PennState
College of Agricultural Sciences

PROPOSAL TRANSMITTAL

Date: 5/11/2017 **PSU Ref. No: 194917**

Title: "Meeting Stakeholder Needs for Pollinators in the Mid-Atlantic Region"

Submitted to: David Leibovitz
david_leibovitz@uri.edu
NERA - Northeastern Regional Association of State Agricultural Experiment Station Directors
14 East Farm Road, Room 111
Kingston, RI 02881

Program: NEED/NERA Planning Grants Opportunity: Integrated Research and Extension

Submitted by: Margarita Lopez-Uribe
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Proposed Project Period: **09/01/2017 - 08/31/2018** **Total Project Request:** **$4,880**

AUTHORIZED UNIVERSITY OFFICIAL

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Please reference PSU Ref. Number in all correspondence.

2017 NEED/NERA Planning Grants Opportunity: Integrated Research and Extension Cover Page

Project Title: "Meeting Stakeholder Needs for Pollinators in the Mid-Atlantic Region"

Team Members:

Name	Discipline	Affiliation	Institution/Agency/Other
Margarita López-Uribe	Entomology	University	Penn State University
Christina Grozinger	Entomology	University	Penn State University
Deborah Delaney	Entomology	University	University of Delaware
Margaret Couvillon	Entomology	University	Virginia Tech
James Wilson	Entomology	University	Virginia Tech
Scott McArt	Entomology	University	Cornell University
Emma Mullen	Entomology	University	Cornell University

Team Leader Contact Information:

Name:	Margarita M. López-Uribe
Address:	547 ASI Building
	Department of Entomology
	Penn State University
	University Park, PA 167802
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Project Description

Problem: The honey bee, *Apis mellifera*, is the most important managed pollinator in agriculture. Their pollination services have been estimated to be worth at least $19.2 billion annually in the United States alone (*1*). Despite their ecological and economic importance for food security, the honey bee population has declined by 61% in the US during the past 70 years (*2*). Beekeepers currently struggle to maintain healthy honey bee colonies in the Northeast region and all over the US. Historically, annual mortality rates were around 10% but currently over 40% losses are the norm and some beekeepers even report 90% colony losses (*3*). In addition, the declines in the number of honey bee colonies in the US have also increased rental prices for growers that need bees for crop pollination. Producers of bee dependent crops also struggle to integrate pollinators with necessary pest and pathogen management practices that involve the use of agrochemicals, which can be toxic to insect pollinators (*4*). **Solutions to improve honey bee health and integrate pollinator protection and pest management are thus essential for economically and environmentally sustainable agricultural production.**

While there are several well-established extension programs throughout the Northeastern region, newer groups are starting to rise in response to the greater need for research that contributes to solutions to honey bee health problems. All these regional programs would therefore benefit from synchronized efforts that could work in synergy to achieve the same goal: provide scientific evidence for approaches that improve overall health and survival of honey bee colonies and lead to more sustainable food production systems. We therefore propose to host a regional meeting with extension faculty and presidents of beekeeper and grower associations to discuss recent advances and developing needs on the topic of pollinator health.

Stakeholders: This meeting will help catalyze multi-level research and extension projects among multiple groups that interface closely with beekeepers and growers in the Mid-Atlantic Region, specifically in Delaware, New York, Pennsylvania, and Virginia.

Justification: Leaders of research and extension programs usually interact with stakeholders during conferences where the format is often scientists presenting updates about how research is (1) advancing our knowledge of topics and (2) providing solutions to problems. However, there is seldom opportunity to have focused discussions among leaders of different research and extension programs, and leaders of multiple stakeholder groups (in this case beekeepers and growers) to identify the most critical current and emerging needs, and how to work together effectively to solve these issues. The challenge of improving honey bee health is critical but multifactorial in nature, so it requires multiple research groups working on solutions to the problem, at multiple levels and with multiple stakeholders. We therefore need to develop a new coalition that can generate synchronized research efforts across states, stakeholder groups, and areas of expertise.

Sustained external funding: We will discuss current themes of our research and extension programs and identify gaps in our knowledge so we can begin pursuing funding opportunities focused on integrated approaches to honey bee health in the Mid-Atlantic region. Candidate programs that will be well suited to fund our research goals include the Pollinator Health program from the National Institute of Food and Agriculture, USDA CARE, NE SARE, and NE IPM Center.

Description of Activities

- Prior to the meeting: Team leader will ask all research and extension teams to send a summary of their ongoing projects. In addition, a form will be sent to stakeholder leaders inquiring about the major current and emerging challenges they have related to pollinators. Team leader will use this information to organize focused round tables to discuss key topics.
- During the meeting: All research and extension teams will introduce themselves and presents an overview of their programs. Team leader will present results from the data she collected from stakeholders about critical needs. Then, we will vote to develop priorities and rankings of the current and emerging challenges, and select ~5 challenge areas to focus on in breakout sessions where teams will discuss how they are or could address different stakeholder needs. The last session of the day will facilitate discussions about how ongoing projects in different groups could be integrated and the need to develop new directions in research.
- Online resources: We will summarize all current activities of research and extension programs in the Mid-Atlantic region using the website of the Mid-Atlantic Apiculture Research and Extension Consortium (MAAREC). This website annually receives an estimated 23,391 unique users with 12,545 of these users being repeat visitors. Visitation rises to more than 8,000 a month during peak summer time activity for beekeepers. This website is therefore a key resource for beekeepers in the region. However, its content is in need of updating due to the dynamic nature of apiculture and the need to integrate information relevant to other stakeholders such as growers. We will redesign the website and update its content including information from the different teams that will be participating of this meeting. Outcomes of the meeting will be published at both the MAAREC and Center for Pollinator Research Websites.

Team Members

The team of researchers and extension specialists that will participate in this meeting are working on programs of complementary expertise in the following 4 main areas: (I) improving coordinated efforts to monitor honey bee health, (II) developing and testing best management practices (BMPs) for beekeepers, including practices for Varroa control and land management, (III) honey bee nutrition, and (IV) improving methods for selecting, identifying and breeding genetically resilient bee stocks. In addition to these team members, we will invite presidents of beekeeper associations and tree and small fruit grower associations from each of the participant states (we expect a total of 20 people to attend)

	Topic I	**Topic II**	**Topic III**	**Topic IV**
Margarita López-Uribe	X	X		X
Christina Grozinger		X	X	X
Deborah Delaney	X	X	X	

Margaret Couvillon		X	X	
James Wilson	X	X		
Scott McArt		X		X
Emma Mullen	X	X		

Timetable

	2017 - IV	**2018 - I**	**2018 - II**	**2018 - III**
Pre-meeting surveys to research/extension teams and stakeholders	X			
Meeting at Penn State - Identification of key research and extension needs	X			
Video-conference to outline goals for NIFA proposal		X		
Video-conference to outline extension activities		X		
Proposal write-up and submission			X	
Execution of extension activities				X
MAAREC website update				X

Other Resources

Funds from the Center for Pollinator Research at Penn State will be used for development of online resources, handouts and extension publications.

References

(*1*) Calderone NW (2012) PLoS ONE
(*2*) Vanengelsdorp D, Meixner MD (2010) J Invertebr Pathol
(*3*) Seitz N et al (2015) J Apicul Res
(*4*) Biddinger DJ, Rajotte EG (2015) Curr Opin Insect Sci.

BUDGET

Item	Description	Individual Cost	Total Cost
Conference Room Rental and Food	Conference room, beverage service, morning and afternoon snack, and lunch for 30 participants	40 people @ $59/ person	$2,360
Lodging for participants	We expect that at least 15 participants will stay overnight in State College	15 rooms @ $168/ night	$2,520
TOTAL COST			**$4,880**

BUDGET JUSTIFICATION

Project Dates: 09/01/2017 – 08/31/2018

Project Title: "Meeting Stakeholder Needs for Pollinators in the Mid-Atlantic Region"

1. **Conference room and food for participants - $2,360**
   We will host a one-day conference at the Penn Stater in State College PA. The cost per person is $59/person, and it includes the meeting room and set up, beverage service throughout the day, morning and afternoon snacks, and lunch.
2. **Lodging for Participants - $2,520**
   We request funding to cover expenses for one night at the Penn Stater. Because participants will be coming from different parts of Pennsylvania, Delaware, Virginia, and New York, we expect at least half of them will request one night at the hotel. We will offer to cover this cost to increase the chances of participation of key growers, beekeepers, and researchers.

