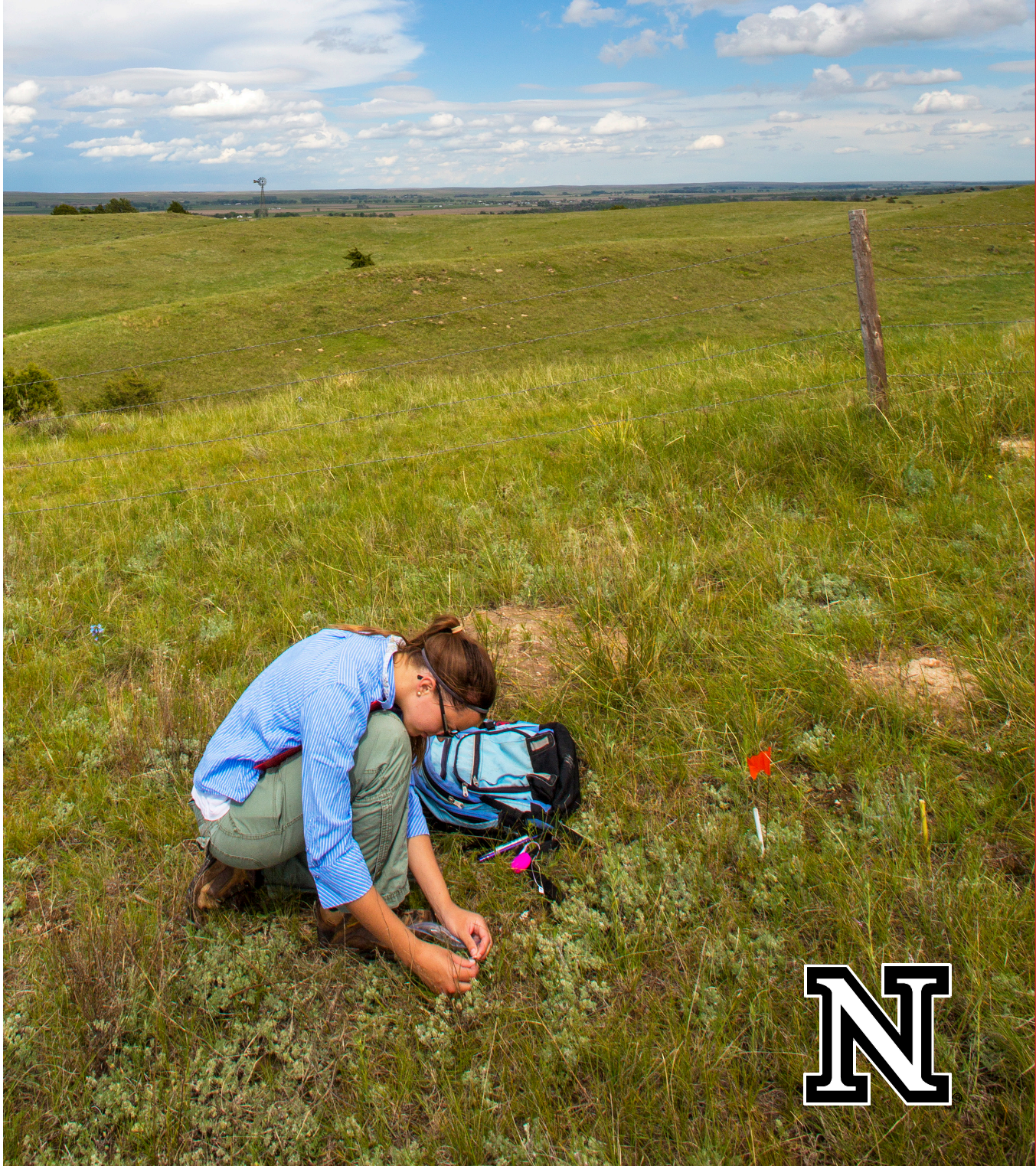


# **2015 Academic Program Review**

## **School of Natural Resources**

### **University of Nebraska–Lincoln**







# 2015 Academic Program Review

## School of Natural Resources, UNL

Acknowledgements: 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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## Executive Summary

Natural resources include everything used or valued by humans and not created by humans. As a result, people, the choices they make, their values and beliefs, are at the core of what the School of Natural Resources does at the University of Nebraska-Lincoln. Because SNR is located at a land-grant university in one of the most agricultural states in the country, we are uniquely positioned to tackle all three of the land-grant functions relative to agriculture from a perspective different from all of the other units in IANR. SNR provides the expertise that society needs to balance the desire for increased food production with other societal priorities.

Today, we are achieving our educational goals at a higher level now than at any time since our founding in 2003. We have more undergraduate students than in 2003, although the number of students in our classes fluctuates a great deal between even and odd years. Our graduate program has quadrupled in size since 2003. Sponsored support for our research averaged \$9.1 million annually since FY 2010-2011.

Despite this ongoing success, SNR faces significant challenges. Sharing faculty members across IANR, the College of Arts and Science and the College of Engineering creates administrative challenges with annual evaluations, salary increases, and promotion and tenure. High faculty turnover and inflexibility in adjusting FTE distributions among Teaching, Research and Extension areas make it difficult to maintain programs over time. A final challenge facing SNR is the significant reliance on either soft (grant-funded) or non-UNL faculty as significant contributors to Mission Areas within the school. It is sometimes difficult for these faculty members to contribute to the overall mission of SNR, since grant or government agency requirements dictate much of their work effort.

IANR is presently making significant investments in SNR, with five faculty positions either interviewing or accepting applications, and a further six positions approved but not yet released. Notably, one of these positions is partially funded through a partnership with Nebraska Game and Parks Commission.

This document focuses on the decisions made by SNR faculty as a whole, and in various sub-units including four mission areas, centers and affiliated educational programs. These decisions involve allocation of resources (operating budget, classrooms, equipment), prioritizing new faculty hires, undergraduate and graduate curricula, and outreach events. In a series of open meetings of staff, students and faculty, we developed a range of objectives to guide our decisions. We developed a series of alternative packages of actions ranging from “status quo” (i.e. no changes) to a “Balanced Mix” of proposed actions for the next five years. At a half-day retreat, participants selected the Balanced Mix alternative that includes:

- Faculty Advisory Committee (FAC) revisits the learning objectives of all curricula, developing a core Natural Resource Curriculum that transcends different majors, and making sure the appropriate coursework is available. FAC also evaluates SNR involvement in online and distance education in light of the CASNR 2025 Online and Distance Education Plan.
- Natural Resources Undergraduate committee develops annual surveys of student engagement and post-graduation success/satisfaction. Establish a teaching improvement roundtable discussion group to help faculty with peer review of teaching.
- SNR Administration focuses on the Applied Climate Science major, particularly student recruitment, and developing a new Community and Urban Forestry major in collaboration with the Department of Agronomy and Horticulture and the Nebraska Forest Service using grant funding obtained from USFS.

- Graduate Committee to review opportunities and challenges for expanding graduate student numbers in SNR.
- Establish an advisory committee at the SNR level comprised of external stakeholders (DNR, NRDs, Game and Parks, EPA, NRCS, USDA-ARS, and others from the public and private sectors) who meet with the faculty and administration to provide advice on curricula and capability needs of graduates as well as identifying research needs. Some members should be from outside Nebraska in order to represent national interests. Engaging with our community of stakeholders will ensure our teaching, research, outreach and extension activities focus on things the community cares about.
- Develop an SNR research committee comprised of senior faculty to develop school-level interdisciplinary teams to pursue large grant opportunities. Establish an external fundraising and development committee to enhance SNR endowment.
- Refocus our outreach efforts on two large events, discontinuing our fall evening public talks. Naturepalooza continues to focus on biotic natural resources in the fall, while we reinvent the spring Severe Weather Symposium to include soil- and water-related activities. SNR Administration to evaluate the role of SNR Extension within IANR Extension Program starting in October 2015.
- Starting in 2016, SNR administration works with an administrative consulting firm to enhance training opportunities for SNR administrative team. Starting in 2017, SNR administration and center directors review sustainability plans for all SNR centers. Starting in 2018, SNR administration reviews operations of Nebraska Maps & More.
- Annually identify core and priority faculty hire proposals with equal weight on teaching, research, service and extension missions.

Development of a core NR curriculum increases the sense of integration among faculty across SNR, improving morale and possibly increasing collaborative research and extension efforts. Surveys of student satisfaction identify problem areas quickly, leading to increased student retention and faster graduation rates. Feedback from employers and alumni increases relevance of coursework and provides evidence of job success for graduates, further increasing enrollment. Interactions with stakeholders lead to increased research funding for relevant research. Expanding the range of outreach activities increases the number of faculty contributing to outreach. In addition to increasing both numbers of students and research dollars, this alternative will improve the quality of our undergraduate programs and the relevance of our research and extension activities.

These SNR-level decisions are combined with decisions from each of the mission areas, centers and affiliated educational programs to form a portfolio of actions that we will pursue over the next five years.

### **SNR Administration Level Priorities**

For the next 5 years a number of key SNR level challenges and priorities will be advanced by SNR administration for development of more effective use and management of resources and human capital, as well as modernization of program in the face of a changing higher education landscape.

- 1) SNR Management Development
  - a) Work with administrative consulting firm to enhance training opportunities for SNR team with administrative appointments. Initiate during 2015-2016 academic year.
  - b) Enhance support of staff professional development opportunities.



- c) Review future of Nebraska Maps and More. To be started in 2018.
- 2) SNR Teaching
  - a) Complete evaluation of undergraduate teaching and management of majors within SNR (Common core, capstone, integration of majors). Program to be lead by FAC starting in September 2015. Outline of questions and issues to be addressed will be delivered to FAC by Director at September 2015 FAC meeting.
  - b) Complete evaluation of SNR involvement in online and distance education. Outline of issues will be delivered to FAC by Director at September 2015 FAC meeting. FAC may choose to undertake this in conjunction with number one above.
  - c) Focus on Applied Climate Science major, especially student recruitment.
  - d) Continue development of Community and Urban Forestry Major. In development with Dept of AgHort and Nebraska Forest Service (grant funding obtained from USFS).
  - e) Review graduate student expansion in SNR including opportunities and challenges. To be undertaken by SNR graduate committee starting in September 2015.
- 3) SNR Extension
  - a) Establishment of a Nebraska State Climatology Office within SNR. Lead taken by SNR administration with key ACS faculty. Process has begun.
  - b) Evaluation of the role of SNR Extension within IANR Extension Program. Informally already begun, but formally starting in October 2015 by SNR administration.
- 4) SNR Research
  - a) Develop SNR research committee comprised of senior faculty to develop School level interdisciplinary teams.
- 5) SNR Centers
  - a) Review/establish sustainability plans for all SNR Centers with Center Directors. Starting in 2017.
- 6) SNR College of Arts and Sciences
  - a) Rebuild Geography Program and continue integration within SNR.
  - b) Meet with other unit administrators within CAS to establish framework for leveraging faculty positions and role of geography in CAS. To begin after new geography faculty hires in 2016.
  - c) Initial Spatial Science Center concept in 2017.
- 7) SNR External
  - a) Develop plan for establishment of External Advisory Boards for SNR and possibly Mission Areas within SNR. Lead taken by SNR administration starting summer 2016.
  - b) Establish Nebraska Stakeholders Board (DNR, NGPC, DEQ, NET, NRDs, Highways, and others) Lead taken by SNR administration starting September 2016.
  - c) Establish an external fundraising and development committee to enhance SNR endowment. Lead taken by SNR administration starting January 2017.

### **SNR Mission Area Priorities**

- 1) Applied Climate Science
  - a) Add two faculty hires (Climate Risk, and Climate Monitoring and Decision Support) to enhance the research capacity of ACS in the areas of climate variability and change and build a stronger undergraduate program to complement the ACS graduate program, increasing the teaching FTE

- to 1.90. These hires will assist with teaching key ACS courses on an annual basis, currently a serious deficiency in the program. (2015-2019)
- b) Increase the number of undergraduates and graduate students and, thus, the number of student credit hours. (2015-2019)
  - c) Enhance the Nebraska State Climate Office and assimilate climate resources geared toward state services (weather monitoring, extension, outreach, research). (2015-2016)
  - d) Coordinate and integrate the extension, research and teaching objectives of the Applied Climate Science faculty to enhance the contributions of climate science to UNL programs and better serve stakeholders needs (2015-2017)
- 2) Applied Ecology Mission Area
- a) Review and adjust undergraduate curriculum to incorporate new capacity and interests of new faculty positions, 2016-2017
  - b) Develop an NSF Research Experience for Undergraduate proposal 2016-2017
  - c) Develop an Applied Ecology stakeholder research symposium to showcase research and deepen collaborations off-campus, 2017-2018
  - d) Develop a strategy for professional development activities to support productivity of faculty and postdocs, 2017-2018
- 3) Environmental Sciences
- a) Review learning objectives for both Water Science and Environmental Restoration undergraduate majors and identify curriculum gaps. Consider advantages and disadvantages of consolidating the two majors.
  - b) Develop a minor for hydrology/water science to promote a departmental wide “water literacy” among all SNR graduates.
  - c) Strategize on the development of a nationally recognized and unique ‘theme’ for our SNR programs, for example, a ‘water’ theme that will attract students and set national standards for water education. The intention is to elevate our international exposure and visibility through a nationally unique theme that recognizes Nebraska’s uniqueness.
  - d) Identify research and teaching areas where ES (SNR) and UNL lack sufficient expertise and leadership, networking and vision to assemble strong and successfully competitive research teams.
  - e) Develop graduate/undergraduate courses in (a) An applied groundwater modeling course, and (b) “GIS in Natural Resources and the Environment” (GIS-NR-E). Offer a Hydrology course every semester to support a department-wide water theme and to promote ‘water literacy’.
- 4) Geography and Spatial Science
- a) Add new faculty hires in the areas of GIS, remote sensing, land use/land cover, and human-environment interactions to re-establish a viable undergraduate and graduate degree programs in Geography. (2015 – 2019)
  - b) Raise the number of Geography majors and students pursuing Masters and Ph.D. degrees. (2015 – 2019)
  - c) Strive for national research and teaching prominence in the areas of remote sensing and GIS, Geography of the Great Plains, and environmental change and raise the visibility and communicating the value of Geography across UNL. (2015 – 2019)
  - d) Integrate Geography research and training in spatial analysis with key initiatives and Centers within SNR and UNL.

**CALMIT** rebuilds recently lost capacity with some positions already advanced and seeks further faculty positions to capitalize on the facilities already available for research.

**Conservation and Survey Division** continues to transition in structure while maintaining the legislatively mandated functions to record and disseminate information about Nebraska's geological resources.

**Great Plains Cooperative Ecosystem Studies Unit** has just been renewed for another five years. The director and National Park Service staff in the unit intend to develop a research theme to bring together land managers and researchers on a larger more collaborative scale than heretofore.

**High Plains Regional Climate Center** is also embarking on a new five-year cycle of funding from NOAA. In addition to meeting NOAA objectives, faculty and staff will work on identifying funding to develop decision support tools for delivering climate information.

**National Drought Mitigation Center** has recently received significant funding through NOAA providing a stable basis for continued operations over the next five years.

**Nebraska Cooperative Fisheries and Wildlife Unit** is still fully staffed with three federal scientists, and will continue to be a powerhouse for graduate education and research in the school for the next five years.

**Environmental Studies Program** continues to diversify the faculty contributing to the core teaching program, and develop new outreach opportunities.

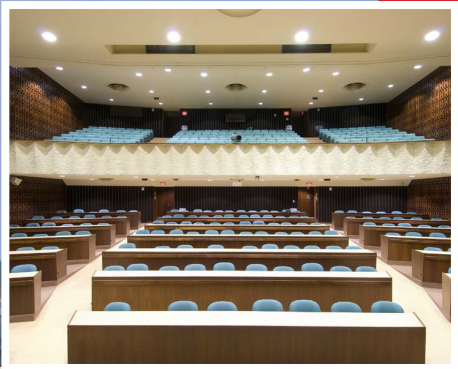
**Human Dimensions Program** capitalizes on new faculty hires to continue delivering social sciences education for our undergraduate and graduate programs while expanding participation in interdisciplinary research projects.

**IANR Science Literacy Initiative** builds a brand new program of disciplinary-based educational research and contributes to core teaching requirements in CASNR.









# School of Natural Resources

## School of Natural Resources

### Our vision and mission

As part of the preparation for this Academic Program Review, the faculty, staff and students of SNR participated in a series of meetings aimed at “re-envisioning” what SNR is about. Our new vision is:

*Empower people to make informed choices about natural resources.*

Our mission is to cooperate with people in Nebraska and beyond to:

- Engage with people who make choices about natural resources.
- Prepare students to excel in their careers.
- Advance understanding of natural resources.

Natural resources may be biotic (e.g. plants, fish and wildlife) or abiotic (e.g. air, water, minerals). Natural resources can be renewable (water, forests) or non-renewable (mineral deposits). In addition to material resources, services such as nutrient recycling are also natural resources. Humans value the appearance of the landscapes around us. People, the choices they make, their values and beliefs, are at the core of what the School of Natural Resources does at the University of Nebraska-Lincoln.

Because SNR is at a land-grant university in one of the most agricultural states in the country, we are uniquely positioned to tackle all three of the land-grant functions relative to agriculture from a perspective different from all of the other units in IANR. Rightly so, most of the units associated with IANR focus on various components of agricultural (food and fuel) commodity production. Agricultural production depends upon natural resources: land, water and many natural services. However, society also expresses priorities for these resources other than agricultural production. Take water as an example. People want water for drinking, providing habitat for fish and wildlife, and outdoor recreation. In addition, there are complex feedbacks between human choices in our homes and workplaces that affect water supply via the climate system and the critically important High Plains Aquifer. SNR provides the expertise society needs to balance the desire for increased food production with other societal priorities.

IANR administration encourages close working relationships with other IANR units leading to collaborative and interdisciplinary research, teaching and extension. Historically, this has already happened at a number of levels reflected in shared faculty positions with Agronomy and Horticulture, Biological Systems Engineering, Agricultural Economics within IANR, and also with departments in the College of Engineering, College of Arts and Sciences, and College of Education and Human Sciences. We also have relationships with Science Literacy Initiative (coordinator and two faculty housed in SNR), Environmental Studies (director housed in SNR), and Forensic Sciences (two faculty housed in SNR). Finally, we have faculty with appointments in the Nebraska Museum (two in curatorial roles; one of these is retiring) and a large number of faculty with appointments or affiliations with the Daugherty Water For Food Institute, and Center for Great Plains Studies.

### Founding and History

Numerous committees, subcommittees, external review teams, and task forces discussed the formation of a broader natural resources unit at the University of Nebraska–Lincoln (UNL) periodically from 1965 onward. Indeed, many of the units merged to form the School of Natural Resources (SNR) were included in a subcommittee report to the Board of Regents in 1980. Their recommendations included the following:



*Study the feasibility and advisability of establishing a School of Natural Resources within the Institute of Agriculture and Natural Resources to include: Conservation and Survey, Meteorology and Climatology, Forestry, Fisheries and Wildlife, Arboretum, Range Management, Hydrology, Environmental Programs, and possibly the Geology Department from the College of Arts and Sciences.*

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After decades of discussion and debate, the **School of Natural Resource Sciences (SNRS)** was formed in 1997 by consolidation of the Department of Forestry, Fisheries and Wildlife; the Department of Agricultural Meteorology; a portion of the Conservation and Survey Division (CSD), including the Center for Advanced Land Management Information Technologies (CALMIT); the UNL Water Center; and faculty from several other academic units, including the Department of Agronomy, the Department of Geosciences, and the School of Biological Sciences. The Nebraska Forest Service and the Nebraska Statewide Arboretum were identified as close affiliates of the new school. Thus, SNRS was formed by the merger of two long-standing units and faculty from several others, yet it did not include all of the units envisioned by the subcommittee report to the Regents in 1980 or by the SNRS Implementation Committee in 1996 (which essentially echoed the 1980 report).

SNRS represented a new model for academic units at UNL, because it was the first unit to be part of *both* the College of Arts and Sciences (CAS, located on City Campus) and the College of Agricultural Sciences and Natural Resources (CASNR), which is part of the Institute of Agriculture and Natural Resources (IANR, located on East Campus). Thus, the director of SNRS reports to four deans in two colleges, one in CAS and three in IANR (i.e., teaching, research and extension). In addition, SNRS comprised many faculty members with *joint appointments* in SNRS and other academic units, as well as a large number of affiliated faculty members with adjunct or courtesy appointments. A major goal of the school was to enhance the professional expertise of the faculty by facilitating programmatic interactions needed to address priority needs. In addition, SNRS was designed to foster partnerships and linkages with state and federal agencies. Since its inception in August 1997, the school has undergone numerous important changes, including several changes in leadership (Table 1). In addition, the Natural Resources Business Center (NRBC), which provided business and administrative support to SNRS (and now SNR) and its affiliates, was centralized in a new location along with SNRS administrative offices, and the Water Center was transferred back out of the school in 2001.

The School of Natural Resources was established on July 1, 2003, by the consolidation of the School of Natural Resource Sciences, Conservation Survey Division and the Water Center. Programmatic opportunities and enhanced service to clientele groups were key elements in the decision to create a new unit. This merger was intended to leverage a history of collaboration at a time when administrative efficiencies and limited funding issues were critical, as they remain today. Integrating CSD with SNRS and the Water Center was a logical extension of a high level of formal and informal integration already in place through SNRS, and it fulfilled most of the recommendations made in 1980.

The Geography faculty and degree programs joined SNR on July 1, 2008. This merger brought the largest group of geography faculty at UNL (faculty working primarily with CALMIT within SNR) together with the Geography undergraduate and graduate programs. The next major organizational change was the departure of the Water Center in February 2012 to become a part of the new Water for Food Institute.

*Table 1* Directors of SNRS and SNR since 1997.

Director	Type of hire	Start of Tenure
Blaine Blad	Internal	August 1997

<b>Ted Elliot</b>	External	June 2000
<b>Kyle Hoagland</b>	Interim	Jan 2002
<b>Mark Kuzila</b>	Internal	Aug 2003
<b>Don Wilhite</b>	Internal (after unsuccessful external search)	Aug 2007
<b>Tala Awada</b>	Interim	Aug 2012
<b>Mark Kuzila</b>	Interim	July 2013
<b>John Carroll</b>	External	Aug 2013

In the lead up to the 2009 review, we established six “Faculty Areas” with the goal of improving communication among faculty with shared interests. The faculty areas were: Applied Climate Science, Geography, Human Dimensions, Applied Ecology, Water and Soil/Geology. Each faculty member nominated three areas to be a part of. Some of these areas were more successful at increasing communication than others, and some had too few primary faculty members to be viable. For example, only two non-tenure track faculty members selected Human Dimensions as their primary area. As a result, in 2014 we streamlined our organization into four “Mission Areas,” which are: Applied Climate Science, Geography and Spatial Sciences, Environmental Science and Applied Ecology. In addition to providing a forum for each group to have a greater critical mass, it creates more internal managerial structure. Mission Area Leaders will be expected to take on increased managerial responsibility in the future.

Today, we are achieving our educational goals at a higher level now than at any time since our founding in 2003. We have more undergraduate students than in 2003 (Figure 1) and our courses are well attended by students from across the university (Figure 2). Our graduate program has quadrupled in size since 2003 (Figure 3). Sponsored support for our research is good but highly variable from year to year (Figure 4). In 2014 the school was ranked well above the median of 50 natural resources departments on 22 variables relating to research outputs and impact (Figure 5). Our growth over the past 5 years has occurred despite a 28% reduction in the total number of faculty with appointments in the school (Figure 6).

We do not have comprehensive data to evaluate the success of Survey, Extension and outreach activities, or stakeholder engagement. Figuring out how to evaluate these aspects of our mission is a key activity for the next few years.



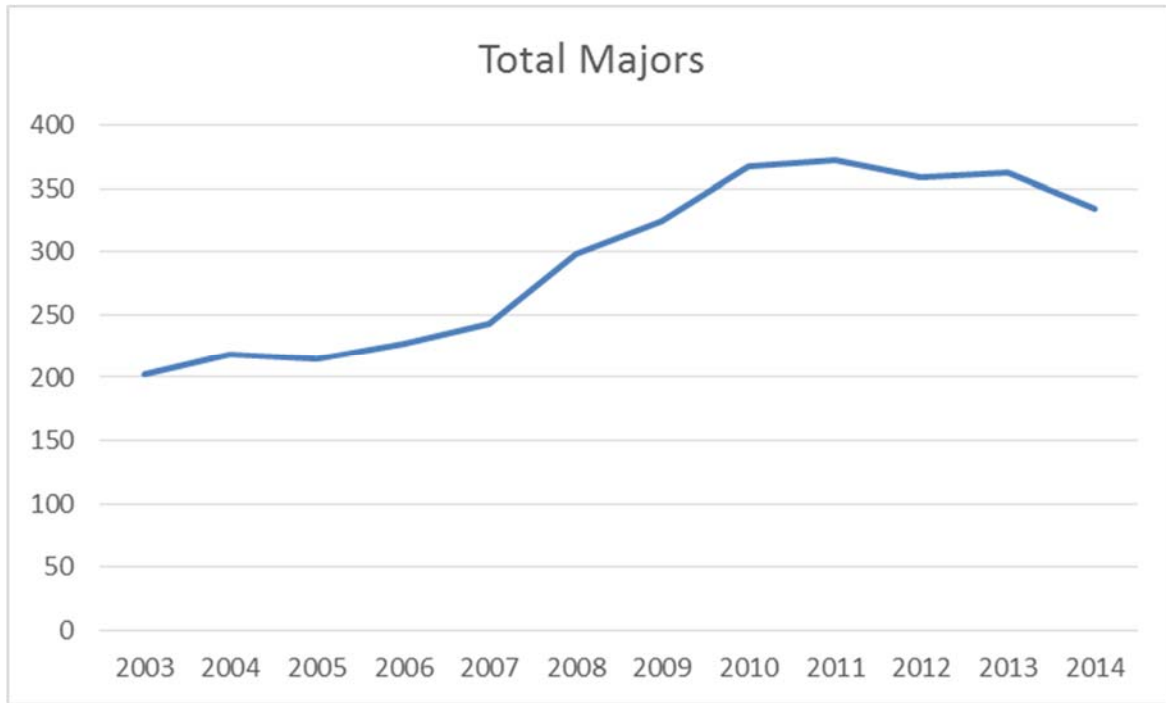


Figure 1 Total number of undergraduate students in the Fall Census across all Majors coordinated by SNR faculty. Data by major are in Appendix A.

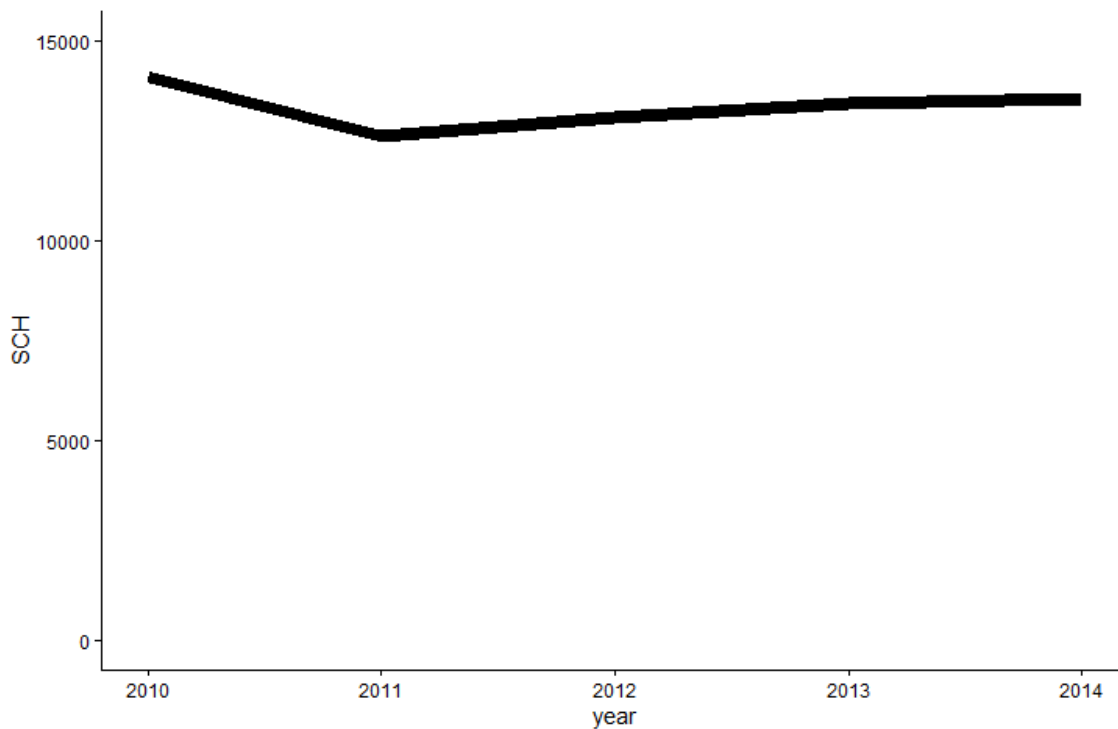


Figure 2 Student credit hour (SCH) production for the past 5 academic years. SCH by Mission Area is in Appendix A.

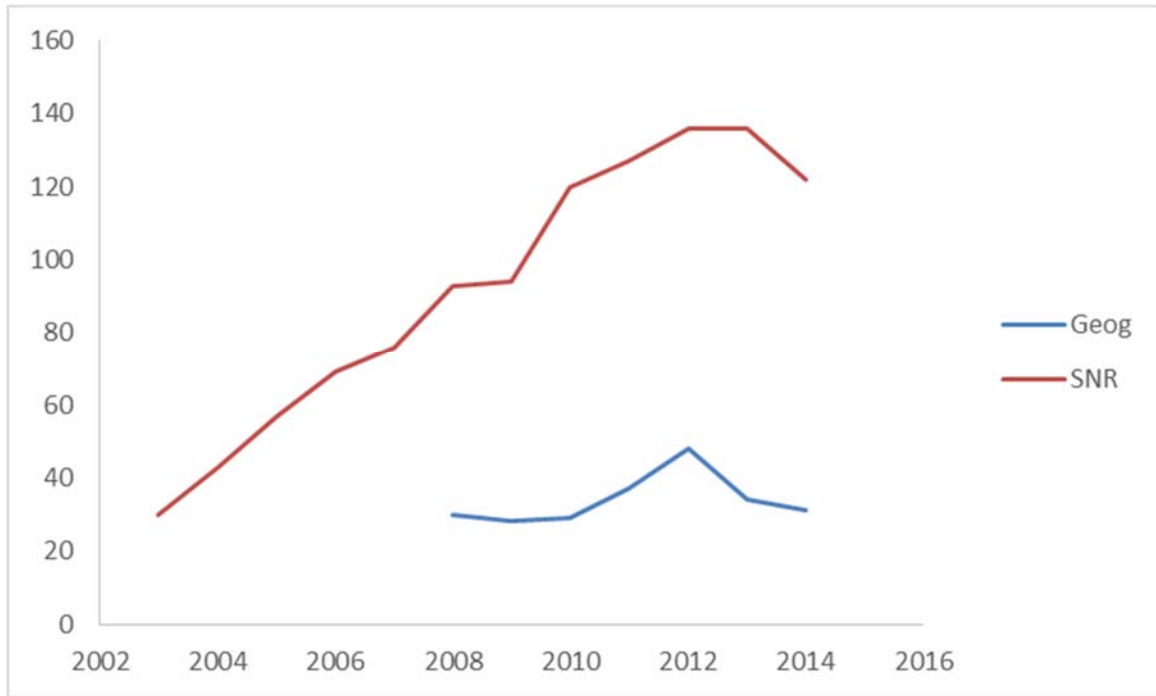


Figure 3 Number of admitted graduate students in Geography and Natural Resources. Data for Geography are unavailable prior to 2008.

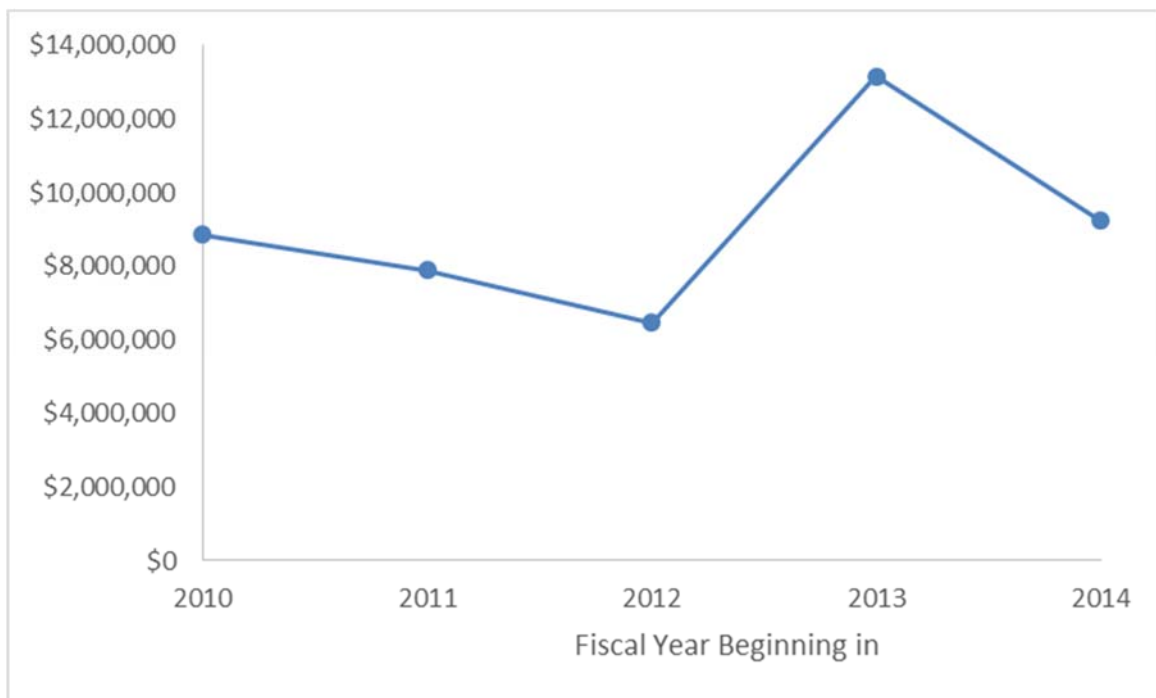


Figure 4 Total funds awarded from all sources, by Fiscal Year awarded. More details are available in Appendix B.

## School of Natural Resources

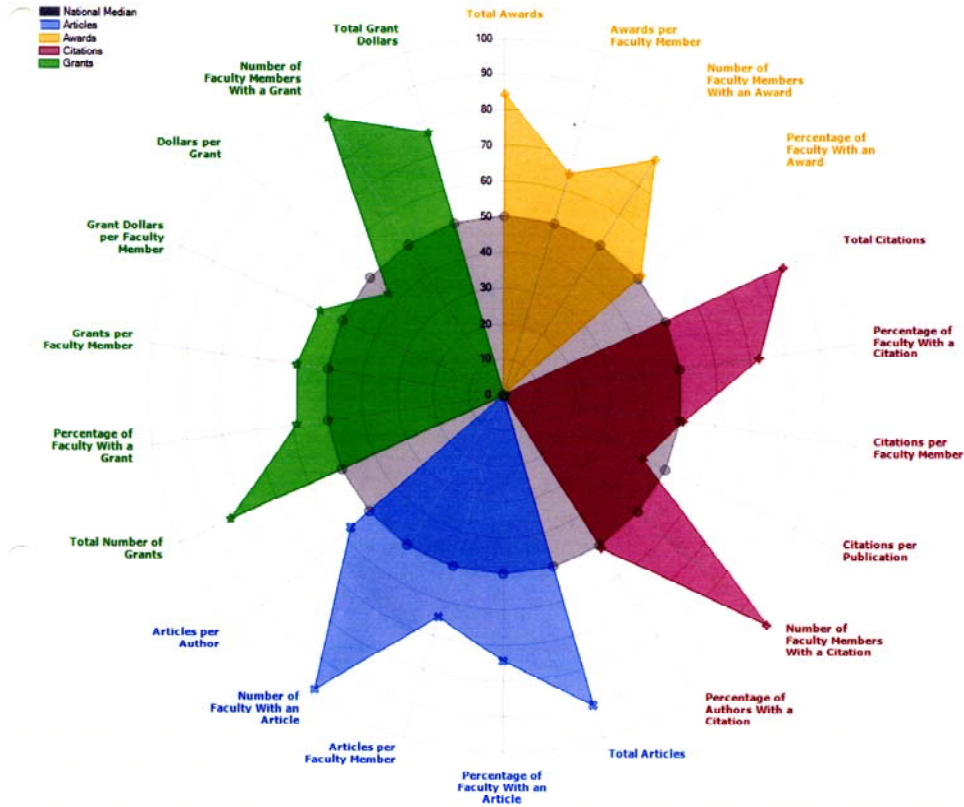


Figure 5 Research outputs in 2014 of SNR compared with 50 similar departments by Academic Analytics.

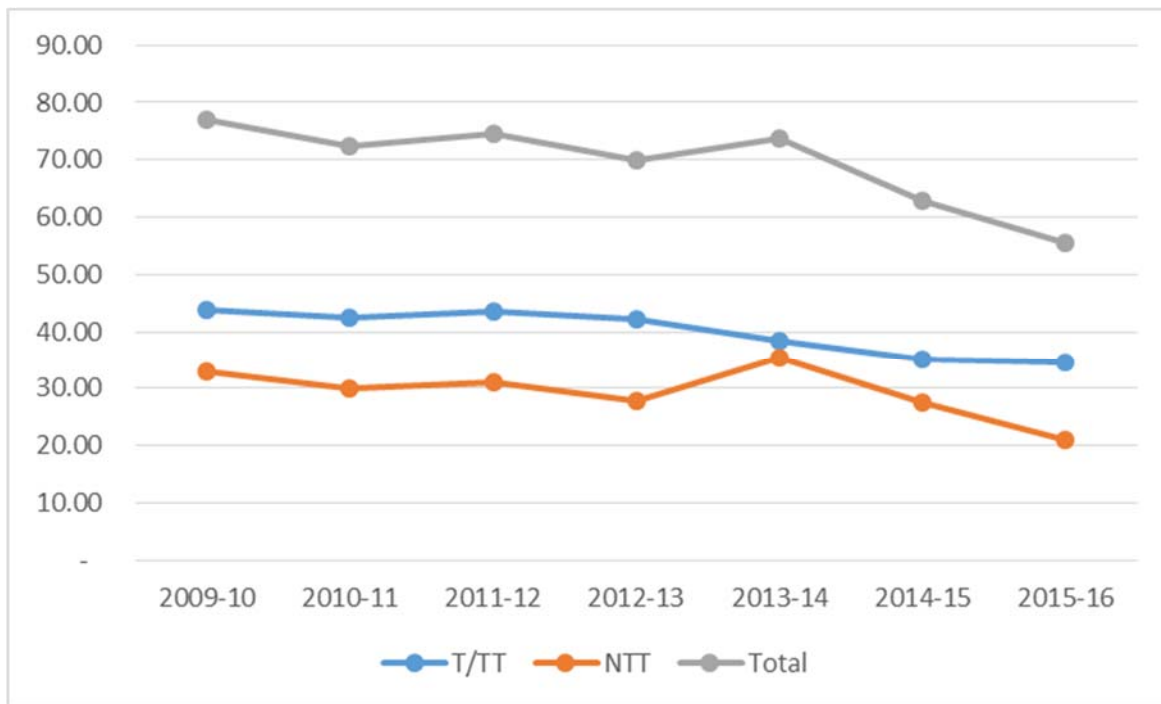


Figure 6 Total faculty FTE in the school, broken down into Tenure/Tenure Track and Non-Tenure Track. Positions approved for hiring but not yet hired are not included. Data by Mission Area are in Appendix C.



## **Internal and External Challenges**

There are a number of internal challenges faced by SNR due in part to professional cultural differences among programs from different colleges at UNL. Sharing faculty members across IANR, the College of Arts and Science and the College of Engineering, while desirable academically, creates enormous administrative challenges in annual evaluations, salary increases, and promotion and tenure. All of these are handled differently in each college-level entity.

Two additional challenges faced by SNR faculty in developing a cohesive programmatic and personnel framework are: high faculty turnover and inflexibility in adjusting FTE distributions among Teaching, Research and Extension areas. High faculty turnover includes both departures of faculty for other institutions, normal retirements and sadly, one death. Maintaining program continuity is challenging under the current model for allocation of new faculty lines because they revert back to the college level and might or might not be replaced. While there is widespread recognition that the cluster hire process has some significant benefits in developing interdisciplinary programmatic themes in IANR, challenges exist. SNR recognizes the importance of production agriculture and related programs, and the established themes do encompass core competencies of SNR Mission Areas. However, while prioritizing positions among units, those seen as less directly involved in production agriculture often rank low. For example, among units in IANR, the need for soybean geneticist is patently obvious to all units; a conservation geneticist is much less so. There is no doubt that same holds true for water quality as well as weather/drought and climate.

FTE distributions for faculty are fixed percentages assigned to teaching, research or extension (see appendices D through G for details by mission area). Shifting effort by existing faculty to take advantage of emerging opportunities is regarded as difficult. Compared to most other institutions changing faculty appointments is difficult and very bureaucratic, making it difficult for faculty to adjust to a changing environment and career direction. In part this is due to salary pools for each part of an appointment being tied to a different dean within IANR, requiring negotiation among up to three deans to make a change. In addition, annual faculty evaluations compare actual activities with these percentages. For example, increasing effort devoted to teaching can improve outcomes for students, but can reduce research output (grant proposals and papers submitted), and if research performance falls below expectations that has negative effects for the individual faculty member.

A final challenge facing SNR is the significant reliance on either soft (grant-funded) or non-UNL faculty as significant contributors to Mission Areas within the school. For example, half the research FTE of Applied Climate Science is soft money (Appendix D). Federal employees represent a similar proportion of Applied Ecology (Appendix E), and our geography program relies on temporary lecturers to deliver much of their teaching function (Appendix G). While these faculty members make enormous contributions to these Mission Areas, it also creates uncertainty in program strategic planning due to financial uncertainty. It is sometimes difficult for these faculty members to contribute to the overall mission of SNR, since grant or government agency requirements dictate much of their work effort.

## **Current Investments**

The present review is taking place at a time of rapid change for IANR and SNR in particular. There are several faculty hires pending at this time in support of our teaching, research and extension missions. Notably, one of these positions are partially funded through a partnership with Nebraska Game and Parks Commission. In addition, SNR was recipient of a spousal accommodation (55%) of a senior faculty with interests in avian systematics and conservation.

## School of Natural Resources

*Table 2* Positions advanced from SNR to CAS or IANR administration. Interviewing means candidates are being short listed or invited for interviews; Approved means administration approved the position but not yet released it for advertising; In progress means that search committee chair assigned and position is moving forward. Proposed means the SNR director proposed the position to administration. Positions advertised or proposed for hiring as Associate or Full professor are marked as Senior hires in position description.

