraft and proximal remote sensing that advances basic and applied research and the larger understanding of our changing biosphere.



$17.5 MILLION
Competitive research grants earned, 2016–2020

134
Scientific publications

56
Graduate committees on which CALMIT faculty have served

10
International students hosted during research projects

"CALMIT is committed to advancing the application of remote sensing to provide new, innovative perspectives of our changing environment from local to global scales through basic and applied research and technical training. Our faculty, staff and students are 'translational' scientists who apply advanced remote sensing methods to investigate key scientific questions and address key issues of environmental change."

- Brian Wardlow, Director, CALMIT

ACHIEVEMENTS ACROSS THE SPECTRUM

CALMIT faculty serve in a number of leading roles in the remote sensing field, including working on editorial boards of key scientific journals. CALMIT faculty have served as chairs and invited experts for the White House Office of Science and Technology, World Meteorological Association and Committee on Earth Observation Satellites. The team has partnered with groups from the United Nations to the City of Lincoln to provide remote sensing expertise. CALMIT faculty lead SpecNet, a scientific non-profit advancing the use of proximal remote sensing.

EXPERTISE AT ANY SCALE

A unique aspect of the Center's work lies in its ability to sample at multiple spatial scales using proximal, airborne, and satellite data. CALMIT resources allow us to scale up our understanding from localized areas, like field plots, to regional and global analyses.

Similarly, the CALMIT team can apply field and airborne remote sensing to design new sampling methods for current and future satellites. Our focus on vegetation function, productivity, stress, and biodiversity allows us to evaluate ecosystem health and resilience in a changing world using these multi-scale approaches.

UNIQUE SCOPE OF EXPERTISE

CALMIT has a unique suite of remote sensing capabilities and infrastructure that allow both basic and applied research to be conducted across multiple spatial scales to investigate an array of scientific questions about our changing environment. These capabilities include multispectral, hyperspectral and ultraspectral sensors deployed on ground- and airborne-based systems that can be used in combination with more traditional, satellite-based imagery.

RESEARCH IN THE AREAS OF

Plant ecology, physiology, and phenology

Biodiversity

Drought

Climate-vegetation interactions

Vegetation photosynthesis, productivity and stress

Ecohydrology and hydrogeophysics

CENTER FOR ADVANCED LAND MANAGEMENT INFORMATION TECHNOLOGIES (CALMIT)

Brian Wardlow
CALMIT Director

The Center for Advanced Land Management Information Technologies (CALMIT) has been a pioneer and global leader in application and advancement of remote sensing in natural resources and agriculture since 1972. CALMIT's mission is to develop and apply novel remote sensing technologies to Earth observation, with the goal of assessing the health and function of natural and managed ecosystems. Key themes include the productivity, diversity, and resilience of natural systems in the face of changing climate and ongoing human activities. CALMIT has five faculty (four tenure and one non-tenure line) and three technical staff with expertise in applying advanced remote sensing methods to pursue research in plant ecology, physiology, and phenology; biodiversity; drought; climate-vegetation interactions; vegetation photosynthesis, productivity, and stress; and ecohydrology and hydrogeophysics.

CALMIT possesses a unique suite of remote sensing capabilities and infrastructure that allow both basic and applied research to be conducted across multiple spatial scales investigating an array of scientific questions about our changing environment. These capabilities include multispectral, hyperspectral and ultraspectral sensors deployed on ground- and airborne-based systems that can be used in combination with more traditional, satellite-based imagery. The Center's capabilities and infrastructure include the Nebraska Earth Observatory (NEO) airborne remote sensing program and a Piper Saratoga aircraft, the CALMIT Spectral Laboratory, CALMIT Field Remote Sensing Program with a mobile ground-based sensing platform.

CALMIT has had a highly productive research program over the past five years, garnering more than $17.5 million in competitive funding from agencies such as NASA, NSF, U.S. Department of Agriculture, Department of Defense, World Bank, US AID and the European Space Agency). Its personnel published more than 130 peer-reviewed articles, three book chapters, and one book. It has had $175,000 in contracts with City of Lincoln, Nebraska (application of remote sensing for urban forestry), Department of Agriculture, U.S. Geological Survey, the AmericaView Program and the U.S. Forest Service. CALMIT faculty have served on the editorial boards of multiple scientific journals and on multiple national and international advisory teams. Additionally, CALMIT has developed and implemented drought indicator monitoring tools for the Middle East-North Africa and Southern Africa with the National Drought Mitigation Center and partners It has also developed a European Space Agency Solar-Induced Fluorescence Workshop, and provided technical consultation for the United Nations on cosmic-ray neutron sensors.

CALMIT faculty are actively involved in multiple courses that attract students from across UNL, namely Introduction to Geospatial Information Sciences (NRES 212), Applications of GIS in Agriculture and Natural Resources (NRES 415/815), Introduction to Remote Sensing (NRES 418/818), Applications of Remote Sensing in Agriculture and Natural Resources (NRES 420/820), Field Techniques in Remote Sensing (NRES 421/821), Independent Study: Investigations of Applied Science (AGRI 485), Water and Society (SCIL 109), Introduction to Water Science (NRES 281), and Hydrology (NRES 453/853).

CALMIT faculty also advised and served on 56 graduate committees over the past 6 years, including those of 12 PhD and 7 MS students who completed degrees with a CALMIT faculty as their advisor.

FIVE-YEAR PLAN

- Re-envision CALMIT's role as leader in remote sensing research and training at UNL. Include possible rebranding of CALMIT's public presence through a new Center logo, website update, promotional materials, and engagement opportunities with the campus.
- Expand and further strengthen research track in drought monitoring and climate-landscape interactions, particularly related to ecological drought and ecosystem responses in collaboration with other SNR and IANR Centers.
- Rebrand the CALMIT Hyperspectral Airborne Mapping Program (CHAMP) as the Nebraska Earth Observatory (NEO) and train three new Center technical staff in the areas of flight management/data acquisition, advanced image processing and data informatics to position CALMIT to pursue advanced scientific research and raise the visibility of the Center's airborne remote sensing program.

- Develop and expand remote sensing educational and training opportunities supported by Center faculty that include formal hybrid remote sensing courses for distance delivery to students at educational institutions in the state of Nebraska, new advanced remote sensing courses, training sessions and workshops on specific remote sensing topics for students and other professionals and student research experiences.
- Initiate capacity-building activities to expand regional expertise in the use of emerging remote sensing methods that may include workshops, short courses, and demonstration projects.
- Explore novel methods of remote sensing to address vegetation functional diversity, productivity, health, and resilience.

CHALLENGES

- Sustain consistent funding for staff and infrastructure support for CALMIT, which has been solely dependent on competitive funding sources. Includes a new financial model for the airborne NEO program and funding strategies for Center service roles on campus that have not had university-funded baseline support in the past.
- Set clearer expectations of CALMIT's service role at the University (e.g., data collection, sensor testing and calibration, data analysis and technical

consultation) versus internal research initiatives. There is an expectation on campus that the Center will provide remote sensing services, but those services need to be more clearly defined with a better financial model.

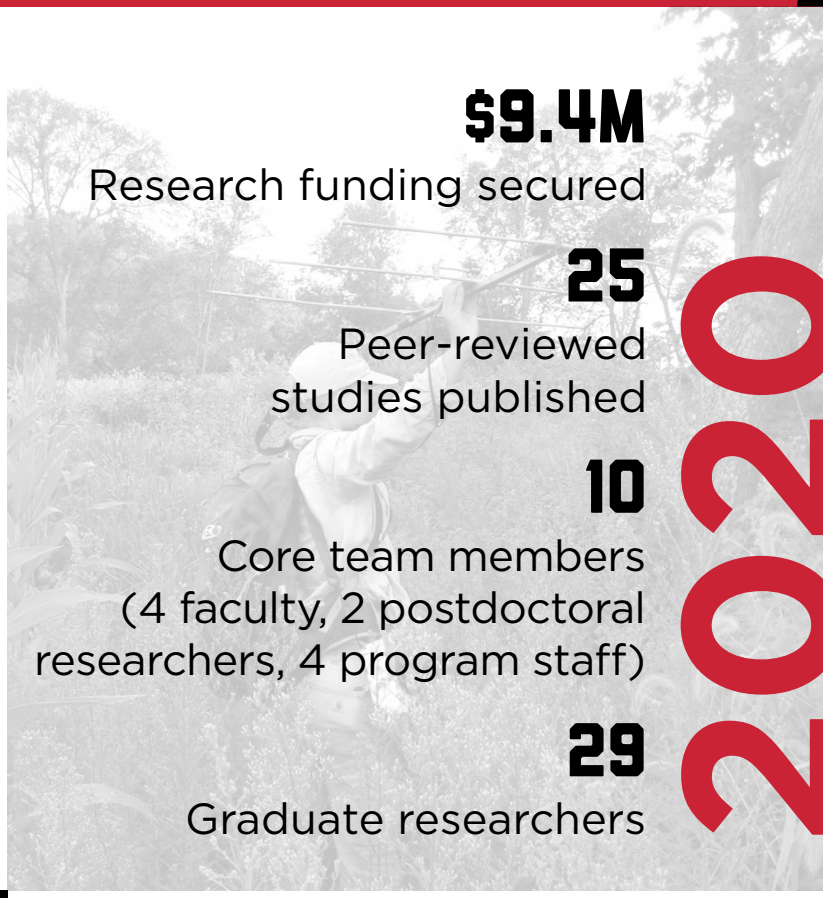
- Raisie the visibility and effectiveness of CALMIT's unique capabilities across IANR and UNL as a center of excellence in scientific applications of remote sensing aligned with emerging science fields and major campus initiatives that the Center can enhance.
- Restructure CALMIT's Service Center business model to maintain competitive, stable rates and services while covering costs and maintaining a primary focus on advancing novel research questions.
- Resolve computational issues related to the storage, analysis, archiving, distribution, and discovery of the vast volumes of remotely sensed image data (e.g., petabytes) being collected by CALMIT for various research projects. Currently, there are no suitable options within IANR and UNL to handle the data-related requirements of these extremely large, multi-dimensional data sets, which prohibits the publication of some research (with data publishing requirement), limits some types of advanced data analysis and modeling, and inhibits sharing these data to achieve a team-based, "open science" approach.

SCHOOL OF NATURAL RESOURCES

Center for Resilience in Agricultural Working Landscapes
centerforresilience.unl.edu

BUILDING MOMENTUM

In a world of rapidly changing landscapes and human and animal populations, the Center for Resilience in Agricultural Working Landscapes (CRAWL) is poised to become an international hub for resilience research and education – ushering in creative local and global solutions to the challenges facing agricultural systems and the health of the people who depend on them. Founded in August 2020, CRAWL addresses a growing need to enhance agricultural sustainability at local and international scales. CRAWL's interdisciplinary team works with other University of Nebraska-Lincoln research centers and programs, as well as partners outside of the university system, to develop landscape techniques that can improve both agricultural intensification and resilience.



$9.4M
Research funding secured

25
Peer-reviewed studies published

10
Core team members (4 faculty, 2 postdoctoral researchers, 4 program staff)

29
Graduate researchers

2020

"Farmers around the world face the issue of growing more food on their land to feed the growing global population while not knowing how that push for productivity may affect resilience. CRAWL's research addresses this central challenge, and our new center will become a global voice for resilience in agricultural working landscapes."