BIOGRAPHICAL SKETCH
Margarita María López-Uribe

Department of Entomology, Center for Pollinator Research
547 ASI Building, Pennsylvania State University
University Park, PA 16802

Tel: (814) 865-3427
E-mail: mml64@psu.edu

A. Education

Universidad de los Andes (Colombia) — Biology B.S., 2004
Universidade Federal de São Carlos (Brazil) — Genetics and Evolution M.S., 2006
Cornell University — Entomology Ph.D, 2014

B. Research Appointments

2016 Assistant Professor, Department of Entomology, Pennsylvania State University
Adjunct Professor, Department of Entomology and Plant Pathology, North Carolina State University
Adjunct Professor, Department of Entomology, Michigan State University

2016 NSF Fellow Postdoctoral Researcher, Department of Applied Ecology, North Carolina State University

2014-2015 Postdoctoral Researcher, Department of Entomology, North Carolina State University

C. Competitive Grants and Fellowships

2016 USDA Animal Health Program ($103,000); PI, project in collaboration with Christina Grozinger

2016 USDA Crop Protection and Pest Management Program ($200,000); Co-PI, project in collaboration with Hannah Burrack

2015 Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) - University of Texas at Austin ($120,000); Co-PI, project in collaboration with Dr. Maria Zucchi, Dr. Kenneth Young, Dr. Shalene Jha

2015 NSF Postdoctoral Fellowship in Biology

2015 USDA-NIFA Postdoctoral Fellowship (*declined*)

2014 Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) Postdoctoral Fellowship (*declined*)

D. Extension Talks

López-Uribe MM. Feral Honey Bees, What can we learn from them? Centre County Beekeeping Association, Bellefonte, PA (April 2017; 40 attendees)

López-Uribe MM. Bees 101: An Introduction to Bee Biology. US Wildlife and Fish. State College, PA USA (March 2017; 20 attendees)

López-Uribe MM. Pollination services: Lessons from wild bees. Mid-Atlantic Fruit ad Vegetable Convention. Hershey, PA USA (February 2017; 80 attendees)

Sastre B, **López-Uribe MM**. Insectos benéficos que aumentan el rendimiento – Amigos de la horticultura. Mid-Atlantic Fruit and Vegetable Convention. Hershey, PA USA (February 2017; 30 attendees)

López-Uribe MM. Honey bee health research at PSU – Center for Pollinator Research. Galveston, TX USA (January 2017; 150 attendees)

López-Uribe MM. An Introduction. Pennsylvania State Beekeeping Association, State College, PA (November 2016; 100 attendees)

E. List of Relevant Publications

Total research publications: 20 peer-reviewed; **3** in revision

§ Undergraduate student; ¶ Graduate student

López-Uribe MM, Fitzgerald AM§, Simone-Finstrom MD. (Accepted) Glucose oxidase production after colony infection: Testing its role in honey bee social immunity. *Royal Society Open Science.*

López-Uribe MM, Soro A, Jha S (2017). Conservation genetics of bees: Advances in the application of molecular tools to guide bee pollinator conservation. *Conservation Genetics.* doi: 10.1007/s10592-017-0975-1

López-Uribe MM, Appler RH, Dunn RR, Frank SD, Tarpy DR. (2017) Higher immunocompetence is associated with higher genetic diversity in feral honey bee colonies (*Apis mellifera*). *Conservation Genetics.* doi: 10.1007/s10592-017-0942-x

López-Uribe MM, Minckley RL, Cane J, Danforth BN (2016) Crop domestication facilitated rapid geographical expansion of a specialist pollinator, the squash bee *Peponapis pruinosa. Proceedings of the Royal Society of London B* 283: 20160443. doi: 10.1098/rspb.2016.0443

López-Uribe MM, Sconiers WB, Frank SD, Dunn RR, Tarpy DR (2016) Reduced cellular immune response in social insect lineages. *Biology Letters* 12: 20150984. doi: 10.1098/rsbl.2015.0984

Youngsteadt E, Appler RH, **López-Uribe MM,** Tarpy DR, Frank SD (2015) Urbanization increases pathogen pressure on feral and managed honey bees (*Apis mellifera* L.). *PLoS One* 10: e0142031. doi: 10.1371/journal.pone.0142031

López-Uribe MM, Morreale SJ, Santiago CK§, Danforth BN (2015) Nest suitability, fine-scale population structure and male-mediated dispersal of a solitary ground nesting bee in an urban landscape. *PLoS One* 10(5):e0125719. doi: 10.1371/journal.pone.0125719

López-Uribe MM, Santiago CK§, Bogdanowicz SM, Danforth BN (2013) Discovery and characterization of microsatellite primers for the solitary ground nesting bee *Colletes inaequalis* using enriched libraries and 454 sequencing. *Apidologie* 44:163-172.

F. Extension articles

Evans KC, Ostiguy N, **López-Uribe MM**. (2017) Efficacy of different methods of oxalic acid application. *American Bee Journal* 157(5):505-507.

López-Uribe MM. (2017) Tracking the Health of Feral Bees in Pennsylvania. *The Pennsylvania Beekeeper Newsletter.* February Issue.

Cornell University
College of Agriculture
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Scott McArt, Ph.D.
Assistant Professor
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May 8, 2017

Dear NEED-NERA,

I'm writing to express my strong support for a Mid-Atlantic bee extension meeting, which is being organized by Margarita Lopez-Uribe. Numerous pollinator extension groups exist in the Mid-Atlantic region (Penn State, Delaware, Cornell, etc.), yet there is minimal formal exchange between the groups. Further, interactions with growers and beekeepers typically occur with individual extension groups, which limits a broader sharing of knowledge and tools that are being developed across the Mid-Atlantic region.

At a time when pollinator declines are occurring and beekeepers are experiencing unsustainable hive loss rates, a NEED-NERA supported meeting would revive much-needed dialogue between all groups (stakeholders and extension professionals) across the broader Mid-Atlantic region. Such dialogue is critical for solving the current pollinator problem.

Sincerely,

Scott McArt
Assistant Professor of Pollinator Health

PENNSTATE

College of Agricultural Sciences
Department of Entomology

The Pennsylvania State University
University Park, PA 16802

May 17, 2017

Dear Margarita:

I am very happy to write in support of your proposal, "Meeting Stakeholder Needs for Pollinators in the Mid-Atlantic Region", to the 2017 NEED/NERA Planning Grants Opportunity: Integrated Research and Extension program. With the diversity of beekeepers (backyard, sideliner, commercial, and queen breeders, spanning natural, organic, and conventional beekeeping practices) and growers that depend on bee pollination services (small fruit and vegetable, fruit tree crops, organic and conventional) in the mid Atlantic region, we have a wealth of opportunities and challenges related to supporting and promoting honey bee health and their critical ecosystems services. Given that several young scientists with research and extension appointments related to pollinator health have recently been hired at several land grant universities in this region, it is an excellent time to bring these individuals together with key stakeholder representatives to develop an integrated, synergistic, and forward-thinking plan for addressing issues related to honey bee health, management, and pollination services. I am very much looking forward to this workshop and to sharing information and developing new collaborative projects with this community!

Sincerely,

Christina M. Grozinger
Distinguished Professor of Entomology
Director, Center for Pollinator Research
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Center for Pollinator Research: http://ento.psu.edu/pollinators

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Dr. Margarita Uribe-Lopez
Dept. of Entomology
Penn State University

May 7, 2017

Dear Margarita,

I am writing in support of your proposal, "Meeting Stakeholder Needs for Pollinators in the Mid-Atlantic Region", for the 2017 NEED/NERA Planning Grant. The Mid-Atlantic is home to many beekeepers, growers and land managers that are faced with unique challenges such as fragmentation, urbanization in close proximity to large-scale agriculture. These anthropogenic influences can have profound effects on pollinator populations and communities.

There has been a new influx of pollinator researchers and educators into the Mid-Atlantic. Therefore, it is imperative that we come together to identify key action items for pollinator health and protection that are shaped and informed by stakeholder needs. A revival of cooperative and collaborative research in the Mid-Atlantic region will serve beekeepers and land managers well as many of the issues these stakeholders face do not recognize state lines.