Position	Justification	Status
<b>Human Dimensions of Wildlife</b>	Priority research (partial external funded by NGPC)	Hired (Chris Chizinski)
<b>One Health Coordinator (Disease Ecology)</b>	Opportunity Hire (40% SNR, 60% VBS)	Hired (Liz Van Wormer)
<b>Avian genetics/Conservation Biologist</b>	Opportunity Hire (55% SNR, 25% SBS, 20% Museum)	Hired (Bob Zink)
<b>Climate Risk Scientist (Senior)</b>	Priority research & teaching in ACS	In progress
<b>Watershed Hydrologist</b>	Priority research in ES	Hired (appointed in BSE)
<b>Groundwater Hydrologist</b>	Priority research in ES	Two Faculty Hired
<b>Remote Sensing (Senior)</b>	Core teaching need in Geog/SS	Offer Made
<b>Vertebrate Zoologist</b>	Core teaching needs in AE	Approved
<b>Fish science</b>	Priority research	In progress
<b>Private Lands Biologist</b>	Priority research	Approved
<b>Geospatial Scientist</b>	Core teaching needs in GSS	Approved
<b>Soil Pedologist</b>	Core teaching needs in ES	In progress
<b>Community and Urban Forestry</b>	Core extension and teaching in AE	Approved
<b>Environmental Geographer</b>	Core teaching needs in GSS	Approved (Joint with other CAS units)
<b>Human Geographer</b>	Core teaching needs in GSS	In progress (Joint with other CAS units)

## Decisions

As a whole, the school makes several decisions on an annual or iterated basis. By decision we mean there is a choice to be made amongst two or more mutually exclusive alternatives. In addition, we are focused here on decisions carried out by the faculty as a whole, rather than what faculty members do to fulfill the teaching, extension and research components of their positions.

## Allocation of Resources

SNR receives an annual operating budget from IANR administration and a smaller budget from CAS to operate the Geography program. We allocate that budget to several activities, including office support, technical support and teaching support, which includes Teaching Assistantships, adjunct lecturers and classroom supplies. Although the total amount of this budget is unlikely to change, we should examine our allocations to make sure the use of these funds maximizes our fundamental objectives. This does not mean we are second-guessing the director in the use of the budget. This is a strategic evaluation of how funds are allocated; final authority over budget expenditures remains completely with the director. In addition to budgetary resources, the school has some control over a number of other resources for teaching, research and extension. These include classrooms and lab space (Physical plant), as well as properties such as Nine-Mile Prairie and Prairie Pines. How we allocate these resources can affect teaching research and extension outcomes in a variety of ways.

### Prioritizing new faculty hires

Perhaps the most important decision is which faculty position descriptions we propose to IANR and CAS administration. At present, these fall into two categories in IANR: core positions and priority area positions. CAS is adopting a similar system. Arming our leadership with position descriptions that support our vision for teaching, research and extension is crucial to taking advantage of negotiation opportunities as they arise.

### Undergraduate and Graduate Curriculum

One key way in which we can collaborate across faculty areas is by developing shared curriculum at the undergraduate and graduate levels. At present, no undergraduate program to which we all contribute exists. One graduate program specialization spans the school: the M.S./Ph.D. in Human Dimensions of Natural Resources.

### Events

The school runs a number of public outreach events, including: a public series of evening seminars, NaturePalooza, the Natural Resources Career Fair and the Severe Weather Symposium and Family Weatherfest. We could expand these, add new events or discontinue one or more of these events.

### Objectives

Objectives are the outcomes by which we evaluate our success in making decisions. Some objectives may be shared between different levels of decision-making, while others may not. Objectives need to be measurable, but need not have a natural scale (such as number of student credit hours). We can construct categorical or ordinal scales as needed. Items marked with a \* are also university objectives.

- 1) Teaching
  - a) # of Undergraduate majors\*
  - b) Student Credit Hour production
  - c) Graduation Rate\*
  - d) # of Graduate Students
- 2) Research impact
  - a) Publications
  - b) Research \$\*
- 3) Extension/Outreach impact
  - a) # of people reached
  - b) Change in Knowledge
  - c) Change in Behavior
- 4) Morale/Engagement of Faculty and Staff
- 5) National/International Recognition of SNR

### Alternatives & Consequences

In a series of meetings throughout the spring semester of 2015, staff, students and faculty suggested all components of the following alternatives. The status quo alternative represents no changes to our current decisions. The “pivot” alternatives package together all actions suggested for a particular function (teaching, research, extension) to explore the consequences of a narrow focus. The “Balanced Mix” alternative represents a mix of actions regarded as valuable by participants at our half- day retreat in May 2015, with some additional actions proposed by the administrative team.

### Status quo

In this alternative, we continue to operate as we have without making any changes. We will retain the structure of Mission Areas plus centers and affiliated educational programs. We will keep the allocation of resources as it is presently. We leave our current graduate and undergraduate curricula in place without making significant changes. Events remain the same and we advance new faculty positions one at a time as needs arise.

Under this option, we expect current trends relative to objectives to continue. Undergraduate enrollment will remain level, with gains in small majors offsetting decreases in our largest major. Graduation rates will remain at current levels. The number of graduate students will level off as we reach the capacity of the current faculty to support and advise graduate students. Extension and outreach activities will decline in proportion to the losses in faculty focused on those activities. The ad hoc approach to advancing faculty positions prevents us from planning strategically. As a result, we remain in crisis management mode, adversely affecting faculty and staff morale. National and international recognition of the school does not increase beyond that awarded to individual faculty.

### Pivot to teaching

Faculty Advisory Committee (FAC) revisits the learning objectives of all curricula, developing a core Natural Resource Curriculum that transcends different majors, and making sure the appropriate coursework is available. FAC also evaluates SNR involvement in online and distance education in light of the CASNR 2025 Online and Distance Education Plan.

Faculty members increase effort in undergraduate student recruitment and seek out opportunities to increase SCH by revising courses or developing new ones. The leadership team invests time in identifying other teaching programs at UNL with opportunities for consolidation of courses and/or new service course opportunities. We develop annual surveys of student engagement and post-graduation success/satisfaction. Require annual teaching evaluations for junior faculty by senior faculty and provide constructive and timely feedback. Establish a teaching program advisory committee at the SNR level (appointed by the director) comprised of external stakeholders (DNR, NRDs, Game and Parks, EPA, NRCS, USDA-ARS, and others from the public and private sectors) who meet with faculty and administration to provide advice on curricula and capability needs of graduates. Some members should be from outside Nebraska in order to represent national interests.

Annually, identify core and priority faculty proposals with a greater weight on contributions to teaching function. Retain larger amounts of F&A funds generated and increase the allocation of funds to GTAs. Everything else is the same as the status quo alternative.

Increased effort in recruitment leads to increases in undergraduate enrollment, with faster gains in small majors and a leveling off in our largest major. Surveys of student satisfaction identify problem areas quickly, leading to increased student retention and faster graduation rates. Feedback from employers and alumni increases relevance of coursework, and provides evidence of job success for graduates, further increasing enrollment. Investment in core faculty positions demonstrates commitment to programs that also leads to increased student enrollment. Identifying service course opportunities leads to dramatic increases in SCH production across the school. Graduation rates improve as required courses are offered more often and curricula are streamlined. The number of graduate students will increase modestly with the additional support, but the capacity of the current faculty to advise graduate students will still be limiting. The additional support will improve the quality of graduate students recruited by increasing the competitiveness of offers.

Sponsored research dollars will decline somewhat with the increased focus on teaching, leading to missed opportunities.

### **Pivot to research**

Recognizing the value of collaborative teams in winning grants, we reallocate resources from graduate assistantships to develop a seed grant program for new teams. The leadership team invests time in identifying research opportunities and building teams to go after those opportunities. Faculty, staff and students increase participation in interdisciplinary SNR seminars and networking opportunities. PIs of research proposals actively engage with extension and outreach faculty and staff to identify and fund outreach/extension efforts. Increase grant-funded stipends for graduate students to improve the competitiveness of GRA offers. Annually, identify core and priority faculty hire proposals with a greater weight on contributions to research mission. Everything else is the same as status quo.

No additional effort in recruiting, and no information from alumni and employers erodes the relevance of our programs and makes it harder to maintain the growth in undergraduate numbers of the past few years. The emphasis on research for new faculty positions leads existing teaching faculty decrease participation in service courses to focus on providing required classes for our majors. This decreases SCH production per teaching FTE. The number of graduate students remains steady, with the reduction in assistantships offset by increased research funding.

Increased seed funding and greater interdisciplinary communication leads to more collaborative research proposals lead by SNR faculty and more collaborative research papers. Greater integration of extension/outreach with research proposals leads to more people reached by extension and outreach efforts. Research and extension focused faculty/staff experience greater engagement in school activities and have improved morale, while teaching faculty experience decreased morale because of reduced TA support, declining student numbers and individual teaching overloads. Increased research productivity leads to greater recognition of SNR faculty by professional societies and more funds are available to support increased participation in national and international activities, increasing our profile.

### **Pivot to the community**

Engaging with our community of stakeholders will ensure our teaching, research, outreach and extension activities focus on things our community cares about. The leadership team invests time in meeting with stakeholders (identified in our survey see Appendix H). Annually, identify core and priority faculty hire proposals with a greater weight on extension mission and human dimensions research. Everything else is the same as status quo alternative.

The increased outreach and extension activity leads to increased enrollment. Contact with stakeholders improves relevance of coursework. Otherwise little effect on student credit hour production and numbers of graduate students. Interactions with stakeholders lead to increased research funding for relevant research. Increased efforts at extension and outreach dramatically increase the number of people contacted, the programs are well-targeted and effective, and we fund the measurement of these things directly.

### **Balanced Mix**

Faculty Advisory Committee (FAC) revisits the learning objectives of all curricula, developing a core Natural Resource Curriculum that transcends different majors, and making sure the appropriate coursework is available. FAC also evaluates SNR involvement in online and distance education in light of the CASNR 2025 Online and Distance Education Plan.



Natural Resources Undergraduate committee develops annual surveys of student engagement and post-graduation success/satisfaction. Establish a teaching improvement roundtable discussion group to help faculty with peer review of teaching.

SNR Administration focuses on the Applied Climate Science major, particularly student recruitment, and developing a new Community and Urban Forestry Major in collaboration with the Department of Agronomy and Horticulture and the Nebraska Forest Service using grant funding obtained from USFS.

Graduate Committee to review opportunities and challenges for expanding graduate student numbers in SNR.

Establish an advisory committee at the SNR level comprised of external stakeholders (DNR, NRDs, Game and Parks, EPA, NRCS, USDA-ARS, and others from the public and private sectors) who meet with the faculty and administration to provide advice on curricula and capability needs of graduates as well as identifying research needs. Some members should be from outside Nebraska in order to represent national interests. Engaging with our community of stakeholders will ensure our teaching, research, outreach and extension activities focus on things the community cares about.

Develop an SNR research committee comprised of senior faculty to develop school-level interdisciplinary teams to pursue large grant opportunities. Establish an external fundraising and development committee to enhance SNR endowment.

Refocus our outreach efforts on two large events, thus discontinuing our fall evening public talks. Naturepalooza continues to focus on biotic natural resources in the fall, while we reinvent the spring Severe Weather Symposium to include soil- and water-related activities. SNR Administration to evaluate the role of SNR Extension within IANR Extension Program starting in October 2015.

Starting in 2016, SNR administration works with an administrative consulting firm to enhance training opportunities for SNR administrative team. Starting in 2017, SNR administration and center directors review sustainability plans for all SNR centers. Starting in 2018, SNR administration reviews operations of Nebraska Maps & More.

Annually identify core and priority faculty hire proposals with equal weight on teaching, research, service and extension missions.

Development of a core NR curriculum increases the sense of integration among faculty across SNR, improving morale, and possibly increasing collaborative research and extension efforts. Surveys of student satisfaction identify problem areas quickly, leading to increased student retention and faster graduation rates. Feedback from employers and alumni increases relevance of coursework, and provides evidence of job success for graduates, further increasing enrollment. Interactions with stakeholders lead to increased research funding for relevant research. Expanding the range of outreach activities increases the number of faculty contributing to outreach. Overall research and extension productivity remains unchanged as these efforts are well within current capacity.

## **Tradeoffs & Conclusion**

While we cannot simultaneously improve all areas without increased resources, we can identify a mix of actions that will allow improvements in many of our objectives without impacting others. The Balanced Mix alternative combines integrating and re-focusing teaching across the school with a significant effort by our leadership to engage and communicate with stakeholders. In addition to increasing both numbers of students and research dollars, this alternative will improve the quality of our undergraduate programs and the relevance of our research and extension activities.

These SNR-level decisions are combined with decisions from each of the mission areas, centers and affiliated educational programs to form a portfolio of actions we will pursue over the next five years. The proposed actions by each group are summarized below; see the relevant section of the document for detailed analysis and justification. Many of the mission areas, centers and affiliated educational programs have proposed new faculty positions for prioritization (Table 3). The positions are in the order they appear in the document; no prioritization is intended or implied at this stage.

### **SNR Administration Level Priorities**

For the next 5 years a number of key SNR level challenges and priorities will be advanced by SNR administration for development of more effective use and management of resources and human capital, as well as modernization of program in the face of a changing higher education landscape.

- 1) SNR Management Development
  - a) Work with administrative consulting firm to enhance training opportunities for SNR team with administrative appointments. Initiate during 2015-2016 academic year.
  - b) Enhance support of staff professional development opportunities.
  - c) Review future of Nebraska Maps and More. To be started in 2018.
- 2) SNR Teaching
  - a) Complete evaluation of undergraduate teaching and management of majors within SNR (Common core, capstone, integration of majors). Program to be led by FAC starting in September 2015. Outline of questions and issues to be addressed will be delivered to FAC by Director at September 2015 FAC meeting.
  - b) Complete evaluation of SNR involvement in online and distance education. Outline of issues will be delivered to FAC by Director at September 2015 FAC meeting. FAC may choose to undertake this in conjunction with number one above.
  - c) Focus on Applied Climate Science major, especially student recruitment.
  - d) Continue development of Community and Urban Forestry Major. In development with Dept of AgHort and Nebraska Forest Service (grant funding obtained from USFS).
  - e) Review graduate student expansion in SNR including opportunities and challenges. To be undertaken by SNR graduate committee starting in September 2015.
- 3) SNR Extension
  - a) Establishment of a Nebraska State Climatology Office within SNR. Lead taken by SNR administration with key ACS faculty. Process has begun.
  - b) Evaluation of the role of SNR Extension within IANR Extension Program. Informally already begun, but formally starting in October 2015 by SNR administration.
- 4) SNR Research
  - a) Develop SNR research committee comprised of senior faculty to develop School level interdisciplinary teams.
- 5) SNR Centers
  - a) Review/establish sustainability plans for all SNR Centers with Center Directors. Starting in 2017.
- 6) SNR College of Arts and Sciences
  - a) Rebuild Geography Program and continue integration within SNR.
  - b) Meet with other unit administrators within CAS to establish framework for leveraging faculty positions and role of geography in CAS. To begin after new geography faculty hires in 2016.
  - c) Initial Spatial Science Center concept in 2017.

- 7) SNR External
  - a) Develop plan for establishment of External Advisory Boards for SNR and possibly Mission Areas within SNR. Lead taken by SNR administration starting summer 2016.
  - b) Establish Nebraska Stakeholders Board (DNR, NGPC, DEQ, NET, NRDs, Highways, and others) Lead taken by SNR administration starting September 2016.
  - c) Establish an external fundraising and development committee to enhance SNR endowment. Lead taken by SNR administration starting January 2017.

### **SNR Mission Area Priorities**

- 1) Applied Climate Science
  - a) Add two faculty hires (Climate Risk, and Climate Monitoring and Decision Support) to enhance the research capacity of ACS in the areas of climate variability and change and build a stronger undergraduate program to complement the ACS graduate program, increasing the teaching FTE to 1.90. These hires will assist with teaching key ACS courses on an annual basis, currently a serious deficiency in the program. (2015-2019)
  - b) Increase the number of undergraduates and graduate students and, thus, the number of student credit hours. (2015-2019)
  - c) Enhance the Nebraska State Climate Office and assimilate climate resources geared toward state services (weather monitoring, extension, outreach, research). (2015-2016)
  - d) Coordinate and integrate the extension, research and teaching objectives of the Applied Climate Science faculty to enhance the contributions of climate science to UNL programs and better serve stakeholders needs (2015-2017)
- 2) Applied Ecology Mission Area
  - a) Review and adjust undergraduate curriculum to incorporate new capacity and interests of new faculty positions, 2016-2017
  - b) Develop an NSF Research Experience for Undergraduate proposal 2016-2017
  - c) Develop an Applied Ecology stakeholder research symposium to showcase research and deepen collaborations off-campus, 2017-2018
  - d) Develop a strategy for professional development activities to support productivity of faculty and postdocs, 2017-2018
- 3) Environmental Sciences
  - a) Review learning objectives for both Water Science and Environmental Restoration undergraduate majors and identify curriculum gaps. Consider advantages and disadvantages of consolidating the two majors.
  - b) Develop a minor for hydrology/water science to promote a departmental wide “water literacy” among all SNR graduates.
  - c) Strategize on the development of a nationally recognized and unique ‘theme’ for our SNR programs, for example, a ‘water’ theme that will attract students and set national standards for water education. The intention is to elevate our international exposure and visibility through a nationally unique theme that recognizes Nebraska’s uniqueness.
  - d) Identify research and teaching areas where ES (SNR) and UNL lack sufficient expertise and leadership, networking and vision to assemble strong and successfully competitive research teams.

- e) Develop graduate/undergraduate courses in (a) An applied groundwater modeling course, and (b) “GIS in Natural Resources and the Environment” (GIS-NR-E). Offer a Hydrology course every semester to support a department-wide water theme and to promote ‘water literacy’.
- 4) Geography and Spatial Science
  - a) Add new faculty hires in the areas of GIS, remote sensing, land use/land cover, and human-environment interactions to re-establish a viable undergraduate and graduate degree programs in Geography. (2015 – 2019)
  - b) Raise the number of Geography majors and students pursuing Masters and Ph.D. degrees. (2015 – 2019)
  - c) Strive for national research and teaching prominence in the areas of remote sensing and GIS, Geography of the Great Plains, and environmental change and raise the visibility and communicating the value of Geography across UNL. (2015 – 2019)
  - d) Integrate Geography research and training in spatial analysis with key initiatives and Centers within SNR and UNL.

**CALMIT** rebuilds recently lost capacity with some positions already advanced and seeks further faculty positions to capitalize on the facilities already available for research.

**Conservation and Survey Division** continues to transition in structure while maintaining the legislatively mandated functions to record and disseminate information about Nebraska’s geological resources.

**Great Plains Cooperative Ecosystem Studies Unit** has just been renewed for another five years. The director and National Park Service staff in the unit intend to develop a research theme to bring together land managers and researches on a larger more collaborative scale than heretofore.

**High Plains Regional Climate Center** is also embarking on a new five-year cycle of funding from NOAA. In addition to meeting NOAA objectives, faculty and staff will work on identifying funding to develop decision support tools for delivering climate information.

**National Drought Mitigation Center** has recently received significant funding through NOAA providing a stable basis for continued operations over the next five years.

**Nebraska Cooperative Fisheries and Wildlife Unit** is still fully staffed with three federal scientists, and will continue to be a powerhouse for graduate education and research in the school for the next five years.

**Environmental Studies Program** continues to diversify the faculty contributing to the core teaching program, and develop new outreach opportunities.

**Human Dimensions Program** capitalizes on new faculty hires to continue delivering social sciences education for our undergraduate and graduate programs while expanding participation in interdisciplinary research projects.

**IANR Science Literacy Initiative** builds a brand new program of disciplinary-based educational research and contributes to core teaching requirements in CASNR.

*Table 3 Faculty resources proposed by mission areas or centers. These proposals are in addition to those listed in Table 2 that have already been advanced to Administration.*

Position Title	Mission Area/Center	Justification
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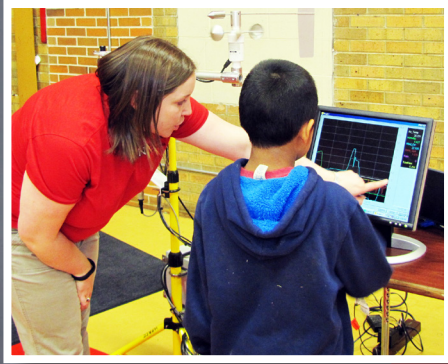
# School of Natural Resources

Drought Risk Reduction	ACS	Support continued research in Drought risk management
Climate monitoring and decision support	ACS	Provide climate based extension and decision support services for agriculture and other sectors of Nebraska
Environmental Microbiologist	ES	Teach new courses for ENRS and conduct research on environmental contamination
Global Hydrologist (Full Professor)	ES	Conduct regional and global hydrologic simulations and work with hydrologic, climate and drought modelers and remote sensing scientists to meld data sets and systems. Teach graduate courses in data assimilation and hydrological modeling.
Geospatial Geographer	GSS	Teaching and research focused on Land Use/Land Cover (LULC) Change and the analyses of processes underlying those changes
Remote sensing data fusion	CALMIT	Teaching and research focused on image-based remote sensing and data fusion of different observations
Geologist	CSD	Service via CSD related to environmental, engineering, or natural-hazards geology
Human Dimensions of Natural Resources	Human Dimensions	Application of social science theory and methods to natural resources conservation and management









# Applied Climate Science Mission Area

## Applied Climate Science

### Introduction

There is a heightened interest in climate change and recognition of its impacts to society. The 2014 National Climate Assessment report states that “global climate change is projected to continue to change over this century and beyond.” The Applied Climate Science (ACS) Mission Area’s current efforts are already bringing an increased national/international prestige to the University of Nebraska-Lincoln. We are in an ideal position to capitalize on this issue within our research, teaching and extension missions. However, this will require replacing key positions that we are losing as well as the potential expansion of ACS faculty and staff. The climate system is fundamental to all SNR mission areas. “Climate change can lead to dramatic tipping points in natural and social systems” (2014 NCA report). For this reason, ACS is a critical component of the overall SNR vision.

The ACS Mission Area within SNR will continue to provide leadership in drought risk management, climate risk and adaptation, climate and crop production, climate monitoring, and carbon water and energy exchanges, in the three mission areas of IANR (research, teaching and extension), while serving the citizens and stakeholders of Nebraska and beyond. We will enhance the understanding of climate variability and change and their effects on natural and managed ecosystems.

The micrometeorology and climatology program has existed in IANR since the early 1960s and is recognized domestically and internationally as a premier program. This program has excelled in basic and applied research addressing the needs in agriculture and natural resources management. The program has also made significant contributions to graduate education.

A major challenge we are facing is how to provide leadership in research, extension/outreach and graduate education with the recent departure of faculty members (Lenters and Pathak) and recent (Hubbard) and projected retirements (Dewey and Wilhite) in the next year. In addition, we are also attempting to launch a new undergraduate major in Applied Climate Science, which was approved in 2013. Hiring is presently underway for a new Climate Risk faculty position (0.65 R, 0.35 T); this position will be filled during the 2015-2016 Academic year.

### Decisions

The faculty and staff affiliated with the ACS Mission Area make decisions on curriculum and teaching activities, research foci and outreach-extension activities central to the mission of SNR, IANR and UNL. However, our ability to address the changing needs of our Mission Area is constrained by an inflexible infrastructure in IANR wherein priority is on preserving the split in state resources assigned to research, teaching and extension rather than reapportioning state funds to accomplish the three missions:

- 1) **Research:** To conduct disciplinary and transdisciplinary research that focuses on integrating areas represented in SNR, UNL and beyond to enhance our understanding of the role of climate variability and change at various scales as an essential element in the conservation, sustainability and management of natural resources.
- 2) **Teaching:** To continue to enhance, develop and deliver science-based climate change education and outreach programs to K-12 and higher education students focused on the importance and role of climate as a key driver in managed and natural ecosystems, and how research and science-based information on climate ecosystem interactions can improve decision-making to address conservation, management and sustainable use of natural resources in natural and managed agroecosystems. By doing so, we will increase societal awareness and effectively reach out to

potential students to join our undergraduate and graduate programs, increase student enrollment and graduate students in a timely manner (four years for undergraduates). Our efforts occur at a time when the needs and opportunities in climate science career paths are more critical than ever.

- 3) **Extension/Outreach:** Serve the UNL community, stakeholders and citizens by raising awareness of the impacts of climate variability and change. ACS will provide appropriate adaptation and mitigation measures as well as provide climate data and data interpretation to various stakeholders, and seek their cooperation and collaboration via the State Climate Office, the High Plains Regional Climate Center and the National Drought Mitigation Center.

## Objectives

To evaluate the success in achieving the three ACS missions, the following objectives have been identified:

### *Research:*

- 1) Amount of grant funding and number of grants
- 2) Number of peer-reviewed publications
- 3) Professional recognition and service (e.g., awards, expert panels, etc.)
- 4) Number of visiting scientists
- 5) Number of collaborations with internal and external university faculty

### *Teaching:*

- 6) Number of graduate students
- 7) Number of undergraduates enrolled in ACS major
- 8) Number of students graduating in ACS major
- 9) Student Credit Hours

### *Outreach/engagement:*

- 10) Number of invited local and state presentations
- 11) Number of invited national presentations
- 12) Number of invited international presentations
- 13) Number of media contacts
- 14) Number of workshops and participants
- 15) Number of climate data websites
- 16) Fulfilling data requests
- 17) Number of public and K-12 education events and participants

## Alternatives & Consequences

The ACS faculty has identified three alternatives with corresponding consequences:

1. Invest in teaching/research/extension
2. No further investment/Minimize research impacts
3. No further investment/Minimize teaching impacts



1. **Invest in teaching/research/extension.** In this alternative, two faculty positions (Drought Risk Reduction and Climate Monitoring and Decision Support), in addition to the Climate Risk hire, are proposed with research/teaching/extension proportions to increase the teaching to 1.90 (which was requested at the time the undergraduate major was proposed). Under this alternative, many research, teaching and extension objectives are increased or maintained. The number of undergraduates and graduate students will increase, as will the number of student credit hours. The Drought Risk Reduction hire will assist with teaching the NRES 452/852 (Climate and Society) capstone course (so it is offered every year). The Climate Risk hire will teach NRES 370 (Basic and Applied Climate) every year. The Climate Monitoring and Decision Support hire will teach NRES 469/869 (Bio-Atmospheric Instrumentation) every year. NRES 478/878 (Regional Climatology), 496/896 (Hydroclimatology) will be taught in alternating years (by Shulski, Muñoz Arriola). The Climate Risk hire will serve as coordinator for the undergraduate major, advise students and work with faculty to engage students in extracurricular activities and recruiting.

Our current teaching FTE of 1.55 is inflated due to Dr. Tala Awada (plant ecophysiologicalist and interim Associate Dean ARD) joining the ACS in late 2014. It should be noted that her Mission Area teaching does not contribute to the ACS undergraduate major.

The number of grants and peer-reviewed publications will surpass that of the current situation. While the new hire will be expected to maintain international connections, it is realistic to assume that some connections will be lost and perhaps others gained while the Drought Risk Reduction hire builds her/his program. Current and new faculty will result in a sustained or likely increase in additional awards, invited presentations (local through international) and media contacts. As a result of a strong research and teaching program, the number of visiting scientists will increase.

In this alternative, the ACS Mission Area will be able to maintain or likely increase our extension objectives. Discussions are currently underway to expand the State Climate Office to more than one person. In this alternative, a strong ACS will provide foundational support for the State Climate Office.

2. **No further investment/Minimize research impacts.** In this alternative, no faculty lines are approved for the ACS mission area beyond that already identified, and adjustments to teaching are made to minimize impacts on research (teaching FTE for climate courses will be at 1.35 with the hire of the Climate Risk faculty and loss of Lenters, Dewey and Hubbard). Drought mitigation and decision support research lines are phased out in this alternative (see appendix). This will result in a loss of grant funds, reduced number of peer-reviewed publications, professional recognition and service, number of visiting scientists and the number of collaborations. The number of invited presentations (local through international) are drastically reduced (e.g., international drought mitigation meetings and workshops) as are the media contacts (e.g., radio shows, weather camps and symposiums).

Currently, ACS faculty primarily offer courses primarily related to the undergraduate and graduate majors, as indicated in the following table:



## Applied Climate Sciences

Course Number	Course Title	E v e n	O d d	Instructor(s)
104	Introduction to Climate Change	X	X	Lowe
208	Applied Climate Sciences	X	X	Walter-Shea
307	Basic and Applied Climatology**	X	X	Dewey
408/808	Microclimate: The Biological Environment**	X	X	Suyker and Walter-Shea
452/852	Climate and Society**	X		Hayes
467/867*	Global Climate Change**	X		Hu
469/869	Bio-atmospheric Instrumentation**	X		Hubbard
470/870*	The Climate System**	X		Oglesby
478/878	Regional Climatology**			Lenters
496/896	Hydroclimatology**			Lenters
906	Crop Growth and Yield Modeling	X		Baigorria
907	Agricultural Meteorology		X	Baigorria
908	Solar radiation interactions at the earth's surface	X		Walter-Shea
954	Turbulent Transfer		X	Suyker Awada

*\*Course Home in Earth and Atmospheric Sciences*

*\*\*undergraduate major requirement*

In this alternative, we would discontinue the ACS major and adjust courses offered as follows: NRES 370 Basic and Applied Climatology and NRES 954 Turbulent Transfer will be discontinued; NRES 469/869 will be taught by Suyker in alternating years; NRES 478/878 Regional Climatology will be taught by Shulski in fall alternating years, NRES 496/896 Hydroclimatology will be cross-listed with BSE and taught by Muñoz Arriola in alternating spring semesters; discontinue to teach capstone portion of NRES452/852; Shulski will discontinue development of course on Environmental Climatology. Service courses (NRES 104 and 208) will continue; however student credit hour production is slightly reduced because of the loss of NRES 370 and NRES 954. In this alternative, no new students are enrolled. In addition, the State Climate Office will remained staffed by only one person.

3. **No further investment/Minimize teaching impacts.** In this alternative, no faculty lines are approved for the ACS mission area beyond the Climate Risk position. However, the remaining faculty will increase their teaching efforts and correspondingly reduce their research efforts. In addition, several lines of research would be phased out; extension and outreach programs would be reduced. The courses offered would potentially be adjusted as follows: NRES 469/869 Bio-atmospheric instrumentation taught by Suyker and alternating with NRES 954 (reducing Suyker's research); NRES 370 Basic and Applied Climatology continued with Al Dutcher as instructor; NRES 478/878 Regional Climatology taught by Shulski; NRES 496/896 Hydroclimatology taught by Muñoz Arriola, with each offered every other year; and continue to teach capstone NRES452/852 alternating with Hayes and the Climate Risk hire, and offered every year.

Student credit hour production would increase slightly because of increased offering of NRES 452/852, and new students enroll in the ACS major. The ACS major would continue, but the four year graduation

rate is not guaranteed since courses are not offered every year. The State Climate Office would remain staffed by only one person.

## Conclusion

The 2015 edition of the World Economic Forum's *Global Risks* report identifies "extreme weather events" as the second most likely global risk facing society and "water crises" and the "failure of climate-change adaptation" as the first and fifth highest global risk in terms of impacts of large-scale socio-economic consequences. This report highlights the current attention that the world's top economists place on climate and corresponding issues such as drought, extreme weather and climate change. In addition, climate change will affect the environment (agriculture, forests, surface and ground water, and ecosystems) (2014 National Climate Assessment report). Responding to this tremendous emphasis on the importance of climate-related issues, we choose Alternative 1 (Invest in Teaching/Research/Extension) as the only viable solution for the future of ACS. This alternative will preserve our success in ACS and position us to be global leaders in the area of climate change and variability and building societal resilience for the future. The following action items emerge from this analysis:

- a) Add two faculty hires (Climate Risk, and Climate Monitoring and Decision Support) to enhance the research capacity of ACS in the areas of climate variability and change and build a stronger undergraduate program to complement the ACS graduate program, increasing the teaching FTE to 1.90. These hires will assist with teaching key ACS courses on an annual basis, currently a serious deficiency in the program. (2015-2019)
- b) Increase the number of undergraduates and graduate students and, thus, the number of student credit hours. (2015-2019)
- c) Enhance the Nebraska State Climate Office and assimilate climate resources geared toward state services (weather monitoring, extension, outreach, research). (2015-2016)
- d) Coordinate and integrate the extension, research and teaching objectives of the Applied Climate Science faculty to enhance the contributions of climate science to UNL programs and better serve stakeholders needs (2015-2017)





# Applied Ecology Mission Area

## Applied Ecology

### Introduction

The Applied Ecology mission area is a large and diverse group of 21 faculty members that has a tradition of a balanced mission of teaching and research to guide management of ecosystems. Applied Ecology is the only mission area in SNR without explicit ties to a Board of Regents approved research center. However, Applied Ecology hosts the Nebraska Cooperative Fish and Wildlife Research Unit (USGS; Allen, Fontaine, Pope). And, Applied Ecology is the current home (Director: Powell; NPS Research Coordinator: Shenk) for the Great Plains Cooperative Ecosystems Studies Unit (CESU).

Faculty in Applied Ecology have served as coordinators and advisors for the Fisheries and Wildlife, Grassland Ecology and Management and Water Science majors. The latter major is also supported by other faculty in Environmental Science in SNR, while the former majors are fully supported within Applied Ecology. During the past decade, Fisheries and Wildlife grew from ~90 majors to more than 200 before stabilizing at ~175 majors in the past five years with a focus on quality over quantity. Grassland Ecology and Management and Water Science have both grown in size with focused recruiting efforts. The Applied Ecology graduate student specialization is a large graduate program that has had over 100 students within the past 5 years.

Although there is no research center in Applied Ecology, meaningful collaboration does occur in groups of two-three faculty. Applied Ecology faculty contribute to research in population and community ecology, landscape ecology and management, decision-making and ecosystem dynamics. Our geographic location contributes to a unique focus on private lands and stressed watershed research based largely in agroecosystems. The past five years saw the culmination of a NSF-funded IGERT program led by Craig Allen with a supporting group of faculty that included many Applied Ecology faculty. The IGERT program (*Resilience of Stressed Watersheds*) recruited (to UNL) and funded 21 Ph.D. students, and many specialized in Applied Ecology.

Extension efforts in Applied Ecology are currently carried by two professors of practice (Pennisi, Ferraro) and an approved, but yet-to-be-filled tenure-track position (Private Lands Biologist). A focus on wildlife damage management that had been maintained by Scott Hygnstrom was recently eliminated. The Applied Ecology group worked with stakeholders to determine Extension needs in Nebraska and the region, and we look forward to the contributions of a new member of our group with the new focus on private land management in the next year.

The Fisheries and Wildlife program has more than doubled in the past decade—the growth is from 95 students in 2002 to more than 200 students in 2014. The program grew at a rate of 8-13% per year during 2004-2011 after making significant curriculum changes that resulted in the development of 10 career-related options. No new courses were added, but the program packaged courses in ways that attracted new students—especially urban females. The faculty also leveraged interdisciplinary connections with programs in other departments, such as range ecology and management (Habitat Management option), criminal justice (Law Enforcement option), and animal science (Zoo Animal Care option). Starting in fall 2015, we reduced the number of options offered to six, which is based on loss of discipline expertise (e.g., wildlife damage management), student recruiting interests and student enrollment information. We are further exploring possible development of an entrepreneur option, as well as a private lands management option that will complement discipline-specific skills as they come on board through IANR hiring initiatives. Faculty instructors needed to meet specific course needs (e.g., retirements or other departures) remains an issue to growth/sustainability of the program.

Grassland Ecology and Management (GECM) is a natural resources degree program that focuses on the ecology and management of rangeland/grassland (the principal land type and natural resources base in Nebraska) and is appropriately offered through SNR. However, most of the GECM FTE, grassland courses, and Range Management Club are in the Department of Agronomy and Horticulture. Enrollment in the major has remained in the range of five to 10 students over the last five years; however, student numbers in grassland courses remain strong because of significant number of students from other program areas. The faculty leveraged interdisciplinary connections to require grassland courses, or to list them as optional courses, in these other program areas, including Grazing Livestock Systems, Animal Science, Agronomy, Plant Biology, and the Habitat Management and Wildlife Ecology and Management options in Fisheries and Wildlife. To further integration of GECM into SNR, Dr. Walter Schacht moved 25% of his teaching appointment from the Department of Agronomy and Horticulture to SNR in early 2014. He developed a new introductory grassland ecology and management course to increase the visibility of GECM in SNR and to grow the major. He also co-developed, with Dr. David Wedin, a new 400-level course in grassland conservation. Both courses have SNR as the home unit and are proposed to be required courses for two Fisheries and Wildlife options or more. A new range ecologist, with a 50% teaching appointment, was hired in fall 2014 and is teaching GECM courses in rangeland ecology and ecosystems evaluation. An instructor position also was added to the program to teach grassland plant identification courses. The strengthening of the GECM program by the addition of strategic courses and teaching faculty is expected to grow the number of students and quality of undergraduate education in grassland ecology and management.

**Challenges:** The Applied Ecology mission area has experienced a decade of growth in numbers of faculty with few losses of faculty to retirement or resignation. A challenge of the next five years for Applied Ecology will be to manage the growth in student numbers and research progress with several planned retirements, losses of key faculty and core support from tentative professor of practice positions. Patricia Freeman (mammologist) and James Brandle (agroecology, agroforestry) retired in July 2015. Scott Hygnstrom (wildlife damage management) resigned to take an administrative position in Wisconsin.

The result of these retirements is that the connection of Applied Ecology to the State Museum (Freeman), a substantial agroforestry research program (Brandle), and an internationally-known outreach program in wildlife damage management (Hygnstrom) have been lost, along with significant levels of institutional memory and Applied Ecology leadership. Additionally, our students have not had access to courses in GIS and remote sensing because of retirements within the Geography and Spatial Sciences mission area. However, retirements in the range group within the Department of Agronomy and Horticulture have been effectively dealt with. The Applied Ecology group has worked to re-vision these positions for the future, and the time/energy spent on this endeavor will have a short-term effect on productivity of faculty. In addition, Dennis Ferraro (herpetology, conservation biology) and Lisa Pennisi (environmental education, ecotourism) serve in professor of practice positions that have required substantial work to continue in the past year.

Indeed, the largest challenge and uncertainty for our Mission Area in the next five years is caused by faculty turnover through retirements and the new Strategic Hires process used by IANR for the release of positions. All decisions made by the Applied Ecology Mission Area must be made in the context of the current process for position replacement.

**Opportunities:** Four faculty positions were approved to support Applied Ecology in early 2015. Applied Ecology worked with the SNR director and our stakeholders to provide input to IANR administration that resulted in the approval of four positions: Human Dimensions of Wildlife (research/teaching; half-funded by Nebraska Game and Parks Commission [NGPC] for five years),



Fisheries Biologist (research/teaching), Vertebrate Ecologist (research/teaching; a response to retirement of Freeman), and a Private Lands biologist (Extension/teaching; a response to resignation of Scott Hygnstrom). The plan for these tenure-track faculty members positions us well for the coming five years, and signifies the support that we have worked to achieve with our stakeholders, especially NGPC. SNR and Applied Ecology have a great need for Human Dimensions capacity; the fisheries program is growing, our Extension programming needs a tenure-track faculty member to lead and revitalize connections with stakeholders, and our Fisheries and Wildlife major would have been non-functional without a person to teach Vertebrate Zoology and Mammalogy. The insertion of these new faculty into a strong program has high potential to take our Applied Ecology group to another level, relative to similar faculty groups among our peer institutions.

### Decisions

The Applied Ecology faculty members make decisions at the individual or Mission Area level as follows:

**Research:** Faculty members in Applied Ecology typically make individual decisions on research topics (directions and questions), funding sources and potential collaborators. The group could decide to work on larger, more collaborative projects or continue the general trend of individual research or smaller collaborative groups. The Applied Ecology group also has a tradition of departmental service, so some members of the group have made decisions to limit their research program to take administrative positions or tasks.

**Teaching:** the biggest decisions in Applied Ecology most recently have revolved around how to spend our teaching time. Should we spend time recruiting more students? Should we have a larger number of majors or should we focus on quality of our program and job placement? And, most recently, the Applied Ecology faculty group has struggled with how to replace vacancies that are core to the program under the method used by IANR recently that requires multiple department heads to form alliances to bring positions to the Deans and Vice Chancellor.

**Extension:** Applied Ecology makes decisions about how much time to spend in outreach activities (for those without Extension appointments) and what Extension programs should be the focus for our limited Extension FTE.

### Objectives

Objectives are the outcomes by which we evaluate our success in making decisions. The Applied Ecology Mission Area developed the following set of objectives during the planning process for this review:

#### *Program Structure*

- We will have a largely tenure-track group of faculty.

#### *Teaching*

- Graduates of Applied Ecology undergraduate, M.S. and Ph.D. programs will have high rates of employment and graduate/professional school acceptance within Nebraska and nationally.
- We will contribute to university goals for the number of enrolled students
- We will contribute to CASNR goals for student credit hour generation at a rate consistent with other CASNR programs.
- Undergraduate students will be able to complete their degrees in a timely fashion with little need for substitution/waivers.

#### *Research*

## Applied Ecology

- We will lead innovative research efforts to provide theory and support decisions made to manage ecosystems in the Great Plains and beyond.
- Our graduate program will be a balanced mixture of funded M.S. and Ph.D. students/candidates.
- We contribute to university goals for research funding at rates consistent with our size.
- We produce quality publications at rates consistent with the rest of IANR and our respective disciplines.

### *Extension/Outreach*

- We will provide technical advice for landscape and plant/animal population management through Nebraska Extension and other outlets for private landowners and state/regional/federal organizations.
- Our products will change attitudes of Nebraskans to increase sustainability and economic development.

## **Actions**

The Applied Ecology Mission Area has developed a set of tactics, or purposeful actions, that we might use to accomplish the objectives listed above. These tactics would be additional actions to the present sets of activities in which we are engaged. These actions include:

**Extension and Outreach:** Applied Ecology faculty could write more popular publications, sponsor booths and activities at public events (e.g., the Nebraska Museum's Sunday with a Scientist), develop a formal strategy for engagement of stakeholders, work with UNL Extension colleagues in other departments (given the lack of Extension FTE in SNR) or the Nebraska Forest Service's outreach team, or develop an Advisory Committee to engage with stakeholders. Applied Ecology could also work to secure more FTE in the Extension and Outreach area.

**Research:** Applied Ecology faculty could work together to develop large research grants (NSF, USDA, etc.), develop a Research Experience for Undergraduates (REU) program, sponsor professional development aimed to increase research productivity of faculty and postdocs, broaden our collaborations (as a group) to similar groups at other Universities or USGS (or similar) research centers, work to find funding to recruit Ph.D. students (including applications for GAANN, NNF or IGERT funds), work to find funding to increase research space, or work to find funding to increase the number of permanent research technicians.

**Teaching:** Applied Ecology faculty could further develop the undergraduate curriculum, develop a formal graduate curriculum, assess our graduate program with an alumni survey, enforce the requirement to submit progress reports for graduate students, develop a SNR-specific Masters of Applied Science program (non-thesis), develop a program to support undergraduate theses for high-quality students, work with the NU Foundation to develop funding to increase the number of teaching assistantships available for teaching support, create and support a seminar course, find funding to support seminar speakers or find funding to create more undergraduate scholarships.

## **Alternative Action Strategies**

The Applied Ecology Mission Area cannot logistically carry out all of the proposed actions, listed above. Time is our limiting resource. Thus, we must decide on a strategy for the next five years to optimize our ability to meet the objectives we have set for our group. During our planning process, we established six specific strategies that we might follow. With the exception of the "Status Quo" and "Balanced"

strategies, our strategies consist of a focus on some portion of our mission. The Applied Ecology Mission Area felt that our group was at the point that we needed a focus to provide invigoration and challenge during the next five years. The strategies are:

**Status Quo:** This strategy would change nothing from the current foci for our energies. Our focus now includes much energy spent on undergraduate recruiting (although numbers have dropped in the past year), design of undergraduate courses to meet growing enrollments and changes to undergraduate curricula. In addition, we spend considerable time, individually, with our large group of graduate students. Last, our group has been very successful with individual research directions and a small amount of individual-based extension and outreach activity. No strategic hires would be proposed under this strategy, although core replacement proposals would be prioritized to maintain status quo. IANR administration has used professors of practice to support Applied Ecology in recent years—thus, the trend for more non-tenure-track faculty to cover core needs would most likely continue under the “Status Quo” strategy.