- Craig Allen, PhD
Director, CRAWL

COLLABORATING TO IMPROVE RESILIENCE

Agricultural production must increase more than 70% by 2050 to meet the increasing global demand for food, fuel and fiber. Sustainable intensification of agriculture is a grand challenge for humanity that will require fostering resilient working landscapes and transforming landscapes that are currently in undesirable states. CRAWL, with the partnership of the Nebraska One Health program and the Center for Grassland Studies, and others, will address this challenge by focusing research, teaching and engagement in a manner capable of protecting the important agricultural resources that drive Nebraska's economy and underpin our global leadership in feeding humanity.

PROJECT FOCUS
BARTA BROTHERS RANCH

James and Clifford Barta donated their 5,000-acre ranch to the University of Nebraska to research range management, prairie forestry, wildlife management, and conservation almost 30 years ago. In 2021, CRAWL and the Center for Grassland Studies, in collaboration with the Eastern Nebraska Research, Extension, and Education Center, embarked on a new research approach that addresses rapid social-ecological changes in ranching.

Using a stakeholder-driven approach, Barta Bros Ranch will model "safe to fail" experiments that are urgently needed but inherently risky for producers to attempt in their operations. The results will allow for new adaptive capacity in the Great Plains–providing management tools for ranchers to navigate their business through economic and environmental uncertainty.

STARTING STRONG

Focusing research, teaching and engagement on the theory and practice of resilience is an important function of the Center's interdisciplinary approach. CRAWL also includes institutions and non-governmental organizations with a stake in maintaining productive and resilient food, energy, water, and ecosystem services landscapes.

The Center takes this further—engaging regional, national, and global groups involved in the management of complex landscapes to create an interactive culture of exchange among academics, practitioners, and industry. In the past year, this approach has resulted in millions of dollars for funding research and recent publications in journals such as *Nature* and the *Proceedings of the National Academy of Sciences*.

FUNDED PROJECTS INCLUDE:

$3.95 MILLION
NSF award to establish program to stimulate competitive research

$2.96 MILLION
NSF award to develop national research trainee program

$1.15 MILLION
Nebraska Game and Parks Commission award to develop cedar encroachment and management program in Nebraska

CENTER FOR RESILIENCE IN WORKING AGRICULTURAL LANDSCAPES (CRAWL)

Craig Allen
CRAWL Director

Since its creation in August 2020, the Center for Resilience in Agricultural Working Landscapes (CRAWL) has published 25 peer-reviewed studies, secured nearly $10 million in research funding, and strengthened its capacity by adding a center director, three faculty members, two postdoctoral researchers, four program staff, and 29 graduate researchers.

CRAWL's momentum is due in part to its interdisciplinary approach and collaboration with UNL's academic programs and other research centers. CRAWL intensifies these efforts by incorporating researchers from within and outside the University, nongovernmental organizations, agricultural producers, corporate partners, and many other stakeholders.

Agricultural production must increase more than 70% by 2050 to meet the global demand for food, fuel, and fiber. Meeting this goal will not only require agricultural intensification. It will also require a deeper understanding of how these systems interact as well as how we train a new generation of researchers to work with agriculturalists and the public to adapt to the complexity of a changing world. In this world of rapidly changing landscapes and human and animal populations, CRAWL is poised to become an international hub for resilience research and education—ushering in creative local and global solutions to the challenges facing agricultural systems and the health of the people who depend on them. CRAWL's robust approach to research and practical application is a key asset as the University of Nebraska prepares for the future. CRAWL is poised to become a global voice for resilience in agricultural working landscapes.

CRAWL serves as the platform for guaranteeing the resilience concept meets its potential to serve the personal and economic well-being of Nebraska's citizens and the state's valued resources. In the past year, these efforts have resulted in millions of dollars of research funding and the recent publication of the Center's work in journals such as *Nature* and *Proceedings of the National Academy of Sciences*.

KEY CRAWL GRANTS SINCE 2020

GRANTOR	AWARD	PROJECT(S)
National Science Foundation	$3.95 million	Nebraska Established Program to Stimulate Competitive Research
National Science Foundation	$2.96 million	National Research Trainee Program
National Science Foundation	$423,000	Dynamics of Integrated Socio-Environmental Systems
Nebraska Game and Parks Commission	$1.15 million	Cedar Encroachment and Management in Nebraska; North American Bat Monitoring Program
Nebraska Environmental Trust	$500,000	Collaborative Adaptative Management – Barta Brothers Ranch
U.S. Department of Agriculture – SARE	$247,000	Assessing Tradeoffs of Grassland Management with Collaborative Management
University of Nebraska	$150,000	Resilience in Agricultural Working Landscapes

FIVE-YEAR PLAN

- Programmatic alignment with the Center for Grassland Studies research, teaching, and extension activities.
- Finalization of remaining appointments and hiring of personnel.
- Formalization of strategic partnerships in research, field-based practice, and technology transfer.
- Accelerate research efforts to maximize agricultural sustainability at local, national, and international scales.
- Develop landscape techniques that allow for agricultural intensification without declines in resilience.
- Enhance national and global relevancy through the conveyance of research, findings, and resulting best management practices.
- Strengthen partnerships with the Center for Grassland Studies and Nebraska One Health and their community of stakeholders, and with other programs focusing on agriculture.
- Fuse interdisciplinary scholarship of Nebraska One Health with resilience research in human-nature-agriculture interactions.

CHALLENGES

CRAWL's emphasis on research, delivering tools of utility to stakeholders, and training a new generation of scientists is a powerful model for future agricultural success. The resulting collaborations bring together a dynamic network of professionals, agricultural practitioners, and researchers working to address rapid social, economic, and ecological changes in agricultural working landscapes. For these efforts to materialize, increased administrative stability will:

- Enhance the center's sustainability through dedicated operating funds.
- Develop additional national and international collaboration to enhance research and education effectiveness, and reach.

SCHOOL OF NATURAL RESOURCES

129 YRS
CSD
1893-2022

Conservation and Survey Division
csd.unl.edu

STUDYING NEBRASKA SERVING NEBRASKANS

CSD has been Nebraska's geological survey—and much more—for thirteen decades.

CSD collects, analyzes, and archives data about Nebraska's geology, groundwater and soils. It maps Nebraska's geology, mineral resources, and water.

CSD is unique among the 49 state geological surveys. It is the only state geological survey within an agricultural institute and one of two affiliated with extension; also, CSD faculty teach multiple courses. An integral part of SNR, it collaborates with many University programs and government agencies.

$3.3M External funding

2,500
Stakeholders served

40 Publications
20 Peer-reviewed articles

1,400
Continuing EducationUnits (CEUs) generated for professionals

Numbers are yearly averages

RESEARCH

- Heterogeneity of High Plains aquifer using multi-resolution methods
- Isotopic, image-based, and data-driven studies of groundwater
- Soil change, dynamic properties, and hydromorphology
- Past and present environmental, hydrologic-system, and climate change
- Biogeochemical cycling of metals, nutrients, and radionuclides
- Shallow geophysics applications
- Quaternary landscape change assesment and luminescence dating
- Drivers of pro-environmental behavior
- Local to regional geology and resources
- Carbon capture and underground storage

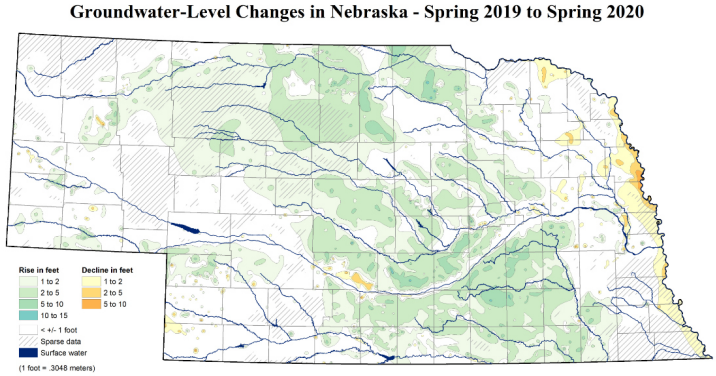
TEST-HOLE DRILLING

- Fundamental basis for many studies; also relevant in carbon-sequestration and infrastructure development
- Designated repository for geological samples and data in Nebraska (>120,000 ft of cuttings and cores valued at $16 billion)

GROUNDWATER ASSESSMENT & MONITORING

- Database of >6,000,000 measurements from 24,000 wells
- Nearly 5,000 wells are measured yearly and 67 hourly
- Singular resource for groundwater management in Nebraska; regional and national relevance

***454,000**
Groundwater-level data entries



EXTENSION AND OUTREACH

- Watershed Aquifer Virtual Education System
- (WAVES) for resource managers
- GeoCloud: 3D web app for geoscience data (25,000 miles of geophysical surveys and 250,00 borehole logs)
- Address needs of numerous stakeholders

***48**
Local, national and international presentations

***137,000**
Page views related to CSD

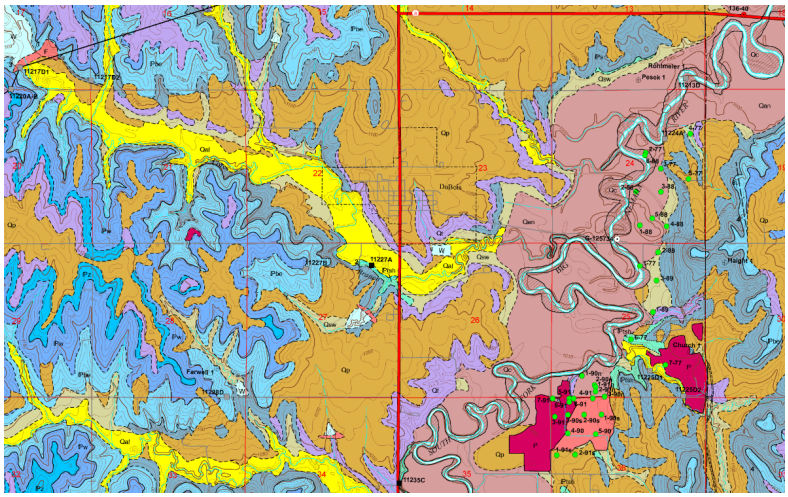
60–100
Organizations served by CSD

**Numbers are yearly averages*

***12,000**
feet of test holes drilled and/or logged yearly

GEOLOGIC MAPPING

- >160 geologic maps since 1993; $2.26 million in funding from the U.S. Geological Survey
- At least two new maps are produced each year and at least two new test holes are drilled for each map
- Designated producer of detailed geologic maps within Nebraska
- Mapping leads to scientific publications



CSD's FOCUS may be on Nebraska, but its impacts extend across the globe.

Conservation and Survey Division (CSD)

Matt Joeckel
CSD Director

The creation of the Conservation and Survey Division (CSD) is outlined in Nebraska Revised Statute 85-163, -164, and -165. A state geologist or a geological survey—now in the form of CSD—has existed at the University of Nebraska for nearly 150 years. All U.S. states except Hawaii currently have some form of state geological survey. CSD is unique among those surveys because it is embedded in the structure of an agricultural school. It is also one of only two surveys that have affiliations with university extension. CSD has experienced many changes since the early 1970s. Those changes culminated with a merger into the School of Natural Resources in 2003 and a protracted decline in total faculty and staff FTEs.