I look forward to working with my fellow researchers and stakeholders to identify key concerns and developing solutions for mitigating pollinator loss.

Sincerely,

Associate Professor of Apiculture
University of Delaware
dadelane@udel.edu

VirginiaTech
College of Agriculture and Life Sciences

Dr. Margaret J. Couvillon
Department of Entomology
302 Price Hall, MC 0319
Blacksburg, Virginia 24061
Phone: 540-231-5705 Fax: 540-231-9131
E-mail: mjc@vt.edu Website: *www.ento.vt.edu*

Dear Dr. López-Uribe,

With this letter I confirm my support of your proposal, "Meeting Stakeholder Needs for Pollinators in the Mid-Atlantic Region", to the 2017 NEED/NERA Planning Grants Opportunity: Integrated Research and Extension program.

Beekeepers are struggling to keep down yearly colony losses. The problem of honey bee health is complex and it requires coordinated efforts from researchers to better inform beekeepers about ways to manage their colonies and for researchers to learn from beekeepers about what they consider to be the most pressing problems in their region.

The type of regional meeting you are planning will allow teams from multiple land-grand universities in the Mid-Atlantic to exchange information about what they are doing to meet beekeeper needs at a regional scale. Establishing better and more organized channels of communication among us will without any doubt help advance our research goals more effectively.

My research program aims to use honey bees as bio-indicators of landscape "health" – their unique communication behaviors will allow us to map at a landscape-scale the profitable and not profitable areas for foraging, information that we hope to develop to be broadly relevant to a host of other pollinators. In addition, Virginia Tech's apiculturist Dr. James Wilson will be establishing a research/extension program with many opportunities to monitor long-term the health of colonies at a regional level. We would both benefit from your meeting.

Given this innovative idea and the excellent team that you have assembled, I have no doubt that this meeting will be able to successfully and efficiently carry out the proposed objectives. Looking forward to participating of this event.

Sincerely,

Dr. Margaret J. Couvillon
Assistant Professor, Pollinator Biology and Ecology
Department of Entomology
Virginia Tech
Blacksburg, VA 24061

2017 NEED/NERA Planning Grants Opportunity: Integrated Research and Extension
Cover Page

Project Title: An Integrated Program for Women Producers in the Northeast

Team Members:

Name	Discipline	Affiliation (AES, CE, both, or other)	Institution/Agency/Other
Beth Holtzman	WAgN-VT, New Farmer	CE	University of Vermont
Tori Jackson	Agriculture - AGNR	CE	University of Maine
Kelly McAdam	Agriculture	CE	University of New Hampshire
Robin Brumfield	Agriculture – Farm Mgmt	AES & CE	Rutgers University
Shannon Dill	Agriculture - AGNR	CE	University of Maryland
Bonnie Collins	Agriculture – Farm Mgmt	CE	Cornell University
Shoshanah Inwood	Community & Applied Econ	AES	University of Vermont
Carolyn Sachs and Patty Neiner	Rural Soc and Women's Studies	Other	Pennsylvania State University

Team Leader Contact Information:

Name:	Mary Peabody, UVM Extension Professor
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	23 Mansfield Avenue
	Burlington, VT 05401--3323
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I. Mission and Goals of the Proposed Program

Our intent with this proposal is to host a planning retreat where participants will draft a multi-year plan of work, including funding opportunities, to establish the first virtual 'center of excellence' for research and extension programming related to the needs of women producers. Our goals include:

- Document the existing education programs for women producers and assess the current and anticipated capacity to continue these programs into the future.
- Develop a research agenda focusing on topics of importance to women farming in the region.
- Identify professional development training needs for educators, extension personnel and ag service providers to help improve service to women farmers across the region.
- Construct a multi-state integrated network of researchers, educators and collaborators for future funding proposals.

The number of U.S. farms operated by women nearly tripled over the past three and a half decades, from 5 percent in 1978 to 14 percent most recently (Census of Ag, 2012). The northeast numbers are among the highest in the nation. The increase in the numbers of women farmers is not without challenges. Many women are drawn to farming as a way to support their family and to strengthen local community yet less than 10% of women-operated farms reported sales and government payments of more than $50,000 (Census of Ag, 2012). Women operators are still not applying for and utilizing agricultural support programs as effectively as their male counterparts and the businesses of many beginning farm and ranch women are not surviving the first five years. Further, the average age of all women operators is an aging 55.6 years and only 8 percent are 34 years and under. Clearly, this is not sustainable for farmers or our regional food systems.

As the number of women operators increases, so does the number of programs developed to provide education and technical assistance to them. The northeast states have been successful in attracting external funds and have pioneered several innovative programs for women farmers. In addition, members of this team have been instrumental in bringing attention to how the gendered aspects of learning influences farmer training. Given this foundation of expertise, it makes sense for the northeast to develop a virtual center of excellence that could serve as a model to rest of the LGU system. As funding becomes more competitive, programs are finding their ongoing sustainability to be challenging. Over time, our programs have become duplicative and, in some cases, weakened from lack of capacity. This is often because the faculty come from a broad variety of content areas and do not share a cross-disciplinary communication system. With a coordinated regional effort, we could have a robust toolkit of curricula available for educators, professional development opportunities to assist extension personnel (and other service providers) in proven strategies for working with women producers, and a team of educational leaders that are willing and available to offer outreach and education where capacity is limited.

In addition, there are large gaps in the research literature that limit the successful growth of future education and outreach efforts. We are fortunate to have nationally recognized faculty in both research and extension already working in this area. Among the topics of importance to women producers are: farm safety, mechanization and ergonomics; business scale and profitability; healthcare; balancing farm and family needs; land access and transfer; and legal issues. While these issues are of interest to all farmers, they pose unique challenges for women farmers at all stages of business development.

II. Justification for the Program Relative to Stakeholder Needs and Potential for Sustained External Funding

Many states in the region have existing programs targeting women producers but most focus on extension and outreach without adequate attention to integrating a research agenda. With our combined experience and a strong regional audience of women farmers, we are well positioned to develop a successful funding plan. Many of our programs could be shared across the region, saving state and county resources for hyper-local needs. Our institutions would benefit from the synergies of working together, integrating research and extension efforts and broadening our reach to include other organizations and agencies who have an interest in the success of women farmers.

Potential funding sources we will investigate include NIFA-AFRI, NIFA-BFRDP, RMA/RME, SARE and private foundations. Several of these funding sources do recognize women as an underserved audience and encourage proposals targeting women producers.

III. Activities to be Engaged in by Team Members

We propose an in-person organizing meeting to develop a consolidated, regional vision for a virtual center of excellence in research and extension. This would enable more effective follow-up meetings via web-conference to develop funding proposals and collaborate on projects.

The primary purpose of the meeting is to enable a focused discussion of the research and extension currently available throughout the region and to assess our future capacity. The meeting would allow a dedicated forum for sharing past, current and proposed research and education targeting women farmers. This would flow into discussion and planning related to the logistics of a virtual center. A key outcome would be a consolidated statement of stakeholder needs matched to our capacity and a list of initial research questions associated with those needs.

This project allows for a multi-disciplinary, strategic planning retreat among research and extension professionals in the region. The immediate outcome would detail the need, scope and development plan for a center focused on the needs of women producers at all stages of business development. A concerted planning effort will define future funding requirements, as well as outline a plan for execution of the idea. Defining the scope of research and extension activities will help to clearly assess our collective strengths and plan for proper training opportunities across the farm business development continuum for women farmers. The output of this activity would serve as a model for other regions who seek similar collaborative programming.

IV. Explanation of Roles of Team Members

Project Leader / PI – Mary Peabody will assume the role of project leads. This role will provide central organization of the activities of the project including meeting logistics, facilitation and communication. The lead will also be responsible for project financial oversight.

Meeting Organizing Committee – Beth Holtzman will provide leadership to this committee. The team listed on the cover page are tasked with planning an effective and successful first meeting. Tasks will include supporting the project lead with logistics and planning as well as helping collect the advanced material in preparation for the retreat.

Project Participants – This team will provide input during active visioning and brainstorming sessions. The leadership team will be encouraged to identify others in the region with interest in future participation. These individuals include additional researchers, extension personnel, and non-LGU partners working with women farmers in the region.