**Community Engagement and Outreach:** A strategy to reduce our focus on teaching and research to provide the time to increase our engagement with the community through Extension and Outreach. Faculty, even those without Extension appointments, could contribute to the Extension and Outreach Actions, listed above. Strategic hires would be proposed to increase Extension FTE.

**Research (PhD/Postdoc):** This strategy would purposely reduce our focus on teaching and Extension/Outreach to increase the impact of our research program. This strategy specifically emphasizes high-level research through collaborative grants designed to increase funding for postdocs and Ph.D. students (at the expense of M.S. and MAS students) to leverage research output. Collaborations within and outside our group would increase. Strategic hires would be proposed to support innovative research at the expense of Extension and teaching FTE.

**Graduate Student (MS/MAS):** A strategy to reduce our focus on undergraduate teaching, Extension/Outreach and high-level research to secure more M.S. and MAS students to produce large numbers of potential workers for state and federal agencies. As a part of this strategy, we would develop a solid graduate student curriculum and ‘graduate experience’ in the Applied Ecology specialization with the goal to enhance job placement. Our research lab group dynamics would be modified to include non-thesis students (MAS). Proposals for faculty hires might be less innovative for research (relative to the “Research” strategy), and requests would be designed to increase capacity for our graduate program rather than undergraduate programs.

**Undergraduates and Stakeholder Engagement:** This strategy would, at the expense of research and Extension/Outreach, deepen our current focus on undergraduate teaching, increase number of majors, and engage our stakeholders to provide undergraduates with even better internship and early-career experiences. Faculty would propose a non-thesis MAS program designed to provide more of our undergraduates with a potential route to a master’s-level degree. We would engage the NU Foundation to increase the number of scholarships available to our students, and we would need to find funding for increased level of TA support to serve our large courses and multiple lab sections, given current limitations. Proposals for faculty hires would be focused on innovative teaching opportunities and core positions to maintain current teaching FTE in the wake of retirements.

**“Balanced” Strategy:** This strategy proposes to select a few obtainable actions from the research, teaching and Extension/Outreach areas, which come at the expense of some current actions and a new, high-level of engagement in any specific area. Specifically, we propose to design stakeholder engagement strategies, embark on professional development programs for postdocs and new faculty, modify

undergraduate and graduate curricula, and work with the NU Foundation to develop scholarships for undergraduates. Individual research and Extension programs would be maintained at current levels. Thus, strategic hires would most likely be related to replacement of core positions lost in the next five years.

## Consequences

The Applied Ecology faculty members have assessed our six strategies to determine how they would help us achieve each of our objectives. As a group, we used available information to make best-predictions as to the potential for a given strategy (listed above) to (1) enhance achievement of the objective in a very positive fashion (marked with a “+”), (2) detract from our ability to achieve an objective (marked with a “-“, or (3) have a null impact on the objective (marked with a “0”). Results are shown in a Consequence Table below.

OBJECTIVE	Alternative Strategies					
	Status Quo	Pivot to Community Engagement and Outreach	Pivot to Research (PhD, postdoc)	Pivot to Graduate Student Program (MS/ MAS)	Pivot to Undergrad Program and Stakeholder Integration	Pivot to Select, “Balanced” Areas
Faculty largely-tenure track.	-	+	+	+	+	+
Graduates are employed and get into grad school	0	0	+	+	+	+
# majors	-	+	-	-	+	-
SCH	-	+	-	-	+	-
Graduation rate	0	-	-	-	+	0
Innovative research applications	0	-	+	+	-	-
More postdocs and PhD students	0	-	+	-	-	-
Research \$\$\$	0	-	+	+	-	0
Publications	0	-	+	+	-	0
Source of technical advice	-	+	+	-	-	+
Change attitudes of Nebraskans	-	+	-	-	+	0
<b>TOTAL:</b>	<b>-5</b>	<b>0</b>	<b>3</b>	<b>-1</b>	<b>1</b>	<b>-1</b>

Total calculated as sum of columns: “+” = 1, “0” = 0, “-“ = -1

The strategy that we felt has the least chance of meeting our group’s objectives was the “Status Quo.” By definition, the “Status Quo” strategy was predicted to hold the line (null effect) on achievement of some teaching and research objectives.

Four strategies were clustered with scores ranging from -1 to 1: Community Engagement and Outreach, Graduate Student Program, Undergraduate Program and the Balanced strategies. All were predicted to

keep a focus on tenure-track faculty, and all except the Community Engagement strategy were predicted to enhance our students' employment rate. But, the strategies differed with regard to which of our objectives were predicted to be achieved due to the focus in different directions.

The strategy with the highest ranking was the "Research" strategy. If our group were to pivot our time and energies to high-level research, with focus on collaboration and postdocs, the ability to improve achievement of teaching objectives is expected to suffer, especially with regard to production of more student credit hours and more majors in our undergraduate programs. However, the quality of our program (not measured by IANR goals for teaching) could increase as research opportunities for undergraduates are expected to increase their employment and graduate school admission rate. This strategy would result in a powerful, although smaller, undergraduate program that could produce exceptional students. To create time for research collaborations, several teaching activities (Cedar Point Biological Station courses, hands-on—and time intensive—labs on campus, and education abroad trips) may need to be curtailed, and our group will have to work to make sure we maintain quality in the program while making the undergraduate teaching program more efficient. It is possible that we might increase the use of distance courses to allow more flexibility for research collaborations. Last, although time would not be available for much Outreach activity from the group as a whole, our research would provide new information to Nebraskans and other stakeholders throughout the world through research designed to have impact. And, of course, we predicted all of our research objectives would be achieved under this strategy.

The result of our consequences discussion is that it is clear that we can improve our group's impact through a focus on teaching, research or Extension/Outreach. Our group believes that we can meet more of our objectives through a focus on high-level research. Intriguingly, IANR has recently focused on a similar research-centric path for new hires, apparently because there is direct feedback to increase in research grants (a portion of F&A flows directly back to programs)—and, there is less direct feedback for programs that increase their SCH, number of majors or Extension programming. Thus, our chosen direction for Applied Ecology mirrors university-level trends.

## Conclusion

The Applied Ecology Mission Area believes we are well-positioned to embark in an exciting, research-centric direction. We have a solid core of mid-career faculty who are experienced in grant writing, research team support and possess a collaborative nature. We also have a set of faculty who can be described as experts in their field with national recognition and international experience—with a solid publication record to support large grant proposals. In addition, we have at least four planned additions to our faculty in the next year. And, our faculty area has a genuine collegial mentality as well—making collaborations possible, and it is time to capitalize on that characteristic of our Mission Area. The following action items emerge from this analysis:

- a) Review and adjust undergraduate curriculum to incorporate new capacity and interests of new faculty positions, 2016-2017
- b) Develop an NSF Research Experience for Undergraduate proposal 2016-2017
- c) Develop an Applied Ecology stakeholder research symposium to showcase research and deepen collaborations off-campus, 2017-2018
- d) Develop a strategy for professional development activities to support productivity of faculty and postdocs, 2017-2018





# Environmental Science Mission Area

## Environmental Sciences

### Introduction

The Environmental Sciences (ES) Mission Area was recently formed in SNR and is a consolidation of two previous faculty areas: Geology & Soils and Water. The Geology & Soils faculty area was the smallest faculty area within the School of Natural Resources (SNR), with only four (current) faculty members designating Geology & Soils as their primary area (Drs. Kuzila, Hanson, Joeckel and Comfort). In 2015, SNR consolidated its faculty areas from six to four with most faculty from the Geology & Soils and Water Science Faculty merging into “Environmental Sciences.” Under this new structure, we have 19 faculty with 8.5 FTE research, 2.9 FTE teaching, 2.4 FTE extension, and 1.45 FTE administration (Appendix A). Thirteen faculty (9.95 FTE) are tenure-track/tenured and six faculty (5.33 FTE) are non-tenure track.

These faculty contribute to the organization and teaching for two undergraduate majors: Water Science and Environmental Restoration Science (as well as other academic programs; Appendix B). Environmental Sciences faculty and staff also contribute to the operations of the Conservation and Survey Division and conduct research on all aspects of the hydrogeosphere.

The Environmental Science Mission Area seeks to support and strengthen the teaching, research and extension missions of IANR by providing students and stakeholders with a broad understanding of environmental systems. Our goal is to enable stakeholders to make informed decisions on natural resources and to improve their quality of life. We will continue to provide targeted scientific and technical information along with innovative approaches to stakeholders who manage water and land resources and work to solve environmental challenges.

UNL has been listed among the top 20 groundwater programs in the world and much of the ecology of Nebraska is water-based. The ES faculty believes it can lead UNL’s effort in water research. Many of the threatened and endangered species of Nebraska have a strong water context and many environmental restoration projects have a strong water focus. Nebraska has the largest area under center pivot irrigation in the country and is home to the top three center pivot companies in the United States. The University of Nebraska is the home of the Daugherty Water for Food Institute (DWFI), which has multiple international partners and supports mission areas aligned with those of the School of Natural Resources.

It is important to recognize that the Environmental Sciences Mission Area is a new association in SNR and we are in the early stages of our organization and planning process. Therefore, it is somewhat difficult to make conclusive statements regarding where and how this group needs to advance. Gap analyses and needs assessments have yet to be conducted – including, for example, outreach and extension needs within the environmental sciences area, new and evolving course needs, and complementary research and faculty focus areas.

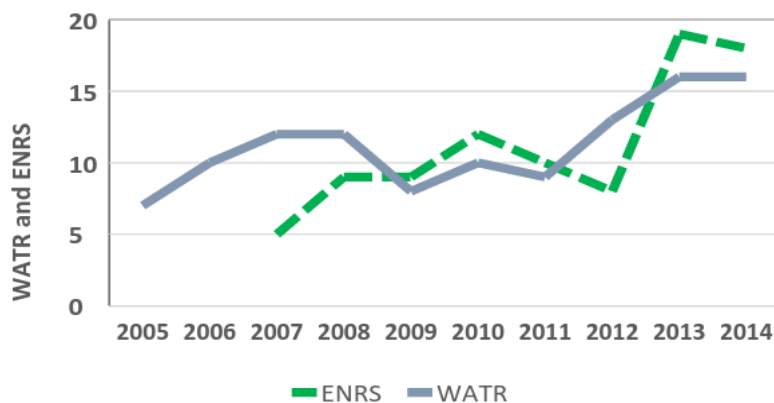
A current challenge for the ES faculty (as well as a strength), following the merger of the Geology & Soils and Water areas, and association with Conservation and Survey Division, are the diverse interests and specialties of the faculty that require program management and coordinating support. Appendix F lists ES faculty members; Appendix H lists courses taught by ES faculty. A major challenge for the group is to continue to provide productive and effective leadership in research and in undergraduate and graduate education given the loss of four faculty from the water science area over the past two years (Mary Spalding, John Lenters, Ed Harvey, Diego Riveros-Iregui) and the retirement in 2015 of a soil pedologist (Mark Kuzila). Some gaps in knowledge and expertise resulting from these departures will be partially filled through current efforts to recruit assistant professors in groundwater hydrology and



watershed hydrology. However, the watershed hydrology position has been filled within Biological Systems Engineering (BSE) rather than SNR, with no joint appointment. In addition, faculty in these positions may not have the depth of knowledge required to teach advanced courses in water chemistry, isotope hydrology, physical limnology or soil pedology. A critical assessment of knowledge gaps will help determine the expertise needed to train future environmental scientists who graduate from the University of Nebraska.

In addition, faculty with joint appointments in two or more departments and static long-term faculty appointments limit our flexibility to reappoint research/teaching/outreach responsibilities to meet evolving needs. Several ES faculty have joint appointments with other departments (Appendix F). While these joint appointments can help bridge programs, colleges and campuses, they also consume valuable time with meetings, reporting and communications as faculty try to keep abreast of two or more departments, operations and cultures. Joint appointments also tend to burden promotion and tenure processes for both candidates and administration.

Figure 7 shows trends in undergraduate student numbers for Environmental Restoration Science (ENRS) and Water Science (WATR) majors in SNR for the last 10 years. Overall, enrollments have been increasing at the undergraduate level since 2003. Water Science and Environmental Restoration Science are relatively small programs, but have grown significantly over the past five years.



*Figure 7. History of numbers of enrolled undergraduate students (residents +nonresidents) for the two ES majors: ENRS-- Environmental Restoration Science; WATR-- Water Science over the past 10 years (Data from Karen Jensen, SNR).*

## Decisions

Faculty in the Environmental Sciences Mission Area make decisions about undergraduate and graduate programs and curricula, new initiatives for research and extension, and the identification and prioritization of needed faculty and resources in this area.

## Objectives

### Teaching

1. Offer undergraduate and graduate programs with national reputations that attract Nebraskan and out-of-state students, including international students, leading to an increase in numbers.
2. Strategically target academic programs to private and public employer needs in Nebraska and nationally, producing graduates who are rapidly hired upon graduation.

### Research

1. Advance the science and understanding of complex water and environmental systems at the local, national and international levels.
2. Increase research expenditures by pursuing all potential public and private sources of funding.

3. Increase graduate student recruitment, quality and retention.

### Extension

1. Improve engagement and stakeholder ‘satisfaction’ with our extension, research and teaching programs and increase public and private sector support for those activities.
2. Effectively deliver research-based education and information to Nebraskans (measured by numbers reached, changes in knowledge and changes in behavior).

### Community

1. Enhance UNL’s national and international reputation in water (external community).
2. Promote a cohesive and mutually supportive group of faculty with active networking, exchange of ideas and mentoring (internal community).

### Alternatives & Consequences

Recent and expected faculty departures mean that the primary alternatives for the Environmental Science Mission Area revolve around different degrees of investment in new faculty positions.

**No further investment:** No additional faculty positions are funded or filled. This would necessitate discontinuing the environmental restoration science major because required pedology courses are not available. Continue offering the Water Science major supported by current hydrology hires. It is possible that no new cross-disciplinary initiatives or programs in research or extension would be explored or developed. The number of undergraduate students will be expected to decline, although modest growth in Water majors may continue. Proceeding with insufficient FTEs will require faculty to use part of their research and extension FTEs for teaching, and courses will need to be cancelled when faculty positions are vacant or faculty are on sabbatical.

Take the following actions to improve employability of graduates by improving the relevance of curriculum:

- Administer surveys of employers and alumni (employed students) to determine employer needs and how they are served by our curricula.
- Develop a nationally recognized unique ‘theme’ for SNR programs, for example, a ‘water’ theme that will attract students and set national standards for water education.
- Develop a Hydrology or Water Science minor to support departmental wide “water literacy” among SNR graduates
- Review learning objectives for both undergraduate majors and identify curriculum gaps (e.g., IT expertise).
- Modify the undergraduate curriculum to require an “internship” (minimum of 3 credits) for ES undergraduate students to help them gain real-world job experience and build a network of contacts in their field prior to employment.
- Add NRES 109 (Water in Society) to the required curriculum for water majors, introducing the scientific, social and economic dimensions of historical and contemporary water systems in which students use their understanding of hydrologic systems to analyze and engage in decision-making about complex challenges associated with water resource use.

Feedback from alumni, employers and teaching program advisory committee increases the relevance of coursework, and provides evidence of job success for graduates. Requiring an internship as part of the undergraduate curriculum helps students gain real-world job experience and build a network of contacts in their field prior to employment that will lead to graduates who are rapidly hired upon graduation.

**Strengthen Investment in Teaching:** Hire two new faculty with research/teaching appointments: one Soil Pedologist and one Environmental Microbiologist. This will allow required courses in the Environmental Restoration major to be taught, and further expand the course offerings there, increasing relevance to employers and improving the resilience of the major to unexpected perturbations. Continue offering the Water Science major supported by new hydrology hires. It is possible that no new cross-disciplinary initiatives or programs in research or extension would be explored or developed. Take all the other actions specified under **No further investment**.

Specific course developments include:

- i. An applied groundwater modeling course (cross-listed undergraduate/graduate) in which students learn the science and art of applying groundwater models to practical problems and gain a basic understanding of forward and backward groundwater flow modeling and MODFLOW, PEST, and other widely-used modeling packages. This course is already listed in the graduate bulletin (NRES 918) and has been taught in the past by Dr. Chen, who has expressed willingness to teach it in the future at the undergraduate level.
- ii. Create a graduate course in “GIS in Water Resources and the Environment” (GIS-WR-E) that is similar to the CIVE “GIS in Water Resources” taught by Dr. Kilic, but is offered on East Campus and does not require the differential tuition required by engineering. The GIS-WR-E course would teach advanced GIS and programming skills in the context of water resources, hydrologic and environmental systems and would be taught by Dr. Kilic if her appointment were transferred from CIVE to SNR only. The CIVE course is already above its capacity of 20 students due to lab constraints.
- iii. SNR offering a hydrology course every semester to support a department-wide water theme and to promote ‘water literacy’ among all SNR graduates (see Community section). This would be taught by the new hires in hydrology.

Achieve impactful teaching by high quality mentoring of junior faculty and encouraging annual informal teaching assessments by fellow senior faculty to provide constructive and timely feedback.

The number of undergraduate students in ENRS and WATR would be expected to continue to grow and possibly accelerate. A consolidation of WATR and ENRS may increase enrollment by creating a more broad-spectrum and attractive program where graduates can present themselves as environmental scientists with preparation in both water (hydrology) and environmental restoration. Additional faculty hires with significant teaching FTE (~50%) would lead to more high-quality graduate courses leading to increased graduate student numbers.

Encouraging feedback from alumni, employers and teaching program advisory committee should increase the relevance of coursework, and provide evidence of job success for graduates. Requiring an internship as part of the undergraduate curriculum helps students gain real-world job experience and build a network of contacts in their field prior to employment that will lead to graduates who are rapidly hired upon graduation.

Faculty devoting increased efforts to teaching will reduce time spent on grant writing and conducting funded and unfunded research, potentially resulting in fewer grant proposals and less funding. These negative effects are offset by increased graduate student quality and retention due to having a higher quality teaching faculty. Negative effects on outreach activities are offset by increased stakeholder satisfaction with program graduates (takes a few years). Feedback from alumni and employers means that



the program is well-engaged with stakeholders, well-targeted to employer needs and effective, and will lead to increased stakeholder satisfaction. Somewhat fewer people are reached by extension efforts.

UNL's national and international reputation in Water and Environmental Sciences would be expected to increase relative to the baseline (of No Further Investment) due to increased notoriety from adopting a Water Theme and capabilities and numbers of UNL graduates. Reputation building may take years.

**Strengthen Investment in Research.**

Identify research areas where SNR and UNL lack sufficient expertise and leadership, networking and vision, to assemble strong and successfully competitive research teams. We target one or two high-profile faculty at the full professor level in identified focus areas with the objective of linking several research (and teaching) threads. The research focus would emphasize climate, soils and water resource data assimilation supported by remote sensing. The faculty positions could be endowed chairs who have a vision for, and experience with, organizing teams of researchers and who can bring national and international networking and funding opportunities.

Invest in faculty positions in areas where SNR lacks expertise and/or where leadership directs us towards new research areas, identify new sources of funding, expand our networks and increase the impacts of our research (increased numbers of publications and increased citations per year) by connecting it to stakeholder interests. Increased numbers of successful grant proposals should allow for more and larger stipends, attracting more graduate students and improving retention. Negative effects of faculty devoting increased efforts to research, at the expense of outreach, will be offset by increased stakeholder satisfaction with problem-solving and research by faculty in important areas, and natural dissemination of impactful research results to the greater community.

Create more industry and other private sector partnerships to foster industry-relevant and targeted research at the forefront of technological advances, and engage science-based expertise and decision-makers worldwide. Actively pursue relationships with industry by offering short courses, seminars and partnering on research proposals and by providing trouble-shooting services as part of outreach.

Engage stakeholders, extension educators and specialists early in the development of research proposals.

Discontinue the Environmental Restoration Science major because required Pedology courses are not available. Continue offering the Water Science major supported by new POE hydrology hires. The number of undergraduate students will be expected to decline although modest growth in Water Science majors may continue. Proceeding with insufficient FTEs would require faculty to use part of their research and extension FTEs for teaching, and courses would need to be cancelled when faculty positions are vacant or faculty are on sabbatical. Although not directly focused on alumni and employers, contact with industry may keep the curriculum relevant, maintaining students' employment prospects.

UNL's national and international reputation (in Water and Environmental Sciences) will grow through the increased numbers of publications, size of research faculty, networking with national and international groups of researchers and organizations and production of graduate students.

Take all the other actions specified under **No further investment**.

**Strengthen Investment in Community.** Hire an extension educator having expertise in environmental sciences and with responsibility to engage stakeholders in the environmental implications of multi-scale hydro-bio-geophysical system interactions and projected changes with time.

Develop a nationally recognized unique ‘theme’ for our programs, for example, a ‘water’ theme that will attract students and set national standards for water education (see Appendix F). Encourage faculty to strengthen research ties with the Water for Food Institute (WFI), Nebraska Water Center, BSE, CIVE, EAS, BIOS, and national and international partners of WFI that include strong student involvement and cross-listing of classes. The intention is to elevate our international exposure and visibility through the stronger internal networking and to increase networking and teaming potential.

Engage faculty having outreach activities to recruit undergraduate and graduate students. Collaborations with stakeholders provides awareness of current problems and research opportunities as well as current trends leading to increased grant funding, increased stakeholder satisfaction with problem-solving and research by faculty in important areas, and natural dissemination of impactful research results to the greater community.

UNL’s national reputation should be expected to grow by elevating the national status of SNR’s programs through increased outreach and notoriety. No change internationally.

Take all the other actions specified under **No further investment**.

**Balanced Investment in teaching and research.** Identify research areas where SNR and UNL lack sufficient expertise and leadership, networking and vision to assemble strong and successfully competitive research teams. We target one high-profile research faculty at the full professor level in identified focus areas with the objective of linking several research (and teaching) threads. In addition, we hire one teaching faculty (significant teaching FTE) focused on environmental microbiologist to offer courses in the sciences and technologies underpinning biological treatments of contaminated soil and water. The number of undergraduate students in ENRS and WATR is expected to continue to grow, although slower than under a focused investment in teaching. Expanding course offerings with new teaching faculty will improve the resilience of the major to unexpected perturbations, increase relevance of our program to employers (i.e. environmental firms), and broader employment opportunities for our graduates.

Investment in one research-focused position should lead to some increase in grant funding per FTE, but not as great as under a focused investment in research.

Develop a nationally recognized unique ‘theme’ for our programs, for example, a ‘water’ theme that will attract students and set national standards for water education (see Appendix F).

UNL’s national and international reputation (in Water and Environmental Sciences) should grow through the increased numbers of publications, size of research faculty, networking with national and international groups of researchers and organizations, production of graduate students, and more slowly via increased capabilities and numbers of UNL graduates.

Take all the other actions specified under **No further investment**.

### **Tradeoffs/Consequences**

Balanced growth of the Environmental Sciences program in teaching, research and outreach is in the tradition and vein of the land-grant university mission and is most recommended to produce the greatest aggregate impact on graduates, community and nation as well as on faculty development. This alternative should have the least number of negative outcomes and has a good balance of positive outcomes among teaching, research and community. The following action items emerge from this analysis:

## Environmental Sciences

- a) Review learning objectives for both Water Science and Environmental Restoration undergraduate majors and identify curriculum gaps. Consider advantages and disadvantages of consolidating the two majors.
- b) Develop a minor for hydrology/water science to promote a departmental wide “water literacy” among all SNR graduates.
- c) Strategize on the development of a nationally recognized and unique ‘theme’ for our SNR programs, for example, a ‘water’ theme that will attract students and set national standards for water education. The intention is to elevate our international exposure and visibility through a nationally unique theme that recognizes Nebraska’s uniqueness.
- d) Identify research and teaching areas where ES (SNR) and UNL lack sufficient expertise and leadership, networking and vision to assemble strong and successfully competitive research teams.
- e) Develop graduate/undergraduate courses in (a) An applied groundwater modeling course, and (b) “GIS in Natural Resources and the Environment” (GIS-NR-E). Offer a Hydrology course every semester to support a department-wide water theme and to promote ‘water literacy’.







# Geography and Spatial Science Mission Area

## Geography and Spatial Science

### Introduction and Overview

Geographers contribute unique insights into understanding human societies, the earth's environments and especially the interactions between the two. Spatial perspectives provided by Geographic approaches and analytical tools are critically important to address issues such as food and water security, natural resources management, human adaptation to environmental change and development of new and improved opportunities for rural areas (National Research Council, 2010). The National Research Council (2010) has noted that literacy in geography is crucial to modern education and a well-informed citizenry. Further, geospatial technologies have been recognized in recent years as one of the top three growth industries in the United States (U.S. Dept. of Labor, 2004). Employment in the field of Geography, including Geographic Information Sciences (GIScience), is expected to grow ~29% between 2012-2022 (Bureau of Labor Statistics, 2014). Elevated awareness of the importance of Geography, accompanied by the rapid development of GIScience, has fostered unparalleled expansion in the field. In just the last decade membership in the Association of American Geographers (AAG) has risen 66%, one of the few professional organizations to experience such growth.

The UNL/SNR Faculty of Geography and Spatial Science teach a broad array of courses that support both undergraduate general education and many specialized degree programs including those in the Center for Great Plains Studies, Environmental Studies, International Studies and Elementary and Secondary Education. In recent years, approximately 900 UNL students enrolled in Geography courses each semester, many attracted to the seven Achievement-Centered Education (ACE) courses that are offered in the Program. Our objective is to grow in the future, in viable and sustainable ways, by enhancing our research programs and maintaining the critical core of the discipline, including offering a large number of ACE courses that are taken by students throughout the University.

### Decisions

We have acted to re-envision and streamline UNL's Geography Program to emphasize two principal areas which we perceive to be areas of future growth and in which we can leverage expertise from other areas of the School: Environmental geography of semi-arid regions and Geospatial Technologies (Geographic Information Science (GIScience) and Remote Sensing). During the past two decades, these are the two areas that have attracted the great majority (more than 85%) of Geography graduate student applicants and undergraduate majors, and there is every reason to expect that this trend will continue. Funding opportunities in the geospatial realm will also continue to grow in the future. Our enhanced program will serve to build enrollments and research capacity.

We will give special consideration to research and instruction that addresses issues critical to the NU mission. This includes the responsibilities of a Land Grant Institution, the NU Water for Food Institute and the Rural Futures Initiatives as well as to a proposed NU Geospatial Initiative.

GIScience Focus: GIScience technologies (e.g., geographic information systems [GIS] and remote sensing) have become increasingly important for addressing problems involving public health, food security, political conflict, international trade, natural resources management and adaptation to environmental change (National Research Council, 2010). The University of Nebraska-Lincoln has been recognized as a center-of-excellence in GIScience for over 40 years. Since its founding in 1972, the Center for Advanced Land Management Information Technologies (CALMIT) has achieved a national reputation for research and instruction in GIScience and has garnered more than millions of dollars in research grants and contracts. Projects have focused on assessing soil erosion, groundwater pollution risk,



lake water quality, wildlife habitat analysis, coral reef viability, invasive species, public health and other issues. CALMIT maintains a 29-hectare field research station at UNL's Agricultural Research and Development Center near Ithaca, NE; has unique close-range remote sensing capabilities including platforms to deploy sensor packages that can operate from the UV through the microwave spectral bands over a variety of land and water environments; and operates an aircraft outfitted with instruments that include a thermal-infrared camera and an AISA Eagle hyperspectral (244 band) imaging system. Such resources make us unique within the Big 10. Our strengths in GIScience position us to play a leadership role in the recently proposed NU Geospatial Science Initiative and to address issues (e.g., land use change) critical for the NU Water for Food Institute and Rural Futures Initiative.

Human-Environment Interactions in Semi-Arid Environments: For over a century UNL geographers have received international acclaim for studies of the Great Plains, one of earth's key "transitional" agrarian landscapes. Semi-arid regions such as the Plains are globally significant agricultural areas, but because of their unique settings they are particularly vulnerable to environmental stressors. Semi-arid regions are characterized by steep environmental gradients and are subject to periodic natural catastrophic events such as drought and flooding events, but also to rapid demographic and socio-economic adjustments to changing environmental and societal stressors. Today, the Great Plains and similar regions in South America, Asia and Africa are confronting significant new issues such as global climate change, changing demographic patterns, increasing demands for biofuels and other forms of renewable energy, increased demands on viable water resources and expansion of invasive species. Issues such as these will undoubtedly have major, though currently uncertain, impacts on water resources, humans and other biota. The expertise developed in Geography through the Great Plains experience provides the robust and reliable methods required to predict the impacts of possible future conditions on transitional systems like the Great Plains and similar regions throughout the world. Further, this expertise will be the source to define adaptive responses that will mitigate impacts of future changes. Given our position within the School of Natural Resources, UNL geographers are uniquely qualified to make substantial contributions to interdisciplinary research on alternative futures.

UNL geographers will specifically apply expertise in analyzing the importance of place, spatial variability and scale, as well as application of tools such as spatial modeling and GIScience technologies. We will engage with colleagues in the School and other programs in UNL to bring our specialized skills and tools to bear on development of adaptation strategies driven by demographics, human behavior, adaptation and management in the context of both current and historical patterns at various scales ranging from local to global. Just as is the case with GIScience, our expertise in the Great Plains region positions us to play a strong role in the proposed NU Water for Food Institute and Rural Futures Initiative. In that regard, we can capitalize on our long-term close relationship with the Center for Great Plains Studies and our well-regarded publications such as the *Encyclopedia of the Great Plains* and the *Atlas of the Great Plains*, among others. A new book, the *Atlas of Nebraska*, a collaboration between geographers and our SNR colleagues is currently in production.

**Challenges:** The greatest challenge for Geography at UNL over the next several years will be allocation of sufficient faculty to meet growing demands for teaching and research, especially in high-demand areas such as GIScience. To meet the demands of students, maintain a viable graduate program, and take advantage of research funding opportunities, at least five tenure-track faculty members and two Professors of Practice are required. We have lost significant expertise in the Geospatial area due to retirements, and only one tenure-track faculty member remains with expertise in traditional remote sensing techniques. Two of the four remaining tenure-track faculty in Geography are rapidly approaching retirement-eligible age. We are proposing to hire at least two Professors of Practice to teach core

undergraduate courses that both attract majors and serve the University through offering ACE certified courses.

### Objectives

A re-envisioned and streamlined Geography Program will focus upon the following objectives:

- Increase student credit hour production
- Increase undergraduate geography majors
- Increase external research funding.
- Increase outreach activities
- Increase collaboration among faculty in SNR/external Centers/Departments

### Alternatives & Consequences

**No further investment.** Current and impending retirements lead to a loss of critical mass of tenure-leading faculty. As a result there are insufficient graduate courses available to support a graduate program in Geography, and upper level undergraduate courses are also discontinued leading to the dissolution of the undergraduate Major in Geography. Teaching efforts, increasingly being led by lecturers, would focus on large enrollment (ACE) classes to continue generating student credit hours. Enrollment caps would be raised to increase SCH generation per lectureship. Work with allied majors that require coursework in geography (e.g., Environmental Studies, International Studies and Elementary and Secondary Education) to ensure required courses are offered.

Teaching assistants would have to be hired from other graduate programs in SNR and UNL generally, reducing the quality of assistants. In particular, collaborate with related units such as Community and Regional Planning. Increased effort devoted to teaching by the remaining faculty and lecturers would lead to reduced research and outreach efforts.

**Refocused investment.** This alternative is characterized by a comprehensive revamping of the Program along lines set forth above. It builds on recognized strengths while proposing increased focus on two areas of specialization and an increased emphasis on collaboration with colleagues in SNR. The Program's future cannot be secured unless issues with staffing are addressed in the short term. In that regard, we propose the following core positions be filled as soon as possible:

- Geospatial Geographer: A 9-month, tenure-track position focused on Land Use/Land Cover (LULC) Change and the analyses of processes underlying those changes. There is currently insufficient faculty expertise in LULC change at UNL and no courses currently deal with LULC change, its causes and consequences. The instruction and research led by this individual will contribute directly to programs such as the **NU Water for Food and Rural Future Initiatives**, and will position UNL to be more competitive for external funding through agencies such as NSF and the U.S. Geological Survey. The successful applicant will have expertise in one or more of the following areas: (1) Geographic Information Science-based modeling at multiple spatial and temporal scales, (2) geographic dimensions of natural resources, agriculture and water, (3) sustainable human-environment systems in transitional semi-arid environments, or (4) geospatial statistics.
- Environmental Geographer: a 9-month, tenure-track position focused on the geospatial dimensions of Human-Environment Interaction with an emphasis on human adaptation to climate change. This faculty will work toward understanding how humans respond to and manage their activities relative to environmental change. This is an inherently interdisciplinary undertaking,

requiring knowledge of the climatic changes or hazards themselves, but also requiring an understanding of risk assessment, public policy, and human behavior. This position will bridge the gap between the social and physical sciences by studying how humans are affected by, and adapt to, shifting climatic conditions and related changes in public policy. Both climate change and the public policies initiated to mitigate its effects span spatial, temporal and organizational scales, with impacts on environment-society relationships, environmental dynamics and disaster vulnerability planning.

Filling these two positions will allow the geography undergraduate and graduate programs to continue. In addition we will also seek to increase the number of Geography majors by doing the following: 1. Developing an introductory Geospatial Course that will be offered on city campus, 2. offering more regional courses at the 300 level, 3. revising all geography course offerings and cross-listing more courses in other units, 4. developing a GISci lab on city campus to support GISci course offerings (Geog 412/422, etc), 5. Exploring the development of new courses that explicitly support NU initiatives in food and water, rural futures and GISci, and 6. work more closely with the SNR advising and recruitment coordinators.

Maintaining 5 tenure-leading faculty within the program is crucial for fulfilling the above stated goals. Expertise in the following areas is particularly critical for the growth of the program:

- Remote sensing and geographic information systems (GIS) emphasizing remote sensing and GIS applications in agriculture/food, water resources, biogeography and LULC change;
- Human geography with a focus on past, present and future agricultural, water and food issues in the Great Plains and other world regions, and on management of natural resources;
- Human geographer with expertise in GIScience. Faculty would augment human dimensions mission in the School of Natural Resources.
- Geopolitical and geo-economic dimensions of global agricultural, energy, water and food issues and the impacts of urbanization.
- Professor of Practice positions (2) in Human Geography to teach large enrollment 100 and 200 level courses.

These are areas that complement Geography programs of our Big 10 partners, reflect the interests of students and will better position us to compete for external research funding. Faculty will be expected to work across traditional programmatic boundaries to engage in interdisciplinary teaching (at both undergraduate and graduate levels) and conduct cutting edge research. And, in every instance of a new hire, we will give special consideration to candidates who have expertise in GIScience and/or a world region (e.g., Asia, Middle East, Africa) as these are important for addressing issues of the NU Water for Food Institute and the Rural Futures Initiative.

### Summary and Conclusions

The Geography program at UNL is well-regarded by colleagues across the United States. Our programs in historical and human geography of the Great Plains and in GIScience are especially well-respected. At the same time, the benefits of our integration with SNR are becoming more widely recognized and we must strive to enhance teaching and research in the geospatial dimensions of natural resources management and human-environment interaction. We plan to build on these strengths. UNL Geography has physical facilities and an institutional infrastructure (within SNR) that are unique among our Big 10 peers. As noted above, expertise in the spatial dimensions of earth's resources and societies is important

in many fields of endeavor. Demands for instruction and research in GIScience have been steadily growing. However, Geography will have increasing difficulty maintaining strengths and building new signature programs unless we can retain a core of tenure-track faculty. This is by far our greatest need. Ideally, the program would consist of a healthy balance of professors of practice, assistant, associate, and full professors.

The following action items emerge from this analysis:

- a) Add new faculty hires in the areas of GIS, remote sensing, land use/land cover, and human-environment interactions to re-establish a viable undergraduate and graduate degree programs in Geography. (2015 – 2019)
- b) Raise the number of Geography majors and students pursuing Masters and Ph.D. degrees. (2015 – 2019)
- c) Strive for national research and teaching prominence in the areas of remote sensing and GIS, Geography of the Great Plains, and environmental change and raise the visibility and communicating the value of Geography across UNL. (2015 – 2019)
- d) Integrate Geography research and training in spatial analysis with key initiatives and Centers within SNR and UNL.

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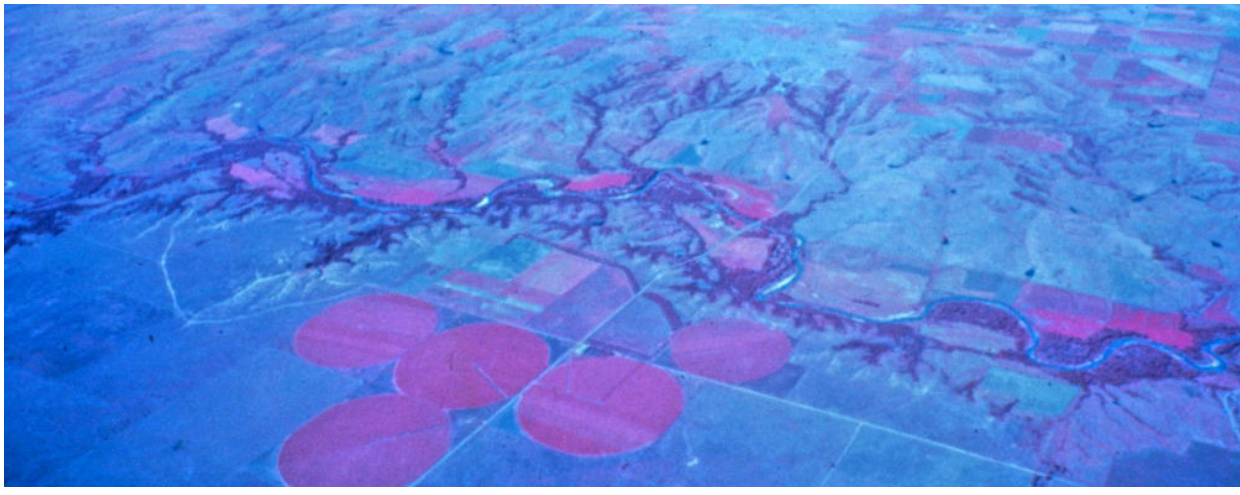
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**Centers**









**CALMIT**

**Center for Advanced Land Management Information Technologies**



## Center for Advanced Land Management Information Technologies

### Introduction

The world is experiencing a “geospatial revolution.” Remote sensing, GIS and GPS data inform researchers and decision makers in a broad variety of disciplines and sectors. Within UNL, several recent major geospatial technology-dependent research programs, e.g., Consortium for Integrated Translational Biology (CITB) and Phenomics Center, and initiatives, e.g., Daugherty Water for Food Institute (DWFI), Rural Futures Institute (RFI) and National Drought Mitigation Center (NDMC), have been established. Government agencies and the private sector need these technologies in the areas of precision agriculture, ecological assessment, environmental monitoring, planning and water and other natural resource management. A number of universities have developed spatial science-oriented centers in response to the growing need (e.g., Harvard University’s Center for Geographic Analysis; University of Minnesota’s U Spatial; Stanford University’s Spatial Analysis Center; and University of Southern California’s Spatial Sciences Institute). The job market also illustrates the high demand for expertise in these geospatial technologies. According to the U.S. Department of Labor (2014), a 29% increase in hiring of geospatial experts is expected between 2012 and 2022 (U.S. Department of Labor, 2014). Hence, there is a high demand at UNL, within Nebraska and across the country for people, services and research in geospatial technologies.

CALMIT is responding with a vision *to advance our understanding of environmental changes within the biosphere from human and natural processes to facilitate sustainable management of agriculture and natural resources using remote sensing and other spatial technologies.* To pursue this vision, the mission of CALMIT is *to be a recognized center of excellence for innovation and service in remote sensing and spatial technologies investigating and developing an understanding of land surface processes and interactions within natural and managed ecosystems as these systems respond to a changing environment.*

CALMIT maintains an extensive remote sensing infrastructure enabling spectral observations to be acquired across various scales, spanning from an individual leaf or plant to the broader field and landscape levels. This includes a state-of-the-art spectral laboratory, mechanized and backpack-deployable systems for field-based remote sensing, and airborne sensing hyperspectral and thermal imaging systems. This unique set of observational capabilities allows an array of research to be pursued across spatial scales and span the basic research-applied research-practical application continuum. The center also possesses various image processing and GIS software, as well as several types of GPS units. Collectively, this unique set of resources enabled CALMIT to pioneer several remote sensing techniques and field methods that are now commonly used in agricultural and natural resource management.

The center seeks to provide fundamental insights into:

- Dynamic plant responses to environmental stresses and change;
- Climate-water-vegetation interactions and agricultural and natural resource sustainability;
- Remote sensing, GIS and GPS spatial technologies application to land and resources management and environmental stewardship.

Our approach focuses on research, education and training that spans basic and applied research across spatial scales ranging from plant to field to landscape.

The Center for Advanced Land Management Information Technologies (CALMIT) was formed in 1986 by the Board of Regents of the University of Nebraska (with origins traced back to 1972 with the Nebraska Remote Sensing Center) with a principal mission to develop and advance the application of remote sensing and other geospatial technologies such as geographic information systems (GIS) and global positioning systems (GPS) in agriculture and natural resources. The center has traditionally provided geospatial technology leadership within UNL and advanced the application of remote sensing and GIS within state and local government. CALMIT has been a recognized leader in training highly-skilled graduate students, many of whom are now in leading remote sensing and GIS experts in academia, federal and state government, and the private sector.

The center is facing a major challenge in providing research, education and training with the recent departure of five tenure-line remote sensing and GIS ‘core’ faculty (four full professors and one assistant professor) through retirement or career change. Currently, the center has two ‘core’ faculty (i.e., research, application development and administrative leadership within the CALMIT): 1) Center Director (Brian Wardlow), a junior tenure-line remote sensing faculty member appointed in 2012, and 2) a senior faculty line (Associate or Full Professor) in quantitative remote sensing (0.70 research in CALMIT and 0.30 teaching in SNR-Geography) scheduled to be filled by spring 2016. Despite a critically low number of FTEs assigned to CALMIT, the center has benefited from a volunteer Research Associate Professor (Art Zygielbaum) who works in the area of quantitative remote sensing. He has garnered significant grant funding to maintain research and support within CALMIT, particularly related to the center’s field-based remote sensing program. The center also has five affiliated faculty (Trenton Franz, Ayse Kilic, Christopher Neale, Elizabeth Walter-Shea and Jun Wang) with remote sensing and GIS expertise. CALMIT also has four granted-funded staff with expertise primarily in remote sensing and some experience in GIS. In total, CALMIT requires ~\$350K per year to sustain the center’s staff and maintain its core functions and suite of observational capabilities and infrastructure.

## **Summary of CALMIT Research Priority Areas**

### **Remote Sensing of Plant Stress**

Relationships between reflected light and leaf status are utilized in developing remote sensing methods to determine vegetation status as changes in the amount of water and nutrients in leaves affects internal structure and many physiological processes. The use of remote sensing offers the possibility of non-destructive measurement over scales from single plants to entire fields or collections of fields across the landscape; such measurements are faster than mechanical or chemical analyses. CALMIT possesses a unique suite of remote sensing capabilities enabling science-grade spectral observations of plants to be collected at leaf, plant, plot, field and landscape scales to pursue advanced research into understanding the response and their underlying processes of crops and other vegetation types to environmental changes (e.g., water and nutrient deficiency). This well positions CALMIT to continue pioneering research in this area and extend the results into practical applications in key areas such as crop breeding, plant and ecosystem resilience, climate change and agricultural and natural resource management.