CSD is involved in $3.3 to $4.0 million in external funding each year. Its personnel produce dozens of publications every year, including many peer-reviewed scientific journal articles. It provides research and scientific interpretations that are critical to university stakeholders. CSD Earth-science and groundwater data support multiple missions within the Institute of Agriculture and Natural Resources and the University of Nebraska at large. CSD interacts with private industry and other public institutions. CSD's research activities are diverse and wide-ranging, and its personnel interact with individuals from around the USA and the world. CSD faculty teach courses in as many as five different degree programs, and they also consistently advise numerous undergraduate and graduate students. CSD is the sole provider of many kinds of Earth-science expertise in Nebraska.

Increasing pressures on Nebraska's groundwater and soil resources, a nationwide drive to study and develop critical mineral resources (e.g., the Elk Creek carbonatite rare earth and niobium deposit), the need for materials for infrastructure development, and the burgeoning carbon capture and underground storage industry are but a few timely examples of why CSD is essential for economic growth in Nebraska. The proliferation of information and data in society demands that CSD not only maintain its position as a trusted resource, but also develop new, dynamic ways of communicating critical geoscience information to the public and decision makers. CSD is the only publicly funded organization in Nebraska that addresses these issues, engages in the full range of geological survey activities, and provides unbiased science accordingly.

CSD personnel are committed to:

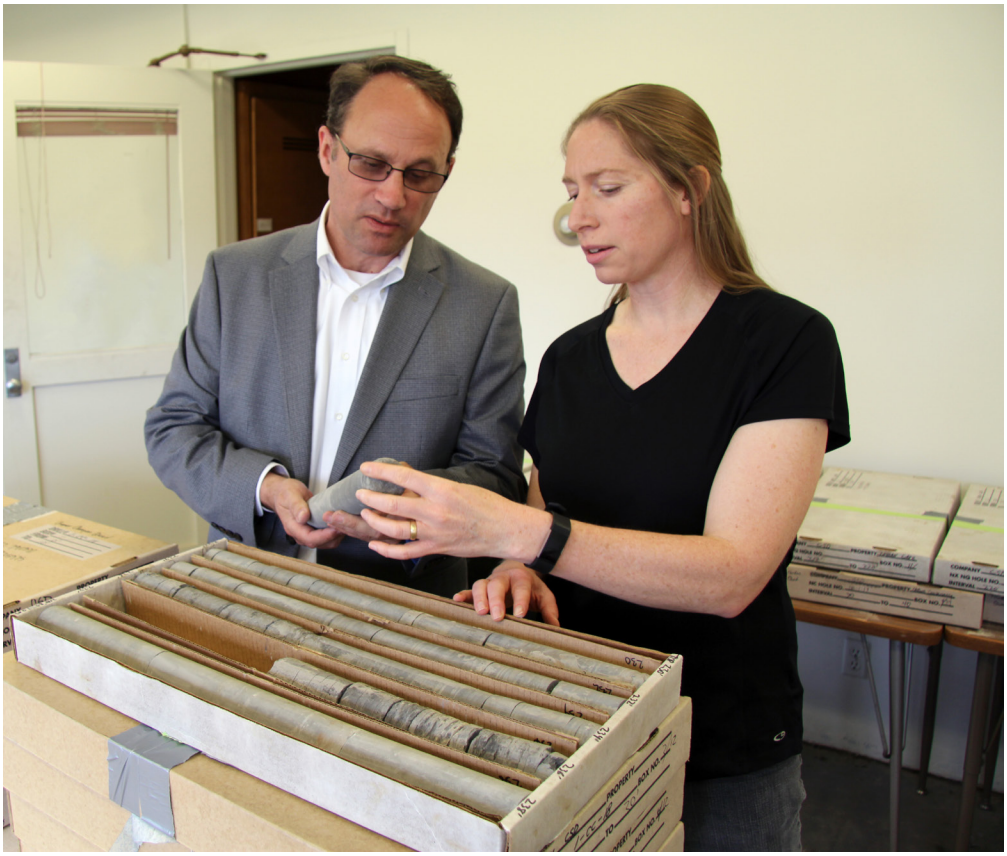
- Continuing CSD's exclusive commitment to fundamental geological-survey activities that are valued by our stakeholders. These activities include:
    - groundwater-level monitoring and the publication of the annual groundwater levels report for Nebraska,
    - geologic and hydrogeologic mapping,
    - archiving of soil and geologic samples and data in the public interest,
    - studying Nebraska's evolving soils and landscapes, and
    - collaborating with the U.S. Geological Survey in monitoring and understanding regional geological hazards such as earthquakes.
- Addressing emerging societal problems in Nebraska and beyond by building on fundamental Earth-science and water research relevant to changing climate, geological hazards, and economic development.
- Maintaining and strengthening working links with scientists in other states and other nations, especially since doing so helps to solve shared or similar problems.
- Continuing to contribute to the educational mission of SNR, IANR, and UNL. CSD faculty have varied, unique qualifications for advising graduate students and teaching specific classes in multiple degree programs.
- Improving the management systems and accessibility of public data that are used by agencies and practitioners in Nebraska and scientists worldwide.
- Developing and employing innovative technologies that lead to scientific discovery and improved management of natural resources.
- Augmenting partnerships with Nebraska's public agencies to provide need-based scientific support, data, information, and education to key decision makers, practitioners, and the public.

FIVE-YEAR PLAN

- Continue to develop our online data tools (GeoCloud, groundwater monitoring, interactive web map, etc.) and develop a sustainable revenue stream for ongoing support of a unified cyberinfrastructure system.

- Develop cyberinfrastructure for data acquisition, data fusion and process-informed machine learning applications in Earth systems, including surficial processes and hydrology as well as aquifers and subsurface geology.
- Secure professional development opportunities for staff and faculty to support cyberinfrastructure development and applications that are critical for building on CSD's existing data resources and for advancing the mission of CSD as technology evolves.
- Utilize observations and assessments of land-surface features and connections between surface water and groundwater to illustrate the importance of subsurface materials and processes in the everyday lives of Nebraskans.
- Expand education and outreach to increase groundwater and geoscience expertise for the public as well as those in state and federal organizations and to support professional development for practitioners, agency staff, and key decision makers.
- Replace any separating staff and faculty, given that personnel are already challenged in fulfilling the designated mission and contributing to those of SNR and IANR. Adding even one new, highly qualified (in the geological sciences) research-oriented faculty member would greatly improve CSD's ability to meet those commitments. Likewise, additional staff support in cyberinfrastructure would be highly efficacious.

CHALLENGES



- Maintaining operational staff: the retention of a core group of technical staff, in addition to faculty, is essential for the accomplishment of CSD's mission. Many tasks, such as drilling and subsurface exploration, groundwater-level monitoring, and the maintenance and utilization of sample and data collections, are no longer construed to be appropriate undertakings for faculty.
- Maintaining geological expertise: groundwater has long been the focus of CSD activities, and it is vital that demonstrable and externally recognizable expertise in geology (e.g., stratigraphy, geologic structure and seismicity, mineral resources, basement geology, etc.) is continued in the unit. Developments in critical minerals and carbon capture and underground storage alone demonstrate the imperative. Geological expertise is critical to meet the water well and onsite wastewater industry needs for continuing education, licensure, and regulation.
- Maintaining essential facilities, equipment, and cyberinfrastructure: the maintenance of databases, data management systems, and web tools requires computer programming skills, data servers, and other specialized components and expertise not readily available within CSD or SNR.
- Maintaining faculty: it is essential that CSD retain a core of research-oriented faculty, including tenurable positions, who embrace modern technology and innovative approaches to scientific inquiry and problem-solving, as well as the effective communication of results and application to stakeholders.

SCHOOL OF NATURAL RESOURCES

Great Plains Cooperative Ecosystem Studies Unit
gpcesu.unl.edu

STRENGTH IN NUMBERS

The Great Plains Cooperative Ecosystem Studies Unit (CESU) is one of 17 regional CESU's in the United States. Hosted at the University of Nebraska-Lincoln's School of Natural Resources, the Great Plains CESU is a network of 22 academic institutions, 13 federal agencies and one non-governmental organization (NGO) across the Great Plains. The Great Plains CESU works to provide simple, rapid funding for collaborative projects between federal and academic partners. Established in 2000, the CESU network in May 2020 renewed the University of Nebraska-Lincoln as the host for 2020–2025.

22
University partners spanning 12 states

13
Federal agency partners

201
Funded projects, 2015–2020

$94.6 MILLION
Federal funds distributed through the Great Plains CESU, 2015–2020

"The CESU network exists to promote, conduct, and provide research in support of the missions of federal agencies and their partners concerning natural and cultural resource management on federal and private lands and waters. The Great Plains CESU prioritizes stewardship of the vital resources across the region."

- Paul Hanson,
Great Plains CESU Director

PURPOSE AND SCOPE

The Great Plains CESU, and the nationwide CESU network, exists to:

- Provide research, technical assistance, and education to federal land management, environmental, and research agencies and potential partners.
- Develop programs to address natural resource issues in an ecosystem context at local, regional, and national levels.
- Facilitate collaborations among federal agencies and universities and NGOs.

PROJECT FOCUS
FISH ECOLOGY IN KANSAS FLINT HILLS

Kansas State University researchers, in partnership with the National Park Service, are collecting stream and pond fish data and additional data to determine impacts of non-native pond fish on native stream fishes — in particular, the Topeka Shiner — found in the Tallgrass Prairie National Preserve in the Flint Hills of Kansas.

LIMITLESS RESEARCH OPPORTUNITIES

Over 330 research projects have been funded since the Great Plains CESU was founded in 2000. Active projects as of late 2021 include acoustic monitoring of bats in the Northern Great Plains, an exploration of the African American homesteading experience in the Great Plains, and a survey of wintering and migratory birds at the Tallgrass Prairie National Preserve.

KEY FUNDING AGENCIES 2015–2020:

$75M, 44 PROJECTS
U.S. Army Corps of Engineers

$4.7M, 95 PROJECTS
U.S. National Park Service

$6.5M, 28 PROJECTS
USDA Natural Resources Conservation Service

$7.2M, 14 PROJECTS
U.S. Department of Defense

Great Plains Cooperative Ecosystem Studies Unit (GP CESU)

Paul Hanson
GP CESU Director

The Great Plains CESU, one of 17 regional CESUs in the United States, is a network of 22 academic institutions and one NGO (non-governmental organization) in the Great Plains region and 13 federal agencies. The primary mission of the GP CESU is to distribute funding opportunities simply and rapidly to our academic and NGO partners and to identify potential collaborators for projects that are funded through the CESU mechanism. The GP CESU also presents an annual award to a graduate student who is working on a project funded through the GP CESU and holds an annual partners meeting. The University of Nebraska-Lincoln began hosting the GP CESU in October 2000. In May 2020, the CESU network renewed the University of Nebraska-Lincoln as the host for 2020-2025.

The GP CESU staff includes Director Paul Hanson, a faculty member in the Conservation and Survey Division, Program Coordinator Brittany Grove (0.5 FTE support staff in SNR), and Dr. Tanya Shenk, our CESU Research Coordinator and employee of the National Park Service. The operation of the GP CESU office is conducted through several funding streams including annual dues from our federal agency partners, and these funds are supplemented from annual contributions from the regional National Park Service office and the Institute of Agriculture and Natural Resources at UNL.