Proposal Committee(s) – A subset of the Project Team tasked with carrying the team's ideas into a formal proposal(s) for funding to NIFA-BFRDP, AFRI and/or other funding sources to allow program development in specific content areas. Not *every* individual will be part of every proposal. Our goal will be to build 'teams' based on interest and expertise. We will make every effort to make each team an integration of research and extension to ensure our work has the anticipated impact for our clients.

V. Timetable for Completion of the Planning Activities and Preparation of a Competitive Proposal

2017	
July	Finalize schedule, location and attendance for visioning meeting. Identify organizing committee.
August	Hold in-person meeting. Project leader to consolidate input and distribute summary and revised purpose statement for the project(s).
September	Hold web-conference to finalize project vision, scope and proposal outline. Identify working committee to finalize proposal(s).
November	Team review of proposal.
December	Submit NIFA-BFRDP proposal (based on anticipated rfp)
2018	
February	Hold web-conference to finalize research vision, scope and proposal outline. Identify working committee to finalize proposal
June	Team review of proposal
July	Submit NIFA-AFRI proposal

VI. Leveraging Resources

Additional resources available to support this project include indirect contributions of time for the leadership team's participation. We have also identified up to an additional $2,500 available from a current NIFA-BFRDP Educational Enhancement project that could be used to contract with a facilitator for the meeting, supplement travel requirements, and/or to expand our leadership team. In some cases travel and other expenses associated with the proposed retreat may be covered by other project funding (e.g. Annie's Projects, WAgN-PA, WAgN-VT, professional development funds, etc.). The proposed budget ensures participation of a core number of participants regardless of availability of other funding.

Several members of this leadership team also provide leadership to a national NIFA-BFRDP Educational Enhancement Team proposal specifically targeting programs for women producers. This four-year project begins its third year in September 2017. Our intent with this regional proposal is to amplify, not duplicate, the work of this national project. As we develop materials to help programs better serve women producers, we are running up against gaps in the research and regional differences. This proposal would be able address these gaps.

VII. APPENDIX A - Budget for Planning Activities (travel, meeting expenses, etc.)

TRAVEL/LODGING AND MEALS:

10 attendees, 1 round trip for 1 meeting, avg. 480 mile RT, $0.53.5 per mile…. $2,568

10 attendees, one night accommodation, 1 meeting, $180 per room… $1,800

Breakfast & lunch at meeting ($60 per person, 10 people)... $600

FACILITATION:

One day of professional facilitation for the planning retreat… ------

Total NEED-NERA Request $4,968

VIII. APPENDIX B - CV of Team Leader

Mary L. Peabody

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Telephone: 802-656-7232 (office); 802.598.4878 (mobile)
E-mail: Mary.Peabody@uvm.edu

PROFESSIONAL EXPERIENCE

2013 – present**. UVM Extension Professor**, Community Resources and Economic Development, University of Vermont Extension System, Central Region. Burlington, Vermont. Planning and delivering educational programs that benefit Vermont's communities, families, businesses, and the natural environment. Specific accomplishments include building civic capacity and strengthening community leadership through research and education involving local government officials.

2005 – 2013. **UVM Extension Associate Professor**, Community Resources and Economic Development, University of Vermont Extension System, Central Region. Burlington, Vermont.

2009 – 2011. Associate Director, **Northeast Regional Center for Rural Development**(NERCRD). Planning and delivering educational programs and research that benefits the northeast region and leverage the resources of the Land Grant Universities. Specific areas of program emphasis include rural entrepreneurship, economic development, and new farmer programming.

2003 – 2005. **Extension Program Coordinator**, Diversified Agriculture program team. University of Vermont Extension. Providing leadership to sixteen faculty and program staff in program design, program evaluation, and advisory board development.

1999-2005. **Extension Assistant Professor**, Community Resources and Economic Development, University of Vermont Extension System, Central Region. Burlington, Vermont.

1993 – present**. Program Director**, the Women's Agricultural Network (WAgN), University of Vermont Extension System, Burlington, Vermont. Director and Principal Investigator for a USDA-funded project totaling $1.5M. All phases of project management and evaluation. Development of a multi-tiered model to assist individuals make informed business decisions, access USDA programs, and participate in policy development.

EDUCATION

Walden University, Bloomington, IN ■ 75 credits
Applied Management and Decision Sciences: Leadership & Organizational Change
University of Vermont, Burlington, VT ▪ 1993
M.P.A.
Areas of concentration: Program evaluation, financial management
University of Vermont, Burlington, VT ▪ 1988
B.S. (cum laude) in Education
Areas of concentration: U.S. History, Women's Studies
Minor: Mathematics

SELECT SCHOLARSHIP-GRANTS & PROPOSALS

2015 USDA-NIFA Beginning Farmers/Ranchers Development Program. 21st Century Management for Women Farmers. I will serve as PI for this national team. The project funds 10% of my salary. Funded at $720,989

2013 USDA-NIFA Proposal, *Optmization Plan for Entrepreneurs and Their Communities website*, $50,000 requested. I will serve as PI for the project. Funded at $37,500. This project will fund 5% of my salary.

2013 USDA-AFRI Proposal, *Improving The Quality Of Labor Management Decisions For Small And Medium-Sized Farm Operators,* $499,663 requested. I will serve as Project Director and co-PI for the project. Fully funded. This project will cover 10-20% of my salary over 3 years.

2012 USDA-NIFA Beginning Farmers/Ranchers Development Program. Whole Farm Planning for Women Farmers. I serve as PI on a subaward of $38,000. The full award received by Holistic Management International is $500,000.

2012 USDA-SARE Proposal, Enhancing Livestock Farm Viability through Pricing Education, Submitted, $121,650 requested. Not funded.

2011 USDA-NIFA Beginning Farmers/Ranchers Development Program. *The Vermont New Farmer Network*. Funded , $659,784. I serve as PI for this project and receive 20% salary support from the grant.

2011 USDA-NIFA Beginning Farmers/Ranchers Development Program. Expanding the Agricultural Individual Development Account Model: A Multi-State Collaborative Developing Asset Building for Beginning Farmers. This is an award received by California Farmlink for $720,000. I serve as PI for the UVM subaward of $38,605 to assist in the development of a unique pilot project serving youth.

SELECTED PRESENTATIONS

5th National Women in Sustainable Agriculture Conference. *The Art of Negotiation: Getting what you need*. Peer-reviewed workshop selection, 140 participants. Portland, OR, December 2, 2016.

5th National Women in Sustainable Agriculture Conference. *Unpacking the Farm Labor Puzzle: What women managers need to succeed*, 30 participants. Portland, OR, November 30, 2016.

Beginning Farmer Learning Network Annual Meeting. *Labor Solutions for Small and Mid-Sized Farms*, 20 participants. Invited presentation for service providers from the Northeast. Hartford, CT, November 10, 2016.

7th National Small Farm Conference. Social Media: Helping customers find the farmer, 40 participants. Invited pre-conference workshop for service providers. Virginia Beach, VA, September 20, 2016.

USDA-AFRI Project Directors Meeting. *Unpacking the Farm Labor Puzzle: What we've learned so far*, 45 participants. Invited presentation for AFRI Project Directors. Virginia Beach, VA, September 19, 2016.

USDA-BFRDP Project Directors' Meeting. *Women in Ag Learning Network Update*, 35 participants. Invited presentation for BFRDP Project Directors. St. Paul, MN, August 24, 2016.

2017 NEED/NERA Planning Grants Opportunity: Integrated Research and Extension Cover Page

Project Title: MidAtlantic Outreach and Education: Women in Agriculture

Team Members:

Name	Discipline	Affiliation (AES, CE, both, or other)	Institution/Agency/Other
Shannon Dill	AGNR	CE	University of Maryland Extension
Jennifer Rhodes	AGNR	CE	University of Maryland Extension
Megan Pleasanton	AGNR	CE	Delaware State University
Tracey Wootten	AGNR	CE	University of Delaware
Candy Hefel	AGNR	CE	University of Maryland Eastern Shore
Kim Morgan	AGNR	CE	Virginia Tech
Meredith Melendez	AGNR	CE	Rutgers, the State University of New Jersey

(Attach an additional sheet if more space is needed.)