Current studies investigating remote sensing techniques to aide in assessing plant status include: 1) assessing nitrogen deficiency in winter wheat varieties to down-select new wheat varieties in breeding programs for nitrogen-limited environments (Wardlow and Baenziger (Agronomy & Horticulture)), 2) identifying genotypes with specific forage quality characters in breeding programs, removing the need for destructive harvests (Zygielbaum and Yerka (USDA-ARS)), 3) quantifying chlorophyll content and its relation to plant productivity applied at leaf, plant, canopy, field and regional scales (Gitelson and Arkebauer (Agronomy & Horticulture) and Suyker (SNR)), 4) impact of vegetation stress on estimates of plant productivity with an emphasis on plant photo-protective effect (a mechanism used by plants to shut

down harmful side-effects of photosynthesis when plants are stressed) (Zygielbaum, Walter-Shea and Arkebauer (Agronomy & Horticulture)), 5) estimating ET using satellite data and surface meteorological data (temperature, humidity, wind speed and cloud cover) (Kilic and Neale), 6) development of a phenotyping facility (greenhouse and field based) on the Nebraska Innovation Campus through its collaboration with the UNL Consortium for Integrated Translational Biology (CITB), and 7) characterizing the ecological response and biodiversity of restored grassland systems (Wardlow, Neale, Allen (SNR), and the Nature Conservancy).

### **Vegetation-Climate-Water Interactions**

Improved understanding of interactions of vegetation-climate-water nexus and the ability to monitor and map these key components of this nexus such as vegetation status (e.g., leaf area and biomass), evapotranspiration (ET), and soil moisture are critical for addressing key societal challenges such as agricultural and natural resource sustainability, food security, water management, climate change and variability (e.g., drought), and biodiversity and ecosystem services. Remote sensing provides a means to investigate different components of this nexus either collectively or separately and understand their interactions across multiple spatial scales. CALMIT is establishing collaborative partnerships in this area with key partners both internally (e.g., DWFI and NDMC) and externally (e.g., Google) to advance the use of remote sensing and other spatial tools (e.g., GIS and GPS) for basic and applied research, as well as practical application solutions.

Current CALMIT studies and activities investigating remote sensing techniques to characterize and monitor the vegetation-climate-water nexus include: 1) developing composite index-based tools for agricultural drought monitoring that integrate satellite-based observations of vegetation health, ET and/or soil moisture for the continental U.S. and other parts of the world (e.g., Canada, Brazil, and Middle East/North Africa region) supported by NASA, World Bank, and US AID (Wardlow); 2) investigating the use of satellite-based vegetation index- and ET-based indicators for drought monitoring and early warning; 3) co-chairing the World Meteorological Organization's task team on the use of satellite observations for climate monitoring (Wardlow); 4) full membership on the NASA/USGS Landsat Science Team (Kilic); 5) developing remote sensing-based ET estimations within Google Earth Engine (Kilic); 6) investigating the use of phenocam observations for characterizing land surface phenology and validating satellite-based observations (Wardlow); 7) studying VI- and ET-based methods for irrigation classification (Wardlow); 8) Nationwide VI-ET relations at the 1 m NAIP scale for residential water management via Google GEARUP (Kilic); 9) Production of ET maps for Nebraska Natural Resources Districts for conjunctive ground-water – surface water management (Kilic); 10) investigating land surface-atmospheric interactions related to source and dispersion of fire particulates and dust emissions (Wang); and 11) investigating the use of cosmic ray sensing to estimate soil moisture and developing advanced spatial interpolation techniques to extend in situ-based soil moisture estimates (Franz).

### **Decisions**

A number of decisions regarding the viability and sustainability of CALMIT need to be considered. The primary factor influencing decisions for CALMIT is authorization to fill critical faculty vacancies. Secondary factors include base-level support for research infrastructure and technicians. Decisions on these factors will affect the ability of CALMIT to meet its charter and respond to the increasing demand.

### **Objectives**

CALMIT has a charter and reputation that enables the strengthening of its research programs in: 1) dynamic plant responses to stress caused by environmental change and more broadly into 2) understanding the climate-water-vegetation interactions and changes affecting agricultural and natural



resources sustainability. The center's charter also positions it to become the flagship organization for geospatial research and application within UNL and the NU system. CALMIT can take a leadership role in this area and fill this current gap in Nebraska, providing service and survey activities that lead to: 1) partnerships with state agencies, local government and the private sector requiring remote sensing and GIS technical support, and underpin applied research and 2) provide short courses for individuals or groups in high interest areas that include field-, airborne- and satellite-based remote sensing methods and plant phenotyping through multi-scale remote sensing observations.

To evaluate the success in achieving the center's charter, the following objectives have been identified:

***Research:***

- 18) Amount of grant funding and number of grants
- 19) Number of peer-reviewed publications
- 20) Professional recognition and service (e.g., awards, expert panels, science teams)
- 21) Number of graduate students
- 22) Number of visiting scientists
- 23) Number of collaborations with internal and external university faculty

***Survey/Service:***

- 24) Number of contracts
- 25) Number of workshops/training

## **Alternatives**

CALMIT has identified three alternatives with corresponding consequences:

- 1. Business as usual (no further investment into the center)
- 2. Rebuilding a recognized program
- 3. Visionary, building a campus-wide center

### **1. Business As Usual Alternative Option**

This alternative assumes no new faculty lines are approved beyond those identified earlier (total research FTE of 0.91). The specialization of the new quantitative remote sensing faculty hire is unknown, but she/he will be expected to provide leadership of the CALMIT field program and staff, as well as generate grant funding. As a result, the research potential in the director's area of expertise (remote sensing of the climate-water-vegetation nexus) will not be reached. The lack of GIS skills (limited faculty with this specialization) denies the CALMIT the ability to pursue grant and contracting opportunities supporting land management and environmental stewardship.

Under this scenario, CALMIT will be limited to only one of three potential research areas: 1) the remote sensing of vegetation and associated biological processes, 2) climate-vegetation interactions and application to water, drought, natural resources and agricultural applications, or 3) advanced remote sensing field methods. CALMIT will be largely dependent on external grant funding, which will be difficult to obtain because of limited faculty and limited funding to maintain support staff and infrastructure. Some external support may come from research funding obtained through our affiliated

faculty. Similarly, CALMIT will be unable to attract and support GRAs because of limited funding and inability to teach the breadth of courses needed for solid academic progression.

As a result, we anticipate the following outcomes:

- 1) Small increase in funding. The center's current funding model is reliant on proposal opportunities that align with the expertise of the current limited number of "core" faculty. The resulting constraint on CALMIT's ability to garner funding puts sustainability at great risk. In recent years, securing \$350K in funding annually to sustain the core capabilities of CALMIT has been a challenge with such a limited capacity. Disbanding the center is a possible outcome.
- 2) Minimal increase in the number of peer-reviewed publications. The number of publications will continue to be limited because of the lack of faculty and limited allocation of research appointments.
- 3) Minimal increase in professional recognition. Limited by number of faculty.
- 4) Minimal increase in number of graduate students because of limited faculty.
- 5) Slight increase in the number of visiting scientists. The new faculty hire and integration of other affiliated faculty into the center should allow more scientists to be engaged and hosted.
- 6) New collaborations in a defined area of interest will likely be forged with new hire and be dependent on their skill set.
- 7) Limited increase in funding is possible. But given the small number of faculty, CALMIT is likely to remain below sustainable funding levels.
- 8) Limited ability to respond to GIS support solicitations.

## **2. Recognized Program Option**

This alternative assumes the addition of three new faculty beyond those in the Business as usual alternative. The faculty skill areas would include: GIS, image-based remote sensing, vegetation phenotyping, and vegetation stress response. These skill sets would enable CALMIT to work at the forefront of ecological, agronomic and resource management research and application.

### ***2.1 Needs***

The following are a sets of needs to achieve this option:

- Increase center director administrative appointment to a minimum of 0.5 FTE
- Three new faculty (0.70 research FTE each for a total of 2.1 research FTE) to keep CALMIT at the cutting-edge in several spatial science areas
  - Two image-based remote sensing positions with expertise in data fusion and use of different observations (e.g., LIDAR, hyperspectral, and/or thermal or ground, UAV, aircraft and/or satellite)
  - GIS position with practical application expertise in agriculture and natural resources
- Base-level center funding (internal funding and/or indirect return) to provide resources to update and maintain center required infrastructure (e.g., data servers, advanced software, web and mobile applications).
- Base-level support for two center staff with expertise in remote sensing and GIS who are currently on staff and grant funded. These positions would provide technical support/services

within UNL and serve as a center technical liaison to state and local government and private sector to stimulate and develop new research opportunities and contracts for CALMIT.

- Addition of one GIS (environmental modeling and/or geovisualization) and one remote sensing (image-based analysis, LIDAR and/or UAVs) staff member to support the increased number of grant- and contract-funded projects.
- Total annual grant and contract funding anticipated to be on the order of \$750K.
- Expansion of remote sensing program to include UAS.

The following outcomes are anticipated from these actions.

- 1) Substantial increase in research funding from USDA, NASA, NSF and DOE. Funding from federal sources can be expected to be at least on the order of \$350K with increased faculty. In addition, CALMIT would be able to respond to service requests from state and private sources for data acquisition and analysis as well as model development. The amount of funding could exceed \$150K per year.
- 2) Sizeable increase in the number of publications / research FTE/year.
- 3) Increased national and international recognition (awards, expert panels).
- 4) Increase the caliber and number of graduate students (three or more students annually) with increased advising capacity, grant-funded student assistantships, and upper-level, advanced remote sensing and GIS offerings.
- 5) Increase in the number of visiting scientists given the center's increased recognition and increased research and training capacity.
- 6) Increase in the number of collaborations with organizations within and outside of UNL including continuing to build collaborative national and international research projects involving globally-recognized organizations such as DWFI, FAO, Google, IAEA, US AID, UNESCO, FAO and World Bank.
- 7) Specialized training courses in field remote sensing and applications in phenotyping, unmanned aerial systems (UAS), drought, and water resources would be developed for internal and external participants, providing additional revenue on the order of \$25-75K.

### **3 Visionary Option**

This alternative focuses on the development of a more holistic, spatial science center that would pursue and support a wide array of research across the sciences using remote sensing, GIS, GPS, geovisualization, geostatistics, spatial reasoning and other spatial methods. The concept comes from previous interest to establish an entity that would support research across all campuses within the University of Nebraska system. This center would have dedicated staff and lab facilities to work with faculty to integrate basic and advanced spatial analysis methods, geographic thought, and other spatial tools into research in the biological, physical, and social sciences and many other academic units (e.g., humanities, computer science, and engineering). This is similar to the service/survey activities defined for CALMIT, but on a much larger scale using a much broader set of spatial skills. This center would likely be an outgrowth of CALMIT service/survey activities, but greatly expanded to advance the spatial science in general across the campuses. UNL becomes one of the top world-class centers in spatial sciences and remote sensing research.

#### ***3.1 Needs***

- Beyond the “recognized” alternative, three new faculty (0.60 research FTE each for a total of 2.4 research FTE, with teaching FTE in SNR-Geography) to expand capabilities into other cutting-edge spatial science areas such as geovisualization and spatial modeling:
  - Advanced GIS position in spatial/environmental modeling
  - Remote sensing position in an emerging area such as UAS applications or LIDAR
  - Geovisualization position with expertise in digital cartography and representation and analysis of spatial data sets
- Grant and contract funding on the order of \$1.5 M per year
- UNL and NU system baseline support of expanded center capabilities to integrate basic and advanced spatial technologies and methods into research across the sciences and humanities across the NU system
  - Two additional staff with expertise in GIS and remote sensing to serve as liaisons that provide technical support and training, as well as application development within the NU systems and externally with state and local government and private industry.
  - Establish a dedicated spatial science center computing lab used for technical training and consulting with faculty, staff, students and other practitioners.

The following outcomes are anticipated from these actions.

- 1) Additional grant funding on the order of \$2.75M per year (\$500K per research FTE).
- 2) Increased number of publications (an additional 3-4 per year per FTE).
- 3) Increased visibility results in increased number of awards and service on expert panels.
- 4) Increased visibility and research grants will increase the number of graduate students conducting research in CALMIT; increased number of graduate student advisees (2-3 per faculty – approx. 12 additional students annually)
- 5) Increased visibility will increase visiting scientists to the center (3-4 per year)
- 6) Growing number of collaborations in state and local agencies and of faculty and groups across the NU system campuses.
- 7) Cross-campus collaboration will develop an ability to respond locally and regionally to geospatial technology research and application needs.
- 8) Increase in number of affiliated faculty working in the spatial sciences.
- 9) Opportunities for cross-campus programs will aid in establishing a strong Geospatial Technology community across Nebraska. Provide technical consultation on the use of tools for specific research projects will result in more contracts. Focused research into extensible applications.

## Conclusion

It is imperative that SNR and UNL respond to the need for spatial data, which enables research and application in a growing number of research, development and decision-making areas. Responding to this need, CALMIT chooses the “recognition” alternative option as the only viable option. The “business as usual” option provides more negative outcomes than positive outcomes; no objective is fully achieved. CALMIT would lack sustainability. In the “recognition” alternative all objectives are achieved. The “visionary” option builds the spatial sciences strength beyond the vision and mission of CALMIT by advancing spatial analysis to disciplines other than agriculture and natural resources. Accomplishing this vision requires a large investment from the NU system.





**CSD**

**Conservation and Survey Division**



## Conservation and Survey Division

### Introduction

Every state in the United States has a geological survey of some kind; the importance of these organizations is explicit in the uniformity of mission, mandate and scope among those organizations and in their contributions to economic activity, sound development, wise resource use and public safety (Association of American State Geologists, 2013; American Institute of Professional Geologists, undated). Moreover, geological surveys can contribute substantively to Earth-science literacy of the general public and thereby promote better decision-making in a world faced with looming environmental and resource issues (National Science Foundation, undated; Tewksbury, 2013; Wardle, 2015).

The Conservation and Survey Division (CSD), which is Nebraska's geological survey, has existed since 1921, although there has been a state geologist or geological survey of some kind since the early 1870s. CSD, its role and place within the University of Nebraska are clearly described in Nebraska Revised Statutes 85-163, 85-164, 85-165, and multiple others (Nebraska Legislature, undated). CSD is unique among the various parts of the university system and among the offices of state government because it is the primary source of unbiased geological and hydrogeological data for the State of Nebraska. The mission of CSD lies fundamentally in research—including long-term groundwater monitoring and ongoing additions to geological databases—as well as engagement, rather than in formal teaching, even though CSD personnel have contributed to the university's classroom teaching mission for decades. CSD also archives important Earth-science data, borehole cuttings, cores and other geological samples for the use of scientists, the public and the private sector.

CSD has played a unique and essential role for more than a century. Activities range from the long-term monitoring and assessment of Nebraska's groundwater resources to the ongoing effort to develop the Elk Creek carbonatite rare-earth and niobium deposit. There is also a large and persistent demand for the data and reports (e.g., Nebraska Statewide Groundwater-Level Monitoring Report, StateMap geologic maps, the Groundwater Atlas of Nebraska, etc.) generated by CSD, as well as for the scholarly expertise of individual staff members (e.g., groundwater consultative service, consultative relationships with mineral exploration and production concerns, Nebraska Well Drillers Association activities, etc.). The recent controversy over the proposed Keystone XL Pipeline Extension in Nebraska highlighted not only the need for a state geological survey as a source of unbiased data and education to fill in major gaps in public understanding about Earth-science issues. Also, CSD is an essential contributor to major regional analyses of resources, such as the Eastern Nebraska Water Resources Assessment (Eastern Nebraska Water Resources, undated).

### Decisions

CSD has experienced a drastic reduction in the number of core geological-survey personnel, chiefly at the rank of faculty, since it was incorporated into the School of Natural Resources in 2003. In the early 2000s, there were at least ten tenured or tenure-track faculty members and three equivalent-rank personnel within CSD. By the summer of 2015, only two faculty members, both of whom now have administrative appointments within SNR, and two individuals in equivalent-rank positions remaining. Five managerial-professional staff members, one of whom is paid partially by an external agency, carry out most of the work formerly done by CSD faculty. Reductions in personnel have severely restricted the ability of CSD to fulfill its mission. Many of the functions of a typical state geological survey can no longer be adequately fulfilled by CSD and any further reduction in personnel will prohibit the organization from adequately fulfilling its mandate and serving Nebraskans in any of the geological survey mission areas.

The scope of expertise within the CSD has already been diminished significantly by attrition and we do not foresee a major re-diversification in that regard. Rather, we emphasize a few core geological survey functions, their relevance to the university overall, and their importance solving problems in Nebraska. These core functions are: (1) active groundwater monitoring and resource assessment, particularly in terms of geographical and geological occurrence, quantity and quality; (2) advancing a thorough conceptualization of the state's geologic framework, particularly surficial materials and the sedimentary strata that hold groundwater and mineral resources, at a meaningful scale of resolution; (3) increasing the understanding of Nebraska's physical landscapes, surficial processes and soils, with at least a rudimentary ability in the areas of geologic hazards and geological engineering.

It is absolutely essential that CSD retain resident expertise in the analyses of data relevant core functions #1 and #2 described above, including personnel who have, through the long term, developed sufficient familiarity with regional geology to contribute to the solution of complex problems that arise in a rapidly changing world. In addition, it is highly beneficial that CSD staff also have some familiarity with a broad range of geological subdisciplines and techniques (e.g. engineering geology, geological dating, mineral resources, sedimentology and stratigraphy, etc.). The core functions enumerated above, whether currently achieved by existing Survey personnel or engaged upon by any future hires, either directly or indirectly support major university missions and initiatives such as Agricultural Research and Extension, Water for Food Institute, Rural Futures Initiative, the overall economic development of the state of Nebraska and others.

## Objectives

CSD should focus on the following objectives:

Objective 1: Increase Output of Products and Research Footprint. In addition to engaging in monitoring (e.g., groundwater levels) and data collection (e.g., test-hole logs) or in one-off service requests, CSD should increase its output of finished research products that: (a) interpret both existing and new data, (b) present such data in highly usable forms, and (c) summarize resident expertise and experience. Such products include, but are not limited to: peer-reviewed publications in scientific journals, hydrogeologic and geologic maps and survey bulletins. This objective articulates with the university's increasing mission emphasis on research, but it also provides a better means by which to disseminate knowledge in accordance with the mission of Agricultural Extension.

Objective 2: Increase Educational Impacts and Public Awareness: Broaden the interface of CSD personnel with formal and informal education efforts in SNR and the university at large and increase the contribution that CSD makes in the broadly-construed education mission. Make Nebraskans more aware of their physical environment and its resources, the wise use of resources and the global relationship between humankind and Earth. An increased output of some types of publications (Objective 1, above) will help accomplish this objective. This objective articulates with the university's abiding mission emphasis on education and engagement.

Objective 3: Increase External Funding: By virtue of a proposed increase in personnel (see forthcoming discussion), increase grant and contract funding from Natural Resource Districts and state and federal agencies.

## Alternatives

Because CSD is mandated and no other university program or state agency achieves its function, the outright abolition of CSD and its functions are considered to be beyond consideration, barring an abrupt change in statutes. Fiscal and hiring trends in the larger university environment, however, very strongly

suggest that CSD will never attain a ca. 2003 level of staffing: the acceptance of this reality, however difficult, is a matter of university citizenship. The need for CSD functions and the legislative mandate, however, remain, and realistic scenarios must be articulated in order to frame the future of the organization. Given present circumstances, scenarios for the future of CSD are:

Alternative 1 Demise by attrition. In order to grow other programs, administrative decisions are made such that staffing levels in CSD are permanently reduced by attrition to a point at which the designated mission is no longer fulfilled at all. The loss of even one or two positions—whether faculty, equivalent-rank, or managerial-professional—will likely fulfill this alternative. In this scenario there would be: (1) a dramatic decrease and eventual cessation in research products; (2) a steady decrease in any educational contribution made by CSD; and (3) a steady decrease, or abrupt cessation, in external funding.

Alternative 2: *Status quo*. Maintenance of the *status quo*, that is, the present minimal staffing levels and breadth of expertise and present levels of productivity. In this scenario, existing staff and faculty positions turn over gradually by virtue of the broad age profile of existing personnel. The gradual replacement of existing personnel might eventually lead to a slight improvement in the fulfillment of CSD's mission, but that outcome is by no means guaranteed. In this scenario, research products, the educational contribution made by CSD and external funding levels are likely to remain at present levels, barring any unforeseen circumstances.

Alternative 3 Modest growth: Promote highly focused but modest increases in numbers of staff and faculty assigned to CSD, and accordingly broaden the expertise and abilities of the organization to some degree. Increase CSD faculty by two (2) positions, one dealing primarily with hydrogeology and likely to be fulfilled by a forthcoming Program of Excellence hire, and another dealing primarily with geology and possibly aspects of environmental, engineering, or natural-hazards geology as well. Increase staff-level (managerial-professional) positions by at least two (2) positions, to be filled by individuals with fully appropriate qualifications in the field of geology. In this scenario, research products, the educational contribution made by CSD, and external funding levels are likely to increase, barring any unforeseen circumstances. This scenario, while by no means ideal, is the preferable one, and its outcomes will have significant benefits within SNR and IANR.

## Conclusion

In its present form and capacity, CSD is barely able to meet some of its designated mission and fulfill its legislative mandate, but by no means the full scope of geological survey duties. Nevertheless, CSD is a unique and essential part of the university that can contribute even more substantively to the overall mission and to the well-being of Nebraskans in general. In the very least, the *status quo* at CSD must be maintained in order for *any* part of the mandated mission to be accomplished to any degree of relevance, but it is far preferable that increases in personnel be implemented so that important objectives can be fulfilled.

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**GPCESU**

**Great Plains Cooperative Ecosystem Studies Unit**



## Great Plains Cooperative Ecosystem Studies Unit

### Introduction

The Great Plains CESU, one of 17 regional CESUs in the United States, is a network of 20 academic institutions and one NGO in the Great Plains region and 11 federal agencies. The University of Nebraska-Lincoln serves as host to the Great Plains CESU, which was established in October 2000. In May 2015, the CESU network renewed the University of Nebraska-Lincoln as the host for 2015-2020. The ‘heart’ of the GP-CESU is the guiding Cooperative Agreement that establishes simple and relatively quick funding mechanisms between federal agency partners and academic institution partners.

The unit encompasses a broad geographical portion of the Great Plains and offers an outstanding group of scientists in grasslands, ecosystems studies and natural and cultural resources management for collaborative research, technical assistance and educational opportunities in the CESU. Since the Great Plains CESU’s inception, offices have been housed in the School of Natural Resources. A National Park Service research coordinator has traditionally been placed with the Great Plains CESU. The director of the Great Plains CESU has been a regular faculty member in the School of Natural Resources with some administrative capacity (i.e., research center director or associate director) or history of administrative experience.

Relative to other CESU regions, the Great Plains CESU has the potential to suffer a challenge of geography—the Great Plains is a geographic region that has some of the highest proportions of private land in the United States. As a result, the land area for public lands administered by federal agencies is often less than 5% of each member state. Thus, the Great Plains CESU will most likely never see the magnitude of projects and flow of federal dollars to non-federal partners that our sister CESUs in the western US enjoy. This factor affects funding and activity levels, and it is important to keep our accomplishments in perspective relative to opportunities in the region.

During the period of the 2010-2015 agreement, operating funds for the Great Plains CESU from the initial member fees for federal partners had largely disappeared, because no schedule for new support dollars was in place from the CESU network. The administrative assistant in the Great Plains CESU had moved to part time by the end of the 2005-2009 agreement, and this position was eliminated because of lack of funds for salary early in the period served by the 2010 CESU funding agreement. The CESU operated on minimal funds provided by DOD (joined late in the 2005-2009 agreement period) and Farm Service Agency (joined during the 2010 agreement period). In addition, the National Park Service provided some critical, sporadic base funding to keep basic operations and travel in place during the past five years.

In August 2011, Dr. Larkin Powell agreed to become the director of the Great Plains CESU when Dr. Sunil Narumalani moved to a higher administrative position in the Dean’s Office of the College of Arts and Sciences. Dr. Powell has a full set of responsibilities as a research/teaching faculty member in the School of Natural Resources (60% teaching/40% research), and no initial reduction in these responsibilities was supplied by UNL in return for serving as director. In December 2012, Dr. Gary Willson retired from his position as the National Park Service research coordinator. The NPS research coordinator position remained empty until February 2015 when Dr. Tanya Shenk began her role as research coordinator in the Great Plains CESU.

As a result of a lack of base support through the CESU system and the retirement (without immediate replacement) of the NPS research coordinator, the Great Plains CESU has functioned with an effective staff of one person: the Director (Dr. Powell). And, for most of the period of the current agreement, Dr. Powell has filled that role on top of his regular expectations as a faculty member. Functions of record-keeping, proactive work to stimulate research projects among partners, and the management of annual

meetings were abandoned to allow focus on the basic functions required to keep the Great Plains CESU at a minimally functional level.

Despite the inability to work proactively during the 2010-2015 agreement period, the Great Plains CESU has marked several impressive accomplishments. The 2010 CESU Agreement was amended four times to add four new non-federal partners (Oklahoma State University, University of Nebraska Medical Center, Texas Tech University, and our first NGO—World Wildlife Fund: Northern Great Plains) and one new federal partner (Farm Service Agency). The addition of FSA was a CESU-wide addition, sparked by primary interest in membership in the Great Plains CESU. The Bureau of Indian Affairs recently declared intentions to become the 11<sup>th</sup> federal partner, and NOAA has expressed interest in becoming the 12<sup>th</sup>.

In addition, the Great Plains CESU succeeded in providing its own temporary ‘fix’ to the problem of base support. In September 2014, the Institute of Natural Resources (IANR) of UNL announced that they were supportive of a CESU-support proposal from Dr. Powell and the director of the School of Natural Resources, Dr. John Carroll. IANR is providing, for a trial period of three years, a \$4,000/yr administrative stipend for the CESU director, \$10,000/year to hire an adjunct faculty member to teach one of the CESU director’s courses, and \$15,000/year to support an office assistant for the Great Plains CESU. Further, in December of 2014, the CESU National System announced changes to host support that will improve the functionality of the CESU host universities by adding continual base support.

Examples of projects funded at the University of Nebraska –Lincoln through the CESU agreements are:

- **Cosmic ray rover**, funded by Department of Defense. A faculty member in the School of Natural Resources is working with DOD to test-prove the use of cosmic rays to assess soil moisture and groundwater.
- **Debris management for USGS tsunami scenario**, funded by USGS. A faculty member is working with USGS to provide guidance and planning for debris management during tsunami conditions.
- **Soil Survey Training Video Development and Support for International Union of Soil Scientists Soil Classification Conference**, funded by NRCS. A faculty member provided educational products to train students and professionals as a means to support NRCS-related missions with a professional soils society.

Other programs at UNL are derived from the presence of the Great Plains CESU. For example, UNL established a new agreement for funding through the US Army Corps of Engineers: Kansas City District. USACE now has an agreement (in addition to the CESU agreement) with five universities in the Great Rivers, Great Rivers and Rocky Mountain regions of the CESU system. The agreement sets up an approved funding agreement of up to a certain dollar amount, under which individual projects can be immediately generated and approved. The universities that are a part of the agreement (including University of Nebraska-Lincoln, University of Missouri-Columbia, Kansas State University and Colorado State University) most likely increased their chances at winning the bids for this position because of their work through CESU-type agreements with USACE in the past.

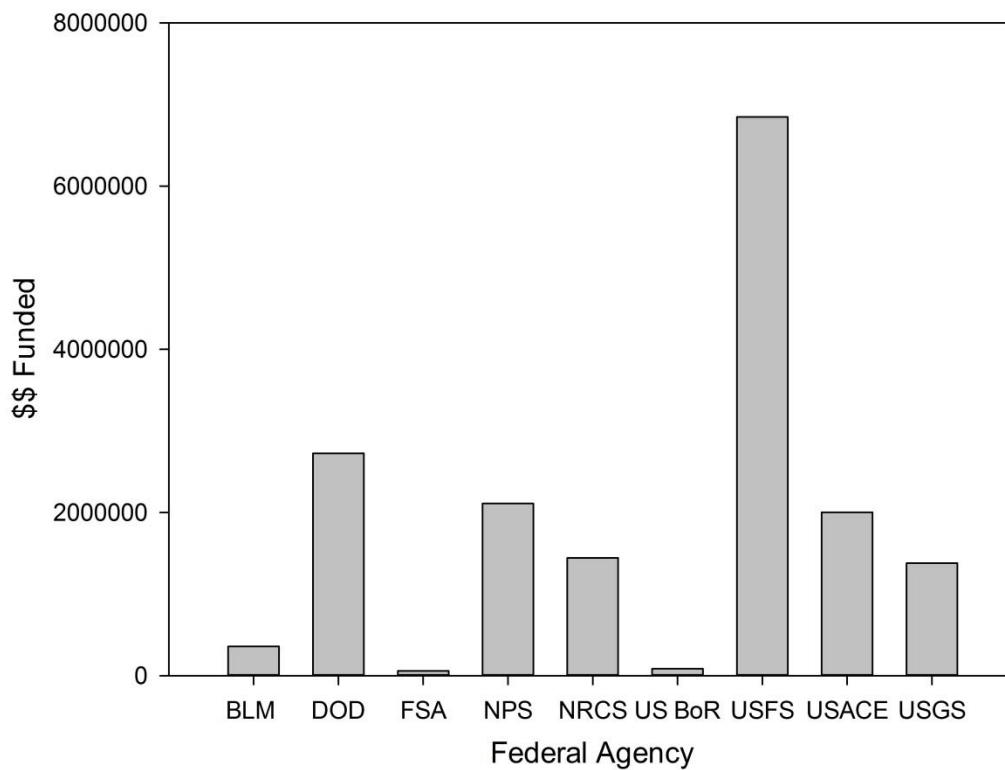
*Table 4. Federal funds distributed within the Great Plains CESU: 2010-2014. USFWS did not report to the Great Plains CESU.*

Agency	\$ Total	# Projects
BLM	\$360,214	7
DOD	2,725,083	19
FSA	60,000	1

# Great Plains Cooperative Ecosystem Studies Unit

NPS	2,110,095	79
NRCS	1,443,826	18
US BoR	86,306	2
USFS	6,846,925	81
USFWS	?	?
USACE	2,002,719	9
USGS	1,378,912	14
<b>TOTAL</b>	<b>\$17,014,079</b>	<b>230</b>

Figure 8. Relative federal funds distributed within the Great Plains CESU: 2010-2014. USFWS did not report to the Great Plains CESU.





# Great Plains Cooperative Ecosystem Studies Unit

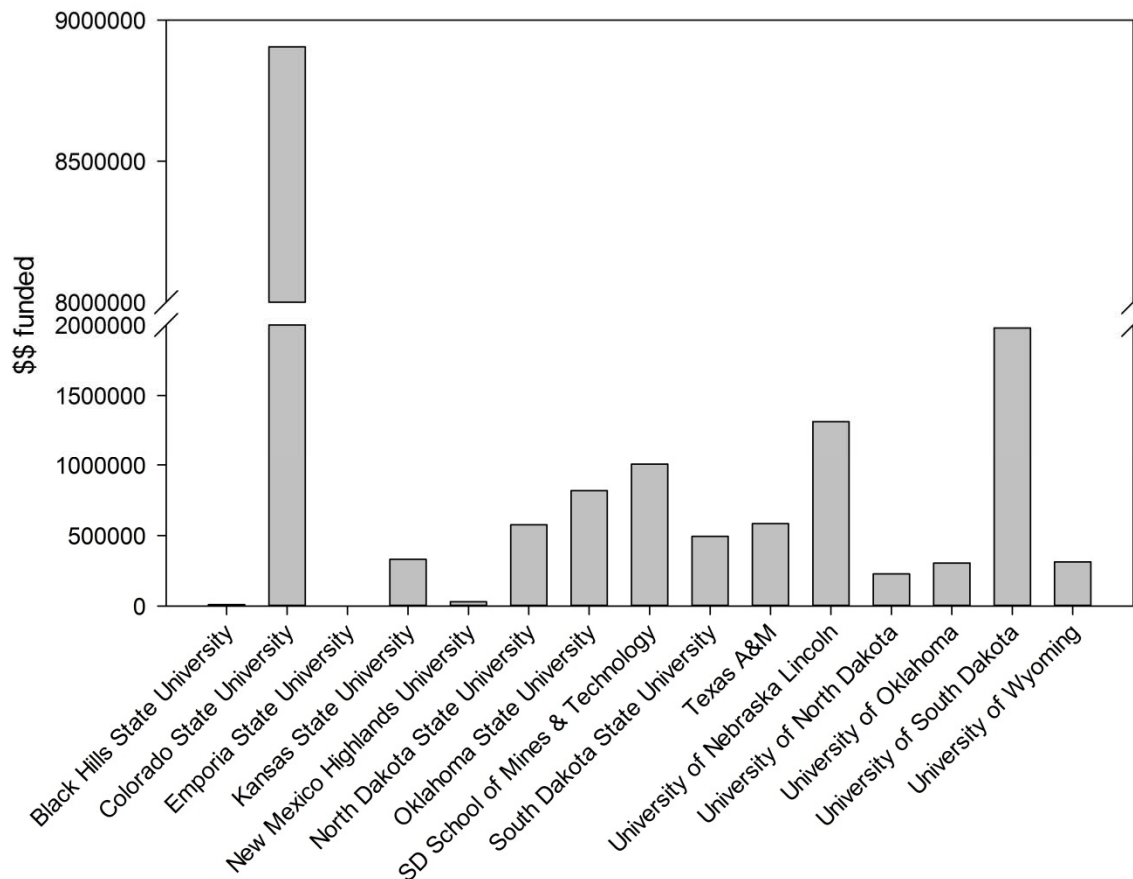
*Table 5. Federal funds distributed to 16 of 21 universities within the Great Plains CESU: 2010-2014. Universities not listed did not receive federal funds (or no record of transaction was provided by a reporting federal agency). NOTE: USFWS and USACE did not report to the Great Plains CESU.*

University	\$ Total	# Projects*
Black Hills State University	9,900	2
Colorado State University	8,905,542	85
Emporia State University	2,497	2
Langston University	0	0
Kansas State University	330,644	10
New Mexico Highlands University	30,386	2
North Dakota State University	575,414	5
Oklahoma State University	818,318	6
South Dakota School of Mines & Technology	1,006,267	20
South Dakota State University	493,282	13
Texas A&M	583,780	4
Texas Tech University	0	0
University of Minnesota	0	0
University of Nebraska-Lincoln	1,315,002	39
University of Nebraska Medical Center	0	0
University of North Dakota	227,728	2
University of Oklahoma	304,858	4
University of South Dakota	1,978,882	18
University of Wyoming	313,000	10
Winona State University	0	0
WWF: Northern Great Plains	0	0

*\*Includes renewals and modifications*



Figure 9. *Relative federal funds distributed to Universities within the Great Plains CESU: 2010-2014.*  
 NOTE: USFWS did not report to the Great Plains CESU.



## Decisions

The Great Plains CESU has few decisions to make. Decisions largely involve how the director and research coordinator allocate their time and energy to specific tasks. The School of Natural Resources decides every five years whether to contribute faculty time and office space needed to serve as the home department to the CESU. And, UNL has made a decision, every five years, to continue as the host university.

## Objectives

The Great Plains CESU has objectives that are set by the national CESU system:

- Provide research, technical assistance and education to federal land management, environmental and research agencies and their potential partners.
- Develop a program of research, technical assistance and education that involves the biological, physical, social and cultural sciences needed to address resources issues and interdisciplinary problem-solving at multiple scales and in an ecosystem context at the local, regional and national level.

- Place special emphasis on the working collaboration among federal agencies and universities and their related partner institutions.

In addition, the Great Plains CESU has established the following local and regional objectives:

- Leverage regional research relating to grasslands.
- Provide contacts to increase the amount of federal funding that comes to the University of Nebraska-Lincoln to justify internal support for the director and the CESU office.

### **Strategies for 2010-2015**

The Great Plains CESU has been able to establish a more proactive strategy for the next five years because of support that is now available. Our strategy includes actions of (1) formally integrating our Manager's Committee (contacts with the federal agencies) to get feedback and make plans for collaborations that can be facilitated, and (2) developing a thematic approach in a topic of interest (e.g., grassland management, pollinator ecology) that would bring together scientists at university partners throughout the region to solve problems bigger than individual contracts with local public land areas.

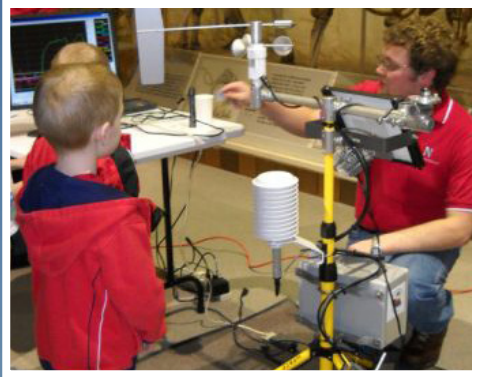
### **Conclusion**

The next agreement period, beginning in 2015, is set to be an impressive period for the Great Plains CESU. We have a new NPS research coordinator who is located on-site. We have institutional support for the CESU director. And, we have the promise of continual support from our federal agency partners.









**HPGCC**

**High Plains Regional Climate Center**

## High Plains Regional Climate Center

### Mission and Objectives:

HPRCC exists to increase use and availability of climate data and information working within a three-tiered system of climate services (state, regional, national). The HPRCC has three primary areas – services, monitoring, and information – in which our staff of 10 focus our efforts to accomplish our mission. We serve a wide variety of customers (i.e. research, agriculture industry, insurance, utilities, government, media and the general public) through provision of climate data and data products. Our services also include educational outreach activities on weather and climate at the K-20 levels and beyond. We participate in local and regional monitoring activities through operation and maintenance of a state network of weather stations as well as the collection and quality control of thousands of observations across our region and nationally. We turn the data into information through data architecture design and development, data product development, and stakeholder engagement.

### HPRCC background:

The HPRCC is recognized as an official Center at UNL and has been in continuous operation since 1987. We are one of the six Regional Climate Centers (RCC) in the U.S. (<http://www.ncdc.noaa.gov/customer-support/partnerships/regional-climate-centers>) and serve the states of ND, SD, NE, KS, WY, and CO. We are an operational center, as opposed to a research center, and must maintain our systems and products such that they are available 24/7/365. We are primarily funded through a contract with the National Oceanic and Atmospheric Administration (NOAA), through the National Centers for Environmental Information (formerly the National Climatic Data Center), which offers an open competition approximately every three years. Our funding has varied in amount somewhat from year to year, depending on available appropriations from Congress, but has been level in the most recent five years. Recently, there has been some uncertainty as to the viability and future of the Regional Climate Center program as it exists in its current form with NOAA, which has resulted in stressors on HPRCC staff. NOAA issued an 18-month contract to the HPRCC (and the other Centers) on October 1, 2013. A four-month extension and subsequently a 12-month extension has been issued at the end of the 18-month contract. This further illustrates programmatic challenges for the RCC program and highlights the importance of supplemental grants and contracts. Our next contract period will begin on July 1, 2016, where we will compete in another open competition.

### Long-term vision for HPRCC:

The HPRCC will remain as the go-to source for regional climate information and focus attention on climate issues related to critical natural resource themes (water and climate extremes in particular). In doing so, the HPRCC will actively engage with stakeholders across the region and country to understand needs and develop usable decision support tools and data products.

The NOAA contract specifies deliverables including provision of basic climate services, collection and maintenance of climate datasets, development of climate data products, and stakeholder engagement. All of the staff are soft-funded through this contract (90%) and supplemental grants (10%) with the exception of the Director, Martha Shulski. Her position is 100% state supported as a tenured faculty member. The decisions where HPRCC has flexibility lie in supplemental grants and contracts outside of our base NOAA funding. As can be seen from the themes below, these dovetail and overlap with HPRCC contract deliverables and the mission of SNR.

### Objectives

These are the fundamental measures of success for the HPRCC.

1. **Availability of regional climate data (uptime)**
2. **Quality and diversity of knowledge products available**
3. **Supplemental funding for product development**
4. **Number of stakeholders engaged**
5. **Number of people reached in education and outreach**

## **Alternatives and Consequences**

In all of the following alternatives we assume that NOAA renews the regional climate center contract starting in July 2016.

**Business as usual** Individual station cooperators and temporary state funds support the Nebraska network of 70 weather stations, leaving the possibility of future gaps in data collection. HPRCC actively engages states in the region and develops agreements for data collection, ensuring regional climate data are highly available. Staff regularly engage with clients and stakeholders through various means (social media, website, quarterly newsletter, invited speaking engagements, etc.), informing future product development, applied research activities, and education and outreach areas of focus.

### **Increased state investment and federal supplemental grants – focus on research & development**

State of Nebraska and UNL commit to the long-term sustainment of the state weather network through annual funding support. Increasing the predictability of funding for the state weather network allows for active solicitation of new weather station cooperators, growing and enhancing the network to better serve the needs of Nebraskans. In addition, the director and staff will seek out funding opportunities and projects that will lead to collaboration among regional and national agencies for climate data product development. Products will utilize climate statistics with applications to various topical themes such as agriculture or health. Better regional climate assessments can be made for a variety of purposes, such as drought monitoring, water resource management, and impact assessments.

### **Increased state investment and federal supplemental grants – focus on outreach and stakeholders**

Identical to the previous alternative, but the director and staff focus on engagement in projects such as Climate Masters of Nebraska – an adult climate education program – rather than funding for research. In addition they host an annual workshop with key stakeholder groups to articulate and understand needs. This will improve the utility of existing knowledge products and suggest possibilities for others.

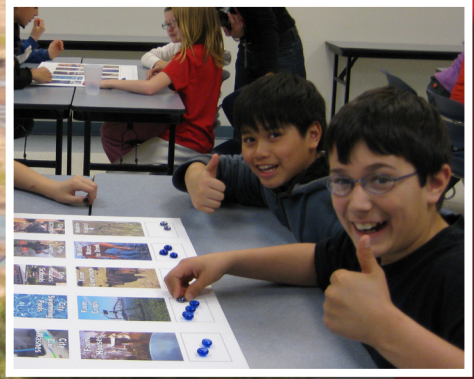
## **Conclusion**

Increased reliability of funding for the State Climate Network frees up the director and staff of HPRCC to do additional product R&D, increasing the utility of services throughout the region and the country. An understanding and prioritization of stakeholder needs outlines the suite of existing products and helps to guide appropriate R&D areas that lead to climate data product development.









**NDMC**

**National Drought Mitigation Center**

## **National Drought Mitigation Center**

### **Mission and Objectives**

The NDMC's mission is to lessen societal vulnerability to drought by promoting planning and the adoption of appropriate risk management techniques. To us, appropriate risk management strategies can be classified into three main components: monitoring and early warning, planning, and mitigation. Therefore, the NDMC's primary objectives are to assist individuals and organizations in drought risk management and help foster drought planning at all scales, including individual farms and ranches, communities, tribal lands, states, river basins and countries around the world.

### **NDMC Background**

The NDMC was established in 1995 around the drought management program built by Dr. Donald Wilhite from the early 1980s through the early 1990s. It was officially approved as a "Center" by the University of Nebraska's Board of Regents in March 2005. The NDMC's efforts emphasize research, outreach, and operational activities that stress a proactive risk management approach to prepare for drought events in contrast to the normal reactive crisis management approach often followed by officials responding to disasters. It is nationally and internationally recognized for its quality programs in drought risk management focused on monitoring and early warning, planning, and mitigation (actions taken to reduce drought risk before a drought occurs). The NDMC works closely with local, state, and tribal governments; federal agencies such as USDA, NOAA, NASA, USGS, EPA, NSF, Bureau of Reclamation, and the Corps of Engineers; and non-governmental organizations. The NDMC includes 18 faculty and staff positions, with expertise that includes climatology, geography, planning, social sciences, and humanities. Salary for the NDMC Director, Michael Hayes, is provided through state funding, while the salaries for the other 17 faculty and staff positions are soft-funded through grants and contracts.