CESU Collaborative Federal Agencies:

- U.S. Army Corps of Engineers
- U.S. Bureau of Indian Affairs
- U.S. Bureau of Land Management
- U.S. Bureau of Reclamation
- U.S. Department of Defense
- U.S. Farm Service Agency
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- U.S. Geological Survey
- National Oceanic and Atmospheric Administration
- National Park Service
- Natural Resources Conservation Service
- Western Area Power Administration

GP CESU Academic Partners:

- Black Hills State University
- Colorado State University
- Colorado State University-Pueblo
- Emporia State University
- Kansas State University
- Langston University
- New Mexico Highlands University
- North Dakota State University
- Oklahoma State University
- South Dakota School of Mines and Technology
- South Dakota State University
- Southwestern Oklahoma State University

Texas A&M University
University of Minnesota
Univ. of Nebraska Medical Center
University of Oklahoma
University of Wisconsin-Extension
Winona University
Texas Tech University
University of Nebraska-Lincoln
University of North Dakota
University of South Dakota
University of Wyoming

Agency	Total	# Projects
BLM	$78,795	3
DOD	$7,151,055	14
FSA	--	0
NPS	$4,722,582	95
NRCS	$6,477,018	28
US BoR	$451,933	5
USFS	--	0
USFWS	$61,584	1
USACE	$75,007,143	44
USGS	$664,419	11
Total	$94,614,719	201

Federal funds distributed within the Great Plains CESU from 2015-2020. Note the number of projects and funds include only those that are reported to the GP CESU office at the end of the year.

FIVE-YEAR PLAN

- Improve the effectiveness of our annual GP CESU Partners and Stakeholders Meeting. Our 2020 virtual meeting was effective in engaging our partners. Future meetings will probably be virtual, but we will also couple our meetings, as possible, with other local meetings involving our federal partners and academic stakeholders.
- Pursue adding federal, academic and NGO (non-governmental organization) partners to the GP CESU. We plan to engage, for the first time, with tribal colleges in the Great Plains region to highlight the advantages of participating in and joining the GP CESU. We will also recruit academic institutions that fall outside of the Great Plains region.
- Improve interactions with our partners and other stakeholders by redesigning our website and re-envisioning social-media engagement (Facebook and Twitter). We seek better ways to highlight the research efforts that are being conducted with GP CESU funding, especially projects involving students.
- Improve engagement with stakeholders in academic institutions and NGOs. Improving our communication with our stakeholders is expected to increase the effectiveness of our operation and our ability to identify researchers for advertised projects. We plan to improve our engagement with local researchers, especially in the University of Nebraska.

SCHOOL OF NATURAL RESOURCES

High Plains Regional Climate Center
hprcc.unl.edu

VITAL, ACCESSIBLE CLIMATE DATA

For over 30 years, the High Plains Regional Climate Center (HPRCC) has provided the public with climate data and information available. We achieve this by providing climate services, developing climate products, engaging our stakeholders, and conducting applied climate research. Our six-state region covers Colorado, Kansas, Nebraska, North Dakota, South Dakota, and Wyoming. The Regional Climate Centers are supported by the National Oceanic and Atmospheric Administration (NOAA) to develop sector-specific and value-added products and services, and to establish digital infrastructure for climate information.

$10.5 MILLION
In grants and contracts since 2016

43,000
Climate maps produced daily with data from over 30,000 weather stations

16 MILLION
Product downloads since 2016

300
National GIS shapefiles produced daily

30
Online tools maintained for users to explore climate data

"The HPRCC engages its stakeholders and partners from local, state, regional, and national levels, conducts research, and develops climate data products and tools for variety of efficient decision-making. These products and tools also assist in decisions, which help to minimize negative impacts of abnormal climate conditions on various sectors of the economy."

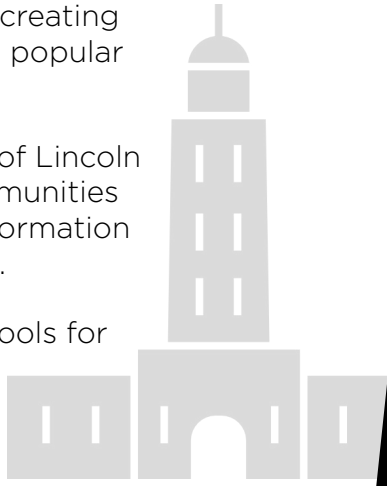
- Rezaul Mahmood, HPRCC Director

KEY ACCOMPLISHMENTS

Developed software for creating shapefile versions of the popular ACIS Maps.

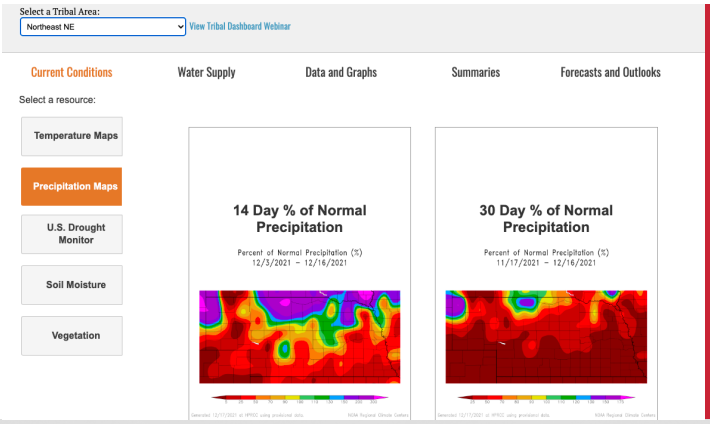
Partnered with the City of Lincoln to engage regional communities in identifying climate information relevant to city planners.

Supported agricultural tools for decision makers



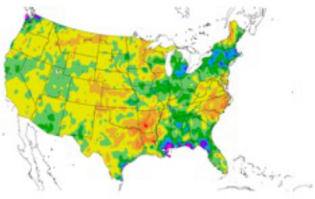
PROJECT FOCUS
CLIMATE DECISION DASHBOARD

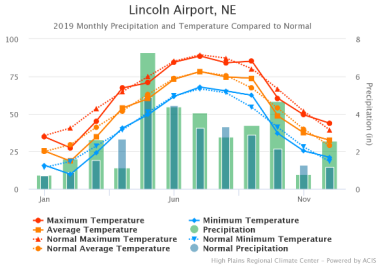
The HPRCC has collaborated with the Native American tribes of Nebraska, Kansas, and Iowa to improve climate and water related decision-making. For this purpose, the Center has worked with tribal representatives to produce a Climate Decision Dashboard that assists in better monitoring climate conditions and water resources.



KEY VOICE
IN CLIMATOLOGY

The HPRCC team — one faculty member, five full-time staff, three graduate students and one undergraduate student — collectively has 80 years of experience working in climate services, climate database and product development, engagement and outreach, climate monitoring and climate research. The team develops products and produces climate summaries and outlooks that stakeholders across the region, country, and globe use to make informed decisions.





TOTAL PUBLICATIONS
SINCE 2016

27
Peer-reviewed articles

63
Monthly High Plains Regional Climate Summaries

23
Quarterly High Plains Regional Climate Summaries and Outlooks

4
Annual High Plains Regional Climate Summaries

High Plains Regional Climate Center (HPRCC)

Rezaul Mahmood
HPRCC Director

The High Plains Regional Climate Center (HPRCC) has received $10.5 million in external funding since 2016. It serves to increase the use and availability of climate data and information. We achieve this by providing climate services, developing climate data and information products, engaging our stakeholders, and conducting applied climate research. Our six-state region covers Colorado, Kansas, Nebraska, North Dakota, South Dakota, and Wyoming. The Regional Climate Centers (RCCs) are supported by the National Oceanic and Atmospheric Administration (NOAA) as part of a three-tiered approach, emphasizing services that are local, regional, and national in scope.

The HPRCC currently includes one faculty member, four full-time employees, four graduate students and one undergraduate student. HPRCC employees collectively have about 80 years of experience working in climate services, climate database and product development, stakeholder engagement and outreach, and climate monitoring and research.

Key Operational Deliverables, Web Products, and Tools

- Climate Maps Produced Daily: Over 43,000 incorporating historical data from over 30,000 weather stations.
- National GIS Shapefiles Produced Daily: Over 300 incorporating historical data from over 30,000 weather stations.
- Total Number of Climate Product Maps: 442,069 with archive back to 2003.
- Total Number of GIS Files: 3,306 with archive back to 2018.
- 30 online tools maintained for users to explore climate information.
- Over 189 monthly, quarterly, and annual climate summaries since 2007.
- Over 16 million product downloads since 2016.
- Online regional and national climate data.
- Applied Climate Information System (ACIS) [provides data and visualization of state, all regions of the country, and overall national climate conditions]. These tools allow climate monitoring and assess trends.
- Agro-climate tools, Custom Climatology Tool, Climate 4 Cities, and Tribal Climate Decision Dashboard.

The center has averaged 24,010 web users and 111,708 page views annually since 2016. There have been users from almost every country; the top 20 countries using our products and tools include the U.S., Canada, China, India, United Kingdom, France, Germany, Brazil, South Korea, Japan, Australia, Italy, Netherlands, Spain, Mexico, South Africa, Iran, and Argentina. Center faculty and staff have taught at least one course each year and contributed to the Applied Climate Science Program. The center has mentored six graduate students and provided experiential learning experience for five undergraduate students.

FIVE-YEAR PLAN

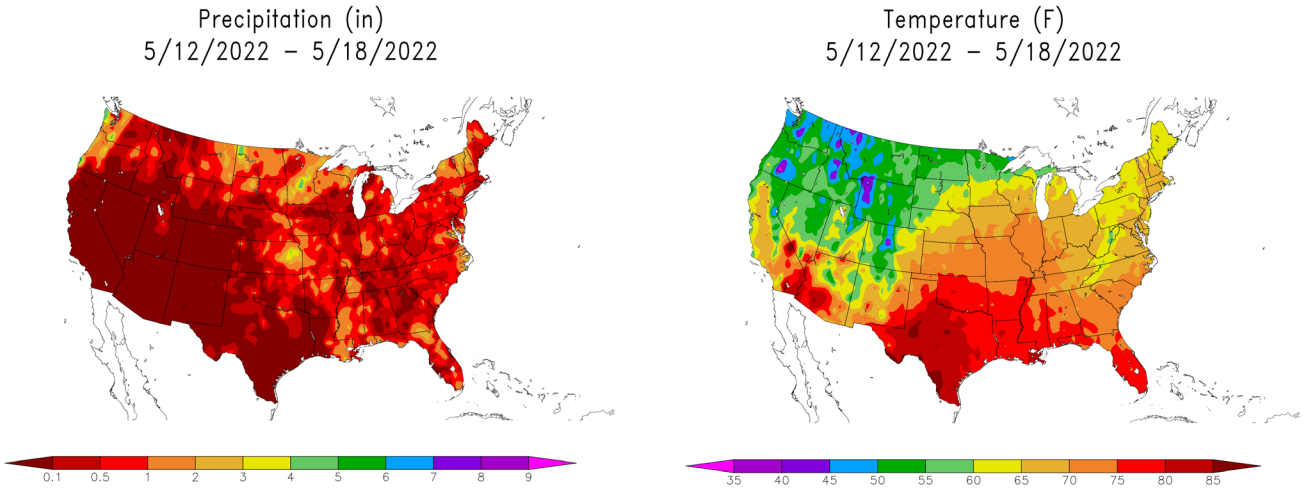
In the context of climate change, increased climate variability, and the increased frequency of extreme events, demands for climate data products and tools have increased. Thus, our five-year plan incorporates the following goals:

- Develop new climate data products and decision tools.
- Increase engagement and outreach activities for our partners and stakeholders.
- Conduct research to assist in the development of new data products and tools.
- Explore new funding sources.