Team Leader Contact Information:

Name:	Shannon Dill
Address:	
	28577 Marys Court Suite 1
	Easton MD 21601
Phone:	410-822-1244
E-mail:	sdill@umd.edu

Shannon Potter Dill

Extension Educator – Agriculture and Natural Resources
College of Agriculture and Natural Resources, University of Maryland Extension
East Region, Talbot County, 28577 Mary's Court, Suite 1- Easton, MD 21601
410-822-1244. sdill@umd.edu

EXPERIENCE

Extension Educator, AGNR 2001 – Present
University of Maryland Extension Talbot County, Forest Hill/Easton, MD

- Serve as a resource person for topics relating to agriculture and the community
- Develop and execute programs in order to educate the county on agriculture subjects
- Supervise nutrient management consultant, horticulture consultant and administrative assistant

County Extension Director 2002-2013
University of Maryland Cooperative Extension Harford/Talbot County, Forest Hill/Easton, MD

- Oversee and supervise office of eight
- Manage administrative and staffing responsibilities
- Create and manage office and personnel budgets

EDUCATION

M.S. Agricultural Economics, Dec. 2000, University of Wyoming, Laramie, Wyoming
B.S. Agricultural Business, Dec. 1999,University of Wyoming, Laramie, Wyoming
Public Agency Pesticide Applicator Certificate, Maryland Department of Agriculture, No. 8939-55374
Nutrient Management Consultant Certificate, Maryland Department of Agriculture, No 1862

TEACHING AND PROGRAM DEVELOPMENT

Selected Teaching
Nutrient Management Voucher Training, County Extension Office, 2001/14 - 293 Trained.
Pesticide Training, County Extension Office, 2001/14 - 496 Trained.
Equine Management, County Extension Office, 2001/14 - 89 Trained.
Small Farm Course, County Extension Office, 2002/2014 – 125 Trained.
Advanced Small Farm Course, County Extension Office. 2008/2009 – 22 Trained.
Direct Marketing, Regional Workshops, 2002/2014 – 160 Trained.
Business Planning, Regional Workshops, 2002/2014 – 204 Trained.
Enterprise Budgeting, Regional Workshops, 2005/2014 – 250 Trained.

SCHOLARSHIP

Selected Invited Talks

Potter, S. (2005). Introduction to Small Farm Enterprises - Fulfills Information Needs of Beginning Small Farmers. The National Association of Agriculture Agents Annual Conference (NACAA). Buffalo, NY. As the 2005 National Winner in Search for Excellence Young, Beginning, Small Farmers/Ranchers, this educator presented a 30 minute summary of small farm enterprise courses taught and impacts of the program to 25 peers. Invited by Association National President.

Potter, S. (2005). Constructing Small Farm Enterprise Budgets. National Small Farm Conference. Greensboro, NC. Educator presented a 40 minute presentation to 32 educators regarding small farm programs. Materials requested by WV for review and possible use.

Dill, S.P. (2014). Maryland Collaborative for Beginning Farmer Success. USDA Beginning Farmer and Rancher Program Professional Development Conference. Baltimore, MD. Invited to speak about the UME grant project to 65 participants.

Dill, S. P. (2010). Business Planning for Small Farms. Farming for Profits Conference. Dover, DE. Presentation on components of a business plan and considerations for small farm enterprises to 13 participants.

Dill, S. P. (2014). Business Planning – The Finances. University of Maryland Eastern Shore Small Farm Conference, Princess Anne, MD. Presentation included information on enterprise budgeting, spreadsheets and financial forms to 18 attendees.

Selected Publications

Beale, B., S. Dill and D. Johnson. (2008). 2008 MD Vegetable Enterprise Budgets EB371. Maryland Cooperative Extension (UME). 44pp. Collection of vegetable crop budgets. Educator researched current prices and reviewed the document.

Dill, S., B. Beale and D. Johnson. (2008). Farm Business Plan Workbook EB370. Maryland Cooperative Extension (UME). 60pp. Workbook that outlines the business planning process for farms. Educator wrote half of the publication and applied for a grant to fund printing.

Matthew, S., & Dill, S. P. (2012). Starting a Farm Enterprise in Maryland: Checklist. FS-946. UME. 4pp. A fact sheet listing resources and considerations when starting a farm enterprise. Adopted by the Maryland Beginning Farmer program.

Beale, B., Dill, S. P., & Shear, H. (2014). Beginning Farmer Guidebook. UME. 200+pp. Guidebook developed for the train the trainer workshops.

Selected Grants

2004. Potter, S. Mid-Shore Financial Management. Northeast Risk Management Agency. S. Potter was principal writer, investigator and manager of funds. Funds were used to develop and implement a Mid-Shore financial management workshop for farm businesses. $1,000.

2004. Potter, S. and B. Beale. Eastern Shore Business Planning. Northeast Center for Risk Management Education. S. Potter was co-writer, investigator and manager. Funds were used for an Eastern Shore business planning project to create a business planning workbook. $2,000.

2007. German, C., S. Dill, J. Berry, R. VanVranken, and C. Belcher. MidAtlantic Direct Marketing Conference. USDA/ Risk Management Agency. S. Dill serves as collaborator and conference committee member. Funds were used for the 2007 Mid Atlantic Direct Marketing Conference. $10,000.

Dill, S. P., & Rhodes, J. L. (2014). Women in Agriculture Educational Programs. NorthEast Center for Risk Management Education. $19,335. P.I., curriculum developer and instructor. Funds will be used to increase capacity for Women in Agriculture Programs statewide.

AWARDS AND HONORS

National Association of County Agriculture Agents (NACAA) Search for Excellence, Young, Beginning, Small Farmers/Ranchers. National Winner. 2005.

University of Maryland College of Agriculture and Natural Resources. Off-Campus Junior Faculty Award. 2008.

Amount Requested: $5,000
Delivery State(s):
Delaware, Maryland, New Jersey, Virginia

Abstract:
MidAtlantic Women in Agriculture Programs will educate, engage and empower women on common issues in risk management. The objective is to provide farm management training to women involving the five areas of risk management (production, legal, marketing, financial, human resource as defined by USDA) with an emphasis on business and financial training. Goals of the program include increased knowledge of risk management, how to implement risk decisions on the farm and to increase the profitability of farm enterprises. A team from MidAtlantic Universities have been collaborating since 2010 to offer a mix of web based, conference, coursework and hands-on activities.

What is the problem in need of a solution? Describe the mission, goals and need for the proposed planning activity.

Farming is a unique business that has strong ties to family, values and land. These strong ties lead to the need for outreach and education on risk management topics such as financial planning, marketing, recordkeeping, legal, budgeting, crop insurance and much more. As profit margins narrow and farm expenses rise the importance of mitigating these risks has increased. This is especially important for underserved, new and beginning farmers that may lack the knowledge and implementation of a risk or financial management plan.

To be profitable, farms must operate like a business and monitor their bottom line. This is supported by USDA which reports that nominal total production expenses have risen by 72% since 2002. These expenses cut into profit margins and force farms to make major production, marketing and business decisions. USDA economists state that farmers should expect a continuation of highly volatile crop prices over the next several years due to export demand, local markets and farm transfer.

To support the above issues the MidAtlantic Women in Agriculture programs have developed the mission of educating women in the areas of farm and risk management. Goals of the program include increasing knowledge of risk management and how to implement them on the farm. In 2008 Annie's Project began. It has evolved over the years through collaboration, adaption and application. Annie's Project in a national Extension program that launched in 2003 and began a 501c3 in 2015. The need for the proposal planning activity is to sponsor multi-state approved Annie's Project Facilitator training and conduct a regional meeting. This will provide the MidAtlantic area Annie's Project trained facilitators. With more facilitators the program has the ability to expand, reach new audiences, conduct coursework and have the ability to apply for grants.

Who is being affected: citizens, businesses or communities?

New and Beginning Farmers

In Maryland urban sprawl and development is on the increase. According to the 2012 Census of Agriculture, 49% of farms are less than 50 acres and 89% of farmers are part-time, working 100 or more days off the farm. This trend is expected to continue because of high land values and farming costs. These small farms and part-time farmers are looking for new enterprises to grow more intensely on small acreage and many of the land owners are new to farming.

Women in Agriculture

Women continue to be an important part of agriculture and the farm. The 2012 Census reports that 30% of all operators are women and 14% are principal operators. The northeast has higher concentrations of women farmers that other areas of the country. Research conducted by Barbercheck at Penn State in 2009 concluded that 46% of farm women surveyed preferred an all women audience. Furthermore, 58.7% of Extension educators surveyed felt that women audiences have educational needs that are somewhat or very different from those of their male farmer counterparts.