Since 1995, NDMC staff members have participated in national drought policy efforts including the Western Drought Coordination Council, the National Drought Policy Commission, the National Integrated Drought Information System (NIDIS), and the National Drought Resilience Program (NDRP). The NDMC has been a key participant in the development of NIDIS, a multi-agency effort to help bridge the drought information gap between federal, state, and local officials and make sure that drought and water management information is being communicated effectively between these levels. A number of NDMC staff serve in leadership roles for NIDIS.

In 2014, NDMC's staff helped organize 6 international drought management workshops, 5 national drought workshops, 6 international webinars, 5 national webinars, 3 workshops for tribes, and 4 regional workshops for agricultural producers; made 115 invited presentations; and conducted an estimated 750 media contacts. NDMC hosted 47 visitors including 37 foreign visitors from United Arab Emirates, Morocco, South Africa, Brazil, Chile, Australia, Vietnam, Japan, Kazakhstan, and Germany as well as hosted visiting scientists from China, Ethiopia, Slovakia, and the Czech Republic for extended stays. Over the years, the NDMC has organized more than 100 workshops around the country. These workshops have often been targets for agricultural producers in order to gather input on their decision-making needs and the NDMC has often served as a liaison between producers, researchers, and various governmental agencies.

In June 2015, the NDMC received a 3-year cooperative agreement with NOAA to locate the Drought Risk Management Research Center (DRMRC) at the NDMC. This center within the NDMC will help enhance the NDMC's research activities and connections with NIDIS, and it provides for some mid-term stability for the NDMC overall.



## Long-Term Vision for the NDMC

Why plan for drought? Drought is a normal, recurrent feature of nearly every climate on the planet, and it makes sense to plan for all contingencies. Planning for drought can also help build capacity to plan for a changing climate. Both involve phenomena that occur so gradually that they are difficult to notice until they are well underway, and many of the action items that boost resilience to drought are also steps toward climate change adaptation or mitigation. Drought is also a threat to food, water and energy security – issues that are becoming increasingly volatile. These issues surrounding drought, water, climate change, and food security will only become more critical in the future locally, across the United States, and around the world. The NDMC is well positioned and experienced as an end-to-end organization emphasizing research, operations, and applications connecting the science with all stakeholders dealing with these issues. As an example, the NDMC has been a key participant in the process to define and implement the National Integrated Drought Information System (NIDIS), and will continue to play a major role within NIDIS. This involvement includes helping to organize NIDIS-sponsored workshops around the country and implementing several pilot projects. An additional focus on drought-related research will be emphasized by the new Drought Risk Management Research Center. Agencies like USDA and NOAA are realizing the importance of interacting with and understanding the wide range of stakeholders, and the expertise within the NDMC's planning and social science program area provides an excellent opportunity to develop these connections with stakeholders.

## Decisions

The NDMC director, faculty, and staff need to make decisions that are related to our role within the School of Natural Resources (SNR) and its objectives (including the objectives of the Applied Climate Science Mission Area) in the following areas: time allocation and emphasis of the NDMC faculty and staff to participate in these objectives; the NDMC's response to the permanent and quasi-permanent funding requests that are pending.

## Objectives

NDMC's fundamental objectives include:

1. Number of organizations (e.g. local, state, and tribal governments) with plans or revised plans;
2. Amount of operational funding obtained;
3. Amount of external grant/contract funding obtained;
4. For outreach: numbers of workshops, invited presentations, webinars;
5. Graduate students supported/trained.

## Alternatives and Consequences

The largest uncertainty facing NDMC at this time is the mix of funds coming into the NDMC. The DRMRC provides some stability in salary support for a 3-5 year period, but additional grant and contract funding is needed to sustain the NDMC's faculty and staff levels. In addition, several other large grants remain pending for the NDMC. Given the DRMRC and potential funding opportunities four different alternatives exist for the NDMC during the upcoming 3-5 year period.

**Status Quo** The DRMRC has just been established but no other large grants are received by the NDMC and there is no additional commitment provided from IANR or UNL. In this case, the NDMC would continue many of its current activities and continue to aggressively apply for additional support through smaller grants and contracts. This alternative would allow for both minimal interactions with SNR and IANR given the effort required by faculty and staff to achieve deliverables and there would be minimal opportunities for graduate student support and training.

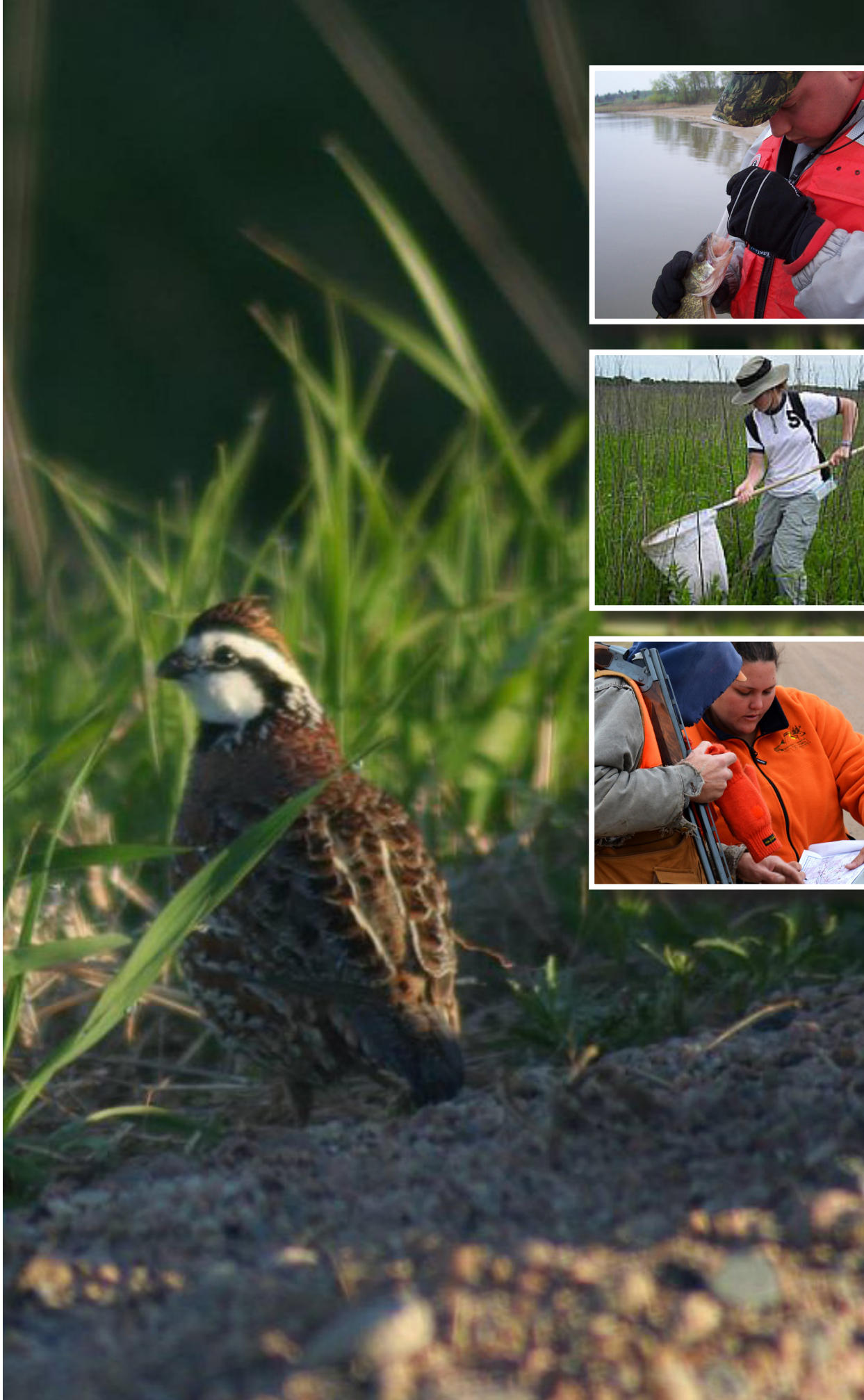
**Increased support by IANR** The DRMRC has just been established and additional investment by IANR or UNL allows NDMC to build stronger connections and interactions across the university as well as develop graduate student support and training. It is possible that IANR support could be used to fund teaching graduate and undergraduate courses and that graduate training in the Applied Climate Science program and SNR is increased.

**Increased commitment to Human Dimensions** Building off of the DRMRC that has just been established, support from IANR and SNR could allow for a stronger commitment from NDMC faculty and staff to support Human Dimensions work within IANR and SNR. The NDMC continues to be able to support organizations within the U.S. and around the world with drought monitoring and drought risk management information. Early engagement with faculty in other parts of SNR leads to additional collaborative proposals that exploit the social science expertise of NDMC staff, increasing external funding. Training opportunities for undergraduate and graduate students are limited to those provided by external funding.

**Additional Large Grants Awarded to NDMC** If one or several of the pending large grants involving the NDMC are successful, in addition to the recently-established DRMRC, this will allow the NDMC faculty and staff number to expand. Although deliverables will need to be met, it is possible that with these additional resources, and with potential IANR or SNR investment or commitment, the leveraging of these resources could allow the NDMC to increase interaction and partnerships across SNR and IANR, as well as increase the training opportunities for graduate students in Applied Climate Science and SNR.







# Nebraska Cooperative Fish and Wildlife Research Unit

## **Nebraska Cooperative Fish and Wildlife Research Unit**

Staff: Craig Allen, Leader & Professor, Wildlife

Kevin Pope, Assistant Leader & Professor, Fisheries

Joseph Fontaine, Assistant Leader & Assistant Professor, Wildlife

Valerie Egger, Administrative Assistant

Caryl Cashmere, Staff Assistant

Christopher Chizinski, Research Assistant Professor

Caroline Jezierski, Coordinator, Nebraska Wind Energy and Wildlife

Allison Zach, Coordinator, Nebraska Invasive Species Program

Lindsey Messenger, Coordinator, Research Specialist

Dana Varner, Science Coordinator, Rainwater Basin Joint Venture

The Nebraska Cooperative Fish and Wildlife Research Unit is considered to be a center within the School of Natural Resources. The Nebraska Coop Unit is a signatory partnership among the University of Nebraska, the Nebraska Game and Parks Commission, the U.S. Geological Survey, the U.S. Fish and Wildlife Service and the Wildlife Management Institute.

The Nebraska Cooperative Fish and Wildlife Research Unit was founded by congressional action in 2002. However, initial staffing did not occur until 2004, at which time Craig Allen was hired as the Leader, and Valerie Egger was hired as Administrative Assistant. The Nebraska Coop Unit is the only Coop Unit founded in the past 30 years, and is therefore the Unit with the least history in the USA.

The mission of the Cooperative Research Program is to:

1. Train graduate students for professional careers in natural resource research and management,
2. Conduct research that will create new information useful for management of natural resources; and,
3. Provide technical assistance to cooperators.

The Nebraska Coop Unit abides by the National Program mission, and does not have a Nebraska-specific mission. Oversight of the Nebraska Coop Unit is provided by a formal Coordinating Committee, with representation from the University of Nebraska, the Nebraska Game and Parks Commission, the U.S. Geological Survey, the U.S. Fish and Wildlife Service and the Wildlife Management Institute.

During the 5 year period 2009 to present, the Nebraska Coop Unit has been fully staffed, which means we have had three federally funded research scientists and 1.5 administrative positions funded and filled. This has helped the Nebraska Coop Unit stay productive during a period of budgetary uncertainty in the federal government. Staff are integral components of the Nebraska

Coop Unit and have diverse roles frequently including outreach to the public. Staff are therefore a highly visible component of Nebraska Coop Unit activities.

Given our specific research and training mission, productivity of the Nebraska Coop Unit is best measured by graduate students supported and publications generated. During the period 2009 to present, we have graduated 32 students with either a MS or Ph.D. degree (Table 6); numbers for 2015 are a minimum estimate.

Nebraska Coop Unit faculty also contribute to the University of Nebraska by teaching graduate-level courses. During the period 2009 to present, Unit faculty taught a total of 16 courses. This includes courses in fisheries management, fish ecology, adaptive management, resilience, landscape ecology and biological invasions, among others.

Table 6. Nebraska Cooperative Fish and Wildlife Research Unit graduate students advised by Coop Unit faculty during the period 2009 – 2015.

Year	MS	Ph.D.	Total	Graduated
2009	14	5	19	4
2010	18	7	25	4
2011	16	9	25	3
2012	16	11	27	4
2013	12	13	25	6
2014	7	15	22	8
2015	7	13	20	3

Nebraska Coop Unit faculty rely on outside grants and contracts to conduct research and support graduate research assistants. The federal government provides no operating funds to the Unit. Active grants for the period 2009 – 2015 (any grant current during that period) total to >\$23,000,000.00.

Publications authored or coauthored by Nebraska Coop Unit faculty measure of productivity and contribution to scientific knowledge. For the period 2009 – present, Nebraska Coop Unit faculty and staff published ~145 peer-reviewed publications, or ~21/year (Table 7).

Table 7. Peer-reviewed publications authored or co-authored by Nebraska Coop Unit faculty and staff. Students are frequently first or coauthors on Nebraska Coop Unit publications.

Year	Peer-reviewed publications
2009	16
2010	23
2011	17
2012	18
2013	24
2014	29
2015	19



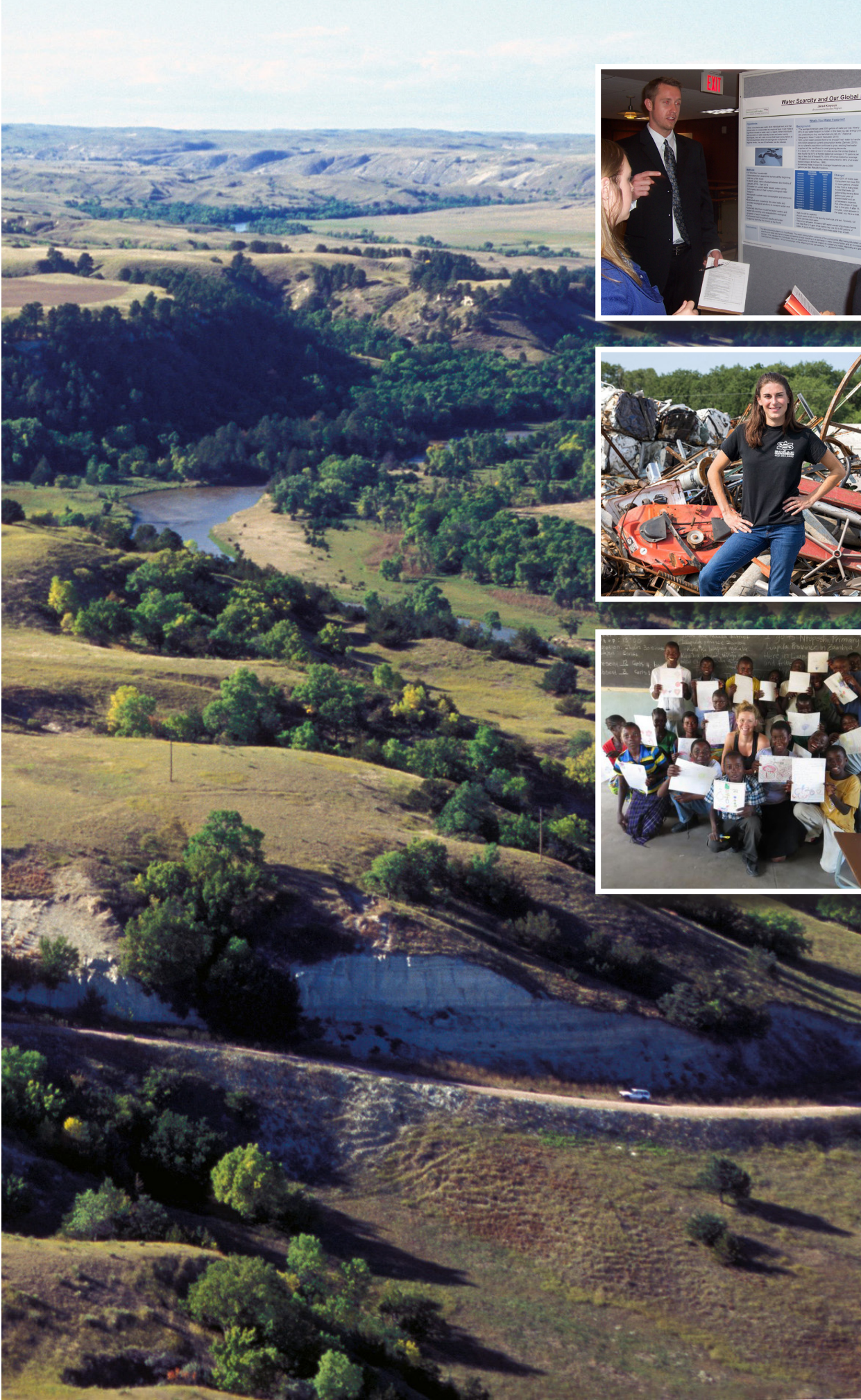




# Affiliated Educational Programs







**Affiliated Educational Program - Environmental Studies**

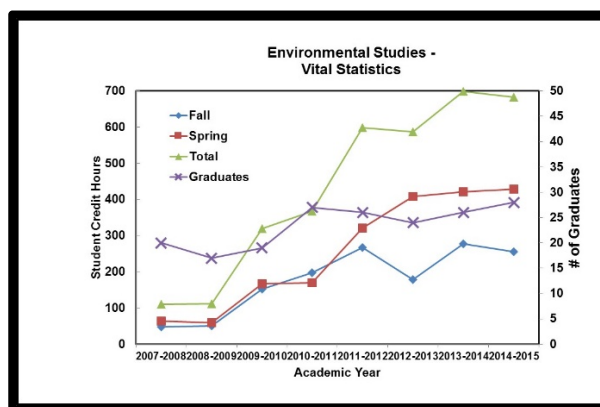
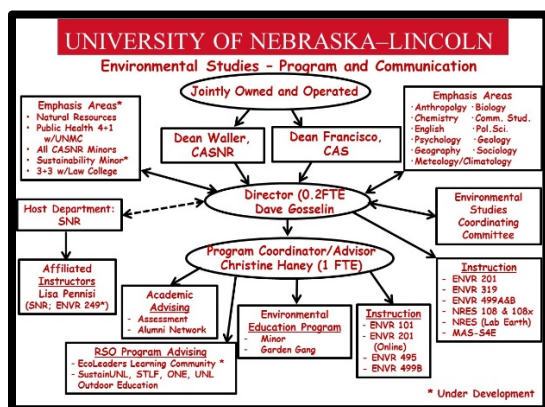


## Environmental Studies Program

### Mission

The University of Nebraska-Lincoln's Environmental Studies bachelor's degree program provides both a comprehensive education in the physical, biological, and social sciences and development of competency in a specific discipline. This combination prepares students to contribute solutions for current and future local, regional, and global environmental challenges. Sustainability is a foundational concept and was a key driver of the curriculum updating process of the Environmental Studies core curriculum that was initiated in Fall 2008. There is also a graduate-level specialization in Environmental Studies. For the Masters and Ph.D degree-level specialization, 9 and 15 student credit hours (SCH) of environmental related courses are required along with a research project related to the environment. There are no graduate courses in Environmental Studies.

**Administrative Structure and Location:** The Environmental Studies program is owned and operated by two colleges, the College of Arts and Sciences (CAS) and the College of Agricultural Sciences and Natural Resources (CASNR). Currently, the host department is the School of Natural Resources (SNR). The program is advised by the Environmental Studies Coordinating Committee (ESCC) that consists of four faculty from each college and a representative from each of the respective dean's offices. A part-time program director (0.2 FTE) and a full-time program coordinator, who serves as the chief academic advisor, administer and teach all the courses in the program. There are no faculty FTE assigned to this program. However, the majority of the current director's time (Dave Gosselin) whose academic appointment is in the School of Natural Resources is devoted to teaching the Environmental Studies core curriculum.



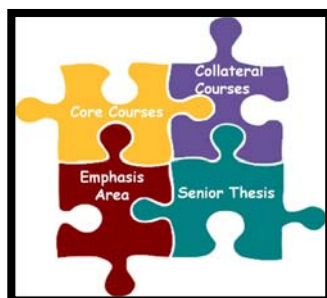
The program currently has about 110 majors (70% CASNR, 30% CAS) including double majors and minors (~10) based on advising lists obtained from MyPlan, CASNR and CAS Blackboard in March 2015. It annually graduates 26 to 28 students and generates nearly 700 student credit hours. The program also benefits from the teaching of the human dimensions component (ENVR 249) of our core curriculum by SNR faculty member Lisa Pennisi.

The environmental studies program consists of four component – ENVR core (13 SCH), collateral courses in Earth Systems, Geospatial Sciences, Human Dimensions, Economics, Policy, Physical and Biological Sciences, Math and Statistics. According to a Spring 2015 analysis by the National Council for Science and the Environment (NCSE), the ENVR curriculum has a Sustainability Solutions focus, which emphasizes a systems-oriented approach, encompasses a broad range of knowledge and skills including natural sciences, field and laboratory research, and focuses on solutions development through



## Environmental Studies Undergraduate Program

collaborative engagement processes and informatics. A Sustainability Solutions program prepares students to solve complex environmental problems using integrated processes that directly inform policy and management decisions to effectively manage human-natural systems. Each student is required to select an emphasis area, also known as concentration or option. The vast majority of CASNR students are in the Natural Resources emphasis area which requires students to take 19-24 SCH in NRES, SOIL, WATS, or GECM courses. Starting in Fall 2015, students will be able to choose an emphasis area from any minor offered by CASNR and selected CAS Minors identified in the program and communication diagram above. The minimum SCH hours required in any minor is 18 and it is strongly encouraged that students take an additional 6 SCH in the minor area of emphasis.



Core Courses – 13 Credit Hours	
ENVR 101	Environmental Studies Orientation (1 Cr)
ENVR 201	Science, Systems, Environment, and Sustainability (3 Cr, ACE 8)
ENVR 249	Individual and Cultural Perspectives on the Environment (3 Cr, ACE 9)
ENVR 319	Environmental Engagement in the Community (2 Cr)
ENVR 495	Internship in Environmental Studies (1 Cr)
ENVR 499A & B	Senior Thesis I & II (3 Cr, ACE 10)

*Elements that distinguish program:* Our interdisciplinary curriculum uses a student-centered approach to create a positive and nurturing learning community that supports the success for all students. The biggest key to the program's success is that we are all about collaboration and compromise. The program explicitly identifies sustainability as a foundational concept for its curriculum. ENVR emphasizes doing real work and engagement in the community through course projects, internship opportunities and the senior thesis/creative project. We explicitly develop skill sets that are needed in the workforce: audience-focused communication skills, collaboration and teamwork, inquiry and problem solving, and leadership skills. We have a recognized assessment program that partners with Target Training International Performance Systems, LTD.

### Decisions

The primary decisions relate to developing and delivering curriculum to students. Starting in 2008 and continuing to the present, the director and the coordinator, with support of the Deans from CASNR and CAS, collaborated with the ESCC, have changed and modified the Environmental Studies curriculum. We used a backward design model to redefine the curriculum. The biggest change to the curriculum was expanding the Environmental Studies core curriculum from 5 SCH to 13 SCH and integrating sustainability as a foundational educational concept. The UNL Environmental Studies program chose to integrate sustainability at the program level where it had control of curriculum content. In the Fall 2014, in an effort to simplify program administration, the ENVR program was moved into Dean's office of CASNR.

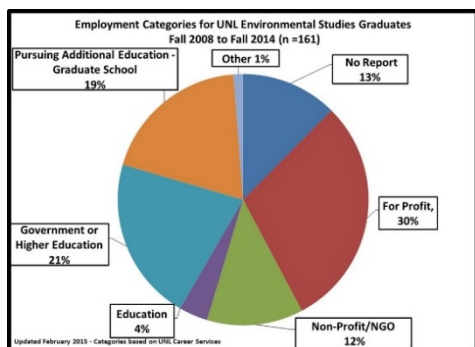
As part of the ongoing process to expand participation in Environmental Studies in CAS, we expanded the number of emphasis areas from 7 to 11 in 2012-2013 by adding Communication Studies, English, Psychology, and Political Science. Beginning in Fall 2015, all majors that have a defined minor in CASNR can be used as an emphasis area along with generic Natural Resources area. We are also excited to be collaborating with the University of Nebraska Medical Center on a 4+1 program in Environmental and Public Health. The program will also be working to establish a sustainability minor to be included in the catalog starting in the fall 2016.

## Environmental Studies Undergraduate Program

Over the course of changes since 2008, the level of university resources and institutional commitment to the program have not changed. According to 2015 NCSE report, the structure of the Environmental Studies program is typical of what is referred to as a unit-spanning program structure where the director (i.e., 0.2 FTE) is tenured in another department and the number of other program staff (i.e., 1 FTE) is limited. Although UNL's structure is similar to five other programs in the Big 10, the UNL staff and faculty investment is well below those in the other Big 10 programs in which the average number of faculty who are full-time, have joint appointments, are formally affiliated, serve on contract, or are adjunct are 1, 3, 17, 4, and 3, respectively. Average program enrollment and graduates for UNL is also well below its peers.

Average from 2009 to 2012	Enrollment		Graduates Ave.		UNL ENVR	
	Mean	Max	Mean	Max	Enrollment	Graduates
Total	166	300	54	110	100	22

According to the 2015 NCSE report, student demand for Interdisciplinary Environmental and Sustainability (IES) education has grown substantially since 2008 as indicated by an increase in the number and percentage of schools offering IES programs (188, 29%), academic units/programs (311, 37%) and degree programs (676, 57%). On average, 51% of four-year institutions located in each state offer one or more IES degrees; the percentage for Nebraska institutions is well below average at 26%. The number of programs declined in Nebraska from 2008 to 2012. The average degree program enrollment numbers (over last three years or since program inception) have increased across the country by 49% for undergraduate programs since 2008. There is an increasing demand for sustainability education as reflected by the significant increase from 2008 to 2012 in the number of sustainability degree programs (13 to 141), the emergence of interdisciplinary energy programs (0 to 37), plus many other sustainability minors/certificates and concentrations within disciplinary and professional degrees.



UNL will not have to opportunity to effectively meet the growing demands of the environmental and sustainability workforce: The size of the environmental protection industry is \$341 billion/year, projected to reach \$496 billion in 2020. The industry created 5.3 million jobs in 2005 across all employment sectors. The environmental sector is “recession-proof” in economic downturns. Graduates of IES programs are in high demand. The United States Department of Labor predicts a 19% increase in the number of environmental scientist and specialist positions between 2010 and 2020, higher than the average for

life, physical and social science occupations (16%), and higher than the average for all occupations (14%). College graduates in environmental fields have some of the lowest unemployment rates compared with other majors. Recent Environmental Studies are finding jobs in a variety of employment sectors as well as being successful in graduate school.

### Objectives

The three long-term program goals and related objectives (a, b, c, etc.) for the UNL ENVR program are as follows:

1. Develop an environmental studies educational program that is recognized for its up-to-date, high-quality educational experience

## Environmental Studies Undergraduate Program

- a. Collect, evaluate, use and present program assessment data to keep the Environmental Studies undergraduate curriculum current.
  - b. Collaborate with local schools, non-profits, government agencies, alumni, and Center for Civic Engagement to provide students with high quality real-world experiences.
2. Implement measures to provide a well-supported infrastructure that provides for the educational needs of Environmental Studies students.
  - a. Increase the number of events for students to enhance engagement in the Environmental Studies program.
  - b. Increase participation in the Environmental Studies Spring Showcase.
3. Implement a recruitment and retention program that is recognized for its ability to maintain student numbers while increasing the diversity, and retention of undergraduate students.
  - a. Collaborate with CAS, CASNR and SNR recruitment teams to increase number of incoming freshmen into Environmental Studies as well as diversity.
  - b. Assess Environmental Studies enrollment in the context of number of students that can be carried in the program using available resources.
  - c. Retain 80% or more of the high school students who start the Environmentors-Upward Bound research experience for high school students through to completion.
  - d. Provide quality advising services for at least 80 percent of Environmental Studies undergraduate students during each enrollment session.
  - e. Enhance the virtual community among current, future, and former Environmental Studies students.

### Alternatives and Consequences

Alternative 1. Maintain status quo in the context of faculty and staff resources. If this alternative is chosen, the long-term goals and associated objectives can be achieved. However, the consequence of this choice is that UNL will not be able to successfully compete in a market where there is student demand both nationally and internationally.

Alternative 2. Increase faculty and staff resources from 1 to 4 FTE. If this alternative is chosen, the Environmental Studies program at UNL could be more competitive with similar programs in the Big 10. Increasing FTE devoted to the program could double the number of majors by increasing recruitment and broadening the available courses.

To implement this alternative would require the creation of mechanism at UNL for small interdisciplinary programs to effectively compete for at least a part of new faculty members. The current director of the program has pursued collaboration with other units, but up to this point has not been successful. Part of the challenge to being successful is the investment of time that needs to go into this pursuit while weighting this investment against the time needed for teaching and facilitating the implementation of existing goals and objectives.







**Affiliated Educational Program - Human Dimensions of Natural Resources**

## Human Dimensions of Natural Resources

### Introduction

Understanding how human attitudes, motivations and behaviors relate to how we maintain, protect, enhance and use our natural resources is critical to addressing environmental problems. Today's natural resource managers increasingly recognize that natural resource management involves not only ecological processes, but also social processes and consequences as well. Human dimensions of natural resource management include the driving forces behind people's decisions (e.g. psychological, social, spiritual, cultural, economic, political, legal and managerial forces), how human behaviors lead to ecological and social change, and how to address these changes with management (Decker, Brown, & Siemer 2001). In a very basic sense, teaching and research in the human dimensions of natural resource management examines how the "science of human systems" or theory-based social science is integral to natural resource management. Moreover, agencies and organizations do not have the necessary resources and staff to effectively address the human dimensions of natural resource management (Sexton et al., 2013).

It is increasingly clear that traditional natural resource management approaches are inadequate. Rethinking resource management in a world of complex ecological and *social* systems with nonlinear relationship, thresholds, uncertainty and surprise is required to long-term sustainability (Folke, Pritchard, Berkes, Colding, & Svedin, 2007). Understanding the linkages between ecological and socioeconomic systems are key to ensuring environmental protection and economic growth (Levin, 2006). Social systems are equally as important as the natural systems traditionally studied in natural resource management. "Conserving species and ecosystems depends on our understanding of social systems and their interactions with ecological systems" (Berkes, Kofinas, & Chapin, 2009, p. 131). Consequently, there has been a several-fold increase in jobs in the human dimensions of natural resources (Knight and White, 2009). In response, 10 universities in the Big 10 group have expanded their Human Dimensions of Natural Resources courses and faculty (Burbach, unpublished data).

The SNR Human Dimensions faculty teach a broad array of undergraduate courses that support many specialized degree programs or minors including Agricultural Leadership, Education and Communications; Agronomy & Horticulture; Community & Regional Planning; Environmental Studies; Environmental Education; Fisheries & Wildlife, and Hospitality, Restaurant, Tourism, & Management. Faculty also teach courses in support of the Human Dimensions graduate specialization. Prior to 2010, outside of Geography courses, the school was home to only two human dimensions courses. Fourteen human dimensions courses taught by SNR faculty have been added or moved to SNR since 2010 (Table 8). Enrollment in human dimension courses has grown to nearly 300 students per year. There are currently more than 20 graduate students enrolled in the HD graduate specialization (Figure 10).

Table 8 Human dimensions courses taught by SNR faculty. Faculty with specific background in HD are indicated with an \*.

Course Number	Title	Faculty	Curricular Role
NRES 108	Earth's Natural Resource Systems Laboratory	Gosselin	Required Environmental Studies
NRES 111	Natural Resource Conservation in Society	Ferraro	Service
NRES 130	People of the Great Plains	Douglass*	Service
ENVR 249	Individual and Cultural Perspectives on the Environment	Pennisi*	Required Environmental Studies; Elective F&W

## Human Dimensions of Natural Resources

Course Number	Title	Faculty	Curricular Role
NRES 260	Environmental Communication Skills	Pennisi*	Elective F&W, GECM, Water Science
NRES 289	People and the Land: Human Environmental Interactions on the Great Plains	Douglass*	Service
NRES 323	Natural Resources Policy	Schoengold*	Required F&W and GECM, Option requirement NREE, Elective Environmental Studies, Water Science
NRES 409	Human Dimensions of Natural Resources	Burbach*	Option Elective F&W, Elective Environmental Studies
NRES 428/828	Leadership in public organizations	Burbach*	Option Elective F&W, Elective Environmental Studies
NRES 434/834	Environmental Education and Interpretation	Pennisi*	Option Elective F&W, Elective Environmental Studies
NRES 452/852	Climate and Society	Hayes*	Capstone Applied Climate Science
NRES 475/975	Water Quality Strategy	Snow	Capstone Water Science
NRES 829	Human Dimensions of Natural Resource Management	Burbach*	Required HD graduate specialization
NRES 832	Laboratory Earth: Human Dimensions of Climate Change	Low*	
NRES 837	Adaptive Natural Resource Management	Fontaine	
NRES 891	Human Dimensions Seminar	Burbach*	Required HD graduate specialization



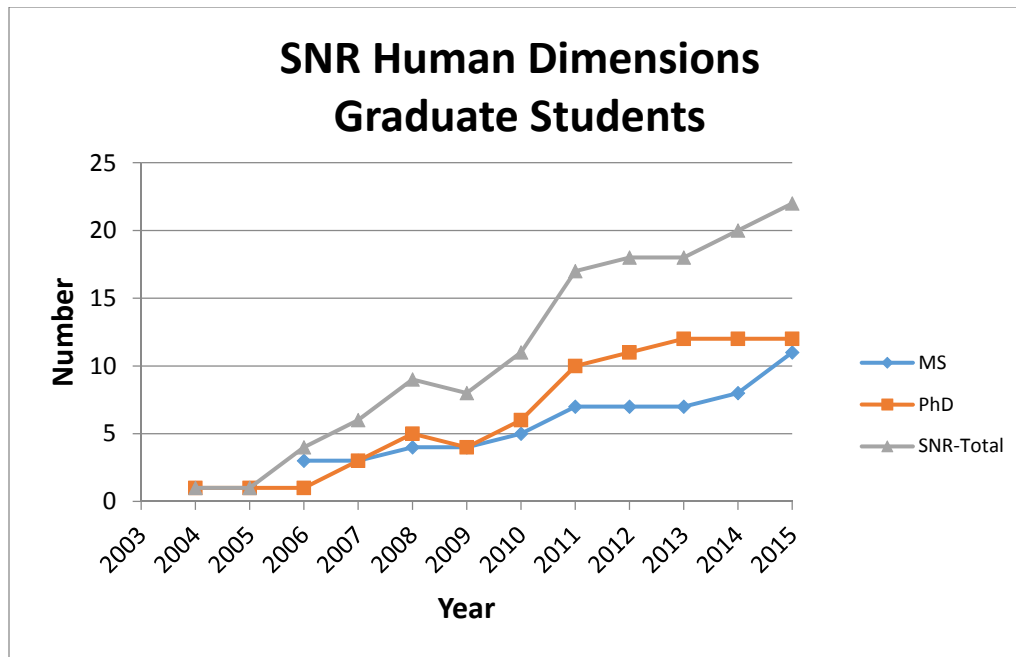


Figure 10 Growth in the number of students enrolled in the Human Dimensions graduate specialization since it was created in 2004.

Further, Human Dimensions faculty are integral members of interdisciplinary research teams. Within UNL Human Dimensions faculty have collaborated with faculty in the departments of Agricultural Economics; Agricultural Leadership, Education & Communications; Agronomy & Horticulture; Anthropology; Biochemistry; Biological Systems Engineering; Community & Regional Planning; Computer Science & Engineering; Cooperative Extension; Civil Engineering; Earth & Atmospheric Sciences; Electrical Engineering; Entomology, Environmental Studies; Psychology; School of Biological Science; Sociology; and Teaching, Learning & Teacher Education. The Human Dimensions faculty have also collaborated with a large number of State (i.e. Nebraska Game & Parks Commission) and federal agencies (i.e. US Department of Agriculture).

## Decisions

The greatest challenge for the SNR Human Dimensions area over the next several years will be allocation of sufficient faculty to meet growing demands for both teaching and research, especially in social/behavioral science theory and application. We have two non-tenure leading faculty with social/behavioral science backgrounds. We have one tenure leading faculty (.3 FTE in SNR) with a background in agricultural economics. There is one tenure leading position soon to be hired (Table 2). We anticipate increasing needs for courses and research in social/behavioral sciences. The new faculty member will be the only full-time tenure-line in the Human Dimensions area. We believe these core faculty can maintain the status quo; additional tenure-line faculty will be needed to be competitive within the Big 10 and increase national visibility.

Given the realities of staffing and budgets, we have decided to emphasize an area which we perceive to be an area of future growth and in which we can leverage expertise from other areas of SNR: Human Dimensions of Great Plains Resource Management. The strengths we have in this area will be maintained and enhanced with three primary emphases:

- Presence of Human Dimensions within existing SNR majors and courses



- Targeted courses in social/behavioral sciences
- Interdisciplinary research

### Objectives

The Human Dimensions area will focus upon the following principal objectives:

- **All SNR undergraduate majors and graduate specializations have clearly articulated HD learning objectives**
- **Increase student credit hour production in SNR**
- **Increase undergraduate enrollment in all SNR majors**
- **Maintain and enhance the Human Dimensions graduate specialization**
- **Increase external research funding**
- **Increase recognition through outreach activities**
- **Increase collaboration among faculty in SNR/centers/departments/state and federal agencies**

### Alternatives and Consequences

**Status quo** Identify what all SNR undergraduate students, irrespective of their majors and careers aspirations, should know or be able to do upon graduation, and integrate these human dimensions learning outcomes into SNR curriculum. Consider if offering existing courses as flipped or blended/hybrid models would allow increased enrollments for less faculty inputs. New faculty hire to develop a new human dimensions of wildlife course, have that course added as a requirement to F&W curriculum, and as an elective for other majors. Ensure collaboration with Geography, Science Literacy, Social and Behavioral Sciences Research Consortium (SBCRC), DWFI, RFI, AgEcon (i.e. newly hired behavioral economist), and other related units to increase research grants. Review and adjust required graduate courses as opportunities within SNR arise and as courses in other departments become available. Maintaining the status quo does not allow us to: 1) capitalize on the increasing demand for college graduates prepared in the human dimensions of natural resources; 2) be competitive in interdisciplinary research, 3) increase our standing within the Big 10 in which 10 universities have grown their human dimension programs.

**Increase investment** Adding another tenure leading faculty position in this area would create a critical mass for recruiting and training graduate students, and lend robustness to the undergraduate/graduate teaching program. In addition to all the actions under the status quo, we propose the following priority position be filled:

Human Dimensions of Natural Resource Management: A 12-month, tenure-track position focused on the application of social science theory and methods to illuminate the human dimensions of natural resources conservation and management. Research would apply and advance contemporary social science theory to improve understanding of human behavior, social and institutional processes and decision-making associated with the sustainable management of natural resources. Use of quantitative and qualitative methods is expected. There is currently insufficient faculty expertise social science theory and methods. The

instruction and research led by this individual will contribute directly to programs such as the NU Water for Food and Rural Future Initiatives and the Social and Behavioral Sciences Research Consortium, and will position UNL to be more competitive for external funding through agencies such as NGPC, NSF, USFWS and the U.S. Geological Survey (Burkett et al, 2011). The successful applicant will have an interdisciplinary background with a Ph.D. and graduate majors/minors in applied social sciences related to natural resource and environmental management.

## Summary and Conclusions

Today, the Human Dimensions area in SNR is well-regarded but very small. The soon-to-be hired faculty member will be the only full-time tenure-line faculty in the human dimensions area. Two other full-time, nontenure-line faculty have backgrounds in social science theory and research methods, and of the two, only one has a research appointment. Courses and research in the human dimensions cross-cut all SNR mission areas. We plan to build on our strengths and contributions. Maintaining the status quo we can continue to support existing courses and contribute to interdisciplinary research. With growth we can become a nationally recognized program supporting the need for more social and behavioral sciences in natural resource management. Ideally, the program would consist of a healthy balance of assistant, associate, and full professors.

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## Affiliated Educational Program - Science Literacy

## IANR Science Literacy Initiative

### Overview

In 2013, the Institute for Agriculture and Natural Resources at UNL embarked upon an ambitious agenda to emerge as a leader in efforts to foster science literacy in the state of Nebraska and beyond. In support of these efforts, IANR has recently invested in the hiring of four science literacy faculty members in Phase I (referred to in this document as ‘core science literacy faculty’): Jenny Dauer (SNR), Joe Dauer (SNR), Cory Forbes (SNR) and Jenny Melander (BSE). IANR also committed minority apportionments of over 30 STEM new faculty positions from Phase I to science literacy. Initial partners represent more than 20 departments and units across the College of Agricultural Sciences and Natural Resources, Extension and the College of Education and Human Sciences. Our efforts to foster science literacy build off of national and international discourse about how science should serve the public, industry and youth. The Science Literacy Initiative is grounded in an explicit organizational model guided by a set of underlying principles:

- Feeding nine billion people
- An emphasis on natural and managed systems
- Linked with standards for STEM teaching and learning
- Partnership-driven

These principles provide a set of heuristics for interventions designed to foster and/or enhance science literacy in four domains: PK-12 education, higher education, the public and organizational partners. Each of these areas is crucial for the long-term success of the Science Literacy Initiative.

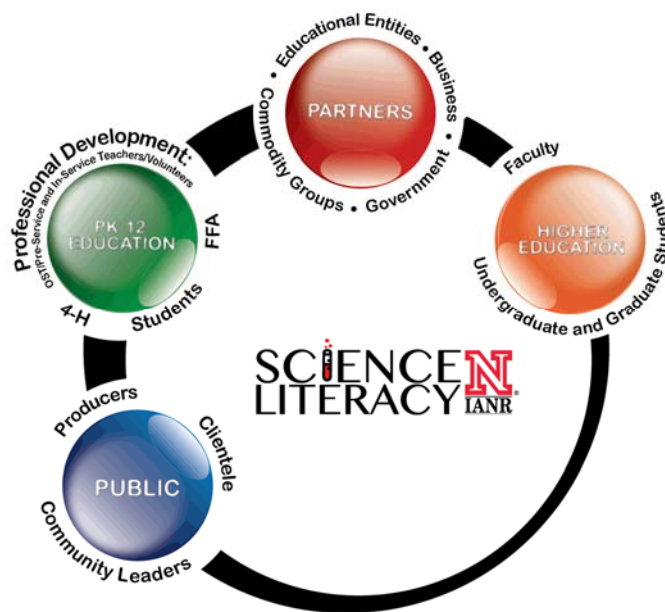


Figure 11. IANR Science Literacy Initiative Framework

### What is Science Literacy?

At UNL, we define science literacy as:

*An enhanced capacity, both at the individual and collective levels, to make effective decisions grounded in STEM-informed analyses of complex, real-world challenges.*

In the context of recent and ongoing STEM education reform, the idea of ‘science literacy’ has served as a primary rationale and global vision for the impact of STEM education on society. The National Research Council defines science literacy as “knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity” (1996, p. 192). Internationally, this perspective is echoed in ongoing conversations about how global citizens should engage with disciplinary knowledge and practices. A common interpretation of this and similar definitions of science literacy is that by supporting students’ to learn science, they will naturally employ this knowledge as a tool to analyze and make effective decisions about challenging real-



world issues. Conversations about science literacy often revolve around defining what baseline science everyone should know and how much knowledge is sufficient.