CHALLENGES

HPRCC receives most of its funding from NOAA and various entities within NOAA. The center currently also receives some funding from the NSF, Department of the Interior, and a few other entities. We are continuously working toward strengthening these relationships and expanding our funding sources. Additional staff members are needed for outreach and engagement activities, society-climate interactions and climate research.

CLIMATE PRODUCT MAPS BY HPRCC



Generated 5/19/2022 at HPRCC using provisional data. NOAA Regional Climate Centers

SCHOOL OF NATURAL RESOURCES

NATIONAL DROUGHT MITIGATION CENTER
UNIVERSITY OF NEBRASKA

National Drought Mitigation Center
drought.unl.edu

BUILDING RESILIENCE

The National Drought Mitigation Center helps decision-makers reduce the effects of drought through monitoring and planning. When the center started in 1995, drought planning in the U.S. was an arcane concept, typically a stand-alone, one-off project. In the past two decades, we have seen drought planning go mainstream, increasingly addressed in hazard, water, climate and various municipal plans. We work with individual, local, regional, state, tribal and national planners across the country and around the world to prepare for drought. Here are some of the ways the NDMC has made an impact.

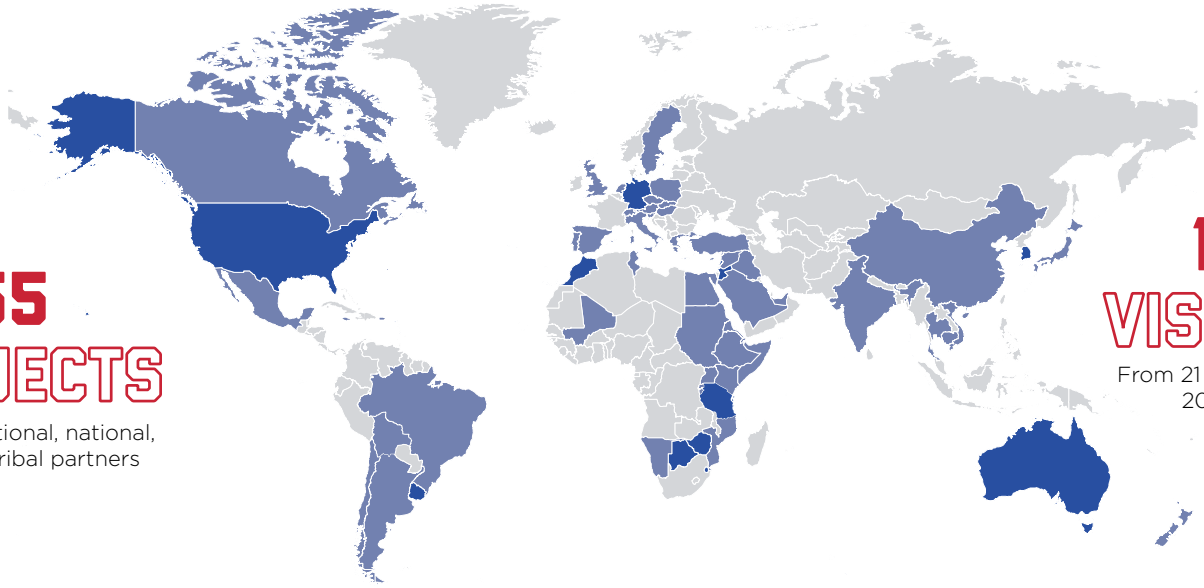
$12 MILLION
Grants and contracts, 2016–2020

21
Total staff members

133
NDMC authored or co-authored publications, 2016–2020

LASTING PARTNERSHIPS
USDA, NOAA, NASA, USGS, United Nations, World Bank and many more

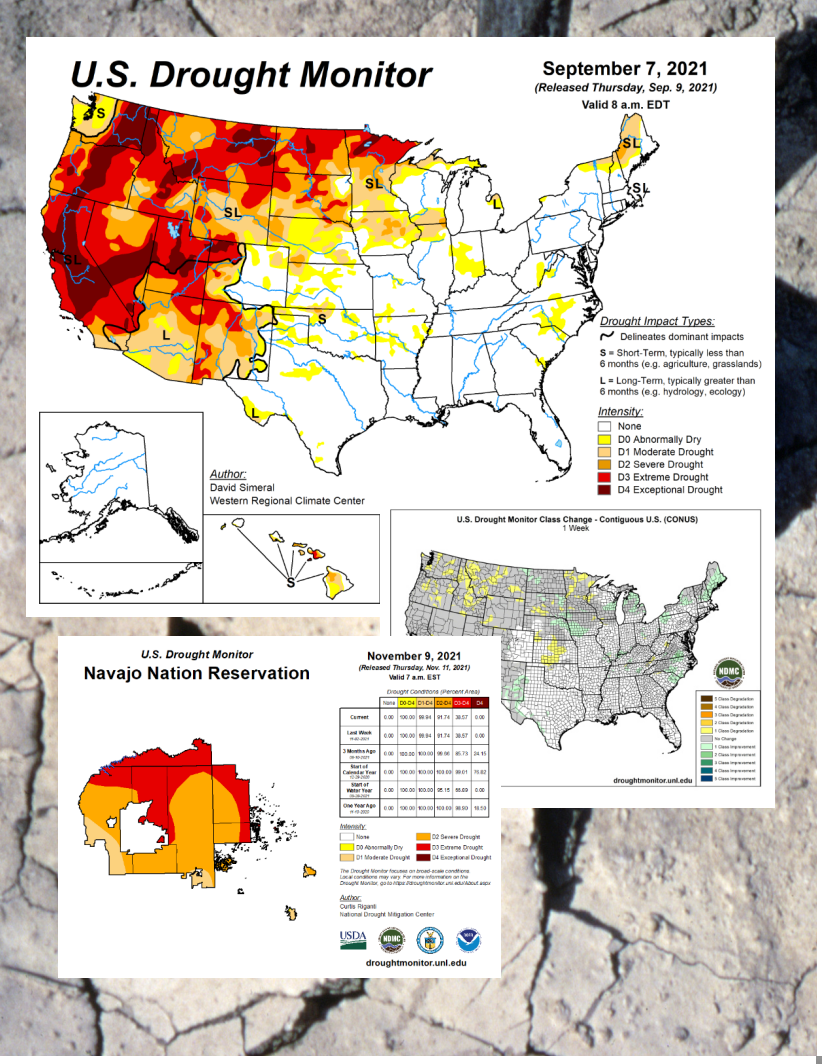
WHERE WE WORK



55 PROJECTS
With international, national, state, and tribal partners

172 VISITORS
From 21 countries from 2016–2020

The NDMC works across the United States and the world, as shown by shading on the map. Countries in **darker blue** are places we worked in 2020. Countries in **light blue** are where we have worked previously.



PROJECT FOCUS
U.S. DROUGHT MONITOR

The NDMC has played a key role in the evolution of the U.S. Drought Monitor (USDM), a weekly map of U.S. drought severity and extent. The USDM, hosted on UNL web servers, is the go-to resource for media and policymakers. It drives:

Aid. The USDM has triggered $7.3 billion in Livestock Forage Disaster program assistance, Oct. 2011–Sept. 2020.

Scientific collaboration. The USDM was the first hybrid, composite drought indicator to use a convergence-of-evidence approach.

Public conversation. According to Meltwater, the Ad Value Equivalence (AVE) of 75,985 USDM mentions in the media from 2016–2020 totaled over $983 million.

PUTTING SCIENCE IN YOUR HANDS

Along with the Drought Monitor, the NDMC also develops and hosts resources that address drought from myriad angles. The center's Drought Impacts Toolkit, featured in the U.S. Climate Resilience toolkit, pulls together many sources of information about how drought affects people, drawing on news, crowdsourcing, and more. Tools such as Managing Drought Risk on the Ranch focus information for specific user groups. Planning guidance walks users through scenario-based drought planning activities, and adds drought to FEMA's Threat Hazard Identification Risk Assessment process.

$90.5 MILLION
Ad Value Equivalence of 12,557 NDMC mentions from 2016–2020

57 MILLION+
Current and archived maps that show drought coverage at global to local levels

50,000+
Global- to local-level drought maps produced on a weekly basis

7.7 MILLION
Annual pageviews over the past 5 years

2.2 MILLION
NDMC-hosted website users

National Drought Mitigation Center (NDMC)

Mark Svoboda
NDMC Director

NDMC, which originated in 1995, provides the basis for essential drought planning, thereby reducing the effects of drought through monitoring and planning. Center personnel work with individual, local, regional, state, tribal and national/international planners across the country and around the world to prepare for drought. Its work has become vital at many scales and in hazard, water, climate, and municipal plans. Active NDMC grant-funded projects since 2016 total $12 million. NDMC personnel also produced an average of nearly 27 peer-reviewed publications yearly during the period 2016 to 2020.

NDMC has played a key role in the U.S. Drought Monitor (USDM) as one of the founding institutions and as the web host of the weekly map of U.S. drought severity and extent. Since 1999, the USDM has provided a uniform frame-of-reference for drought assessment. Furthermore, the USDM is the essential resource for policymakers and the media. It triggers assistance under the Livestock Forage Disaster Program ($7.3 billion in the period October 2011–September 2020) and it releases lands enrolled in the Conservation Reserve Program for haying. The USDM has been emulated by dozens of countries around the world. A 2019 assessment showed that the NDMC and Drought Monitor together accounted for 10% of UNL's non-sports-related media mentions in states other than Nebraska, and 9% of the ad value equivalence, based on data from the Meltwater media search service.

NDMC is a boundary organization, connecting cutting-edge drought research with real-world planners, translating science into tools and developing and providing usable information for decision-makers. We maintain more than 20 websites, adding more than 30,000 maps and data products each week, with five-year-average annual page views of 7.7 million, 2.2 million users, and 3.5 million sessions. We maintain state-of-the-art drought monitoring tools, planning guides, and other public-facing information. NDMC is the web home of the U.S. Drought Monitor, QuickDRI, VegDRI, VegOut, GrassCast, NASA's GRACE-based soil moisture maps, and the Drought Risk Atlas. The center's Drought Impacts Toolkit, featured in the U.S. Climate Resilience toolkit, pulls together many sources of information about how drought affects people, drawing on news, crowdsourcing, and more. Tools such as Managing Risk on the Ranch focus on specific users. Planning guidance walks users through drought planning activities and adds drought to FEMA's Threat Hazard Identification Risk Assessment process.

In the process of providing information to researchers, reporters, and the public at large, the drought center and U.S. Drought Monitor bring attention to the University of Nebraska. According to Meltwater, the Ad Value Equivalence (AVE) of 75,985 USDM mentions in the media from 2016-2020 totaled over $983 million. Through just October of 2021 – a year in which at least 40% of the Lower 48 has been in drought through the fall – the AVE of 22,955 USDM mentions in the media has totaled over $975 million. The NDMC has been referenced in 12,557 news reports from 2016-2020, which Meltwater equates to an AVE of over $90.5 million. There were 5,625 news reports that mentioned the USDM and the University of Nebraska-Lincoln from 2016-2020, and Meltwater equates the media mentions to an AVE of $46.4 million over the period. Through October of 2021 alone, USDM and UNL mentions in 801 news stories have equated to an AVE of $22.9 million. From 2016-2020, the 4,198 stories that mentioned the NDMC and UNL totaled an AVE of $31 million.