The MidAtlantic Women in Agriculture program has a contact list of over 1,000 participants. These are participants through our multiple programs and include farmers, service providers, educators, government and those with a general interest in agriculture. Annually we conduct the following programs:
1. One large conference reaching 180 participants from 4 states
2. Webinars twice a month reaching between 50-100 participants
3. Annie's Project Classes conducted in Maryland, Delaware and Virginia. Approximately 5 classes per year reaching 80 women. Annie's Project collects demographic information. We have reached a total of 598 participants. The average age is 46, in total they own 51,394 acres and farm 119,317 acres.

Justification for the planning activity

The MidAtlantic Women in Agriculture program is reaching its ten year mark. With that there are concerns over program development, participant saturation and marketing. The team that plans and conducts Women in Agriculture programs is situated across the region. Communication and program planning is generally conducted through email or conference calls. This allows the committee to discuss upcoming events and tasks however it does not create an opportunity for professional development, collaboration or future planning. This planning activity would bring the committee together for more discussion about the future of the program, marketing and curriculum. It would also allow for the committee members to become nationally certified as Annie's Project facilitators.

Potential for sustained external funding (what agencies?)

Local Sponsors – the women in agriculture program receives sponsorship dollars due to its collaboration and success of the program

NorthEast Center for Risk Management	USDA-FSA
USDA-NIFA	USDA-RME

Activities to be engaged in by team members

Team members will engage in the following activities:

- MidAtlantic Women in Agriculture Team Planning Meeting – A planning meeting will be an important activity including the discussion of current programs and curriculum and how to evolve it to the next level. It also includes marketing and how/who we should be reaching our audience as well as diverse audiences. Funding is another main objective of this team meeting which will review grant programs and priorities.
- Annie's Project Facilitator Training – Annie's Project is an Extension program that began in the MidWest and has adapted around the nation. In order to teach Annie's Project the newly formed 501c3 expects all facilitators (those conducting Annie' Project Classes) to be trained by the national office. An Annie's project facilitator training would be conducted in the MidAtlantic for all partners (12 will get certified).

Explanation of roles of team members (clear demonstration of integration)

MidAtlantic Women in Agriculture Programs have strong support from University of Maryland and partnering Universities (University of Delaware, Virginia Tech and Rutgers) including two 1890 Universities (University of Maryland Eastern Shore and Delaware State University). There are also numerous agency and private industry collaborators and partners that include accountants, financial advisors, government organizations, insurance companies, attorneys and computer specialists. They assist with curriculum and teaching as needed

Leveraging resources (do you have other sources of funding that can be leveraged?)

This program has other sources of funding which include conference and workshop fees, sponsors and Extension program dollars.

Women in Agriculture 2018 Planning

Women in Agriculture 2018 Planning		
Request		$5,000.00
Travel	Mileage (15 facilitators @ $0.575/mile *120 miles)	$ 1,035.00
Meeting Expenses	15 Facilitators*15 per person	$ 225.00
Annie's Project Training	National Office Travel and Fee	$ 3,000.00
Materials	Copies, Printing, Annie's Project Manuals	$ 740.00
Total		**$ 5,000.00**

Budget Justification:

1. Travel - Mileage reimbursement will include 15 member planning committee that will travel on average 120 miles each. Each individual is estimated to travel approximately 120 miles each and mileage is reimbursed at a rate of $0.575/mile for a total of $1,035.

2. Meeting Expenses – Include refreshments and lunch during the meeting. It is expected to be a 5 hour meeting.

3. Annie's Project Training – This will be an agreement with the national Annie's Project office. They have a fee and expenses to train facilitators around the country.

4. Materials – Printing, folders and supplies will be needed for both trainings.

2017 NEED/NERA Planning Grants Opportunity: Integrated Research and Extension Cover Page

Project Title: NE Vegetable IPM Working Group Meeting

Team Members:

Name	Discipline	Affiliation (AES, CE, both, or other)	Institution/Agency/Other
Ann Hazelrigg, PI	Plant Pathology	AES/CE	UVM Extension
Vern Grubinger	Vegetable Specialist	CE	UVM Extension
Katie Campbell-Nelson	Vegetable Specialist	CE	UMASS
Angie Madeiras	Plant Pathologist	CE	UMASS
David Handley	Vegetable and Berry Specialist	CE	UMAINE
Becky Sideman	Vegetable Specialist	AES/CE	UNH
George Hamilton	Vegetable Specialist	CE	UNH
Cheryl Smith	Plant Pathologist	CE	UNH
Kristian Holmstrom	IPM Veg Specialist/Entomolo	CE	Rutgers
Heather Faubert	Plant Pathologist	CE	URI
Andy Radin	Vegetable Specialist	CE	URI
Meg McGrath	Vegetable Pathologist	AES	Cornell
Amy Ivy	Vegetable Specialist	CE	Cornell
Andy Wyendandt	Vegetable Pathologist	CE	Rutgers
Beth Gugino	Vegetable Pathologist	CE/AES	Penn State
Eric Sideman	Vegetable Specialist	Maine Organic Farming	MOFGA
James Lamondia	Pathologist/Nematologist	AES	UConn

Abby Seaman	IPM Veg Specialist	CE	Cornell
Marion Zuefle	IPM Veg Specialist	CE	Cornell

(Attach an additional sheet if more space is needed.)

Team Leader Contact Information:

Name:	Ann Hazelrigg
Address:	Jeffords Hall, 63 Carrigan Drive
	University of Vermont
	Burlington, VT 05405
Phone:	802.656.0493
E-mail:	ann.hazelrigg@uvm.edu

NEERA2017 NEED/NERA Planning Grants Opportunity: Integrated Research and Extension
Northeast Vegetable IPM Working Group Meeting

Vegetables are an economically important crop throughout the Northeast. In the New England states, the farms are generally small and diversified and vegetables are marketed fresh through wholesale avenues, local on-farm stands and through Community Supported Agriculture (CSAs) shares. The total acres in fresh market vegetable production in New England is approximately 110,000 acres (USDA NASS, 2015). In the Northeastern states of New York (135,997 fresh market acres), Pennsylvania (49,397 fresh market acres) and New Jersey (50,396 acres harvested vegetables), larger farms are more common, and in addition to similar markets as those represented by the small diversified farms in New England, several acres of vegetables are grown for processing (USDA NASS, 2012). Both conventional and organic farms are represented throughout the Northeast. In recent years, many farms throughout the region have incorporated the use of high tunnels for high value crops such as tomatoes and cucumbers. These tools have lengthened growing seasons, offered protection from pests and diseases and have mitigated the effects of climate change on farms. However, new insect and disease issues can emerge with these crop production systems.

Pest and disease identification and knowledge of successful integrated pest management strategies are crucial for the successful vegetable farm. Vegetables can be difficult to grow in the humid Northeast and there is no shortage of new and emerging pest and production constraints challenging growers. Particularly challenging to farmers are the diseases late blight of tomato and potato, black rot of crucifers, new emerging races of downy mildew on spinach and a new destructive potato disease, Dickeya black leg. Vegetables are also attacked by variety of pests, including potato leafhopper and striped cucumber beetle in addition to new and emerging pests such as Swede midge and onion leek moth among others. As both funding and people resources to address vegetable production issues become increasingly more limited, there is an even greater need to coordinate efforts across the region to address production constraints that are not limited by state boundaries. With recent and upcoming vacancies in the vegetable program at UMass (Ruth Hazard, Vegetable IPM Specialist and Entomologist and Rich Bonanno, Vegetable Weed Specialist) and University of Connecticut (Jude Boucher, Vegetable IPM Specialist) we continue to lose IPM, entomology and weed science expertise further eroding long term regional collaborations. Regionally, we expect to see several more retirements in the next few years and University budgets seem to be continuously strapped leaving uncertainty about whether positions will be refilled. Meanwhile, many new and remaining Extension Educators continue to conduct research and education in areas requested by our stakeholders. In the Northeast, several of the IPM and vegetable specialists are approaching retirement age, making it imperative to strengthen existing collaborations in the region for future grant efforts and to work with the younger educators to help them successfully implement IPM practices/IPM knowledge into their programs.