Yet, a sizeable body of empirical research continues to show that this perspective is over-simplistic in its assumptions about the nature of knowledge, scientific or otherwise. The utilization of abstract ideas or concepts in novel contexts is rarely observed, whether in K-12 classrooms, university classrooms, or the contexts of everyday life (Feinstein, 2010). As Mullen and Roth concisely state, “You can know all you need to know about your world and still not know what to do, which choices to make” (1991, pg. 1). A key distinction must therefore be made between supporting students simply to learn science and supporting students to *learn to use science* (Bybee, 2009). To truly foster science literacy, we must go beyond simply helping them learn a pre-determined body of knowledge. Instead, they must be actively supported to learn to leverage and employ this scientific knowledge, negotiate its intersection with social, cultural, and economic values, to concretely identify relevant problems, evaluate real options for action, and move towards fundamentally different methods of accomplishing their goals. Science literacy, then, must fundamentally foreground decision-making about challenging real-world issues and how individuals mobilize science to support this process.

### Rationale

Projected increased in the human population (9.1 billion by 2050), will necessitate a 70% increase in global food production (Food and Agricultural Organization of the United Nations). This increase in agricultural production must be achieved while simultaneously confronting increased costs and decreasing availability of natural resources, a situation that demands technological innovation, human ingenuity and leadership. However, the human capital needed to confront these challenges is underdeveloped and, in some cases, threatened. A majority of students and adults do not have a fundamental understanding of agriculture or natural resource issues, their underlying STEM foundations or how they impact their lives (NRC, 1988). Efforts to recruit and prepare highly-skilled members of agriculture and natural resources workforce already fall short of the needs of industry (Goecker, Smith, Smith, & Goetz, 2010). A sustained and systemic effort is therefore required to support youth and adults to become scientifically literate consumers, producers, advocates and policymakers.

Post-secondary institutions must take a leading role in fostering science literacy; however, few systematic educational efforts currently (NRC, 1988). As the epicenter of global food production, Nebraska is uniquely positioned to carry out this work. One in three jobs in Nebraska is directly tied to agriculture or agribusiness and the richness of the natural resource base in the state makes it an international leader in production of agricultural products and services. However, this effort requires innovations that span disciplinary boundaries because, “Agriculture now so thoroughly combines basic and applied aspects of the traditional STEM disciplines of science, technology, engineering and mathematics that the acronym might rightly expand to become STEAM, joining agriculture with the other fundamental disciplines” (NRC, 2009, pg. 3). The science and social implications associated with food, energy and water are too important to Nebraska and the global community to be taught only to students pursuing careers in these areas. Increased knowledge of agriculture, natural resources and the life sciences will allow leaders and consumers to make informed decisions that will impact their lives and the lives of future generations.

### Long-Term Vision for Science Literacy

The long-term vision for the IANR Science Literacy Initiative is to foster science literacy among the citizens of Nebraska and beyond. Through investments in the Science Literacy, IANR will position itself as a recognized global leader in ‘cradle to grave’ (i.e., PK-adult) teaching and extension programs that cultivate effective decision-makers capable of engaging with highly complex, challenging issues associated with food, energy, water, landscapes and people, both current and future. Through research and

other creative activity, IANR Science Literacy Initiative will contribute meaningfully and significantly to understanding how and why individuals and groups make decisions about agriculture and natural resources issues, as well as how to optimally support them to enhance their knowledge and decision-making abilities over time. The School of Natural Resources will play a crucial role in contributing to the IANR Science Literacy Initiative.

### Decisions

Dauer, Dauer and Forbes contribute to Science Literacy through their appointments and direct involvement in the Science Literacy faculty cluster. Many SNR faculty and staff contribute to Science Literacy through pre-existing research, teaching and extension activities. The School of Natural Resources will make decisions about how to strategically contribute to the IANR Science Literacy Initiative.

### Objectives

The overarching goal of the Science Literacy Initiative is to *foster a scientifically-literate society capable of making effective decisions grounded in STEM-informed analyses of complex, real-world challenges associated with food, fuel, water, landscape and people issues*. These efforts are being pursued through an integrated suite of programs grounded in a multidisciplinary body of theory and research and spanning campus, local, state, national and international boundaries. In defining ‘impact’, we not only emphasize the *reach* of programming that falls under the umbrella of the Science Literacy Initiative, but also *effect*. By effect, we mean measureable changes in knowledge, beliefs, and/or behaviors associated with decision-making grounded in STEM-informed analyses of complex, real-world challenges associated with food, fuel, water, landscape, and people issues. This composite definition of impact can be articulated in a simplified form as:

$$\text{Reach} + \text{effect} = \text{impact}$$

Science Literacy Initiative objectives address both reach and effect across multiple domains of 1) teaching and extension programming targeting demographic groups (PK-20 students and the public) represented in the science literacy framework in Figure 1 and 2) associated research and creative activity. The primary objective for Science Literacy within SNR is:

*Engage in a deliberate strategic planning process to develop a plan for SNR’s contribution to the IANR Science Literacy Initiative*

Efforts directed toward this primary objective will address each of the following three strands:

1. Engage graduate and undergraduate students through course-based experiences that foster their science literacy
2. Engage youth (informal and non-formal settings) and the public through extension programming that fosters their science literacy
3. Engage K-12 students and teachers in formal school settings in educational programming that fosters their science literacy

These efforts will also emphasize two cross-cutting components across the three programming strands:

1. Conduct high-impact social science research on science literacy (discipline-based educational research, human dimensions, etc.)
2. Cultivate significant stakeholder engagement and involvement in SNR science literacy activities

### Alternatives & Consequences

Status quo: Faculty members throughout SNR contribute to the vision of IANR Science Literacy through undergraduate and graduate education, extension and research. The status quo option is for SNR to

## Science Literacy Initiative

contribute to science literacy in a decentralized manner that is driven solely and exclusively by the expertise, interests and FTE distributions of individual SNR faculty members and personnel. No additional inputs (personnel, resources, etc.) are required. However, unknowns may persist, including potential gaps in programming, contribution of programming to objectives, sustainability of programming and partnerships and capacity for research. This plan would not be expected to enhance efforts within the three strands and two cross-cutting components of the IANR Science Literacy Initiative beyond what current contributions of SNR. Examples of current activities within the unit that contribute to IANR Science Literacy are included in Table 1.

Table 9: Current SNR Activities Contributing to Science Literacy

<b>Strands</b>	<b>Programs/Activities</b>
Postsecondary	AGRI/NRES 103 Issues in Agriculture and Natural Resources
	LIFE 120/121
	SCIL/AECN/NRES 109 Water in Society
	Lab Earth Courses (NRES 809, 814, etc)
	NRES 898 Teaching and Learning about Water Systems
	Environmental Studies program
PK-12	Weatherfest and the Central Plains Severe Weather Symposium (CPSWS)
	WeatherCamp
	NaturePalooza
	Water for Elementary Teachers of Science (Ne WETS) project
	Multistate Research Committee on Agricultural Literacy: Development and Testing of a 3rd-Grade Life Science Unit to Foster 3rd-grade Students' Agricultural Literacy and Life Science Learning
	National Center for Ag Literacy, Translating Applied STEM Research into Secondary Science (TASRs) program
	Masters of Applied Science, Science for Educators specialization
Public	Climate Masters
	NE Master Naturalist
	Water Leaders Academy
Stakeholders	Engage stakeholders as partners in Science Literacy programming and research
	Develop programming to foster science literacy among stakeholders
Research	Execution of and publication of empirical results from studies on education, outreach, and/or extension efforts in one or more of the program strands undertaken from one or more disciplinary perspectives (discipline-based educational research, STEM education research, human dimensions of natural resources, etc.).

Alternative: The primary alternative is to invest in a unit-wide strategic planning process to analyze, facilitate, organize, and plan for SNR's contribution to the IANR Science Literacy Initiative. At the least, this alternative will require an additional contribution of personnel time and potentially modest resources. An ad hoc committee could be formed comprised of science literacy faculty, representatives from standing SNR committees and other SNR personnel to lead the strategic planning process. The outcome of this work would be a forward-looking plan for SNR's contribution to the IANR Science Literacy

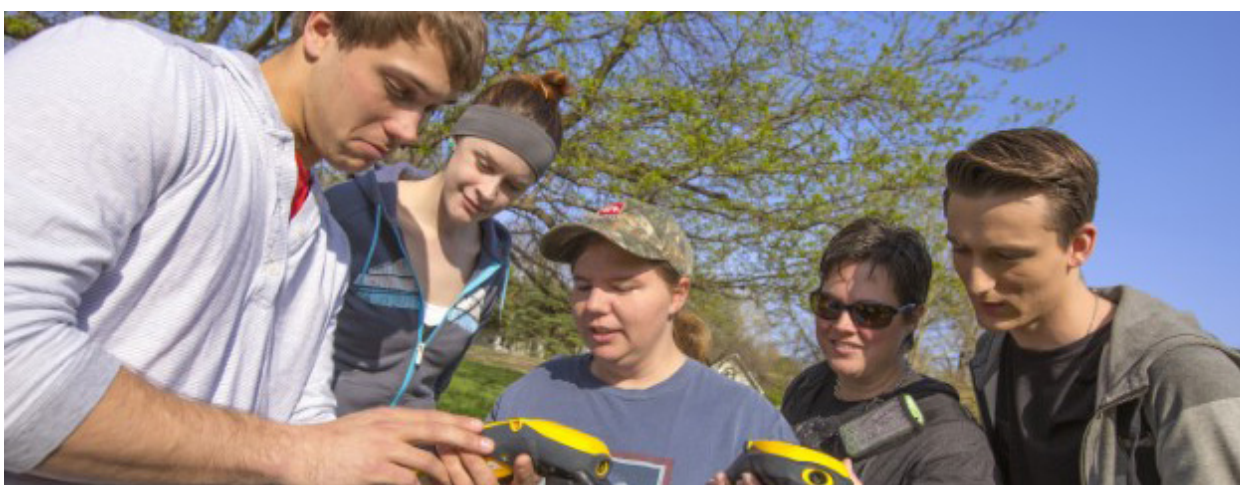
Initiative. This strategic effort would help identify gaps in current programming, study the contribution of programming to objectives, enhance sustainability of programming and partnerships, and enhance the capacity for research. This plan would enhance efforts within the three strands and two cross-cutting components of the IANR Science Literacy Initiative.

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# Appendices

## Appendix A: Student numbers across SNR

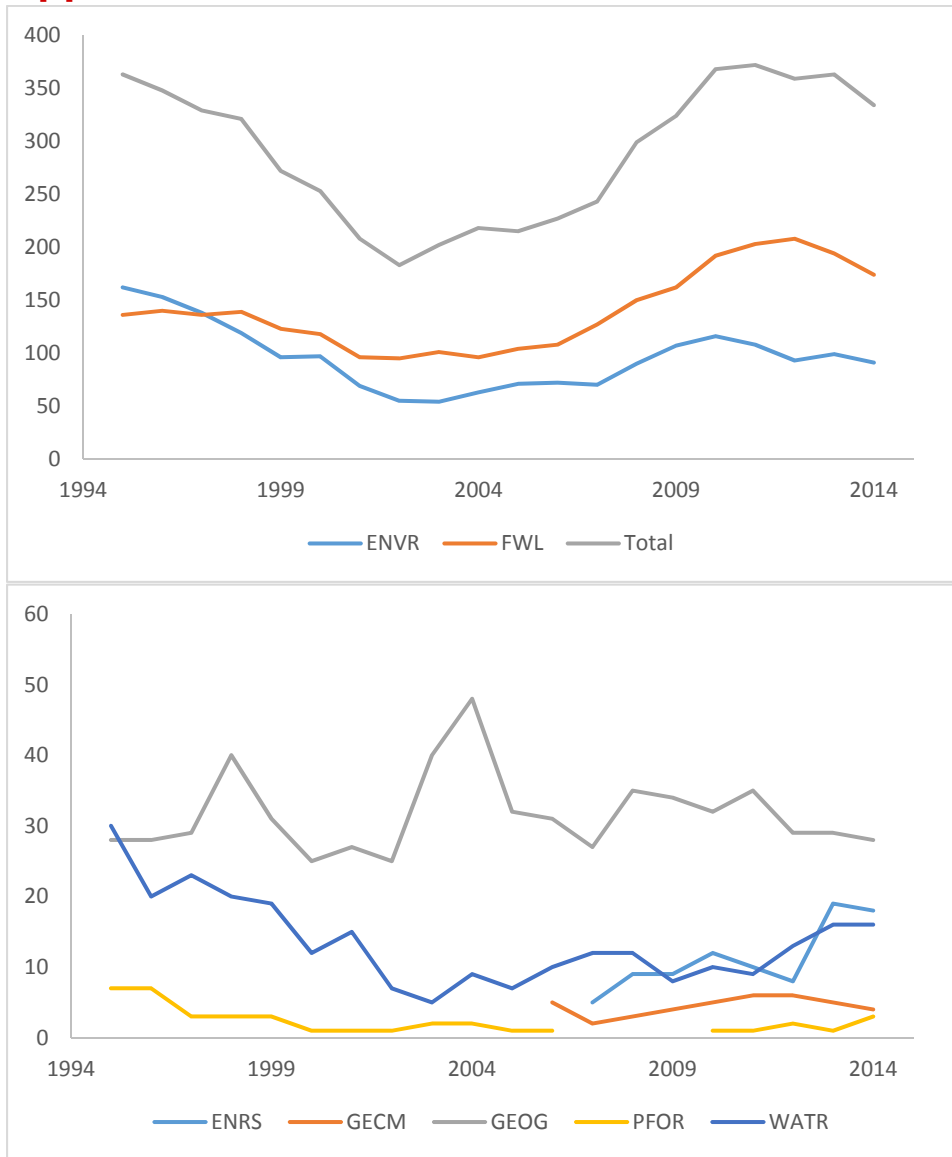


Figure A1. Number of undergraduate students (residents +nonresidents) enrolled in SNR majors at the fall Census date. Top Panel is Total of all Majors plus ENVR and FWL, and the bottom panel is all majors other than ENVR and FWL. ENRS: Environmental Restoration Science; GEOM: Grassland Management and Ecology; GEOG: Geography; PFOR: Preforestry; WATR: Water Science; FWL: Fisheries and Wildlife; ENVR+AENVR is Environmental Studies in the College of Agriculture Science and Natural Resources (CASNR) and College of Arts and Science (CAS), respectively.

## Student numbers across SNR

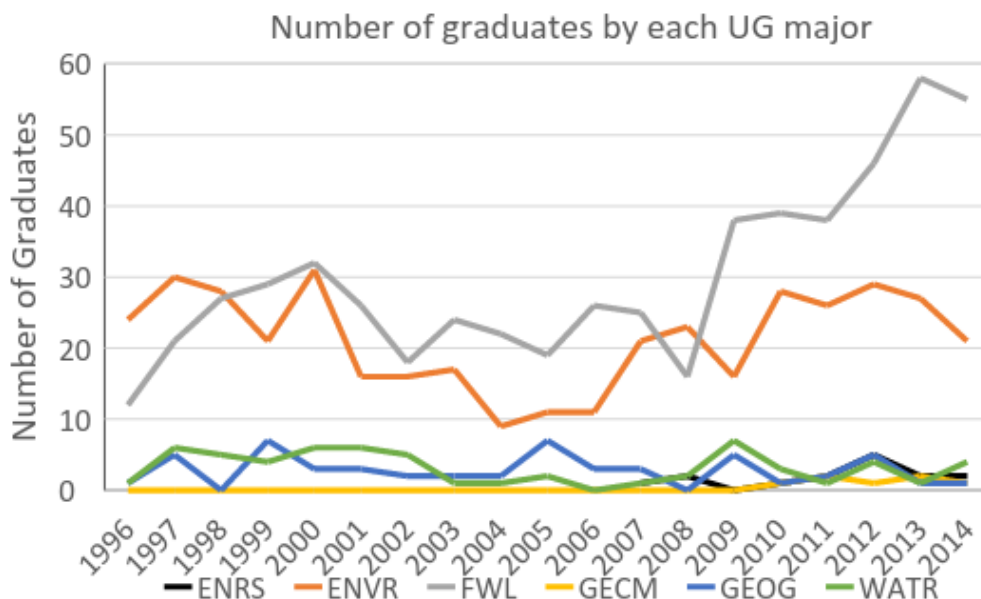


Figure A2. Number of undergraduate students graduating in a year in each SNR major. ENRS: Environmental Restoration Science; GECM: Grassland Management and Ecology; GEOG: Geography; PFOR: Preforestry; WATR: Water Science; FWL: Fisheries and Wildlife; ENVR = Environmental Studies in the College of Agriculture Science and Natural Resources (CASNR) plus those in College of Arts and Science (CAS), respectively for both BS and BA degrees.

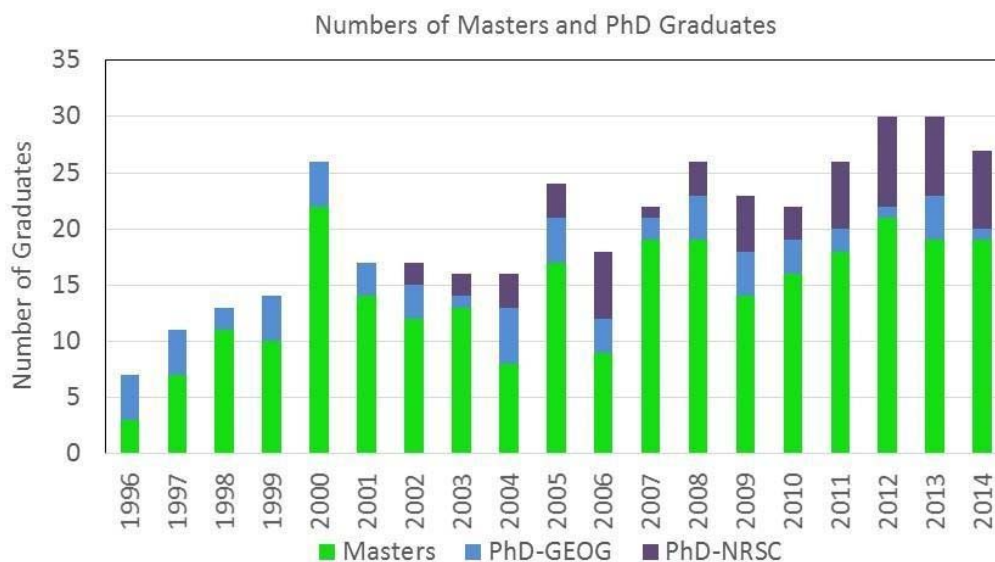


Figure A3. Number of graduate students graduating in SNR M.S. (all combined) and the two Ph.D. programs over the past 20 years.

## Student numbers across SNR

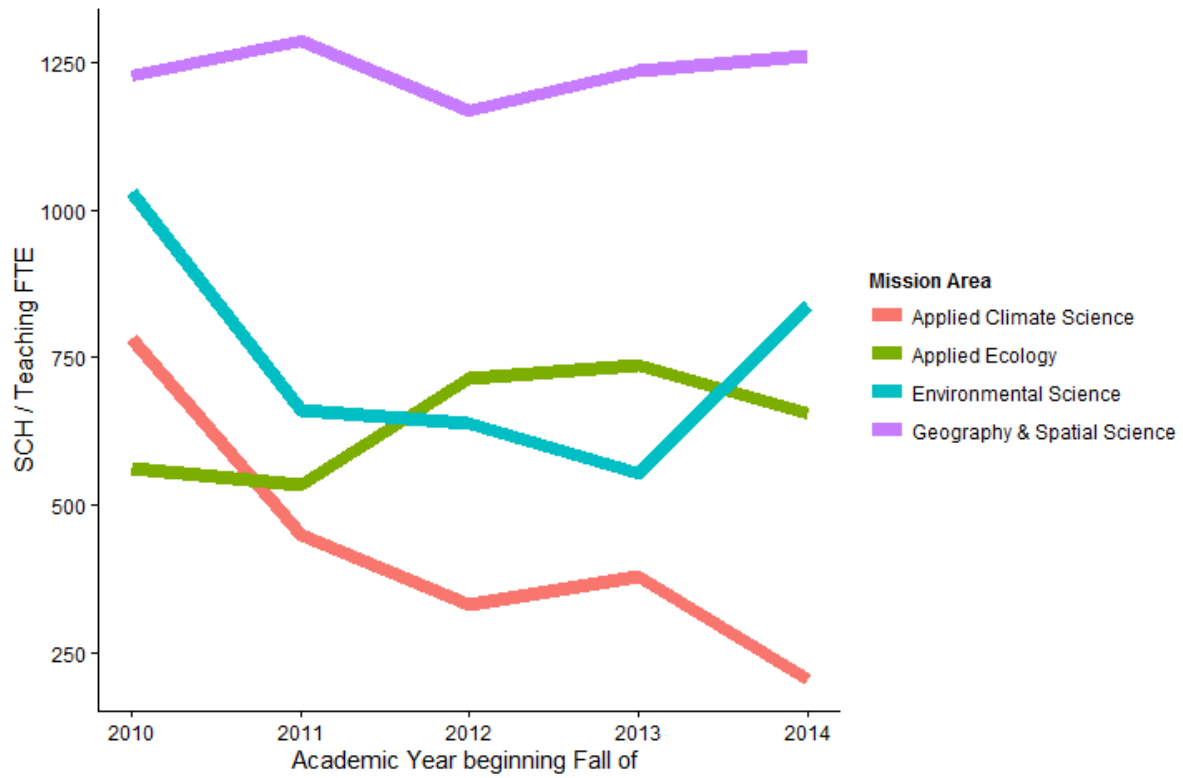


Figure A4 Student Credit hours per budgeted teaching *FTE* for each mission area. FTE and mission area are assigned based on 2015.



## Appendix B: Research Productivity Data

Table B1: Research funds awarded by source, FY 2010-2011 through FY 2014-2015. The total amount awarded is included in the year awarded, regardless of the duration of the grant.

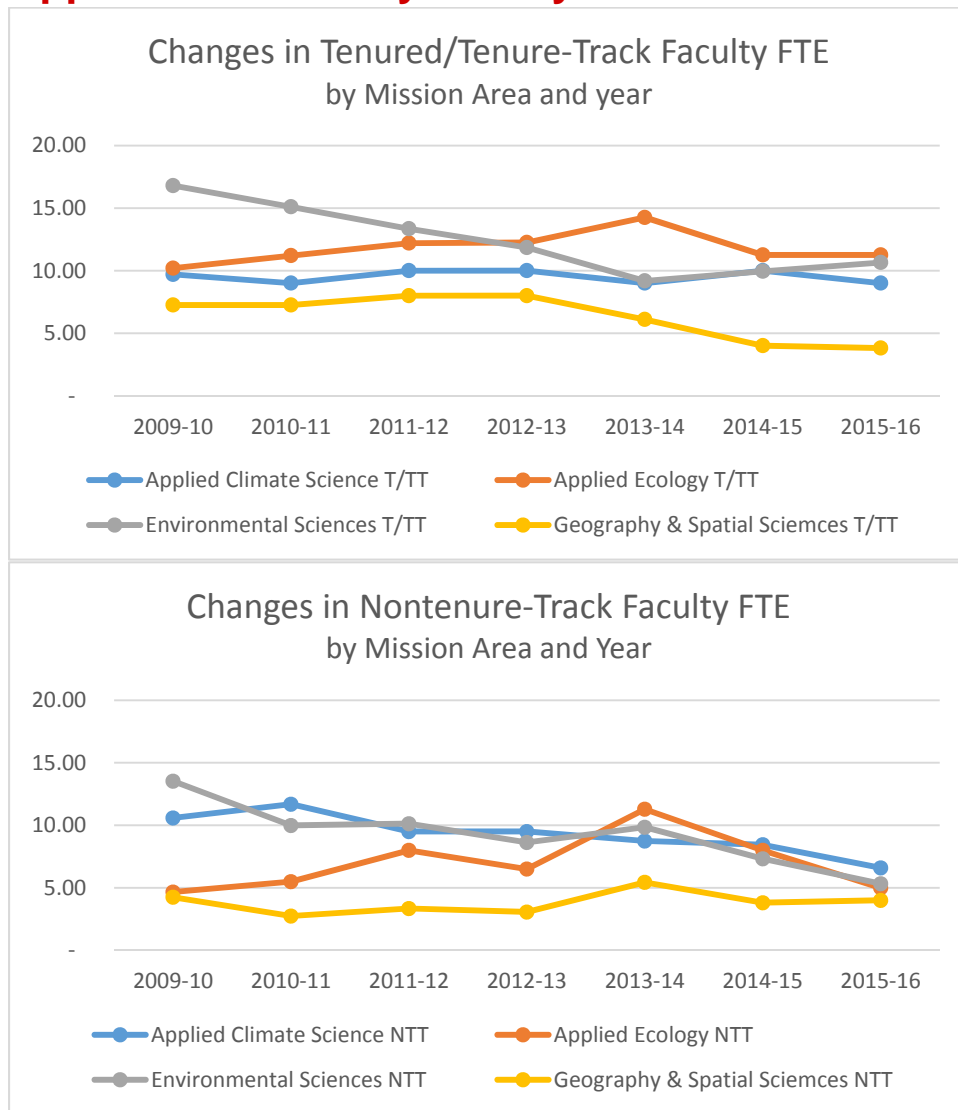
<b>Fiscal Year</b>	<b>Source</b>	<b>Amount</b>	<b>Percentage</b>
<b>FY 2010-2011</b>	Federal Funds	\$5,478,872	61.91%
<b>FY 2010-2011</b>	NE State Funds	\$2,362,807	26.70%
<b>FY 2010-2011</b>	NE NRDs	\$464,237	5.25%
<b>FY 2010-2011</b>	Subcontracts	\$508,303	5.74%
<b>FY 2010-2011</b>	Fdn/Trusts/Priv	\$36,049	0.41%
<b>FY 2010-2011</b>	<b>Total</b>	<b>\$8,850,268</b>	<b>100.00%</b>
<b>FY 2011-2012</b>	Federal Funds	\$4,815,415	60.94%
<b>FY 2011-2012</b>	NE State Funds	\$2,354,031	29.79%
<b>FY 2011-2012</b>	NE NRDs	\$125,028	1.58%
<b>FY 2011-2012</b>	Subcontracts	\$364,285	4.61%
<b>FY 2011-2012</b>	Fdn/Trusts/Priv	\$242,728	3.07%
<b>FY 2011-2012</b>	<b>Total</b>	<b>\$7,901,487</b>	<b>100.00%</b>
<b>FY 2012-2013</b>	Federal Funds	\$3,898,757	60.31%
<b>FY 2012-2013</b>	NE State Funds	\$1,779,576	27.53%
<b>FY 2012-2013</b>	NE NRDs	\$171,860	2.66%
<b>FY 2012-2013</b>	Subcontracts	\$437,347	6.76%
<b>FY 2012-2013</b>	Fdn/Trusts/Priv	\$177,342	2.74%
<b>FY 2012-2013</b>	<b>Total</b>	<b>\$6,464,882</b>	<b>100.00%</b>
<b>FY 2013-2014</b>	Federal Funds	\$4,762,572	36.23%
<b>FY 2013-2014</b>	NE State Funds	\$7,394,411	56.25%
<b>FY 2013-2014</b>	NE NRDs	\$335,416	2.55%
<b>FY 2013-2014</b>	Subcontracts	\$290,216	2.21%
<b>FY 2013-2014</b>	Fdn/Trusts/Priv	\$363,011	2.76%
<b>FY 2013-2014</b>	<b>Total</b>	<b>\$13,145,626</b>	<b>100.00%</b>
<b>FY 2014-2015</b>	Federal Funds	\$5,432,371	58.8%
<b>FY 2014-2015</b>	NE State Funds	\$2,333,727	25.3%
<b>FY 2014-2015</b>	NE NRDs	\$114,300	1.2%
<b>FY 2014-2015</b>	Subcontracts	\$811,801	8.8%
<b>FY 2014-2015</b>	Fdn/Trusts/Priv	\$431,926	4.7%
<b>FY 2014-2015</b>	Internal Funding	\$116,407	1.3%
<b>FY 2014-2015</b>	<b>Total</b>	<b>\$9,240,532</b>	<b>100.00%</b>

## Research Productivity Data

Table B2: Publication output by calendar year.

<b>Year</b>	<b>Book Chapters</b>	<b>Books</b>	<b>Conference Proceedings</b>	<b>Journal Article</b>	<b>(all)</b>
<b>2009</b>	22	0	14	210	246
<b>2010</b>	22	2	17	208	249
<b>2011</b>	19	3	12	275	309
<b>2012</b>	47	8	15	258	328
<b>2013</b>	27	2	10	305	344
<b>2014</b>	10	3	15	240	268
<b>Average</b>	24.5	3	13.8	249.3	290.7

## Appendix C: Faculty FTE by Mission Area 2009-2015



## Appendix D: Applied Climate Sciences Core Faculty FTE distribution

Name	Rank	State-Funded	Teaching	Research	Extension	Outreach (CAS-funded)	Service (CAS-funded)	Admin	Total
<b>Nontenure-Track Faculty</b>									
Bathke, Deb (AY, .50 SNR; .50 EAS)	Assistant Professor of Practice		–	0.50	–	–	–	–	0.50
Dutcher, Al	Associate Geoscientist	x	–	0.20	0.80	–	–	–	1.00
Fuchs, Brian	Assistant Geoscientist		–	1.00	–	–	–	–	1.00
Knutson, Cody	Research Associate Professor		–	1.00	–	–	–	–	1.00
Svoboda, Mark	Geoscientist		–	1.00	–	–	–	–	1.00
Tadesse, Tsegaye	Research Assistant Professor		–	1.00	–	–	–	–	1.00
You, Jinsheng	Research Assistant Professor		–	1.00	–	–	–	–	1.00
Zeng, Jing (Lily) (AY; .10 SNR; .90 EAS)	Lecturer		0.10	–	–	–	–	–	0.10
<b>Subtotal Nontenure-Track</b>			<b>0.10</b>	<b>5.70</b>	<b>0.80</b>	<b>–</b>	<b>–</b>	<b>–</b>	<b>6.60</b>
<b>Tenured/Tenure-Track Faculty</b>									
Awada, Tala (AY)	Professor	x	0.25	0.25	–	–	–	–	0.50
Baigorria, Guillermo (.70 SNR; .30 Ag-Hort)	Assistant Professor	x	0.15	0.75	0.10	–	–	–	1.00
Dewey, Ken (AY) (75% SNR-CAS, 25% SNR-CED)	Professor	x	0.15	–	0.25	0.58	0.02	–	1.00
Hayes, Mike	Professor	x	0.10	0.60	–	–	–	0.30	1.00
Hu, Qi (Steve) (.70 SNR, .30 EAS)	Professor	x	–	0.53	0.17	–	–	–	0.70
Oglesby, Bob (AY; .30 SNR; .70 EAS)	Professor	x	–	0.28	–	–	0.02	–	0.30
Shulski, Martha	Associate Professor	x	0.25	0.45	–	–	–	0.30	1.00
Suyker, Andy	Associate Professor	x	0.20	0.80	–	–	–	–	1.00
Walter-Shea, Betty	Professor	x	0.35	0.65	–	–	–	–	1.00
Wilhite, Don	Professor	x	–	1.00	–	–	–	–	1.00
<b>Subtotal Tenured/Tenure-Track</b>			<b>1.45</b>	<b>5.33</b>	<b>0.50</b>	<b>0.58</b>	<b>0.04</b>	<b>1.10</b>	<b>9.00</b>
<b>Total</b>			<b>1.55</b>	<b>11.03</b>	<b>1.30</b>	<b>0.58</b>	<b>0.04</b>	<b>1.10</b>	<b>15.60</b>



## Appendix E: Applied Ecology Core Faculty FTE distribution

Name	Rank	State-Funded	Teaching	Research	Extension	Outreach (CAS-funded)	Service (CAS-funded)	Admin	Total
<b>Nontenure-Track Faculty</b>									
Allen, Craig	USGS Research Professor		–	–	–	–	–	–	–
Burbach, Mark	Geoscientist	x	0.45	0.30	0.25	–	–	–	1.00
Dauer, Jenny (AY) <sup>1</sup>	Assistant Professor of Practice		0.75	0.25	–	–	–	–	1.00
Ferraro, Dennis (AY)	Professor of Practice	x	0.70	–	0.30	–	–	–	1.00
Fontaine, TJ	USGS Research Assistant		–	–	–	–	–	–	–
Loecke, Terry <sup>2</sup>	Research Assistant Professor		–	1.00	–	–	–	–	1.00
Pennisi, Lisa	Associate Professor of Practice	x	0.75	–	0.25	–	–	–	1.00
Pope, Kevin	USGS Research Professor		–	–	–	–	–	–	–
Shenk, Tanya	Adjunct Research Professor		–	–	–	–	–	–	–
<b>Subtotal Nontenure-Track</b>			<b>2.65</b>	<b>1.55</b>	<b>0.80</b>	<b>–</b>	<b>–</b>	<b>–</b>	<b>5.00</b>
<b>Tenured/Tenure-Track Faculty</b>									
Burgin, Amy (AY) <sup>2</sup>	Assistant Professor	x	0.30	0.70	–	–	–	–	1.00
Carroll, John	Professor and Director	x	–	–	–	–	–	1.00	1.00
Chizinski, Chris	Assistant Professor	x	.50	.50					1.00
Dauer, Joseph <sup>1</sup>	Assistant Professor	x	0.60	0.40	–	–	–	–	1.00
Higley, Leon	Professor	x	0.20	0.80	–	–	–	–	1.00
Pegg, Mark	Professor	x	0.49	0.51	–	–	–	–	1.00
Powell, Larkin	Professor	x	0.60	0.40	–	–	–	–	1.00
Reinhard, Karl <sup>1</sup> (AY) .75 SNR-CAS; .25 SNR-ARD	Professor	x	0.30	0.50	–	0.15	0.05	–	1.00
Schacht, Walter (.25 SNR; .75 Aq-Hort)	Professor	x	0.25	–	–	–	–	–	0.25
Thomas, Steven	Associate Professor	x	0.20	0.80	–	–	–	–	1.00
Tyre, Drew	Associate Professor	x	0.40	0.60	–	–	–	–	1.00
Wedin, Dave	Professor	x	0.40	0.60	–	–	–	–	1.00
<b>Subtotal Tenured/Tenure-Track</b>			<b>4.24</b>	<b>5.81</b>	<b>–</b>	<b>0.15</b>	<b>0.05</b>	<b>1.00</b>	<b>11.25</b>
<b>Total Applied Ecology</b>			<b>6.89</b>	<b>7.36</b>	<b>0.80</b>	<b>0.15</b>	<b>0.05</b>	<b>1.00</b>	<b>16.25</b>

<sup>1</sup>Affiliate program<sup>2</sup>Leaving SNR/UNL in 2015-16

## Appendix F: Environmental Sciences Core Faculty FTE distribution.

Name	Rank	State-Funded	Teaching	Research	Extension	Outreach (CAS-funded)	Service (CAS-funded)	Admin	Total
<b>Nontenure-Track Faculty</b>									
Lackey, Susan (Norfolk)	Geoscientist	x	–	0.75	0.25			–	1.00
Low, Russanne <sup>1</sup>	Research Assistant Professor		0	1.00	–			–	1.00
Pekarek, Kathryn (Katie)	Assistant Extension Educator	x	–	–	1.00			–	1.00
Sibray, Steve (Scottsbluff)	Geoscientist	x	–	0.75	0.25			–	1.00
Snow, Dan (acad home SNR)	Research Associate Professor		0.10	0.90	–			–	1.00
Szilagyi, Joe (.33 FTE)	Research Professor	x	–	0.33	–			–	0.33
<b>Subtotal Nontenure-track</b>			<b>0.10</b>	<b>3.73</b>	<b>1.50</b>			<b>–</b>	<b>5.33</b>
<b>Tenured/Tenure-Track</b>									
Chen, Xun-Hong	Professor	x	–	1.00	–			–	1.00
Comfort, Steve	Professor	x	0.20	0.65	0.15			–	1.00
Forbes, Cory <sup>1</sup>	Associate Professor	x	0.25	0.50	–			0.25	1.00
Gilmore, Troy (.70 SNR; .30	Assistant Professor			.70					.70
Gosselin, Dave <sup>1</sup>	Professor	x	0.70	0.10	–			0.20	1.00
Hanson, Paul	Associate Professor	x	0.25	0.25	–			0.50	1.00
Hoagland, Kyle	Professor	x	–	1.00	–			–	1.00
Joeckel, Matt (.70 SNR; .30	Professor	x	–	0.09	0.11			0.50	0.70
Kilic, Ayse (.60 SNR, .40 CE)	Associate Professor	x	0.15	0.45	–			–	0.60
Korus, Jesse	Assistant Professor	x		.70	.30				1.00
Neale, Christopher (.10	Professor	x	–	0.10	–			–	0.10
Schoengold, Karina (.30	Assistant Professor	x	0.25	0.05	–			–	0.30
Shea, Pat	Professor	x	0.10	0.80	0.10			–	1.00
Woldt, Wayne (.25 SNR; .75	Associate Professor	x	–	–	0.25			–	0.25
<b>Subtotal Tenure-Track</b>			<b>1.90</b>	<b>6.39</b>	<b>0.91</b>			<b>1.45</b>	<b>10.65</b>
<b>Total Environmental</b>			<b>2.00</b>	<b>12.12</b>	<b>2.41</b>			<b>1.45</b>	<b>15.98</b>

<sup>1</sup>Affiliate program

## Appendix G: Geography and Spatial Sciences Core Faculty FTE distribution

Name	Rank	State-funded	Teaching	Research	Extension	Service (CAS-funded)	Admin	Total
<b>Nontenure-Track Faculty</b>								
Buller, Becky (AY; .75 SNR) <sup>3</sup>	Lecturer	x	0.75	–	–	–	–	0.75
Nashleanas, Katherine (AY) <sup>3</sup>	Lecturer	x	1.00	–	–	–	–	1.00
Perk, Rick	Assistant Geoscientist		–	1.00	–	–	–	1.00
Ramirez, Juan Paulo (AY) <sup>3</sup>	Lecturer	x	1.00	–	–	–	–	1.00
Zygielbaum, Art (.06 FTE)	Research Associate Professor	x	–	0.06	–	–	–	0.06
<b>Subtotal Nontenure-track</b>			<b>2.75</b>	<b>1.06</b>	–	–	–	<b>3.81</b>
<b>Tenure-Track</b>								
Archer, Clark (AY) <sup>4</sup>	Professor	x	0.60	0.30	–	0.10	–	1.00
Franz, Trenton	Assistant Professor	x	0.40	0.60	–	–	–	1.00
Wardlow, Brian	Associate Professor	x	0.40	0.45	–	–	0.15	1.00
Wishart, David (AY) <sup>4</sup>	Professor	x	0.60	0.30	–	0.10	–	1.00
<b>Subtotal Tenured/Tenure-Track</b>			<b>2.00</b>	<b>1.65</b>	–	<b>0.20</b>	<b>0.15</b>	<b>4.00</b>
<b>Total Geography &amp; Spatial Sciences</b>			<b>4.75</b>	<b>2.71</b>	–	<b>0.20</b>	<b>0.15</b>	<b>7.81</b>

<sup>3</sup>Temporary lecturers in geography paid through CAS

<sup>4</sup>Tenured faculty in geography paid through CAS

## Appendix H: Courses taught by all Faculty

Courses offered at least once by SNR faculty, sorted by average students enrolled per year. Frequency refers to which years the course is taught. Times offered is the number of years out of academic years starting in fall 2010-2014 that the course was offered by an SNR faculty member. Courses offered only once with no intent to repeat have been deleted. 400/800 courses are combined as the 400 level.