In addition to a core of climatology expertise, the 21 NDMC employees have backgrounds in academic disciplines including physical and social sciences as well as the humanities, and relevant professions. We conduct needs assessments and evaluation using surveys, interviews and focus groups; develop and test web sites; and collaborate with local partners on process design and facilitation for public participation, outreach and education opportunities. Our published research spans physical and social sciences. We currently have four graduate students.

FIVE-YEAR PLAN

Recognizing that responding to drought in a changing climate is a complex social and political challenge, NDMC is actively growing its social science capacity, addressing broad questions of vulnerability and risk management. Five years from now we'd like to have more connections with social science and humanities researchers across the university, the country and the world. This complements our ability to tailor composite drought indicators, based on many data streams, including vulnerability, for countries around the world and for decision-makers across Nebraska and the U.S.

CHALLENGES

Historically the largest share of NDMC's support has come from USDA, NASA, NOAA, and other federal funders, as well as various United Nations agencies and the World Bank. In addition to continuing to cultivate and solidify these relationships, we would like to identify and work with foundations who share our vision for protecting people and ecosystems from water shortage and its consequences. Being a predominantly soft-money center, the NDMC will continue to work toward growing our core staff and capacity in order to meet the increasing demand for our services not only here in Nebraska, but also for the country and world. Additional resources in the form of state "core funding" would provide a real boost in our base operations, which could then be leveraged to help grow our collaborations across IANR/UNL, state and basin offices and ultimately serve in providing our student interns and those on assistantships with real-world applications and hands-on experience.

NEBRASKA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT (NECFWRU)

The Cooperative Research Units Program has been in existence for over 85 years as a partnership among the U.S. Geological Survey, the U.S. Fish and Wildlife Service, State fish and wildlife agencies, host universities, and the Wildlife Management Institute. The first unit was located at Iowa State University in Ames, Iowa. The program currently has 42 units in 40 states.

Kevin Pope
COOP Unit Leader

In 1960, the U.S. Congress gave statutory recognition to the program when they enacted Public Law 86–686, the Cooperative Research Units Act. The intent of the act was to "facilitate cooperation among the Federal Government, colleges, and universities, the States, and private organizations for . . . research and education relating to fish and wildlife, and for other purposes [by developing] coordinated, cooperative research and training programs for fish and wildlife resources. . . ."

DISTINCTION IN COLLABORATION

The Cooperative Research Units Program is a unique collaborative relationship among federal and state agencies, universities, and a non-profit organization. The tripartite mission of the Cooperative Fish and Wildlife Research Unit Program is:

1. Train graduate students for professional careers in natural-resource research and management.
2. Conduct research that will create new information useful for natural-resource management.
3. Provide technical assistance on application and integration of new science.

The Nebraska Cooperative Fish and Wildlife Research Unit (NECFWRU) embraces the mission of the Cooperative Research Unit Program and contributes daily to the overall success of the Cooperative Research Unit Program.

The NECFWRU meets this mission:

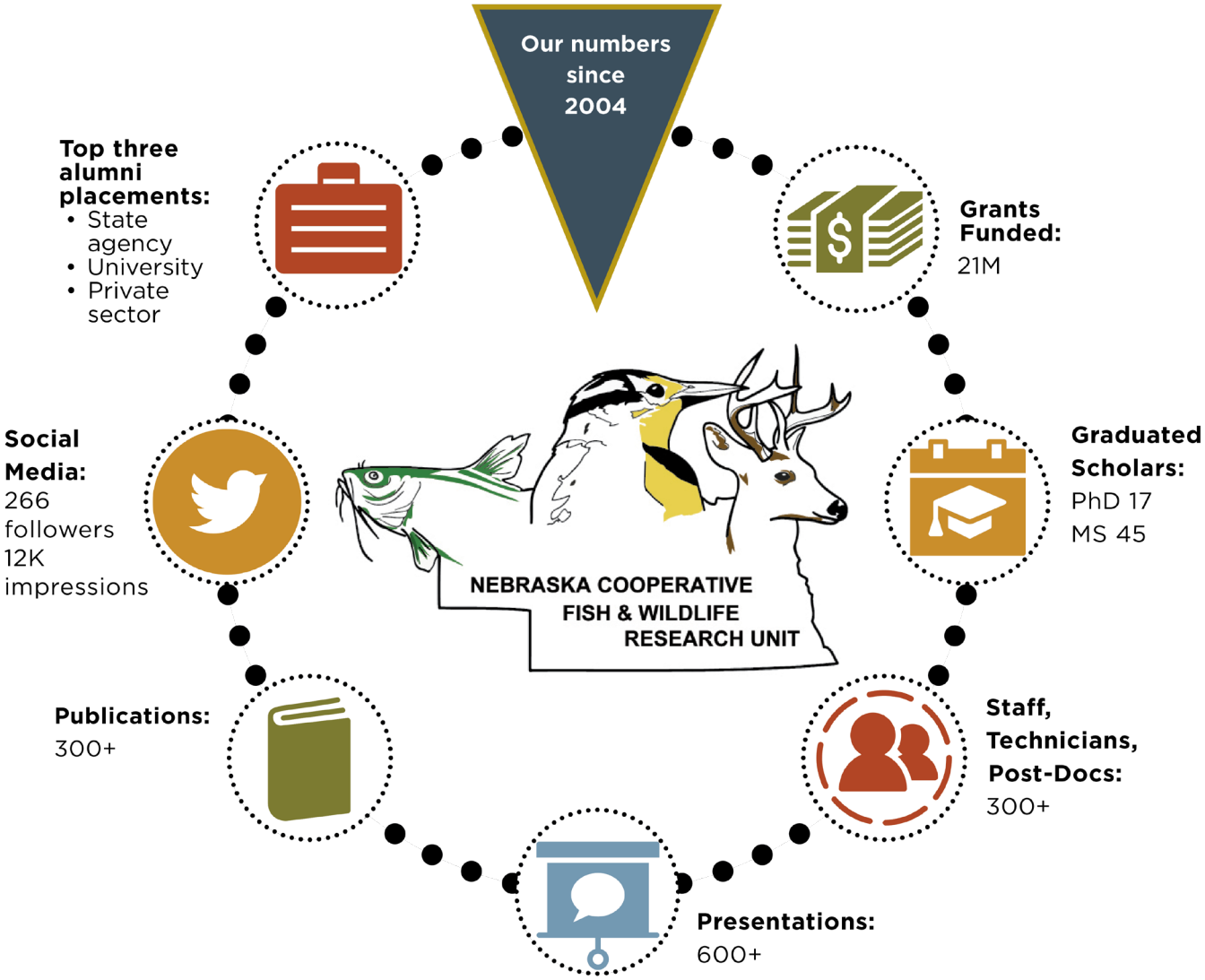
- Education: Unit scientists teach graduate-level university courses and provide graduate students academic guidance, linking the research mission with student training.
- Research: Unit scientists conduct research that supports the needs of local cooperators and partners. Research can be of local, regional or national interests.

- Technical Assistance: Unit scientists provide technical assistance and training to state and federal natural resource managers, and to other natural resource managers as needed. Cooperators benefit from the expertise of unit scientists, cooperating university faculty, and biologists at state natural resource agencies.

U.S. Congress founded the Nebraska Cooperative Fish and Wildlife Research Unit in 2002. Following congressional action, five signatory agencies signed a cooperative agreement, which since has been modified twice. Initial staffing of the NECFWRU occurred in 2004.

Components of the NECFWRU include three federal scientists, two state administrative assistants, and grant-funded graduate students, coordinators, and technicians. Also included are biologists, managers, and decision makers of government agencies, faculty members, administrators of universities and colleges, and personnel of non-governmental agencies. The NECFWRU will continue to be a powerhouse for graduate education and applied research in the school for the next five years.

ACADEMIC EXCELLENCE



FIVE-YEAR PLAN

- Continue alignment with national Cooperative Research Units program.
- Maintain formal and informal education efforts to enhance professional development of graduate students (who will become the next generation of natural resource managers).
- Maintain research efforts to enhance science-based management of natural resources at state, national, and international levels.
- Maintain technical assistance efforts to enhance professional development of biologists and managers.
- Enhance state, national, and global relevancy through graduate education, applied research, and technical assistance.

CHALLENGES

NECFWRU's emphasis on training professionals in the growing field of natural resource management while delivering scientific knowledge to State and Federal fish and wildlife agencies is a powerful model for future success. The resulting collaborations bring together a dynamic network of natural resource practitioners and researchers working to address rapid social-ecological changes in wildlife and fisheries. A primary challenge to the success of these efforts is managing planned and unplanned turnover of personnel. Throughout our profession, government agencies, including UNL, are having difficulties increasing pay of employees in the face of inflation and competition. Further, the loss of a Unit scientist generally results in a vacancy lasting 5-10 years. Fortunately, the NECFWRU has outstanding cooperator support.

SIGNATORY AGENCIES

The Nebraska Cooperative Fish and Wildlife Research Unit is jointly supported by a cooperative agreement among the U.S. Geological Survey, the Nebraska Game and Parks Commission, the University of Nebraska, the U.S. Fish and Wildlife Service, and the Wildlife Management Institute.

SCHOOL OF NATURAL RESOURCES

Nebraska State Climate Office
nsco.unl.edu

NEBRASKA'S CLIMATE RESOURCE

The Nebraska State Climate Office helps people across the state make climate-smart decisions through monitoring, assessments and engagement efforts. The NSCO monitors conditions across the state with the Nebraska Mesonet, a network that consists of 65 stations providing real-time weather and climate information. NSCO provides weather and climate assessments at conferences and meetings, news releases, website articles, and university conference calls. The NSCO regularly interacts with media, education and the agriculture sector, fielding data requests and making presentations.

6
Staff with expertise in climatology, meteorology and ecology

$2.28 MILLION
Grants and contracts, 2016–2020

16
Peer-reviewed articles since 2016

400–500
Data requests fulfilled annually

"We want to express our appreciation for all the work you are doing for our shared environment, as well as for your presentation and the way you wove together the comments from the farmers. Your panel got the most positive comments from our participants. It's comforting to know that more Nebraskans want the benefit of your knowledge about the climate."

- Elders for the Earth event participant

COLLABORATION AT ALL LEVELS

The NSCO participates in a range of collaborative efforts with a variety of agencies. They include: the NOAA High Plains Regional Climate Center, Weather Forecast Offices, the USDA Northern Plains Climate Hub, Natural Resource Districts, Nebraska Indian Community College, University of Nebraska – Lincoln researchers, University of Nebraska Medical Center, the National Drought Mitigation Center, the Nebraska Conservation and Survey Division, Platte Basin Timelapse Project, Creighton University, the National Soil Moisture Project.

PROJECT FOCUS
WEATHER STATION CALIBRATION

To provide people with accurate data about rainfall, temperature, wind speed and more, climatologists in states across the nation lead strategic installations of research-grade weather stations across their states. The NSCO now offers weather station sensor calibration services for research-grade equipment used in other states.

"We've always calibrated our instrumentation in house," NSCO director Martha Shulski said. "Now we're opening up this service to other state weather networks. We've got the expertise. Nebraska Mesonet technician Glen Roebke (pictured) has been doing this for roughly 20 years."