The vegetable and IPM specialists in the region have a track record for successful grant and educational collaborations, including editing and updating the NE Vegetable IPM Management Guide, serving on the Northeast Vegetable and Berry Conference steering committee, development of a regional Vegetable IPM Scouting Network (New England Fruit and Vegetable Pest Scouting Network grant, NE IPM Center 2012-2014-Campbell-Nelson, Hazelrigg

and Radin) with weekly pest alert calls in the growing season, coordinated multi-state pest scouting and reporting, and two regional grants, "Training the trainers: Expanding the use of seed heat treatment for management of bacterial diseases of tomato in the mid-Atlantic and surrounding region", (NE IPM Center, 2011-2013-Rutgers, Cornell) and "Decision Support System for tomato and potato late blight" (NE IPM Center 2010-2012, Cornell), among others. However, we rarely have time to meet as a group to discuss vegetable pest and disease issues and IPM management. We would use these funds to defray costs for a meeting to strengthen regional collaboration, identify future grant priorities and support professional development of new and existing Extension and research professionals.

We propose a two day meeting (actually 1 half day for 2 days) with approximately 20 vegetable and pest management specialists with extension/research appointments in addition to organic organization vegetable specialists. The group will include representation from all the states in the Northeast region: NY, PA, NJ, ME, NH, MA, RI, CT and VT. The group will focus on vegetable pest and disease issues and IPM in both conventional and organic pest management systems. We will also address emerging problems and those pest/disease problems encountered with innovative systems that help mitigate effects of climate change such as the use of high tunnels, use of plasticulture and the expanding use of drip irrigation, etc. Our first half day will be spent sharing new and recurring disease and pest problems and describing research and outreach efforts in each of our states. Each state represented will have adequate time to present slides, discuss subject-relevant websites and share written resources. We will discuss IPM strategies in each crop, and discuss the efficacy and use of biologicals, bio-rational and conventional pesticides as last resort options for management. The evening will be spent informally, allowing time to network. The group will reconvene after dinner to finish the presentations and sharing. The next day will be spent identifying education and research priorities for future work in addition to identifying funding opportunities for future grants. We will also discuss the possibility of leveraging existing resources. We will identify and develop 2-3 person teams to pursue different topics/grant opportunities. The rest of the work will be accomplished through emails and periodic conference calls with the goal to be at least one successful grant as a result of the meeting.

Potential for future funding sources for our group may include the NE IPM Center Partnership and Working Group Grants, SARE-NE plus the USDA AFRI and USDA Specialty Crops Research Initiatives grants. We also may have opportunities within each of our state Departments of Agriculture that can be identified.

Objectives and Timeline:

Fall/Winter 2017-2018:

- **Objective 1**. Hazelrigg with input from group will select a central site and invite a group of ~20 Northeast vegetable and IPM specialists including researchers, extension personnel and organic association technical personnel to participate in a Northeast Vegetable IPM Working Group meeting.
- **Objective 2**. To share existing and emerging disease and pest problems in each state and discuss current and new IPM management strategies. Each state represented will have

adequate time to present slides and have ample time for in-depth discussions. We will address gaps in knowledge among vegetable stakeholders for future education.

- **Objective 3**. To discuss current grant research, educational resources, and outreach efforts in vegetables and pest management in each state.
- **Objective 4.** To identify and collaborate on critical education and research opportunities for vegetable crops across the region.
- **Objective 5**. Identify grant opportunities and topics to be addressed. These will be explored/developed further after the meeting through emails/conference calls. Several teams may be evolve depending on topic and funding source.

Winter/Spring/Summer 2018

Objective 6. Write collaborative grant (s) as identified at the meeting.

Bibliography and References Cited:

USDA NASS. 2012. Agricultural Census. Volume 1, Chapter 1. State Level. http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/

USDA NASS. 2015. NE Fruit and Vegetable Report New Release. April 24, 2015 http://www.nass.usda.gov/Statistics_by_State/New_England_includes/Publications/Special_Reports/eos2015v2.pdf

NEED/NERA Planning Grant
Budget Justification/Budget Narrative

PD (Lead Institution): Ann Hazelrigg, University of Vermont
Project Title: NE Vegetable IPM Working Group Meeting

Total Cost: $5,000

Travel:
Hotel and meal costs are estimates for early/mid-week (Tuesday-Thursday late fall 2017) rates to minimize costs.

Hotel: Rooms for 20 attendees estimated at $130 for 1 night are **$2600.**

Meals-will include 1 breakfast, 1 lunch, 1 dinner, snacks and coffee for 20 are estimated at $100 per person including tax and gratuities equals **$2000.00**

Travel Total $ 4600

Other costs: $400

This will cover meeting room costs and any audio visual costs.

Total Direct Costs: $ 5,000

Total Requested: $5,000

Ann Hazelrigg, Ph.D.
Assistant Professor
Plant and Soil Science Department
Jeffords Hall
63 Carrigan Drive University of Vermont
ann.hazelrigg@uvm.edu 802.656.0493

Education

Colorado State University	Horticultural Science	B.S., 1977
Cornell University	Pomology/Plant Pathology	M.S., 1981
University of Vermont	Plant and Soil Science	Ph.D., 2015

Research and Professional Experience:

Assistant Professor, UVM Plant and Soil Science Department	2015 to present
Extension Instructor UVM Plant and Soil Science Department	1986-2015
Research Field Technician IV, UVM Plant and Soil Science Department	1982-1986

Synergistic Activities:
VT Plant Diagnostic Clinic Director.
Oversight of UVM Master Gardener Program
VT IPM Coordinator
VT Pesticide Education and Safety Program Coordinator
VT Northeast Plant Diagnostic Network Coordinator (NEPDN)
VT Urban Forestry Council Chair
Advisory Board of VT Vegetable and Berry Growers
Steering Committee member New England Vegetable and Fruit Growers Assn.
Chair, NE Small Fruit IPM working group
Member, NE Tree Fruit IPM working group
Member, Great Lakes Vegetable Working Group
Member, NE SWD Working Group
New England Vegetable Management Guide disease section contributor
New England Fruit Management Guide- disease section contributor

Newsletters: Regular contributor to multi-state newsletters for vegetable growers:

- **VT VEG and BERRY bi-weekly listserv (Grubinger, V.) Newsletter listserv** Regular contributor to for vegetable farmers on disease and pest observations from the Plant Diagnostic Clinic and the field.
- **UMASS Vegetable Notes. (Campbell-Nelson, K.) Newsletter Weekly contributor** to online newsletter "UMASS Veg Notes" on pests and diseases on VT vegetable farms (Weekly scouting at Intervale Community Farm, UVM Horticultural Research Farm and Jericho Settlers Farm) that reaches 2,128 New England commercial growers, university researchers, industry personnel, crop consultants and extension personnel. **https://ag.umass.edu/vegetable/newsletters**

New England Vegetable IPM Management Guide. 2000-present. Contributor, reviewer for disease portions with current pesticide and cultural management recommendations. https://nevegetable.org/

New England Fruit IPM Management Guide. 2000-present. Contributor, reviewer for disease portions with current pesticide and cultural management recommendations. http://ag.umass.edu/fruit/ne-small-fruit-management-guide

External Funding with cooperation across state lines-(Does not include all grants).