Course ID	Average Students per year	Frequency	Times offered	Instructor	Mission Area
<b>GEOG 140</b>	546	both	5	multiple	Geography & Spatial Science
<b>GEOG 155</b>	393	both	5	multiple	multiple
<b>NRES 103</b>	356	both	5	multiple	multiple
<b>NRES 220</b>	223	both	5	multiple	multiple
<b>LIFE 121</b>	211	both	2	multiple	Applied Ecology
<b>GEOG 272</b>	183	both	5	multiple	Geography & Spatial Science
<b>METR140</b>	146	even	1	Bathke, Deborah Jean	Applied Climate Science
<b>NRES 498</b>	145	both	5	multiple	multiple
<b>GEOG 181</b>	139	both	5	Nashleanas, Katherine	Geography & Spatial Science
<b>GEOL 101</b>	97	even	2	Joeckel, Robert Matthew	Environmental Science
<b>NRES 222</b>	84	both	5	multiple	multiple
<b>NRES 311</b>	82	both	4	multiple	Applied Ecology
<b>NRES 898</b>	75	both	5	multiple	multiple
<b>WATS 281</b>	71	both	5	multiple	multiple
<b>BIOS 386</b>	65	both	5	Freeman, Patricia W	Applied Ecology
<b>NRES 312</b>	63	both	5	multiple	multiple
<b>GEOG 271</b>	62	both	5	multiple	Geography & Spatial Science
<b>ENVR 201</b>	61	both	5	multiple	Environmental Science
<b>NRES 108</b>	54	both	5	multiple	Environmental Science
<b>GPSP 377</b>	51	both	5	Buller, Rebecca Ann	Geography & Spatial Science
<b>NRES 104</b>	50	both	5	multiple	multiple
<b>NRES 450</b>	46	even	3	Tyre, Richard A	Applied Ecology
<b>NRES 433</b>	46	both	4	multiple	Applied Ecology
<b>NRES 101</b>	43	both	5	multiple	multiple
<b>NRES 211</b>	41	even	1	multiple	Applied Ecology
<b>ENVR 101</b>	39	even	2	multiple	multiple
<b>ENVR 249</b>	39	both	4	multiple	multiple



Courses taught by Environmental Sciences Faculty

Course ID	Average Students per year	Frequency	Times offered	Instructor	Mission Area
<b>GEOG 334</b>	37	both	5	Wishart, David J	Geography & Spatial Science
<b>NRES 208</b>	36	both	5	multiple	Applied Climate Science
<b>GEOG 361</b>	35	both	5	Archer, John Clark	Geography & Spatial Science
<b>GEOG 370</b>	33	both	5	Buller, Rebecca Ann	Geography & Spatial Science
<b>GEOG 283</b>	33	both	4	Amedeo, Douglas M	Geography & Spatial Science
<b>WMNS 385</b>	32	both	2	Woudenberg, Donna Louise	Applied Climate Science
<b>NRES 260</b>	30	both	3	multiple	multiple
<b>GEOG 427</b>	26	both	5	multiple	Geography & Spatial Science
<b>GEOG 412</b>	26	both	5	multiple	Geography & Spatial Science
<b>ENVR 499A</b>	25	both	5	Gosselin, David Charles	Environmental Science
<b>NRES 361</b>	25	both	5	Comfort, Steven	Environmental Science
<b>NRES 459</b>	23	both	5	multiple	Applied Ecology
<b>NRES 474</b>	23	even	1	Ferraro, Dennis M	Applied Ecology
<b>NRES 489</b>	23	odd	2	Pegg, Mark A	Applied Ecology
<b>GEOG 418</b>	23	both	5	multiple	Geography & Spatial Science
<b>NRES 497</b>	22	both	5	Winn, Sara Ruth	NA
<b>NRES 832</b>	22	even	1	Low, Russanne	Environmental Science
<b>NRES 803</b>	21	both	4	Tyre, Richard A	Applied Ecology
<b>ENTO 414</b>	21	odd	1	Higley, Leon G	Applied Ecology
<b>FORS 445</b>	21	both	3	Reinhard, Karl Jan	Applied Ecology
<b>GEOG 378</b>	21	both	2	Ramirez, Juan P	Geography & Spatial Science
<b>NRES 163</b>	20	even	1	Pegg, Mark A	Applied Ecology
<b>NRES 323</b>	20	even	1	Moncure, Shannon Lee	Applied Ecology
<b>NRES 463</b>	20	both	5	multiple	Applied Ecology
<b>NRES 348</b>	20	even	3	multiple	Applied Ecology
<b>NRES 310</b>	19	both	3	Awada, Tala N	Applied Climate Science
<b>NRES 412</b>	19	both	5	multiple	Geography & Spatial Science
<b>NRES 299</b>	19	both	2	Pegg, Mark A	Applied Ecology
<b>NRES 475</b>	19	both	3	multiple	multiple

Courses taught by Environmental Sciences Faculty

Course ID	Average Students per year	Frequency	Times offered	Instructor	Mission Area
<b>AGRO 907</b>	18	even	1	Baigorria Paz, Guillermo A	Applied Climate Science
<b>NRES 423</b>	18	even	1	Bleed, Ann S	Environmental Science
<b>NRES 434</b>	18	both	2	multiple	multiple
<b>NRES 408</b>	18	both	5	multiple	Applied Climate Science
<b>NRES 476</b>	18	both	5	Freeman, Patricia W	Applied Ecology
<b>CIVE 898</b>	18	both	4	multiple	Environmental Science
<b>NRES 424</b>	17	even	3	Wedin, David A	Applied Ecology
<b>ALEC 428</b>	17	both	5	Burbach, Mark Eugene	Applied Ecology
<b>CIVE 353</b>	17	both	5	multiple	multiple
<b>ETHN 398</b>	17	both	3	Alapo, Victoria Oluyemisi	Geography & Spatial Science
<b>NRES 406</b>	17	even	1	Awada, Tala N	Applied Climate Science
<b>NRES 814</b>	17	both	4	multiple	Environmental Science
<b>ENVR 189H</b>	16	both	4	Benson, Lorrie B	Environmental Science
<b>ENTO 814</b>	16	odd	1	Higley, Leon G	Applied Ecology
<b>ENVR 489</b>	16	both	3	Gosselin, David Charles	Environmental Science
<b>NRES 484</b>	16	both	5	multiple	Environmental Science
<b>SOIL 279</b>	16	both	5	Kuzila, Mark Steven	Environmental Science
<b>METR 312</b>	15	both	3	Hu, Qi S	Applied Climate Science
<b>ENVR 319</b>	15	both	4	Gosselin, David Charles	Environmental Science
<b>GEOG 419</b>	15	both	5	multiple	Geography & Spatial Science
<b>NRES 809</b>	15	both	3	multiple	Environmental Science
<b>GEOG 398</b>	14	both	3	Alapo, Victoria Oluyemisi	Geography & Spatial Science
<b>GEOG 402</b>	13	both	5	Wishart, David J	Geography & Spatial Science
<b>NRES 477</b>	13	both	5	Kuzila, Mark Steven	Environmental Science
<b>METR 311</b>	13	both	3	Hu, Qi S	Applied Climate Science

Courses taught by Environmental Sciences Faculty

Course ID	Average Students per year	Frequency	Times offered	Instructor	Mission Area
<b>GEOG 444</b>	12	odd	2	Archer, John Clark	Geography & Spatial Science
<b>GEOG 422</b>	12	both	5	multiple	Geography & Spatial Science
<b>CIVE 456</b>	12	both	3	multiple	Environmental Science
<b>FORS 446</b>	12	both	5	multiple	Applied Ecology
<b>GEOG 217</b>	11	both	3	multiple	Geography & Spatial Science
<b>GEOG 317</b>	11	even	1	Ladegard, Christopher Floyd	Geography & Spatial Science
<b>NRES 478</b>	11	even	1	Lenters, John D	Applied Climate Science
<b>NRES 810</b>	11	even	1	multiple	Applied Ecology
<b>GEOG 447</b>	11	even	2	Archer, John Clark	Geography & Spatial Science
<b>NRES 891</b>	11	both	4	multiple	multiple
<b>NRES 492</b>	10	both	5	multiple	multiple
<b>NRES 452</b>	10	both	5	multiple	multiple
<b>GEOG 498</b>	10	both	5	multiple	multiple
<b>HORT 418</b>	10	both	5	Brandle, James R	Applied Ecology
<b>FORS 300</b>	10	both	3	Reinhard, Karl Jan	Applied Ecology
<b>NRES 409</b>	10	both	2	multiple	Applied Ecology
<b>NRES 965</b>	9	even	3	multiple	Applied Ecology
<b>AGRO 440</b>	9	both	2	Stubbendieck, James L	Applied Ecology
<b>GEOG 432</b>	9	odd	1	Guan, Qingfeng	Geography & Spatial Science
<b>NRES 111</b>	9	odd	1	Ferraro, Dennis M	Applied Ecology
<b>NRES 880</b>	9	odd	2	Multiple	Applied Ecology
<b>NRES 319</b>	9	both	5	Snow, Daniel Davidson	Environmental Science
<b>NRES 461</b>	9	both	3	Skopp, Joseph M	Environmental Science
<b>NRES 370</b>	9	both	4	Dewey, Kenneth F	Applied Climate Science
<b>NRES 829</b>	9	both	4	Burbach, Mark Eugene	Applied Ecology
<b>NRES 320</b>	8	both	5	Snow, Daniel Davidson	Environmental Science
<b>AGRO 361</b>	8	both	5	Comfort, Steven	Environmental Science
<b>GEOG 903</b>	8	both	3	Wishart, David J	Geography & Spatial Science

Courses taught by Environmental Sciences Faculty

Course ID	Average Students per year	Frequency	Times offered	Instructor	Mission Area
<b>NRES 451</b>	8	even	2	Comfort, Steven	Environmental Science
<b>GEOL 450</b>	7	both	5	Joeckel, Robert Matthew	multiple
<b>NRES 830</b>	7	both	3	Low, Russanne	Environmental Science
<b>GEOG 902</b>	7	both	5	Merchant, James W	Geography & Spatial Science
<b>GEOG 935</b>	7	odd	2	Wishart, David J	Geography & Spatial Science
<b>GEOG 901</b>	7	both	5	Merchant, James W	Geography & Spatial Science
<b>CIVE 916</b>	7	both	4	Bleed, Ann S	Environmental Science
<b>ENVE 851</b>	7	even	2	Comfort, Steven	Environmental Science
<b>BSEN 954</b>	6	even	1	Verma, Shashi B	Applied Climate Science
<b>GEOG 983</b>	6	even	2	Amedeo, Douglas M	Geography & Spatial Science
<b>NRES 469</b>	6	odd	1	Hubbard, Kenneth Gene	Applied Climate Science
<b>NRES 479</b>	6	even	1	Lenters, John D	Applied Climate Science
<b>GEOG 922</b>	5	even	2	Guan, Qingfeng	Geography & Spatial Science
<b>GEOG 898</b>	4	both	5	multiple	multiple
<b>GEOG 417</b>	4	both	3	multiple	multiple
<b>GEOG 806</b>	4	both	4	Amedeo, Douglas M	Geography & Spatial Science
<b>GEOG 406</b>	4	both	4	Amedeo, Douglas M	Geography & Spatial Science
<b>AGRO 906</b>	3	odd	1	Baigorria, Guillermo A	Applied Climate Science
<b>GEOL 917</b>	3	even	1	Harvey, F Edwin	Environmental Science
<b>NRES 862</b>	3	both	4	Higley, Leon G	Applied Ecology
<b>NRES 871</b>	3	odd	1	Pope, Kevin L	Applied Ecology
<b>NRES 874</b>	3	even	1	Ferraro, Dennis M	Applied Ecology
<b>AGRO 419</b>	3	both	2	Multiple	Geography & Spatial Science
<b>GEOG 940</b>	3	odd	2	Amedeo, Douglas M	Geography & Spatial Science
<b>FORS 498</b>	2	even	1	Reinhard, Karl Jan	Applied Ecology
<b>ALEC 495A</b>	2	odd	1	Pennisi, Lisa A	Applied Ecology



Courses taught by Environmental Sciences Faculty

<b>Course ID</b>	<b>Average Students per year</b>	<b>Frequency</b>	<b>Times offered</b>	<b>Instructor</b>	<b>Mission Area</b>
<b>GEOL 985</b>	2	odd	1	Skopp, Joseph M	Environmental Science
<b>METR 898</b>	2	even	1	Feng, Song	Applied Climate Science
<b>NRES 876</b>	2	both	4	Freeman, Patricia W	Applied Ecology
<b>AGRO 450</b>	2	odd	2	Hayes, Michael J	Applied Climate Science
<b>GEOG 897</b>	2	both	2	multiple	Geography & Spatial Science
<b>GEOG 497</b>	1	both	4	Wishart, David J	Geography & Spatial Science
<b>AGEN 955</b>	1	even	1	Skopp, Joseph M	Environmental Science
<b>CIVE 998</b>	1	even	1	Kilic, Ayse	Environmental Science
<b>ENVE 890</b>	1	odd	1	Dvorak, Bruce Irvin	Environmental Science
<b>ENVR 499H</b>	1	odd	1	Gosselin, David Charles	Environmental Science
<b>GEOG 399</b>	1	both	3	Wishart, David J	Geography & Spatial Science
<b>GEOS 898</b>	1	even	1	Harvey, F Edwin	Environmental Science
<b>HORT 897</b>	1	even	1	Chen, Xun-Hong	Environmental Science

## Appendix I: Stakeholder Survey Results

During spring 2015 we began eliciting information from faculty and staff about who our stakeholders are. We used an online form to collect the information into a spreadsheet. As of May 5, 2015, we had 98 entries from 21 faculty and staff. The entries are summarized below, and a map of their location by US State is in Figure H.1. These results do not include substantial databases held by the Coop Unit, HPRCC and NDMC.

### State/Local Government Agencies

- Nebraska Game and Parks
- Nebraska Department of Environmental Quality
- Natural Resource Districts (NRDs)
- Nebraska Geological Society
- Nebraska Department of Agriculture
- Nebraska Public Power District
- Nebraska Department of Health and Human Services
- Lincoln-Lancaster County Health Department
- Lincoln Mayor Office
- Nebraska Department of Education

### Associations/Districts/Organizations/Coalitions

- Nebraska Well Drillers Association
- Irrigation Districts
- Nebraska Oil and Gas Commission
- The Nature Conservatory
- Nebraska Educational Telecommunications
- Nebraska Grazing Lands Coalition
- Kansas Grazing Land Coalition
- South Dakota Grassland Coalition
- Texas Grazing Lands Conservation Initiative
- Nebraska Public Power District
- Central Nebraska Public Power and Irrigation District
- American Association of Petroleum Geologists
- Izaak Walton League(s) of Nebraska

## Stakeholder Survey Results

### Corporations

Google  
NioCorp Developments  
Martin Marietta Materials  
SocioEnvironmental Synthesis Center

### Federal

NASA  
United States Geological Survey

### International

World Meteorological Organization  
Global Water Partnership and World Meteorological Org.  
Talent Training International  
Ethiopian Meteorological Society



**Figure H.1** Distribution of 98 identified SNR stakeholders across the USA.

## Appendix J: Research publications in 2014 by all SNR faculty

There were 401 unique publications (Books, book chapters, journal articles, newsletters and websites) produced by SNR faculty in calendar year 2014. They are listed in Alphabetical order by lead author. Data in each citation reflects what was entered in Activity Insight database, and is not a complete citation in many instances.

- AghaKouckak, A., Farahmand, A., Teixeira, J., Wardlow, B., Melton, F., Anderson, M., Hain, C. (in press). Remote sensing of drought: progress, challenges, and opportunities. *Reviews of Geophysics*.
- Allen, C. (2014). Assessing resilience in stressed watersheds.
- Allen, C. (2014). Integrating resilience and law. *Social-ecological resilience and law*. Columbia University Press.
- Allen, C. (2014). *Social-ecological resilience and law*. Columbia University Press.
- Allen, C. (2014). *Social-ecological resilience and law*. *Social-ecological resilience and law*. Columbia University Press.
- Allen, C., Angeler, D. G., Fontaine, J. J., Garmestani, A. S., Hart, N. M., Pope, K. L., Twidwell, Jr, D. Adaptive management of rangeland ecosystems.
- Allen, C., Angeler, D., Garmestani, A., Gunderson, L., Holling, C. (2014). Panarchy: Theory and application. 17, 578-589.
- Allen, C., Myers, E. (2014). Consuming fire ants reduces northern bobwhite survival and weight gain. 30, 49-58.
- Almeida, A., Dutta, R., Franz, T., Terhorst, A., Smethurst, P., Baillie, C., Worledge, D. (2014). Combining Cosmic-Ray Neutron and Capacitance Sensors and Fuzzy Inference to Spatially Quantify Soil Moisture Distribution. *IEEE Sensors Journal*, 14(10).
- Al-Sammak, M., Hoagland, K., Cassada, D., Snow, D. (2014). Co-occurrence of the cyanotoxins BMAA, DABA and Anatoxin-a in Nebraska reservoirs, fish, and aquatic plants. 6(2), 488-508. <http://www.mdpi.com/journal/toxins>
- Anderson, L., Schacht, W., Powell, L. A., Lusk, J., Vodehnal, W. (in press). Greater Prairie-Chicken Brood Site Selection and Survival in the Nebraska Sandhills. TBD, TBD.
- Angeler, D., Allen, C., McKie, B., Johnson, R., birge, H. (2014). Assessing and managing freshwater ecosystems vulnerable to global change. 43, 113-125.
- Angeler, D., Allen, C., Vila-Gispert, A., Almeida, D. (2014). Fitness in animals correlates with proximity to discontinuities in body mass distributions. 20, 213-218.
- Arbogast, A. F., Luehmann, M. D., Miller, B. A., Wernette, P. A., Adams, K. M., Waha, J. D., Oneil, G. A., Tang, Y., Boothroyd, J. J., Babcock, C. R., Hanson, P., Young, A. (in press). Late-Pleistocene paleowinds and aeolian sand mobilization in north-central lower Michigan. Elsevier.
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## **Appendix K: SNR's Response to the [2009] Comprehensive Review Team's Report**

In the following text, Director Don Wilhite summarized each of 44 recommendations and provided a response. For each of these responses, we summarize what took place between April 2010 (the date of the response document) and 2015.

The faculty, staff, and students of the School of Natural Resources express appreciation to members of the Comprehensive Program Review team for the comments and thoughtful suggestions included in their final report. As stated in the Review team's report, the goal of the review was "to provide an objective assessment of the strengths and challenges of the SNR and serve as the basis for recommendations that will enable the SNR to more effectively achieve its land-grant university educational, research, and public service goals." SNR believes the Review Team's report will be a valuable asset to the unit as it moves forward with the implementation of its strategic plan. The issue-based strategic planning process that was initiated by SNR in the fall of 2007 and culminated in the publication of our comprehensive review document in August 2009, coupled with the suggestions and recommendations of the Review Team, will serve as a roadmap for the unit over the next 5 years and beyond.

In our comprehensive review document, we sought the Comprehensive Program Review Team's counsel on a number of specific issues that were deemed important to SNR's faculty, staff, and students. These issues and related questions are restated below since they formed the context for many of the review teams' comments and recommendations.

### **Review Team Members**

Louis Tupas, Team Leader, USDA/CSREES

Jerry Hatfield, USDA/ARS

Dan Brown, University of Michigan

Kathy Jacobs, University of Arizona

Edward Miles, University of Washington

William Shilts, University of Illinois

Ron Yoder, University of Nebraska (IANR Unit Head representative)

Shelley Fuller, University of Nebraska (Academic Planning Committee representative)

John Quinn, University of Nebraska (Graduate Student representative)

Laura Snell, University of Nebraska (Undergraduate Student representative)

### **Issues and Questions:**

1. SNR engaged in an issue-based strategic planning process beginning in fall 2007 in preparation for the 5-year review. This process involved an assessment of current and future science and societal needs along with an evaluation of SNR strengths in natural resources and environmental science. That process identified five current and emerging issues in natural resources and environmental science: climate variability and change; water quantity and quality; ecological challenges; human-environment interaction; and natural resources and environmental science education. In early 2009,

through a self- selection process, faculty were organized into six faculty areas based on their disciplinary strengths to further facilitate our ability to address these issues over the next 5 to 10 years.

- a. Based on your understanding of science and societal needs and your assessment of SNR strengths, would you recommend any redirection of the unit's programs related to these five issues? If so, please include these recommendations in your report.
- b. Was the organization of SNR's five year review document around these five issues effective in helping you understand the unit's programs, strengths, and future goals?
- c. Resource needs have been identified in each of the "issue" chapters. How would the review team prioritize these requests to best enhance SNR's ability to achieve its vision?
2. In our view, SNR has been a successful experiment to develop an interdisciplinary unit that focuses on cross-cutting natural resources and environmental issues. Although principally based in the Institute of Agriculture and Natural Resources (IANR), the unit also has an increasing number of joint appointments and collaborations with the College of Arts and Sciences (CAS) and other colleges/units as well.
  - a. Should SNR pursue increased collaboration with other units/colleges and, if so, what would you recommend to be the goal of this collaboration? Current collaboration is with the Department of Geosciences (e.g., meteorology, climatology, geology, and water), School of Biological Sciences (ecosystem science), and social science departments (e.g., Sociology, Political Science) pertaining to programs in human dimensions of natural resources and environmental science.
  - b. Based on your experience, does the review team recognize any administrative or institutional barriers or constraints to increased collaboration between SNR and other units/colleges? If significant barriers are identified, what recommendations does the review team have for helping to overcome these barriers or to find ways to work within them?
3. SNR currently houses five centers officially recognized by the NU Board of Regents: Water Center, National Drought Mitigation Center, Center for Advanced Land Management Information Technologies, High Plains Regional Climate Center, and Great Plains Regional Center for Global Environmental Change. Each of these centers contributes considerably to the unit's visibility and also attracts significant external resources.
  - a. Is SNR effectively integrating the mission and activities of these centers into its overall program of activities?
  - b. Is there a need to enhance the synergy between these centers and other SNR programs and faculties? If so, how?
  - c. After reviewing the vision and mission of each of the centers, what is your assessment of the progress toward each center's vision and mission?
  - d. What recommendations do you have regarding the improvement of each center's programs and/or for monitoring progress toward achieving its vision and mission?
4. The Geography program merged into SNR in August 2008. In our opinion, SNR and the Geography program have benefited from this merger. This program has been integrated with existing SNR faculty expertise in geography and GIScience. This merger has also enhanced SNR's human

dimensions area. A new faculty position in GIScience was filled recently with funding from IANR and CAS.

- a. Is SNR at an effective level of productivity in terms of its research and teaching capacity in GIScience, geospatial technologies, and human dimensions?
  - b. As we continue to enhance this merger, what disciplinary areas would you consider most advantageous to enhance our Geography/GIScience and human dimensions faculty program areas?
5. SNR offers MS and PhD degrees in natural resource sciences and MS and PhD degrees in geography. Offering degrees in natural resource sciences, as opposed to graduate degrees in all of the major disciplines in SNR, was the approach we followed in order to facilitate an expedited (2-year) approval process through the university system, including Board of Regents. Graduate students in natural resources have the option to select from a list of specializations that represent the disciplinary areas of expertise that exist in SNR. Alternatively, we could have chosen to pursue multiple graduate degrees in the various disciplinary areas represented in SNR.
  - a. Does the review committee have any recommendations regarding the alternatives of offering one graduate degree (i.e., the current approach) vs. multiple graduate degrees in the various disciplinary areas reflected in SNR? What has been the experience of other interdisciplinary units at other universities?
  - b. If we stay with the current degree program, should SNR graduate students (not including geography students) be required to select a specialization? This requirement does not exist currently.
  - c. Should a minimal set of core courses be required for all graduate students regardless of specialization?
  - d. Would you recommend developing other specializations to better match the strengths of SNR faculty and professional career opportunities?
6. The undergraduate majors currently available to students through SNR pre-date the development of the unit. These programs are advised by a Natural Resources Undergraduate Curriculum Committee (NRUCC) composed of major coordinators (not all of these coordinators are in SNR). Several majors have recently been revised to be more current and attractive for students. Some majors (natural resources and environmental economics, grassland ecology and management, water science, and environmental restoration science) have traditionally had a very low number of majors.
  - a. Even though the cost associated with majors with low numbers is minimal, should we continue to support these majors?
  - b. Should the core curriculum be revised? If so, what courses, or perhaps more specifically, what skill sets would you recommend we focus on in a revised, core curriculum?
7. Following the merger of the Conservation and Survey Division (CSD) in 2003 into what became SNR, there have been significant challenges in meeting increasing stakeholder needs in the face of reductions in staffing and resources.
  - a. How can SNR maintain traditional survey activities that are in demand among stakeholders?

- b. How should ecological and climate survey activities be better integrated with traditional geological, water, and soil survey activities now practiced in SNR?
  - c. How should SNR's extension FTE be used to enhance our overall survey/outreach mission?
  - d. What constructive strategies can we learn from the experience of Illinois and other states in which similar mergers or declines in staffing and resources for survey activities have occurred?
8. The vision of SNR is to become an international leader in natural resources and environmental science in areas of research, outreach, and teaching. Appendix I includes faculty collaborations and also a sampling of SNR's international programs and travel over the past 5 years.
- a. What is the review team's assessment of the international activities of faculty members and centers in SNR?
  - b. What opportunities do you see for engaging SNR faculty in international activities to further the recognition of SNR's programs and the professional development of faculty?
9. SNR faculty have been competitive in attracting funding from state and federal sources.
- External funding in SNR was \$6.2 in 2007 and \$8.2 million in 2008. It will likely exceed the \$12 million threshold in 2009.
- a. Can you recommend internal strategies or approaches that could enhance our responsiveness to RFPs and further increase funding of SNR programs in research, education, and outreach?
  - b. Can you suggest private foundations that could be targets for funding SNR's research, outreach, and teaching programs and its facilities?
10. With SNR's move to Hardin Hall in 2006, faculty and staff collaborations and the building of community within the unit was enhanced significantly. As program expansion continues, space is at a premium. Office, classroom, laboratory, and conference room space is becoming a significant constraint to further growth.
- a. How big is too big? Administering SNR programs effectively is becoming an ever-increasing challenge.
  - b. How do we balance the desire for program growth without jeopardizing opportunities for enhancing current programs, given space constraints in Hardin Hall?
  - c. Is the current SNR administrative structure appropriate for program management and planning? If not, can you identify other models that might help with administrative oversight and communication?

### **Review Team's comments and recommendations.**

We felt it was imperative to respond to all comments and recommendations rather than to be selective and include responses only to those of greatest substance. Clearly, one of the most important themes present in the Review Team's Report was the issue of FTE balance between research (36.94), teaching (15.91), and extension (5.10) for the School as a whole and within each of its six faculty areas. The imbalance that currently exists is largely a product of the units that were merged to form the School in 1997, 2003, and 2008. We certainly highlighted this imbalance in the review document as well as in our many group



discussions with members of the review team. SNR has nine faculty that have attained retirement-eligible age and eight faculty between the ages of 61 and 65. Thus, there is a significant opportunity for SNR to redirect faculty lines into high priority areas within the School and to make significant adjustments in FTE distribution between research, teaching, and extension as these retirements occur.

#### Response to the Review Team's Recommendations

The unit's response to the review team's recommendations has been divided into three sections: (1) administrative issues; (2) faculty area/degree program concerns; and (3) SNR-based centers.

### ADMINISTRATIVE ISSUES

1. Communication through a School newsletter or bulletin recommendation needed. (Section VIII, Page 20)

Response: SNR previously published both an external and internal newsletter, but they were not highly valued or read by most members of the faculty and staff. Thus, they were discontinued. Currently, communication in SNR is facilitated by the director's monthly newsletter, through monthly faculty and staff meetings, through email correspondence, through spring and fall semester town hall meetings, and through the unit's website. SNR events are advertised to all employees and students through an events calendar.

ACTION: We continue to strive to improve communication through a variety of mechanisms, including enhancements of the School's website.

2015 OUTCOME: We continue all of these activities, except that the director's monthly newsletter has been replaced by a weekly email digest of stories called "Inside SNR". These stories are also pushed up to the University's daily news system "UNL Today", increasing our visibility across UNL.

2. School needs to be more flexible in the apportionment of FTE. (Section VIII, Page 20)

Response: The School's leadership cannot make changes in the apportionment of FTE unilaterally. All changes in apportionment must be negotiated with IANR and the College of Arts and Sciences administration.

ACTION: SNR administration will continue to work with IANR to better apportion the distribution of FTE between research, teaching, and extension/outreach, such as the method used within CAS. An analysis of FTE distribution and course offerings is in progress to determine if our teaching FTE can be allocated more strategically to address some of the unit's teaching concerns.

2015 OUTCOME: Re-allocation of FTE remains difficult; see External Challenges section of main document.

3. FTE distribution is out of balance between faculty areas in terms of teaching. (Section IV, Page 8)

Response: We acknowledge that the FTE distribution in SNR is out of balance between research, extension, and teaching and also between the various faculty areas specifically related to teaching. The current distribution was inherited from the various departments/units that were consolidated into the School. For example, only Applied Ecology and Geography have a critical teaching mass that supports a significant number of majors and generates large student credit hours. However, it should be noted that the teaching FTE in applied ecology has diminished significantly in recent years as a result of retirements while enrollments in Applied Ecology courses and the number of undergraduate

majors have increased dramatically. Also, the ability to meet the future teaching demands in Geography is of concern because of the number of faculty at or beyond the retirement-eligible age.

Therefore, it is essential to maintain and enhance teaching FTE in these two programs while building student credit hour production and majors in other faculty areas in SNR. The shortage of teaching FTE in applied climate science, water, and GIScience, among others, is particularly glaring and continues to hinder development of new majors and courses.

**ACTIONS:** We are attempting to address these teaching-related issues in several ways.

First, we are increasing the teaching FTE in some new faculty positions where there is budget flexibility to do so. However, given the current budget climate, this approach will not allow us to significantly address this problem in an expeditious manner. Second, we are pursuing opportunities to create a Professor of Practice position with a significant teaching assignment to specifically address the teaching and advising overloads that exist in applied ecology courses. Third, the Applied Ecology faculty are looking at options to restructure the Fisheries and Wildlife major to reflect their ability to support that major at its current size. This may involve reducing the number of courses with labs and reducing the number of field trips associated with some courses. Fourth, through an analysis of course offerings and course enrollments, we are identifying courses that could be taught with less frequency or deleted from SNR course offerings because of low enrollment. The outcome of this analysis may allow FTE to be redirected to other courses or, potentially, to faculty in other faculty areas. Fifth, we are trying to identify other sources of revenue that would provide SNR with the opportunity to hire part-time lecturers (as is done in Geography) or to buy out a portion of non-tenure track faculty on external funds that would allow them to teach courses in SNR. Finally, we are asking faculty with teaching FTE who don't teach at their FTE level to consider a temporary release from teaching and corresponding increase in research or extension or to consider teaching an additional course. Each of these options present significant challenges to the unit and UNL administration.

**2015 OUTCOME:** The distribution of FTE within SNR remains skewed towards research at 32.34 FTE research (down from 36.94), 16.44 FTE Teaching (up from 15.91), and 5.67 Extension/Outreach (up from 5.1). Overall FTE declined from 57.95 in 2009 to 56.94 in 2015. This includes the addition of two professors of practice (Dr. Lisa Penisi and Dennis Ferraro) whose teaching contributes to environmental students and the Fisheries and Wildlife major. Growth in the Fisheries and Wildlife major has leveled off, in part due to the implementation of a minimum GPA of 2.5 for those students. The primary difficulty with reallocating teaching FTE from areas with few students or faculty that do not teach in the classroom is that their expertise and background do not match with areas with high teaching demand.

4. Enhance flexibility of teaching, research, and extension apportionment to meet the teaching obligations of SNR. (Section V, Page 11)

**Response:** This issue is well recognized by SNR faculty. Teaching FTE is disproportionate across faculty areas/disciplines. This is not an issue that SNR administration can address without a strong commitment/partnership between IANR administration, CAS administration, and SNR to add new lines or redirect lines as retirements occur.

**ACTION:** We will continue to explore each of the options stated in #3 above to help find a solution to this issue. We will continue to work with IANR and CAS administration to address this issue.

**2015 OUTCOMES:** see #2 and #3.

5. Clarify distinction between scholarly service and extension. Define scholarly service in research, teaching, and extension. (Section V, Page 11)

Response: Scholarly service is primarily associated with faculty research appointments, and in a few instances, extension appointments in IANR, not teaching. It is a subset of research or extension, and is included only in positions in which it is applicable. As such, it is difficult to derive a single definition. In general terms, the goal of scholarly service is to provide expertise, service, or support to federal, state, and local government and educational agencies, industry, the press, the general public, and extension educators. Scholarly service also includes giving presentations, participating in training or workshops, evaluating, interpreting, describing data, preparing reports, and providing options for decision makers to consider. It may also include the development of programs for local and state agencies and non-profits and working collaboratively to deliver information/materials, responding to questions, participating in outreach activities, and providing instructional and/or educational support.

ACTION: To better focus our scholarly service efforts, we have attempted to define our outreach program holistically in terms of programs in extension, survey, and scholarly service since all are focused on serving the needs of clientele. The clientele served by these programs are often different. We will continue to follow this approach.

2015 OUTCOME: IANR deans recently made the decision that faculty position descriptions cannot include "Scholarly Service" language, so if a position currently has it included, it will be revised/removed. Survey positions and NDMC positions have historically had the highest percentage of scholarly service (research in NDMC and research or extension in CSD) because it's either a part of their legislative mandate (Survey) or their grant requires it (NDMC). This primarily impacts Nontenure-track faculty and a few tenured/tenure-track.

6. Current & Emerging issues provide structure for collaborative questions and proposals; convert to implementable programs and incorporate Teaching, Research, and Extension into all issues. (Section III, Page 5)

Response: The current and emerging issues identified by SNR faculty are at early stages of implementation. Our intent has always been to use them as a platform for action, integrating across disciplines. Teaching, research, and extension are elements of each issue. The goal of issue-based strategic planning is to focus the organization's efforts around key themes or goals. In the case of our unit, which has such significant disciplinary diversity, these themes can be helpful in capturing cross-disciplinary linkages that will foster interdepartmental collaborations. The greatest challenge with this approach in SNR is to bring the scientific expertise that exists in the unit together to address each of these issues in a collaborative environment. The identification of faculty areas in the spring of 2009 is one mechanism being used to foster this collaboration; since that time, faculty have chosen colleagues in up to three faculty areas as their collaborating partners. Thus, integration across disciplines has been initiated. Our goal over the next five years is to use the faculty areas and current and emerging issues as a foundation to facilitate collaboration.

ACTION: As part of our annual unit review process, we will establish goals and action items that relate to the current and emerging issues.

2015 OUTCOMES: no additional goals and action items were established by the faculty related to the emerging issues.

7. SNR external advisory committee should meet regularly with water faculty, not just the director. (Section III, Page 6)

Response: SNR's External Advisory Committee can be used more effectively in planning and program development. This committee was reconfigured in 2007 following the appointment of a new SNR director.

ACTION: The suggestion for the external advisory committee to meet with water faculty and the director is an excellent one, but we feel that faculty from all faculty areas should be invited to attend these sessions. We will strive to implement this approach; however, scheduling meetings with members of the committee continues to be a challenge. The mission of the external advisory committee is currently being redefined through an active dialog with members of the committee and with SNR faculty.

We would also add that major components or elements of SNR also interact with and solicit input from clientele through a number of other mechanisms. This would include the significant interactions of SNR-based centers, the Coop Unit, and other groups with clientele. SNR faculty are also fully engaged with other groups such as the Izaak Walton League, Nebraska Well Drillers Association, and the Natural Resource Districts. Given the size of the unit, many active avenues provide for significant interactions with clientele. The External Advisory Committee is only one of these avenues.

2015 OUTCOMES: The External Advisory Committee has not met since the review in 2009, primarily due to constraints in scheduling. One of our strategic actions going forward is to re-establish this committee and also to improve our tracking of other external stakeholders.

8. Suggestion boxes and School newsletter. (Section IV, Page 9)

Response: We have previously had in place both external and internal SNR newsletters, but they were not highly valued or read by most members of the faculty and staff or by our clientele. Thus, they were discontinued. Currently, communication in SNR is facilitated by the director's monthly newsletter, through monthly faculty and staff meetings, through email correspondence, through spring and fall semester town hall meetings, and through the unit's website. SNR events are advertised to all employees and students through an events calendar.

ACTION: A formal survey of SNR faculty and staff did not indicate a preference for suggestion boxes as a means of improving communication. We will strive to implement other methods to improve communications once the results of the communication survey are finalized.

2015 OUTCOME: A virtual suggestion box was implemented on the website. This was replaced by a generic comment box during the last website redesign. The comment box receives very little internal traffic (Webmaster Mark Mesarch, 7/24/2015).

9. Space evaluation needed, more efficient use of space. (Section VI, Page 19)

ACTION: New space allocation and retention policies are under development for office, laboratory, and storage space, as well as graduate student space. We are also examining the possible acquisition of space in other facilities on East Campus in support of some SNR programs and reallocating space accordingly in Hardin Hall. The expected long-term growth of SNR programs will continue to stress the capacity of our current Hardin Hall facility.

Acquiring additional space in Hardin Hall would be the optimum solution. Otherwise, the synergy created by moving almost the entire unit into Hardin Hall in 2006 will be negated as SNR's programs once again become scattered across campus.

We will continue to work with the NU Foundation on the identification of a donor as part of the recently initiated capital campaign to construct an addition for Hardin Hall in order to accommodate the projected growth of the unit and to incorporate the laboratories of Steve Comfort and Pat Shea and the Water Sciences Laboratory under the direction of Dan Snow. It is disadvantageous to the unit to have these facilities at other campus locations.

2015 OUTCOMES: No additional space has been developed within Hardin Hall. New facilities were developed for water science laboratories and the Nebraska Herpetology Lab in buildings on the north side of East campus. State Geological Survey records were reduced and relocated to another building; which allowed us to create a wet lab and a graduate student office for 23 students. Allocation policies for office, classroom and laboratory space are in place and operating without issues.

10. Safety issues expressed by students. (Section VI, Page 19)

ACTION: A walk-through of Hardin Hall has been conducted and recommendations have been suggested to administration to address safety concerns. We have solicited estimates from Facilities Management to implement these safety improvements and the IANR Facilities Coordinator has requested funding from the IANR Vice Chancellor in order to make these required changes.

2015 OUTCOMES: Added hand-rails and lighting in the auditorium, added windowed doorways to stairwells, created student meeting area with outlets for them to plug in electronic devices,

11. Evaluate metrics for extension, outreach, and survey activities. (Section V, Page 12)

ACTION: The SNR director has asked the leadership of the unit's extension, outreach, and survey activities to further examine the metrics in each of these areas in association with the appropriate faculty.

Evaluation metrics already exist through the extension program as well as for the survey program in association with the annual report of accomplishments that all faculty in SNR complete annually. These metrics focus on the impact of each faculty member's activities on inducing behavioral change of clientele. The contact between faculty and clientele can and does occur through a wide array of communication channels.

2015 OUTCOME: No new metrics were identified; metrics collected for individual faculty by IANR Extension metrics are not made available for planning at the unit level.

12. Develop a forward looking model for extension in SNR. (Section V, Page 12)

Response: This recommendation seems to relate to our attempts over the past year to join the activities of extension, survey, and scholarly service and relate to extension action teams. With SNR's overall small extension apportionment, relative to research and teaching, our approach has been to integrate across extension, scholarly service, and survey. The recent identification of Spires of Excellence by IANR and Extension offer greater opportunities for SNR faculty to be engaged in the climate, water, and environment spire. However, we are concerned that this Spire in Extension has been further defined into two components, community and agriculture, while apparently excluding natural resources. SNR faculty with extension and survey/extension appointment have typically had trouble linking with the Action Teams that exist in Extension.



**ACTION:** SNR will strive to develop a strong Extension Affiliates program. We will work with the Dean of Extension to foster greater interactions with extension educators/specialists in areas of climate science, water use and management, and other areas as appropriate. SNR will also engage extension educators and specialists in other IANR departments and at the Research and Extension Centers as we strengthen our Extension program.

SNR will also renew its efforts to engage with the Extension Action Teams, although there will need to be some flexibility demonstrated by these teams to enable SNR's Extension faculty to be fully engaged. It would be helpful if an additional action team could be developed which would better fit the interests and expertise of SNR faculty in addressing clientele needs across the full spectrum of Extension issues in agriculture and natural resources.

**2015 OUTCOMES:** Extension Action Teams have been replaced with a new focus on identifying significant Issues where extension faculty and staff can demonstrate a change in attitudes within five years. Our extension faculty continue to work on engaging with Nebraska Extension to identify Issues where SNR's expertise can play a role in changing public attitudes.

13. Take greater advantage of stakeholders, state and federal agencies, etc.—increase the engagement of these groups in SNR programs. (Section V, Page 12)

**ACTION:** SNR will plan a faculty retreat/meeting during the 2010-11 academic year to discuss further engagement of these groups. This has been done in the past, but stakeholders need to be re-engaged in discussion since the leadership of many of these agencies/organizations has changed in recent years.

**2015 OUTCOMES:** See #7. We also engaged with faculty during the past spring to begin the process of identifying stakeholders with mixed success (see Appendix I). Some groups within SNR (e.g. NDMC, HPRCC, and Coop Unit) do a good job of tracking stakeholders.

14. Survey programs—degraded in recent years; replace 2-3 senior people who will be retiring with others. (Section V, Page 13)

**ACTIONS:** Plans are underway to create a partnership between UNL and other groups such as NRDs to share funding for key technician positions to provide improved service to clientele. Ability to replace senior faculty members with other faculty will depend on support from IANR administration and budgetary constraints. We feel that the appointment of competent M.S.-level technicians will allow CSD to better meet the needs of clientele. However, in shifting the emphasis from faculty positions to technician-level positions, we are creating a far different model for survey than has existed in the past. We will also identify other survey entities in other states that have experienced similar trends and consider the possibility of bringing in a small team of external experts to provide recommendations on future directions.

**2015 Outcomes:** The shift from faculty to managerial professional positions is well underway. See the CSD section of the current report for recent history and future plans for CSD.

15. Questions to be addressed—(Section V, Page 14)

1. What does the State of Nebraska lose if they don't have a CSD?
2. What should a CSD be doing for Nebraska if it were properly supported?

Response: A considerable amount of information is currently available on the needs of survey clientele in the state. This information was gathered through a recent survey of NRD personnel.

ACTION: The CSD will use this information and gather other information, as necessary, to prepare a white paper that will address the two questions raised by the review team.

It is important to note that legal mandates exist by state statute for the continued existence of CSD, including the continued maintenance of data bases on the state's geology, soils, and water resources.

ACTION: We continue to work with IANR administration and stakeholders on how to meet these requirements given budgetary and other constraints (e.g., university priorities).

2015 OUTCOMES: The white paper was prepared, and forms the basis for the CSD section of this report.

## **FACULTY AREA/DEGREE PROGRAM CONCERNS**

16. The faculty has substantial expertise in climate variability but some limitations in capacity to deal with climate change. SNR should focus on climate variability first as a topical area of investigation while building capacity in climate change science. (Section III, Page 5)

Response: The current capacity of the Applied Climate Science (ACS) faculty area is greatest in climate variability, but significant expertise in climate change exists within the group as well. However, SNR's strength in climate variability and change should not be judged solely by faculty in the ACS faculty area. Addressing the issue of climate variability and change will draw on expertise that exists throughout the unit (see the response above). SNR also intends to be a catalyst in both climate variability and change research and education across UNL. Substantial efforts have been directed at climate risk and fundamentals of surface-atmosphere interactions in a highly variable climate.

ACTIONS: We will build our capacity in climate change science. This will include further enhancement of regional climate modeling and examination of land use strategies to assess "best practices" in future climate scenarios. In addition, initiatives will be developed to link the results of this basic research with practical applications and stakeholders, such as the Summer Institute for Climate Change starting in May 2010, which will emphasize our unique connections with the U.S. Great Plains and target an audience of extension educators, state and federal agency personnel, and NRD staff. We have recently hired an extension educator who will enhance the SNR effort on outreach and education in climate variability and change. The Institute's program is engaging faculty from SNR, Animal Science, Biological Systems Engineering (BSE), Agricultural Economics, and Agronomy and Horticulture.

We are also aware of the importance of SNR faculty and staff to work with IANR faculty in other units, especially Animal Science, Agronomy and Horticulture, and BSE, on issues associated with climate change. Although there may be a perception that interactions with these departments have not been very significant over the last decade or so, the fact is that there have been significant interactions between SNR faculty and faculty in these units, and these interactions continue. In addition, there have been long-standing interactions with faculty in these departments prior to the formation of SNR. We will continue to pursue opportunities to engage with faculty from these and other units in areas of research, extension, and teaching.

Recent and pending collaborations between the Applied Climate Science faculty with faculty in other IANR departments are:

Steve Hu and Terry Mader for the current AFRI call and on two other projects over the last 8 years on animal production and reproduction.

Mike Hayes, Bob Oglesby, Ed Harvey, and Tala Awada were funded on the recent IANR Strategic Investment grant with Lilyan Fulginiti as the lead PI, “Forty-first Parallel Agro-Ecosystem Sustainability and Productivity.”

Ya Ding and Tsegaye Tadesse with Karina Schoengold on a project on climate variability and farm-level economics.

NDMC Risk Management Agency projects with Jerry Volesky, Pat Reece, and Matt Stockton as collaborators.

Martha Shulski and Cody Knutson are working on an AFRI proposal with faculty and scientists from eight other states on developing useful and useable climate information and training for corn producers in the north central region.

Ken Hubbard is leading efforts to develop an AFRI proposal that involves faculty from Agronomy and Horticulture, Educational Psychology, Public Policy Center, Geosciences, and collaborators from other universities and national laboratories. The focus of the proposal is “Predicting Managed Ecosystem Responses to Climate Change: Creating and Validating the Coupled Models and Ensuring Their Use in Informed Decision-making.”

Shashi Verma’s Carbon Sequestration Project through DOE with Tim Arkebauer, Ken Cassman, Dan Walters (Agronomy and Horticulture), and Adam Liska (BSE).

Shashi Verma, NSF Water Sustainability and Climate Proposal (pending) with Tim Arkebauer (Agronomy and Horticulture) and Derrel Martin (BSE).

AFRI Carbon Sequestration Proposal (pending) with Shashi Verma and Tim Arkebauer, Ken Cassman, and Dan Walters (Agronomy and Horticulture) and Adam Liska (BSE).

AFRI Proposal on climate change related to beef cattle (pending) involving Shashi Verma, Andy Suyker (SNR) and Tim Arkebauer, Ken Cassman (Agronomy and Horticulture), Galen Erickson and Terry Klopfenstein (Animal Science), and Adam Liska and Richard Stowell (BSE).

The recent addition of Tapan Pathak, Extension Educator in Climate Change/Variability, is yet another example of how we intend to further collaborate with other departments and the Research and Extension Centers on climate variability and change issues. Although Tapan is in the early stages of developing his extension program, significant opportunities exist to engage faculty from other units and the Research and Extension Centers in this program.

2015 OUTCOMES: Although Tapan Pathak’s program was very successful, he left UNL in 2014 to pursue opportunities elsewhere. Several senior faculty in Applied Climate Science are presently retiring or near retirement, and there are several new positions pending (see main document).

17. The SNR must further define the role of the School in climate variability and change.

Does the School want to focus primarily on drought, or does it want to be a player in the broader climate change science that addresses adaptation, mitigation, modeling, agriculture, and climate change linkages among others? (Section III, Page 5)

Response: The projection of higher temperatures and highly variable precipitation in the future and subsequently the possible increase in drought duration and severity justifies continued efforts to understand drought onset, impacts, mitigation, and policy.