SHARING VITAL CLIMATE
INFORMATION ACROSS NEBRASKA

The NSCO regularly interacts with media, educators, students and the agriculture sector to share the latest information about weather conditions and climate trends developing across Nebraska. That includes sharing information on the NSCO website and social media accounts, participating in presentation and interviews as requested, producing a weekly weather outlook provided to Market Journal television and KRVN regional radio, briefing the Governor's Climate Assessment and Response Committee, and more. The NSCO is a proponent of getting the word out, and is looking to explore new avenues like podcast development to provide Nebraskans with key climate and weather info.

GET THE WORD OUT

50
In-person or virtual presentations per year on average

10
Articles published annually in Nebraskaland magazine

52
Weekly weather updates broadcast per year

4
Quarterly climate outlook published per year

12
Monthly climate summaries published per year

Nebraska State Climate Office
(NSCO)

Martha Shulski
NSCO Director

The Nebraska State Climate Office was founded in 2016. It focuses on weather and climate monitoring, climate services, and stake holder engagement. NSCO personnel (six staff, two graduate students and an undergraduate intern) seek to inform climate-smart decisions at local and state levels. The center has expertise in applied climatology, climate variability and change, meteorology and agricultural meteorology, and instrumentation and weather networks

Over the past five years, the Climate Office has been awarded $2.28M in grants and contracts. Funding agencies for applied research projects include USDA, NSF, NOAA (National Oceanic and Atmospheric Administration), a private engineering firm, the Nebraska Center for Energy Science Research, and the UNL (University of Nebraska Lincoln) Office of Research. Nebraska Mesonet funding is provided by NOAA, the Nebraska Department of Natural Resources, 10 Natural Resource Districts, Central Nebraska Public Power and Irrigation District, Nebraska Research and Extension Centers, Platte River Recovery and Implementation Program, Kimmel Orchard, UNL Department of Agronomy and Horticulture and the Nebraska Forest Service.

Publications

- 16 peer-reviewed articles since 2016
- 10 articles per year in Nebraskaland magazine
- Weekly weather update (52 per year)
- Quarterly climate outlook (4 per year)
- Monthly climate summary (12 per year)
- Special topics reports, as needed (10 per year)

The NSCO participates in a range of collaborative efforts and with a variety of agencies. In addition to some of the groups mentioned previously, the following are included: the NOAA High Plains Regional Climate Center, Weather Forecast Offices, the USDA Northern Plains Climate Hub, Natural Resource Districts, Nebraska Indian Community College, University of Nebraska – Lincoln researchers, University of Nebraska Medical Center, the National Drought Mitigation Center, the Nebraska Conservation and Survey Division, Platte Basin Timelapse Project, Creighton University, and the National Soil Moisture Project.

The NSCO maintains and operates the Nebraska Mesonet – one of the first such state networks in the U.S. The network consists of 65 stations providing real-time information to a variety of end users. The Mesonet has been a member of the National Mesonet Program since 2017 and is funded by 22 unique entities. It benefits weather forecasting, ground and surface water management, on-farm management, rangeland management, crop growth and disease assessment, emergency management, wildfire danger, drought and flood risk, public health, and research applications. Nebraska is part of a regional Mesonet effort in the Upper Missouri Basin to enhance snowpack and soil moisture monitoring for improved flood and drought risk services.

NSCO also provides weather and climate assessments through a variety of methods for university extension programming, crop insurance planning, state government climate monitoring, NOAA drought assessment, irrigation scheduling, peak energy load forecasting, insect development, cattle comfort forecasting, flood risk assessment and crop yield projections. We regularly participate in Nebraska's Climate Assessment and Response Committee (carc.nebraska.gov) and the development and delivery of NOAA's North Central Region Climate and Drought Webinar. NSCO provides risk assessments for upcoming growing seasons for the agricultural community through interviews, presentations, NOAA regional assessments, Climate Assessment and Response Committee input, and the NSCO website. Weekly assessments look at the latest National Agricultural Statistics Service statistics, summarize climate patterns the previous week, and assess the latest outlooks for the next 4 weeks. Bi-monthly reports include a monthly outlook and multi-season outlooks for the next year.

FIVE-YEAR PLAN

- Develop sector- and region-specific climate change material for Nebraska.
- Publish a digital climate atlas.
- Determine soil moisture frequency distributions to enhance climate monitoring.
- Move weekly agricultural weather updates to podcast format.
- Develop user-specific downloads for Mesonet data.

CHALLENGES

To fully accomplish its mission, NSCO needs four new personnel: a climate impacts specialist, a communications specialist, a web developer, and an applications specialist.

SUMMARY

Centers remain critical components in SNR's mission, operations, and overall success. The importance of these centers is likely to be magnified as the University addresses various challenges at different scales. The scores of faculty members, staff, and graduate-level students and undergraduate interns who work for the seven centers at the School of Natural Resources develop or facilitate the development of, research and resources to help Nebraskans and partners around the nation and the globe. Centers that do not have dedicated operating funds seek them, as well as additional funding resources, to sustain and enhance their work. Almost all of the centers express needs for additional operational staff, including communications specialists. Collaborating with additional federal, academic, or NGO partners is a goal of most of the centers. Developing new tools, data, and services to address needs in the face of a changing climate were listed as goals by multiple centers.

EXTENSION

SCHOOL OF NATURAL RESOURCES

Extension
snr.unl.edu/extension

COMMUNICATING COMPLEX SCIENCE

The SNR Extension team communicates complex science in innovative ways that resonate with both rural and urban audiences and produce positive outcomes for a diverse set of stakeholders.

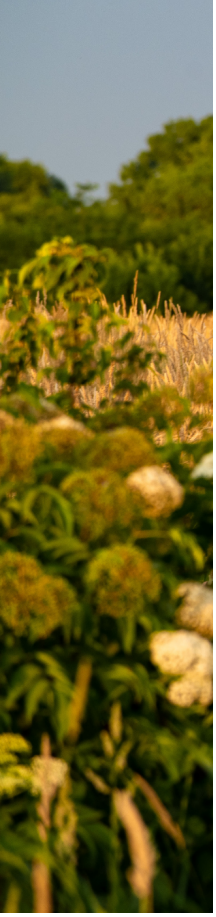
"The School of Natural Resources (SNR) Extension program is diverse with faculty and staff representing various disciplines such as surface- and groundwater, wildlife, geology, climate, agrichemical tracking, community and urban forestry, and remote sensing. Our extension professionals provide Nebraska communities with easily digestible and usable natural resources information to make scientifically based land management decisions."

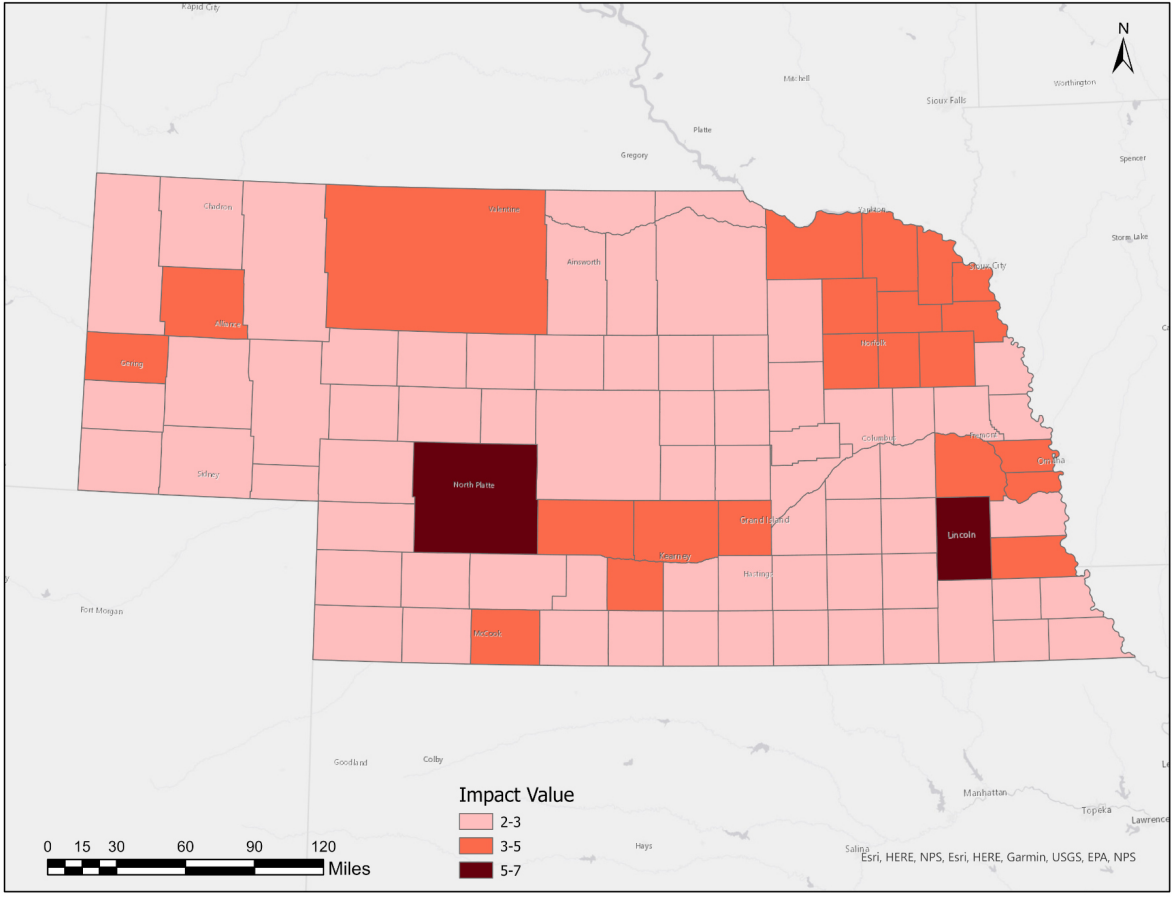
- Andrew Little, SNR Extension Coordinator

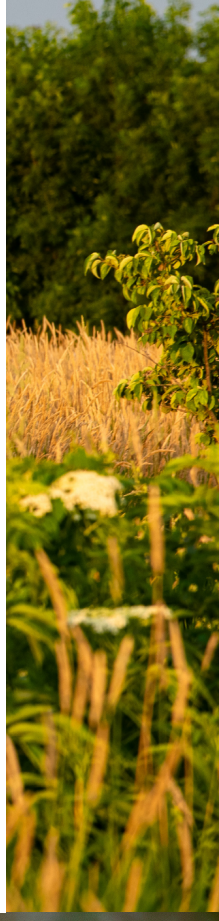
DEVELOPING PROGRAMS TO SUPPORT EXTENSION

SNR Extension personnel identify and occupy unique problem-solving spaces—climate, wildlife, geological and hydrogeological problems and resources, water quality, and environmental education—that would not be addressed otherwise.

Our programs include rare and critical long-term monitoring and research projects that are not duplicated in any other academic programs or governmental or non-governmental agencies. We identify and undertake projects on emerging issues of interest to Nebraskans. In these ways, we have meaningful impacts across the state.







ENABLING NEBRASKA STAKEHOLDERS AND DECISION MAKERS

SNR Extension engages federal, state, and local agencies, as well as key decision makers in natural resources management, in all 93 counties. These message multipliers directly influence agricultural practices and land management statewide.

SNR Extension is diverse, far-reaching, and has major impacts despite the relatively small total Extension FTE in SNR.

EXTENSION

INTRODUCTION

The School of Natural Resources (SNR) Extension program is diverse with faculty and staff representing various disciplines such as surface- and groundwater, wildlife, geology, climate, agrichemical tracking, community and urban forestry, and remote sensing. Our extension professionals provide Nebraska communities with easily digestible and usable natural resources information to make scientifically based land management decisions.

SNR Extension is active in all of Nebraska's 93 counties. It is the lead for programming in multiple centers, including the State Climate Office, Conservation Survey Division, and Nebraska One Health. Extension programming in SNR is supported by disciplinarily diverse group of faculty (5.3 FTE) and staff (7.4 FTE).

SNR Extension has lost faculty and staff support due to recent budget reductions, yet it is still required to produce impactful Extension programs and materials to Nebraskans. For example, Nebraska Extension hired two tenured faculty with more than 50% Extension Wildlife duties and two Extension Educators working in urban and rural wildlife damage management in 1994. That program became nationally recognized for leadership in human-wildlife conflict. However, the University reduced the personnel in the program to a single full-time Professor of Practice in 2015. The same individual was expected to produce all wildlife education and wildlife damage management training for UNL Extension Educators and Extension Assistants; he was also required to teach classes and answer all wildlife damage contacts from the public.

The lack of permanent state funding for personnel has created significant challenges for SNR Extension in accomplishing its mission. SNR is often not engaged in the Extension hires. Recently, SNR degree programs in environmental and water science were not even mentioned in a major hiring initiative of extension educators for the Water and Integrated Cropping Systems (WICS) program

ACHIEVEMENTS

Despite constraints in personnel, SNR Extension has had several notable achievements since the time of the last APR. These achievements include:

- Maximizing existing resources and developing new ones to achieve broad programming impacts. SNR Extension is diverse and far-reaching, and it has major impacts, especially relative to the relatively small total Extension FTE in SNR.
- Communicating complex science to diverse audiences. We communicate complex science in innovative ways that resonate with rural and urban audiences, producing positive outcomes for diverse stakeholders. This includes online forums, autonomous learning modules, face-to-face interactions, newsletters, websites, on-demand web tools, social media, game development, virtual and in-person workshops and presentations, and more.
- Developing niche programming to support the mission of Extension. SNR Extension personnel identify and develop Extension programming unique to our disciplines (climate, wildlife, geological and hydrogeological problems and resources, water quality, and environmental education) that would not be addressed by Extension programs otherwise. SNR programs include unique long-term monitoring and research projects that are not duplicated in any other academic programs, or governmental or non-governmental agencies. We identify and undertake work on emerging issues of interest to Nebraskans. In these ways, we are nimble and responsive to the needs of Nebraskans while having meaningful impacts across the state.
- Leveraging partnerships in the terms of support dollars, infrastructure and materials support, and personnel contributions to have broad impacts.
  - Participating in a collaborative project examining the role of bioenergy crop production on reducing the demand on the High Plains aquifer system. This project is a partnership between faculty and staff in the School of Natural Resources and the departments Agricultural Economics, Agronomy and Horticulture, and Entomology, as well the USDA-ARS and Argonne National Laboratory.
  - Participating in a research project examining the role of precision conservation in agricultural systems in Nebraska. Partners include faculty and staff in the School of Natural Resources and the Department of Agronomy and Horticulture at UNL, and faculty in the biology programs at the University of Nebraska at Omaha and the University of Nebraska at Kearney.
- Engaging Nebraska stakeholders and decision makers. SNR engages federal, state, and local agencies, as well as key decision makers in natural resources management across Nebraska. These message multipliers directly influence agricultural practices and land management statewide.

FIVE-YEAR PLAN

- Maintain our excellence. Our successes to date demonstrate that SNR has a core of dedicated personnel that can guide future successes in Extension, but the magnitude of our impact will depend on total FTE and other factors outlined in forthcoming sections.
- Address the University's Grand Challenges. Centers in SNR are well-positioned to address recently identified grand challenges. Ideally, centers could coordinate efforts and appropriately frame some outreach activities within Extension structures to increase SNR Extension visibility and impact.
- Improve communication. SNR Extension needs to better communicate its value to IANR administration. One strategy to increase the perceived value of SNR Extension is to improve our impact analysis by comprehensively evaluating SNR Extension programming. An increase in federal funding (e.g., NSF and USDA) may also increase our perceived value. SNR should look to funding opportunities that incorporate andragogy, systems thinking, STEM concepts, and/or an evolving vision of Extension activities.
- Achieve fuller engagement and recognition of SNR activities within the IANR Extension overall, including involvement in major initiatives. SNR Extension work is at the forefront of many local to global natural-resources issues, but individuals do not always feel included in current Extension structure and initiatives. We suggest that the Extension Leadership Team should facilitate connections between large-scale Extension initiatives and SNR programming.
- Foster diversity, equity, and inclusion. Specifically, we will stress inclusivity in the development and delivery of our programs.
- Emphasize evaluation in our programming. In this way, we will increase and better document our impacts. We should identify and seek to employ metrics such as acres influenced by our programs, behavioral impact, financial impact (e.g., "our programs saved landowners $_____") compared to the traditional approach of "we gave _____ presentations this year." Internal leadership in this transition and communication of the resulting impacts are critical.
- Include the Platte Basin Timelapse (PBT) in SNR Extension efforts because it has major potential for community engagement. Additionally, their expertise of storytelling can provide a platform for other SNR faculty and staff to communicate their message to a broader audience.
- Provide climate-based extension and decision support services for agriculture and other sectors of Nebraska.
- Hire multiple Extension Educators and/or Extension Specialists to address public health and water, and wildlife damage management.
- Hire at least one communication specialist to help SNR Extension personnel improve

the dissemination of their research to a broader audience through various media forms such as social media, and website development.
- Develop programming in support of, and in collaboration with, the University of Nebraska Medical Center's Water, Climate, Health Program.

CHALLENGES

- More state-fund Extension FTEs will be required if we are to build upon our successes. SNR Extension is growing because of timely external grants. This growth is unsustainable, and that constraint hampers planning at scales of five years and beyond. Previous staff cuts during budget reductions have left individual SNR Extension personnel trying to accomplish the jobs of multiple personnel. This mode of operation is unsustainable.
- More communication and engagement with Extension administration will greatly benefit us. SNR Extension faculty and staff frequently feel excluded from the traditional UNL Extension model, and they feel that their work is insufficiently noticed. Additional engagement with UNL Extension administration and other UNL Extension personnel could amplify our work.

SUMMARY

SNR Extension is clearly successful, but it needs additional state-funded faculty and staff FTEs, including a communicator, to amplify its impact. The future portends many great opportunities for highly effective collaboration, but improved communication with Extension administration and other Extension personnel must be developed. Simultaneously, an external understanding of the value of SNR's diverse disciplines, missions, and skill sets needs to be achieved across IANR.

CONCLUDING REMARKS FROM THE DIRECTOR

We in SNR will always strive to fulfill our mission, contribute to shared success, and serve Nebraskans to the best of our ability. We are always grateful to be included within a forward-thinking Institute that appreciates our disciplinary diversity.

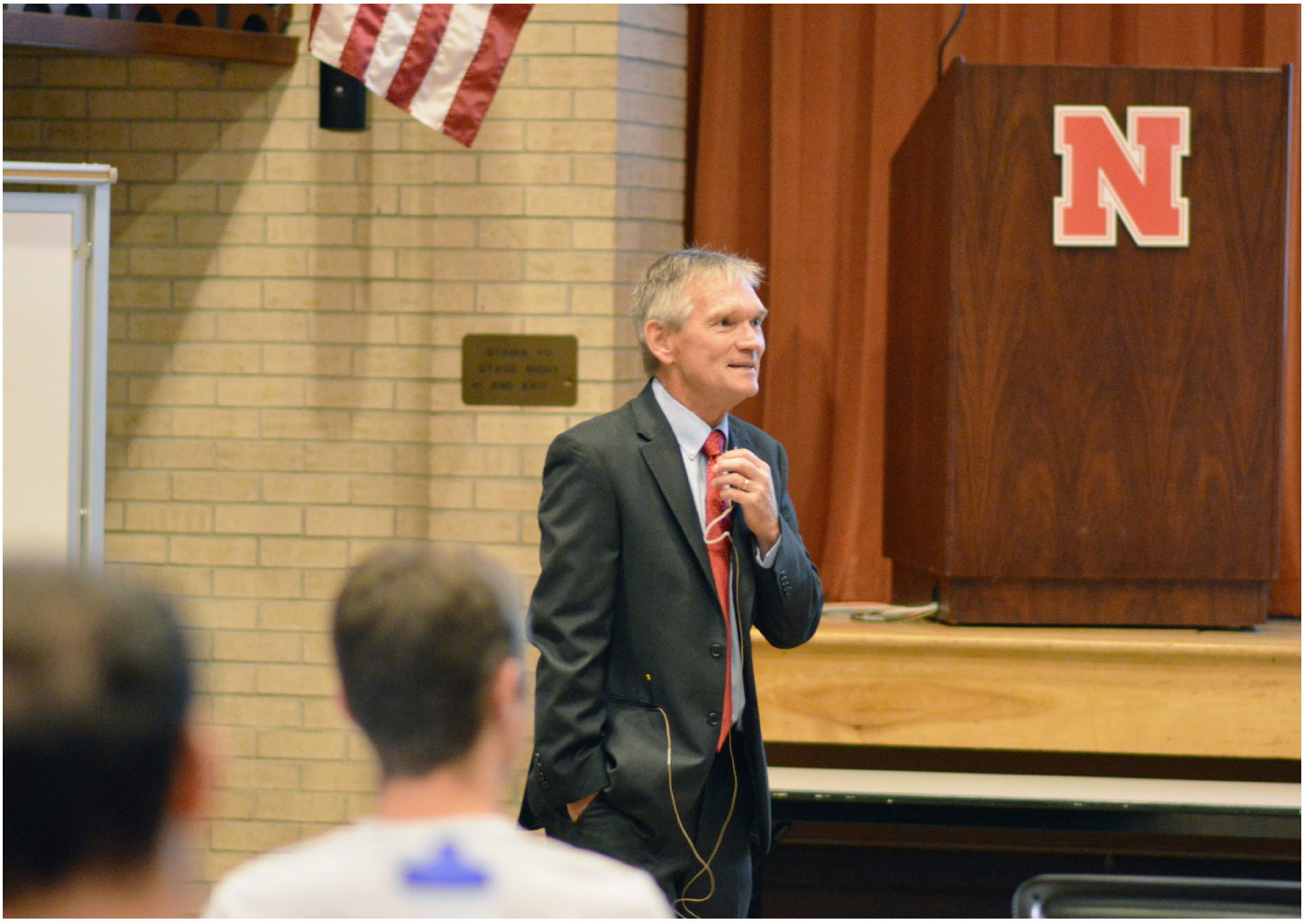
I extend my heartfelt thanks to those who contributed to this document and to those who will read it. I strongly believe that our investment in this Academic Program Review will bear fruit in our search for excellence.

All of the SNR community appreciates the opportunity to educate interested parties in the context of this review. Moreover, we welcome the constructive criticisms and overall guidance that will emerge from this process.

I reiterate my contention that SNR is a critical asset for IANR and the University at large. With the cooperation of administration, I am adamant that our full potential has yet to be realized. Thus, I foresee a brilliant future for the School.

Our journey toward excellence will require commitment and investment--who will join us?

–John P. Carroll



Photos by Ethan Freese, Michael Forsberg/Platte Basin Timelapse

University of Nebraska Lincoln