ACTIONS: We will continue a strong focus on drought; drought serves as a complex cross-disciplinary issue and therefore serves as a great model for many adaptation strategies related to climate variability and change. In addition, we will continue to be an active player in climate change science including surface-atmosphere processes and regional scale climate change impacts. As mentioned above, we will continue to focus on regional climate modeling, which was highlighted in recent IPCC reports. To help bridge the gap between basic and applied climate science, we propose two major initiatives, each requiring additional investments in faculty and staff positions, to determine responses of ecosystems and economies to predicted climate change. Each of these efforts will provide an effective mechanism to collaborate with other IANR departments and work toward the recruitment of new faculty with the potential of joint appointments.

Ecosystem modeling: This initiative will help quantify interactions between biological and physical processes, including abiotic and biotic stresses of managed and unmanaged ecosystems important to Nebraska. This will be a collaborative effort between the SNR Applied Ecology and Applied Climate Science faculty areas and will serve to further engage faculty in BSE, Plant Pathology, and Agronomy and Horticulture.

Environmental economic modeling: This initiative will focus on developing an integrated ecosystem-economic modeling approach to analyze the impacts of climate change on economies associated with ecosystems important to Nebraska. This will be a collaborative effort between SNR (Applied Climate Science and Applied Ecology) and the Department of Agricultural Economics. Currently, IANR does not have a faculty member with expertise in environmental and economic modeling. It would be expected that this faculty member would have a joint appointment between SNR and Agricultural Economics.

2015 OUTCOMES: Neither of these two faculty positions were pursued further.

18. Opportunities exist to develop stronger collaborations in natural resources science with the meteorology program in the Geosciences Department (name changed to Department of Earth and Atmospheric Sciences). Faculty should increase their collaborative efforts in areas such as weather and climate modeling. (Section III, Page 6)

Response: Substantial collaboration already exists and is increasing because of joint appointments and administrative cooperation. We will continue to strengthen our collaborations with the Department of Earth and Atmospheric Sciences.

ACTIONS: We propose to develop an umbrella program of atmospheric sciences with the Department of Earth and Atmospheric Sciences to help provide visibility to UNL's educational and research programs in applied climate and atmospheric science. This umbrella program has been proposed for some time but a more positive administrative environment will likely facilitate greater progress in achieving this goal at this time. UNL students in the umbrella program will benefit from the coordination of both undergraduate tracks in atmospheric sciences: meteorology-climatology (through the College of Arts and Sciences) and applied climate science (through the College of Agricultural Sciences and Natural Resources). SNR will be developing a proposal in the fall of 2010 for a new major in Applied Climate Science. Support for this new program has been received from the Department of Earth and Atmospheric Science. While we pursue approval for this major, we will

promote an umbrella atmospheric sciences program. Applied Climate Science faculty have also proposed development of a minor in Climate Change Studies to serve majors in several colleges (e.g., Journalism, Business, and Education and Human Sciences).

Collaborative research efforts with colleagues across campus are in progress or are planned. Examples include (a) the use of surface flux measurements to improve the ability of regional climate models to accurately simulate these fluxes, (b) the use of vadose zone measurements to explain the interaction between surface and groundwater and (c) employing global and regional climate models to decipher the physical processes responsible for droughts and floods in the central United States.

Efforts to bring about more collaborative efforts in water science between SNR and the Department of Earth and Atmospheric Science have recently been initiated by Drs. Wilhite and Watkins. A faculty committee has been formed to develop an overarching graduate program in water science and to collaborate more fully in a joint water science seminar series.

2015 Outcomes: The new Applied Climate Science major was developed and is available to students now. No new graduate programs or seminar series were developed.

19. Little engagement in water management within SNR. (Section III, Page 6)

Response: Because of increased demands for diminishing water resources, efficient management of water in the agriculture sector is a critical need. Other competing interests for water resources, such as urban and environmental sectors, are also critically important aspects for water management, especially from the perspective of the School of Natural Resources. As indicated by the review team, most water use is in the agricultural sector, and the School will continue to provide expertise to help quantify and conserve this resource to the extent that internal FTE resources are available. However, SNR faculty and staff are also committed to the wise use and stewardship of water for uses other than agriculture.

Additional examples of existing efforts directed toward improved water management include programs and projects in:

Limnological surface energy and water balance studies directed at quantifying the relationship between climate variability, lake evaporation, and water levels;

Evaluation of invasive riparian vegetation and the impacts of its removal on the regional water balance, water quality, and stream ecology;

Statistical and modeling approaches for understanding uncertainty in water and adaptive management;

Expertise in ecological resilience theory and new adaptive management specializations in the M.S. and Ph.D. programs. A recently awarded NSF IGERT adaptive management grant deals directly with over-appropriated watersheds on the Great Plains.

The existing UNL program in agricultural water resources management (highlighted on the [water.unl.edu](http://water.unl.edu) website) includes several SNR faculty, and demonstrated collaborations with Agronomy and Horticulture, Biological Systems Engineering, and Civil Engineering.

ACTIONS: SNR will continue to contribute to advancing integrated water resource management by identifying areas with gaps in information required for balanced use and protection of water resources and working across disciplines to fill these gaps. The undergraduate water science program has been



enhanced recently with the development of a series of options for students, the appointment of a new degree program coordinator, and the appointment of curriculum committee members from SNR and the departments of Earth and Atmospheric Sciences and BSE. Efforts are also being directed within SNR to engage water faculty in the Departments of Earth and Atmospheric Sciences, BSE, and Civil Engineering in more cross-campus collaboration on water research and education programs. The recent hire of a watershed hydrologist through the WRRI with his tenure home in SNR will further enhance collaborative efforts with other water-related units. The pending hire of an aquatic ecologist/limnologist jointly funded by the WRRI and IANR will provide yet another opportunity for cross-campus linkages in water use and management.

There are efforts to become engaged with stakeholders, but often we find the gap lies between our own resources and the needs and expectations of stakeholders. Future goals and directions related to agricultural water resources management in SNR can include, where appropriate, increased collaboration to better understand and integrate water availability with soil fertility, pest management, irrigation systems, waste treatment, and tillage practices. Consideration of increased FTE extension effort for future faculty positions, such as those directed at providing water resources information and understanding how this information is used, will be helpful in meeting the needs of stakeholders.

2015 OUTCOMES: There has been significant change within water sciences at UNL, most notably with the shift of the Water Center from SNR to the Daugherty Water for Food Institute. SNR does have a full time Extension Specialist in water quality management (Katie Pekarek), hired in 2013.

20. The water science program should be strengthened through better integration within SNR. Better engagement with stakeholders. (Section III, Page 6)

Response: The Review Team may be referring to either the Water Science undergraduate major (a multi-department program) or to both the undergraduate and graduate water science educational program.

The undergraduate Water Science major was recently revised, adding several new, updated areas of specialization, and formalizing the internship/senior thesis component of the major. All advising responsibilities were also transferred to faculty within SNR, for greater program continuity and identity.

ACTIONS: Teaching appointments in the SNR Water faculty area have increased since the 5-year review, and Ed Harvey has assumed the role of degree program coordinator, which includes coordinating the Water Science Curriculum Committee, as noted above. Courses and course requirements in Water Sciences will continue to be strengthened and integrated since responsibility for maintaining this degree program now lies in SNR. The graduate specialization will require greater attention as well, including a more integrated/coordinated recruitment effort (this has been addressed to some extent via formation of a new UNL water portal, <http://water.unl.edu>), additional graduate-level-only water courses, more cross-listing of water courses across colleges, and more team-teaching of selected water courses. The recent hire of a watershed hydrologist and recruitment of an aquatic ecologist/limnologist will have significant involvement in undergraduate and graduate teaching. In addition, new distance-learning based watershed programs are being developed to further extend UNL's outreach efforts.

UNL and SNR's capacity for interdisciplinary water research clearly benefited from the Water Resources Research Initiative (WRRI). Unfortunately, undergraduate education was not a part of the charge of the WRRI when it was originally formulated.

Improved integration of the campus-wide water science program is now being revisited as we make new hires through the WRRI to replace faculty that have left UNL for other job opportunities. We have also addressed this issue by including recent WRRI hires on the Water Science Curriculum Committee in order to better engage them in water curriculum discussions. In addition, a committee composed of faculty from SNR and the Department of Earth and Atmospheric Sciences is directing their efforts at a campus-wide graduate water program. Our strategy is to bring this proposal to the Graduate College during the 2010-2011 academic year.

SNR's outreach efforts for stakeholders have been conducted through the Water Center, drought and climate-related outreach/education programs, climate symposia, and stakeholder-related education efforts. Water Center outreach to stakeholders has increased dramatically in the past five years, including the formation of a new external advisory group (Water Resources Advisory Panel) to provide direct input to UNL administration on all UNL matters related to water and the initiation of several large and ongoing conferences and/or seminar series dedicated to water issues (e.g., the annual UNL Water Law, Policy, and Science Conference), as well as the Platte River Symposium. The Water Center conducts a summer water tour each year, as well as other major outreach/stakeholder activities such as a spring water seminar series that is organized jointly with SNR and widely promoted to the public. The National Drought Mitigation Center (NDMC) provides outreach with stakeholders across the state on water-related issues, with recent projects funded by the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS) which have focused on the North Platte and Republican River basins. The NDMC and the Water Center are also involved in the Nebraska Children's Groundwater Festival and Lancaster County's Earth Wellness Festival. An innovative mobile water resources education system, The WATER MACHINE, has just been deployed to provide a multimedia active-learning water resource tool for engaging a wide range of audiences at events across the state. These examples and others demonstrate continued enhancement of the overall Water Science outreach program in SNR.

2015 OUTCOMES: See #19. The Environmental Science Mission Area has adopted the Water Science major as a core priority (see the Environmental Science section of this report), which should enhance the integration of that program with other SNR activities.

21. Applied Ecology program should be used as a model; limit number of students in the undergraduate program. (Section III, Page 6)

Response: SNR is trying to develop critical mass in teaching in other faculty areas, but this is a challenge given administrative and budgetary constraints. Success of the applied ecology faculty area is due to its long history of teaching and critical mass of teaching FTE, although the teaching FTE in this faculty area has diminished in recent years because of retirements.

ACTIONS: With the potential for a number of faculty retirements in all SNR faculty areas, we propose increased teaching FTE in all faculty positions as retirements occur. Capping enrollment in Fisheries and Wildlife should only be explored as a last resort. Hiring a wetland ecologist, which has been proposed, would ease pressure on teaching and advising in both the applied ecology and water areas.

Recent growth in the Fisheries and Wildlife major, now CASNR's second largest major, reflects the quality of the program and the efforts of faculty and staff. Six faculty within SNR's Applied Ecology group have disciplinary training in zoology, fisheries, or wildlife. These faculty are the backbone of the Fisheries and Wildlife major and currently teach 17 courses (12 annually, 5 in alternate years) necessary for the program at the undergraduate and graduate level. This list does not include forestry-

related courses or introductory courses such as AGRI/NRES103 and NRES220. Although budgeted at a combined 2.20 teaching FTE, these six faculty have a combined calculated teaching FTE (CASNR formula) of 3.40. They teach approximately 1400 student credit hours per year. This already heavy teaching load is a significant constraint limiting both further expansion of the Fisheries and Wildlife major and increased enrollments in non-major service courses taught by Fisheries and Wildlife faculty. The non-zoologist Applied Ecology faculty (e.g., T. Awada, J. Brandle, D. Wedin) cannot pick up more of the Fisheries and Wildlife teaching. Their teaching FTE also exceeds their budgeted FTE with classes in forestry, plant science, introductory ecology, and AGRI/NRES103. The recent GIScience hire and a proposed Wetland Ecology hire will allow SNR to teach critical courses needed by many or all natural resources students, but these new faculty cannot cover the disciplinary courses necessary to support the Fisheries and Wildlife program. In summary, SNR and the Applied Ecology faculty are proud of the Fisheries and Wildlife major and the success that it has attained. However, we agree with the review team that the major is near or at capacity. As noted earlier, the Applied Ecology faculty are in the process of identifying options for maintaining the Fisheries and Wildlife major without a significant increase in teaching FTE.

Although the Geography program was not specifically included in this review document, it is also imperative that SNR maintains existing teaching critical mass in this program. Currently, the Geography program has 40 undergraduate majors and 30 graduate students, and teaches a high number of courses that are part of the general education (ACE) requirements for many majors across campus. Approximately 1300 UNL students enroll in Geography courses each semester. A continuing challenge for Geography over the next several years will be allocation of sufficient faculty FTE to meet growing student enrollments, especially in high-demand areas such as human-environment interaction and GIScience. This challenge will be especially difficult because of the number of faculty (estimated at 6 FTE) who have attained, or will soon be reaching, retirement-eligible age.

2015 OUTCOMES: We established a minimum GPA requirement for the Fisheries and Wildlife major in 2012, and growth in that major has slowed. Nonetheless, two retirements this year and another faculty departure have left the program again scrambling to deliver required courses. New pending faculty positions will address these gaps. Geography/GIScience is facing a similar crisis of expertise due to retirements and departures of faculty for other career opportunities.

22. Human-Environment Interaction should be a component of all research areas. Expand to address these intellectual themes. (Section III, Pages 6-7)

Response: This recommendation will be possible only through a combination of adding tenure-track faculty in human dimensions (HD) and enlisting the participation of other human dimension/social science faculty in HD programs and projects. All but one of the current HD faculty are non-tenure track and/or grant funded. When the HD program was initiated in SNR in the late 1990s, it was accomplished by developing collaborations with faculty in sociology, community and regional planning, political science, law, and agricultural economics. Some of these collaborations continue, but several have been interrupted through retirement or the departure of faculty to other institutions.

ACTIONS: Through the leadership of the HD faculty in SNR, the unit will once again strive to enlist the collaboration of faculty from other departments in the Colleges of Arts and Science, Architecture, Law, and IANR. Recent faculty hires in several departments provide the opportunity to create a campus-wide program in this field of study. However, it will not address the need of developing core courses in SNR in support of the HD graduate specializations at the M.S. and Ph.D. levels. Without

increased teaching FTE in HD in SNR either through the hiring of new faculty, joint appointments, or the buying out of a portion of a faculty member's time currently funded on external funds, new course offerings will not be possible. HD has become a thrust of all faculty areas in SNR and is a component of each of the current and emerging issues.

We will continue to explore all available pathways to hire at least one HD faculty member, including a joint hire between IANR and CAS, with a significant teaching and research FTE. A contingency plan will be developed in order to respond to opportunities to fill some Geography positions with faculty with an emphasis in human-environment interaction as retirements occur in these Geography faculty lines. Future research collaborations in human dimensions will continue to be explored within SNR, IANR, and the entire campus. Seed grants will be completed to explore interdisciplinary approaches to graduate student education with regard to human-environment interaction.

2015 OUTCOMES: One professor of practice position with HD expertise was hired (Dr. Lisa Penisi), but this simply ensured that her expertise was not lost to the University as she was already on the faculty in another unit. We hired a tenure track HD faculty this year (Dr. Chris Chizinski).

23. Natural resources and environmental science education is not an emerging issue but an essential component of SNR's mission. (Section III, Page 7)

Response: We agree with the review team's comments that natural resources and environmental science education is an essential component of SNR's mission. SNR sees it also as an emerging and growing issue because there is substantial evidence that misconceptions and misunderstandings exist among people of all ages about the potential causes, consequences, and solutions related to our most current and future serious global environmental problems. SNR needs to enhance its leadership role in providing all UNL students, not only those majoring in natural and environmental science fields, with opportunities to learn and improve their understanding of the environment and the sustainable use of natural resources.

We will contribute to transformative change in the individual and collective mindset of students at the University about the environment in which they live and the environment upon which they depend. However, this effort will require additional faculty to be successful.

ACTION: We will initiate discussions with other groups at UNL, to develop and assess new approaches and teaching strategies that will improve student learning of science and its application to natural resources and the environment. We very much agree that SNR needs to choose a progressive view of education that goes beyond just transmitting information, to a view that education is about engaging and empowering people to become scientifically and environmentally literate.

2015 OUTCOMES: SNR faculty have increased efforts to participate in teaching across all Mission Areas, and the present report reflects our renewed focus on strengthening and refining our undergraduate and graduate curriculum areas.

24. GIS curriculum is strong, but oversubscribed. (Section III, Page 7)

Response: ACTIONS: In order to address the increasing demand for instruction in GIS, NRES 312 and GEOG/NRES 412/812 are now offered both spring and fall semesters. During 2010, NRES 312 will be modified to include separate lab sections. In order to meet demand for instruction in GPS, we have developed a new 2-credit course focused entirely on GPS applications. This course is also being offered both spring and fall semesters. The recent addition of Dr. Gene Guan to the faculty in

August 2009 has also enabled us to offer two new advanced courses in GIS. Demand for these courses has been strong.

Issues:

Dr. Ayse Irmak will teach NRES 312 each semester. ACTION: If demand continues to increase because of requirements for this course from natural resources and other majors, it may be necessary to engage a senior graduate student to serve as instructor for one term annually.

NRES 412/812 has been taught by Dr. Sunil Narumalani (fall) and Dr. James Merchant (spring). Dr. Narumalani became Associate Dean of Arts and Sciences in August 2009 and is no longer available to teach GIScience courses. In fall 2009 a senior graduate student taught the course. Dr. Gene Guan will teach GEOG/NRES 412/812 in fall 2010 and successive fall semesters; this, however, detracts from Dr. Guan's ability to offer other GIScience courses. ACTION: We need to explore other alternatives for teaching this course each fall semester.

The GPS course is currently being taught by a staff member. It would be desirable to have the course taught by a faculty member, although no qualified faculty member appears to be available at this time. ACTION: SNR will continue to provide support for the 2-credit-hour GPS course each semester as demand dictates.

The interest in GIS and GPS continues to grow across campus (e.g., in Community and Regional Planning, Geosciences, Computer Science and Engineering, Biological Systems Engineering, Agronomy and Horticulture, UNL Libraries). ACTION: SNR will work with other units to address increasing demands for instruction, research, and outreach.

2015 OUTCOMES: Dr. Guan left UNL to pursue other career opportunities, and coupled with recent retirements and one faculty member passing away the GIS curriculum remains heavily over-subscribed relative to capacity. Pending faculty appointments should help with this situation.

25. Improve advising space on city campus for greater visibility of Geography program and improve the quality of office space for faculty affiliated with program. (Section IV, Page 8)

Response: The recent integration of Geography with the School of Natural Resources (SNR) has been, in almost all respects, very successful and beneficial to both units. However, one important issue remains unresolved. Until August 2008, Geography faculty and staff offices, as well as most classes, were located on City Campus. Although all Geography faculty have now relocated their offices and many classes to Hardin Hall, the long-term viability of the Geography undergraduate program requires that Geography continue to have a strong and visible presence on City Campus. During the fall 2009 term, for example, more than a dozen Geography classes and labs, enrolling some 660 students, were taught in classrooms on City Campus.

ACTIONS: In December 2009 Dr. James Merchant and Dr. Donald Wilhite met with Dean David Manderscheid and Associate Dean Greg Snow (College of Arts and Sciences) to discuss Geography space issues. A proposal to relocate Geography City Campus offices from Oldfather Hall to better and more visible space in either Brace Hall or Behlen Hall has been submitted. This proposal included a request for one additional office.

In early January 2010 Dean Snow and Dr. Paul Hanson toured the geography instructional laboratory in Morrill Hall. It was agreed that the lab needs significant renovation and enhancement. A meeting to discuss technical details and means to fund renovation was held in mid-January 2010. Also



discussed were concerns regarding access and egress from the laboratory in Morrill Hall, and a request has been made to Environmental Health and Safety to assess this situation. A proposal has been made to the College of Arts and Sciences requesting that Geography labs be taught in Brace or Behlen Hall and co-located with Geography office/advising space. This change would better serve students and the Geography program.

We believe that progress on these issues demonstrates the continuing commitment of both the College of Arts and Sciences and the College of Agricultural Sciences and Natural Resources to seek innovative, collaborative solutions to address needs of the SNR Geography degree program.

2015 OUTCOMES: Signage for Geography advising offices in Oldfather hall was improved. No other changes have been made. Teaching laboratory space in Morrill Hall remains out of date. It is possible that these labs will be moved to make space for the State Museum in Morrill Hall, but there are no commitments at this time.

26. Maintain strength of remote sensing program as faculty retire. (Section IV, Page 8)

Response: We agree that it is critically important for our strength in remote sensing to be maintained. However, maintaining the strength of SNR in other faculty areas is also of concern as more faculty reach retirement age. As the review team pointed out elsewhere in their report, the School also needs to increase gender and ethnic diversity in the unit.

ACTIONS: To address all of these concerns, we are making a concerted effort to attract greater gender and ethnic diversity into our applicant pool for faculty positions, as they get released. Recent examples are the watershed hydrologist and aquatic ecologist/limnologist positions. Given that SNR is a campus-wide program, we also plan to seek support from both IANR and the College of Arts and Sciences to fill high-priority positions, where appropriate. Given the interdisciplinary nature of SNR, it is imperative that new faculty have interdisciplinary interests that cut across the disciplines that exist in the unit while at the same time addressing issues of gender and ethnic diversity.

2015 OUTCOMES: Dr. Brian Wardlow was hired as a remote sensing scientist to help offset retirements, but this does not match recent losses from this area of expertise. See the CALMIT section of this report for more details. Both the watershed hydrologist and limnologist positions were filled, but both faculty have since left for other career opportunities.

27. Redefine the faculty areas—combine Geography with Human Dimensions and GIScience/Remote Sensing. (Section IV, Page 9)

Response: The six faculty areas within SNR were identified in 2008 after lengthy deliberations by SNR faculty. At that time the establishment of a separate Faculty of GIScience/Remote Sensing was rejected for two primary reasons:

GIScience and remote sensing are technologies that cut across all areas of SNR (e.g., water, applied ecology, geography, applied climate science), and CALMIT already provides opportunities for faculty with interests in the technologies to collaborate.

Although there has been no formal discussion of merging the Geography/GIScience and the Human Dimensions faculty areas, we do not believe this is warranted. Geography is adjusting to the transition into SNR, so we are opting to not pursue any changes at this time. We agree, however, that there are many opportunities to create synergy between the Geography/GIScience and the Human Dimensions faculty areas. Geographers have a long tradition of work in human-environment

interaction, and several SNR geographers have selected the Human Dimensions faculty area as a secondary affiliation, and one geographer has selected the Human Dimensions faculty area as a primary affiliation. Moreover, the Geography degree program offers a number of courses that involve instruction in human dimensions of natural resources (e.g., GEOG 181 – Quality of Environment, GEOG 283 – Space, the Environment and You).

**ACTION:** The SNR faculty areas of Geography/GIScience and Human Dimensions will collaborate to develop a plan for further integration that will include the possible hiring of faculty that can contribute to both areas. However, we do not plan to merge these two faculty areas for the reasons mentioned above.

**2015 OUTCOMES:** In 2014 we further reorganized into four Mission Areas, including the recommended merger of Geography/GIScience. Human dimensions is considered an essential component of all four Mission Areas.

28. Student organizations based around a major or curriculum. (Section IV, Page 10)

**Response:** The development of student-based organizations in association with various majors is largely tied to the size of the major. Several student organizations exist, and we expect others will be formed in the future as the number of majors in climate science, water science, and other areas increases. The Range Club is quite active and Grassland Ecology and Management students are also quite active, winning national awards. We also have the Soil Judging Team and the Wildlife Club. Environmental Studies students are active in two organizations, the Environmental Resource Center and Ecology Now. There are two graduate student organizations in SNR, one engaging Natural Resource graduate students and one that serves the Geography undergraduate and graduate students.

**2015 OUTCOMES:** One new student organization was formed, a student chapter of the American Fisheries Society. Other majors remain too small to support their own student organizations.

29. Faculty should choose compelling problems that relate to Nebraska's geography, climate, geology and market. (Section IV, Page 10)

**Response:** Perhaps because of the organization of the review document or the way in which the review team's visit was structured, the focus of SNR's faculty on problems related to Nebraska's geography, climate, geology, and other areas was not specifically addressed.

**ACTION:** The faculty feels strongly that we have targeted many existing and emerging issues/problems in the state through our research, teaching, and outreach programs and will continue to do so. In addition, our faculty will continue to focus on issues of regional, national, and international significance.

30. Engage students, post-docs, and junior faculty in innovative, collaborative research. (Section V, Page 11)

**Response:** Junior faculty and post-docs are engaged in innovative, collaborative research associated with their appointments in SNR. SNR has a large number of faculty in faculty equivalent positions (post-docs, research assistant professors, geoscientists) that are primarily supported by external funding. Their research programs are directly tied to specific projects or the work of the various centers located in SNR. Students, both graduate and undergraduate, are actively engaged in research through their graduate programs, internships, or through the UCARE program.

31. Balance academic programs before exploring areas for growth. (Section V, Page 11)

Response: We fully agree with this approach and have no plans to develop new areas within the unit or to merge other programmatic areas into the unit. Obtaining greater balance in our academic programs is a high priority for the unit. Areas of growth will occur within the existing faculty areas as we attempt to embellish our capacity to address our current and emerging issues.

32. Combine [graduate] specializations rather than create new ones. (Section V, Page 11)

Response: ACTION: We are currently revisiting our specializations. It is likely that there will be some consolidation or elimination of existing specializations.

2015 OUTCOMES: We combined several MSc. Specializations in Wildlife Management, Fisheries, and others into a single “Applied Ecology” specialization to mirror the PhD specializations. Two new specializations were developed in Bio-atmospheric interactions and Climate Assessment and Impacts.

33. Create specializations in Geography to reflect breadth of field. (Section V, Page 11)

Response: Geography currently has three graduate specializations, but, because the Geography program was new to SNR and was not specifically reviewed, the review team was not provided information on these specializations.

(<http://www.unl.edu/gradstudies/prospective/programs/Geography.shtml>). The specializations are:

Environmental Geography (MA and PhD)

GIS, Cartography, and Remote Sensing (MA and PhD)

Community and Regional Planning (PhD only)

ACTION: The Geography faculty area will explore the potential advantages of adding additional specializations.

2015 OUTCOMES: Despite the response, there are in fact no formal specializations available to students in the Geography MSc. and PhD. Programs. The three areas listed are areas of strength among the faculty, but are not available as graduate specializations that would be recorded on a student’s degree or transcript.

## CENTERS/COOP UNIT

34. Coop Unit needs to engage more with other parts of university to increase multi- disciplinary systems approaches to natural resources issues. (Section III, Page 6)

Response: The three SNR faculty members who compose the Coop Unit strive to engage other SNR and university faculty in collaborative efforts where possible and appropriate. The Coop Unit recently (August 2009) received NSF-IGERT funding for a project that includes a lead PI from the Coop Unit and PIs from SNR, Computer Science and Engineering, Geosciences, and the Public Policy Center and collaborators from additional departments (including Agricultural Economics, Political Science, Biological Sciences, Sociology, and the College of Law), additional SNR faculty (including faculty from the Water Center), the U.S. Geological Survey, Emory University, and the International Institute for Applied Systems Analysis. Recent publications from Coop Unit Faculty from 2008 to present include more than 30 co-authors from a variety of disciplines and from UNL and other institutions. Their involvement helped formalize a graduate emphasis area in Adaptive Management, an approach to natural resource management that is by definition multi- disciplinary. The Coop Unit Faculty regularly incorporate other disciplines from within SNR, the University of Nebraska, and other

institutions into their research proposals, and are involved with several large multi-disciplinary proposals originating from the UNL Office of Sponsored Programs.

**ACTION:** The Coop Unit will continue to expand their collaborations as opportunities are developed or presented, and embrace interdisciplinary approaches to natural resource education, research, and management. The recently awarded NSF IGERT grant has faculty PIs from several departments, and the Coop Unit is recruiting Ph.D. students to be advised by these faculty members. The recent hire of a third scientist, providing full staffing to the Coop Unit for the first time, will provide opportunities for collaboration in the area of climate, ecology, and behavior.

**2015 OUTCOMES:** The Coop unit remains a research and graduate training powerhouse with extension collaborations within and without UNL.

35. Centers are partially integrated units in SNR suggestive of opportunistic rather than deliberate strategies of development. (Section VI, Page 15)

**Response:** One of the strengths of SNR is its centers. Each of the SNR centers has developed as a result of individual faculty initiatives or in response to federal initiatives. Admittedly, they have been opportunistic as a direct result of the success of a faculty member's program of excellence. It is also important to point out that these centers were developed before the formation of SNR. Each center is unique and adds significantly to the diversity of SNR programs and to our visibility at the state, regional, national, and international levels. Future centers will likely follow a similar course of development as opportunities arise.

Each of the centers has its own history, funding, and mission. The centers' missions, however, do not necessarily match the balance of research, teaching, and extension/outreach that SNR, as a UNL academic unit, must strive to achieve. The review team noted that balance in the Applied Ecology area. As we work toward that balance in areas such as climate or water, the challenge therefore is not to reinvent our centers by, for example, more fully integrating them into our teaching or outreach missions. Rather, we need to build from the strength and energy provided by the centers, and ensure that disciplinary areas have an identity and balanced approach in SNR independent of the centers.

**2015 OUTCOMES:** Not applicable.

36. CALMIT—SNR and UNL should provide some base funding in the form of extension personnel to enable a more complete integration with SNR's mission. (Section VI, Page 15)

**Excerpt of Review Team comments regarding CALMIT –** CALMIT maintains a robust soft-funded operation in the development, application, and delivery of geospatial technologies. This center has developed world-class capabilities in field-based remote sensing, including development and application of close-range and airborne multispectral devices and techniques for evaluating biophysical characteristics of plant communities.

**Response:** Geospatial data, and technologies such as geographic information systems (GIS) and remote sensing, are increasingly critical for managing our cities and rural lands and protecting our natural resources. Hundreds of geospatial datasets have been developed for Nebraska, many by SNR faculty, staff, and students working on grants and contracts. During the past 15 years, CALMIT has been successful in obtaining short-term external funding to provide Nebraskans with support and training in the acquisition and use of geospatial data (e.g., NebraskaView, the Consortium for the Application of Space Data to Education [CASDE] and NebraskaMAP). However, grant-funded

support is no longer sufficient to address the continuing and growing demands for geospatial data and assistance in the use of such data.

**ACTION:** During the next year, SNR will seek to partner with UNL Extension to acquire partial funding to establish within CALMIT a Nebraska Geospatial Extension Specialist position. The Geospatial Extension Specialist will be the principal point of contact for Nebraskans who require geospatial data on Nebraska's natural resources, provide training and assistance in use of tools such as GIS for analyzing such data, serve as the liaison between SNR and other agencies and organizations in the Nebraska GIS community, and provide leadership to establish policy and protocols for long-term archiving and online delivery of geospatial data produced by SNR faculty, staff, and students.

**2015 OUTCOMES:** no additional funding was obtained to support CALMIT, which remains largely soft-funded.

37. CALMIT should undergo an internal visioning exercise to evaluate and prioritize future directions. (Section VI, Page 15)

**Response:** During the next five years, several key CALMIT faculty are likely to either retire or significantly reduce their faculty appointments.

**ACTION:** In 2010, CALMIT faculty and staff will initiate a strategic planning process to identify ways in which SNR can maintain a robust research and instructional program in remote sensing and GIS.

**2015 OUTCOMES:** The predicted losses due to retirements have come to pass. Sadly, one other faculty member passed away in early 2015. Dr. Brian Wardlow was hired as the director of CALMIT, but this has not fully compensated for the loss of expertise. The CALMIT section of this report represents the outcome of a strategic planning process.

38. The Review Team recommends that the GPRC continue to refine the model to include land use change parameters and develop scenario-based outcomes for Nebraska's changing landscape from climate variability. (Section VI, Page 16)

Excerpt of Review Team comments regarding the GPRC - The GPRC has been a successful research endeavor that has focused its efforts on carbon dioxide fluxes in various ecosystems. It has been a good area for collaboration among faculty and between centers in the School. The inclusion of water vapor in its research objectives will further enhance the systems science approach to addressing complex variables in both the carbon and hydrologic cycles. The GPRC has also created a conceptual framework for future research that creates the transdisciplinary approach to addressing economic value of greenhouse gas sequestration.

**Response: ACTION:** GPRC personnel will explore opportunities to examine the effects of land use/land cover on the fluxes of carbon, water, and energy. SNR will also seek collaboration with regional climate modelers and ecosystem modelers to help develop information needed to assess impacts of land use/land cover and future climate.

It should also be noted that CALMIT and the NDMC have significant efforts underway to address issues related to land use and land cover change. We will explore new opportunities for collaboration between these centers as well as with other programs in SNR and beyond.



2015 OUTCOMES: The GPRC was entirely grant funded, and those funds were repurposed by the Federal Government leading to the closure of GPRC in 2010. Nonetheless, the Mead Carbon Sequestration sites (in operation since 2001) became an AmeriFlux Core Site, becoming part of a network measuring greenhouse gas/energy exchange in different ecosystems across the US. The Mead sites are the only irrigated agricultural ecosystem in the network. DOE funding of this network is expected to continue on a long-term basis. In addition, ARD has provided funds to upgrade the data collection systems with the objective of maintaining the research sites at the cutting edge of technology and continue collecting high quality data for the next decade.

39. Although it does not have an outreach component, GPRC has the potential to contribute to creating decision-support systems for land managers and producers. It is recommended that GPRC look at creating decision support tools in collaboration with appropriate social science expertise. (Section VI, Page 16)

Response: Presently the GPRC's activities are totally dependent on grant funding. If state resources become available, we will consider including an outreach component in relation to developing decision support tools as recommended by the review team.

It should also be added that although providing decision support to the diverse clientele served by SNR centers, CSD, and other programs are important goals for the unit, limited resources significantly constrain the opportunities to do so.

2015 OUTCOMES: See #38

40. The GPRC's extensive collaborations with institutions outside Nebraska also give it the potential to be a leader in time-series flux measurements. Opportunities for technological development from an engineering perspective may also increase collaborative work through this Center. (Section VI, Page 16)

Response: ACTIONS: The GPRC will continue to emphasize its priority on time-series flux measurements. They will work with AmeriFlux, Fluxnet Canada, and other flux network leaders to stay on the cutting edge of state-of-the-art eddy covariance instrumentation technology. They will also focus on improving the accuracy of flux data processing technology and will regularly participate in national intercalibration studies to keep a high standard of quality control on our sensors and data processing procedures.

2015 OUTCOMES: See #38

41. HPRCC—teaching faculty should be encouraged to define course content that is directed toward practical applications of climate information. (Section VI, Page 17)

Excerpt of Review Team comments regarding the HPRCC – The HPRCC has a well- developed program that encompasses the collection of weather data from automated stations located across the region including some additional stations in Iowa. The unit has established a system for quality control of the data and has assembled different data bases that can be accessed through the web sites along with a number of map products.

Response: HPRCC faculty currently teach at the undergraduate and graduate level within the School of Natural Resources in the areas of climate and climate change, atmospheric instrumentation, and climate data analysis. They are involved in curriculum development for courses within SNR that incorporate practical applications of climate information.

**ACTION:** A new course is being developed (i.e., environmental climatology) that will be a capstone, or synthesis, course for the new Applied Climate Science major in which real- world applications of climate information will be a major topic. HPRCC staff will continue to be engaged in the academic program by providing free online accounts for all students and faculty who wish to utilize the center's climate data and information web portal.

**2015 OUTCOMES:** HPRCC faculty continue to participate in the Applied Climate Science major and in delivering other undergraduate service courses and graduate courses.

42. NDMC—explore ways of providing long-term employment of key center employees, including tenure track positions. (Section VI, Page 17)

Excerpt of Review Team comments regarding the NDMC - Within the NDMC, the staff is characterized by great depth and high esprit de corps. The unit also possesses substantial social science expertise, including several genuine hybrids crossing both the natural and social sciences. To support its program of organizing 15 workshops a year, the 23-member staff consists of 6 faculty, 3 post-doctoral fellows, 14 managerial/professional staff, and 4 graduate students. However, only 1.6 FTE are state-funded constituting about 10% of a \$2.2 million/yr budget. Clearly then, survival means a steady demand of designing workshops, developing new themes, and deepening its collaboration with NOAA on the Drought Monitor.

**Response:** It is unlikely that SNR would have funds to directly support positions within the NDMC.

**ACTIONS:** The SNR and NDMC directors will continue to explore ways to support key positions within the center, such as teaming together to fund joint positions as they are already doing in several cases or by identifying other opportunities with other centers or units for joint positions that would improve collaboration. In addition, the NDMC, other centers, and SNR could possibly pool resources for critical educational and outreach opportunities. It is also possible that some of the NDMC faculty may be able to compete successfully for redefined positions as ACS and other faculty retire.

Again, it is noted that similar funding issues exist for most SNR-based centers. The School does not have the resources to provide additional salary support for staff positions or tenure- track lines to allocate to specific centers.

**2015 OUTCOMES:** No additional SNR or UNL funding was identified to support the NDMC. NDMC was recently successful at obtaining a five year grant from NOAA that will provide substantial baseline support for it's operations (see NDMC section of this report for details).

43. SNR should look at long term funding of the NDMC as part of a larger Climate Service Unit for Nebraska. (Section VI, Page 17)

**Response:** Long-term funding through a line item in USDA's budget has been pursued previously.

**ACTION:** With the assistance of UNL administration, we continue to pursue stable baseline funding for the NDMC.

There was discussion previously of creating an overarching center on climate to incorporate the NDMC, HPRCC, and GPRC to gain added visibility and resources. This could be part of the proposed Climate Change Research and Education Center proposed recently through PoE funding (i.e., Climate Change Initiative).

2015 OUTCOMES: As in #42, no additional UNL funding was obtained. However, SNR administration, Applied Climate Science faculty and IANR administration are pursuing funding a State Climatology office with long-term funding.

44. Combine fundraising for the Global Water for Food Institute (GWFI) with the Water Center. Rename the Nebraska Water Center. (Section VI, Page 18)

Excerpt of Review Team comments regarding the Water Center – The UNL Water Center serves multiple roles, but perhaps the most important is service as the “public face of the university” for water. They have a long and productive history of building the water- related capacity of UNL, in part through the Water Initiative, which has allowed increased investment in this topic area over time, particularly through new hires.

Response: This is a decision for upper administration since they are formulating plans for the GWFI; however, given the broad role that the Water Center plays in water research, education, and outreach, combining it with the new GWFI, which has a narrower focus by design, would seem not to be in the best interest of our Nebraska clientele. Nevertheless, with the recent gift to the University of Nebraska for the formation of the GWFI, it is important to determine how the structure of the Institute will include the Water Center.

ACTION: Hire a high-profile rising star as the new WC director, perhaps someone with background in human dimensions science, climate change, adaptive management, and experience with stakeholder engagement.

Response: ACTION: A search is currently underway to hire a high-profile leader of the Water Center. We expect to complete this search by fall 2010 and have a new center director on campus by January 1, 2011.

2015 OUTCOMES: Dr. Chittaranjan Ray was hired in August 2013 as the Director of the Nebraska Water Center. The Water Center was moved from SNR to the new Daugherty Water for Food Institute in 2012.

## Appendix L: Classroom Utilization Data

	<i>Room Number and Count</i>	<i>Assignable Square Feet</i>	<i>Student Stations Available for Use</i>	<i>Student Stations Occupied Average /Period</i>	<i>Weekly Hours Scheduled for Use</i>	<i>Actual Weekly Total of Student-Station Hours Used</i>	<i>Weekly Student-Station Hours based on 30 hours</i>	<i>Percent of Student-Station Utilization based on 30 hours</i>
<b>Fall 2014</b>	023	1,195	24	10.0	13.0	130.0	720.0	18.1%
	024	1,223	30	17.5	12.0	210.0	900.0	23.3%
	107	3,021	300	96.2	15.0	1,443.0	9,000.0	16.0%
	141	631	25	12.0	2.0	24.0	750.0	3.2%
	142	623	24	13.1	17.0	223.4	720.0	31.0%
	163	951	45	25.1	33.0	827.2	1,350.0	61.3%
	209	446	15	8.5	5.0	42.5	450.0	9.4%
	228	570	36	15.5	22.0	341.0	1,080.0	31.6%
<b>Total</b>	<b>8</b>	<b>8,660</b>	<b>499</b>	<b>24.7</b>	<b>119.0</b>	<b>3,241.1</b>	<b>14,970</b>	<b>21.7%</b>
<b>Fall 2013</b>	023	1,195	24	9.1	13.0	130.0	720.0	18.1%
	024	1,223	30	15.0	12.0	210.0	900.0	23.3%
	107	3,021	300	81.7	15.0	1,443.0	9,000.0	16.0%
	141	631	25	16.7	2.0	24.0	750.0	3.2%
	142	623	24	13.0	17.0	223.4	720.0	31.0%
	163	951	45	23.3	33.0	827.2	1,350.0	61.3%
	200	401	12	6.0	3.0	18.0	360.0	5.0%
	209	446	15	6.0	5.0	42.5	450.0	9.4%
	228	570	36	4.3	22.0	341.0	1,080.0	31.6%
<b>Total</b>	<b>9</b>	<b>9,061</b>	<b>511</b>	<b>18.1</b>	<b>122.0</b>	<b>3,259.1</b>	<b>15,330</b>	<b>21.3%</b>
<b>Fall 2012</b>	023	1,195	24	12.7	24.0	304.0	720.0	42.2%
	024	1,223	30	20.7	11.0	227.3	900.0	25.3%
	107	3,021	300	94.8	18.0	1,707.0	9,000.0	19.0%
	141	631	25	11.5	6.0	69.0	750.0	9.2%
	142	623	24	15.3	15.0	230.0	720.0	31.9%
	163	951	45	22.0	31.0	682.0	1,350.0	50.5%
	200	401	12	10.5	12.0	126.0	360.0	35.0%
	209	446	15	8.8	8.0	70.0	450.0	15.6%
	228	570	36	22.4	25.0	560.0	1,080.0	51.9%
<b>Total</b>	<b>9</b>	<b>9,061</b>	<b>511</b>	<b>18.1</b>	<b>150.0</b>	<b>3,975.3</b>	<b>15,330</b>	<b>25.9%</b>

# Classroom Utilization Data

	<i>Room Number and Count</i>	<i>Assignable Square Feet</i>	<i>Student Stations Available for Use</i>	<i>Student Stations Occupied Average /Period</i>	<i>Weekly Hours Scheduled for Use</i>	<i>Actual Weekly Total of Student-Station Hours Used</i>	<i>Weekly Student-Station Hours based on 30 hours</i>	<i>Percent of Student-Station Utilization based on 30 hours</i>
<b>Fall 2011</b>	023	1,195	24	16.7	19.0	317.6	720.0	44.1%
	024	1,223	30	18.0	17.0	306.0	900.0	34.0%
	107	3,021	300	87.1	21.0	1,830.0	9,000.0	20.3%
	141	631	25	17.0	6.0	102.0	720.0	14.2%
	142	623	24	12.1	18.0	218.6	720.0	30.4%
	163							
	200	401	12	9.0	4.0	36.0	360.0	10.0%
	209	446	15	8.0	10.0	80.0	600.0	13.3%
	228	570	36	17.4	24.0	418.7	1,080.0	38.8%
<b>Total</b>	<b>9</b>	<b>8,110</b>	<b>466</b>	<b>18.1</b>	<b>119.0</b>	<b>3,308.9</b>	<b>14,100</b>	<b>23.5%</b>
<b>Fall 2010</b>	023	1,195	24	22.3	18.5	413.2	720.0	57.4%
	024	1,223	30	15.3	30.0	460.0	900.0	51.1%
	107							
	141	631	24	10.3	7.0	72.3	720.0	10.0%
	142	623	24	11.5	14.5	166.8	720.0	23.2%
	163	951	45	31.8	34.0	1,080.7	1,350.0	80.1%
	200	401	12	10.0	6.0	60.0	360.0	16.7%
	209							
	228	570	36	16.4	36.0	588.9	1,080.0	54.5%
<b>Total</b>	<b>9</b>	<b>5,594</b>	<b>195</b>	<b>18.1</b>	<b>146.0</b>	<b>2,841.9</b>	<b>5,850</b>	<b>48.6%</b>



## Classroom Utilization Data





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