Pending:

Colley, M., B. Brouwer, H. Darby, A. Hazelrigg, L. Winkler and J. Zystro. USDA-NIFA-OREI. Assuring quality and expanding variety choice in organic small grain stock seed. 9/1/2017-8/31/2021. **$1,073,270**

Sabbatini, P. (PD), Hazelrigg, A. (PI) plus 41 other CO-PIs. USDA Specialty Crops Research Initiatives. $7,526,444. 10/1/2017-9/30/2021. *Northern Grape Project II: Optimizing Crop Management, Enology, and Marketing for Sustainable Wine Industries in Nontraditional Viticultural*

Funded Grants:

Darby, H. and Hazelrigg, A.L. Organic Seed Alliance Grant. NIFA. Strengthening Organic Grains Breeding and seed systems. 9/30/16-9/30/20**. $337,684-VT**

Mallory, E. et al. (Hazelrigg, A.L. Key Personnel). OREI. Helping Farmers Design Durable Organic Grain Systems-Innovative Sowing, cultivation and rotation strategies to address weed, fertility and disease challenges in organic food and feed grains. 9/1/15-8/31/19. $999,120 ($399,297-VT)

Hazelrigg, A.L. NE IPM Center. Grape Pest Management Strategic Plan. $20,000 4/1/16-3/31/18

Bradshaw, T.L. and Hazelrigg, A.L. NE IPM Center. Unique IPM Needs in Northeast cider orchards. 4/1/16-3/31/18. $48,426

Hazelrigg, A.L. NE IPM Center. Strawberry Pest Management Strategic Plan. 4/1/14-3/30/16 (Co PI: Kingsley-Richards). **$20,000**

Campbell-Smith, K. NE IPM Center. New England Fruit and Vegetable Scouting Network. 4/1/14-3/30/16. (Co PI: Hazelrigg, Radin). $49,380

Davis, T. Tri State Hatch. Assessing the Potential for Emergence of New Cropland Weeds in Northern NE Region as a Consequence of Climate Change. 6/1/13-5/31/14-NCE 12/15). (Co PI: Smith, Gallandt, Hazelrigg, Bosworth). **$120,000**

Relevant Publications:

Hazelrigg, A.L. and S. Kingsley-Richards. 2017 Grape Pest Management Strategic Plan for Northeast Growers. *In press.*

Richard G. Smith, Sonja K. Birthisel, Sidney C. Bosworth, Bryan Brown, Thomas M. Davis, Eric R. Gallandt, Ann Hazelrigg, Eric Venturini, and Nicholas D. Warren. 2016. Environmental correlates with germinable weed seed banks on organic farms across northern New England. Journal of Weed Science. *In press.*

Hazelrigg, A.L. and S. Kingsley-Richards. 2015. Strawberry Pest Management Strategic Plan for Northeast Growers. http://www.northeastipm.org/neipm/assets/File/Strawberry-PMSP-2015.pdf

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2017 NEED/NERA Planning Grants Opportunity: Integrated Research and Extension Cover Page

Project Title: A Collaborative Extension Program for Developing Sustainable Recreation Economies

Team Members:

Name	Discipline	Affiliation (AES, CE, both, or other)	Institution/Agency/Other
Doug Arbogast	Rural Tourism Specialist Co-Chair National Extension Tourism Team	CE	West Virginia University Extension Service
Daniel Eades	Rural Economist	CE	West Virginia University Extension Service
Doolarie Singh-Knights	Assistant Professor Agribusiness Economics and Management	AES, CE	West Virginia University Extension Service
Lisa Chase	Natural Resource Specialist	CE	University of Vermont Extension
Geoffrey Sewake	Extension Field Specialist	CE	University of New Hampshire Extension
Charlie French	Program Team Leader	CE	University of New Hampshire Extension Community and Economic Development Program
Miles Philips	Associate Professor, Tourism and Business Development	CE	Oregon State Extension Sea Grant
Frank Burris	South Coast Watershed Educator	CE	Oregon State Extension Sea Grant

Team Leader Contact Information:

Name:	Doug Arbogast
Address:	701 Knapp Hall/PO Box 6031
	Morgantown, WV 26501
Phone:	304-293-8686
E-mail:	Doug.arbogast@mail.wvu.edu

I. Mission and Goals of the Proposed Program

National Extension Criteria for Developing Recreation Economies - Increased demand for outdoor recreation in rural areas has motivated an increased demand for community's to provide products and services to support the recreation economy yet a clear understanding of the products, facilities, and services needed to provide visitors with a quality experience and local residents with a high quality of life is lacking. Furthermore, there is limited intentional integration of individual research and extension efforts related to the recreation economy in the region. Extension tourism professionals have recognized the need for common guidelines and criteria for developing successful and sustainable recreation economies and the sharing of best practices.

Recreation Economies Performance Indicators – Rural communities in the Northeast lack research-based performance indicators to measure and evaluate their strengths and weaknesses and clearly identify where additional resources are needed to enhance the recreation economy. This group of stakeholders has indicated an interest in identifying those indicators and developing an integrated process for measuring and evaluating these performance indicators and sharing best practices. A regionally integrated research and extension network would be best suited to delivering this programming.

A National Model Recreation Economies Integrated Planning and Development Process - An opportunity exists to create a national model for developing sustainable recreation economies through USFS, USDA, Land Grant University, and local and regional partnerships that can be coordinated and shared through the National Extension Tourism Design Team and Extension programs throughout the country. The team of Extension specialists assembled and coordinated through the National Extension Tourism Design Team is uniquely qualified to meet this need and capitalize on this opportunity.

II. Justification for the Program Relative to Stakeholder Needs and Potential for Sustained External Funding

The outdoor recreation economy generates $646 billion in spending including $524.8 billion on trips and travel- related spending that each year supports 6.1 million direct jobs and $80 billion in federal, state, and local tax revenue (Outdoor Industry Association, 2012). According to the OIA, outdoor recreation is a growing and diverse economic super sector that is a vital cornerstone of successful communities that cannot be ignored. Most importantly, outdoor recreation is no longer a "nice to have," it is now a "must have" as leaders across the country recognize the undeniable economic, social and health benefits of outdoor recreation. Cities and towns across the country are tapping into the business of outdoor recreation recognizing that outdoor recreation and open spaces are key ingredients to healthy communities, contribute to a high quality of life, and most importantly, attract and sustain businesses and families (Outdoor Industry Association, 2012).

Yet, many rural communities lack the capacity and resources needed to successfully support and capitalize on the recreation economy. In response to these trends, USDA's Forest Service (FS), Rural Development (RD), and the National Institute for Food and Agriculture (NIFA) have developed a Recreation Economy resource guide for field staff use to improve the coordination of delivery of assistance. The main goal of the toolkit is to empower Rural Development field staff and Forest Service district rangers in identifying funding and technical assistance resources and best practices available to best support small business development in the communities they serve, enhance the local recreation economy, improve quality of life for locals and the positive experiences of visiting recreation enthusiasts. The objectives of the toolkit include encouraging both Rural Development field staff and Forest Services District Rangers' to collaborate with the Cooperative Extension System within the Land Grant University System, which has broad educational, research and technical assistance resources that can help with planning associated with the recreational economy.

Since the Recreation Economies Resource Guide seeks to encourage collaboration among USDA RD and USFS field staff to improve the coordination of delivery of assistance to grow recreation economies, a team of Extension Specialists has recognized an opportunity for multi-state, collaboration to develop an integrated research agenda to support the development of sustainable recreation economies. While each of the team members are actively engaged in tourism and recreation related planning, research, training, and development efforts, a coordinated Extension program to support recreation economies is

Members of this team recently collaborated on a Regional Collaboration of Successful CRD Extension Programs Planning Grant awarded by the Northeast Regional Center for Rural Development to share scholarship and innovations in the First Impressions Program. The current proposal would allow for continuity of the team's collaborative efforts to continue to develop and share Extension programming to develop sustainable destinations and result in a strong proposal in the next National Institute of Food and Agriculture (NIFA) Agriculture and Food Research Initiative (AFRI) Coordinated Agricultural Project (CAP) Research, Education, Extension, or Integrated Project proposal round for an expanded project.

III. Activities to be Engaged in by Team Members

We propose an in-person organizing meeting to develop a consolidated, regional vision and process for collaboration through Extension, USDA RD, USFS, and local partners in developing and supporting the recreation economy as the recreation economy has been recognized by USDA as an emerging or priority area of national need. This would enable more effective follow-on meetings held via teleconference or web-conference in order to prepare a successful AFRI proposal and collaborate in general.

The primary purpose of the meeting is to enable a focused discussion of currently ad-hoc and disparate recreation economy research, extension and education throughout the Northeast US. The meetings proposed would enable two dimensions of engagement; (1) a dedicated forum for sharing of past, current and proposed research and education among this cohort and (2) discussion and planning related to a coordinated and shared research, planning and education process to develop recreation economies. A key outcome would be a consolidated statement of stakeholder needs associated with developing recreation economies, a research agenda associated with those needs that such a collaborative process could address, and roles and responsibilities of key partners for successful program implementation.

This project would allow for an integrative, multi-state strategic planning activity among collaborating recreation economy research and extension professionals in the northeast US along with support and guidance from a western state actively engaged in developing recreation economies through partnerships with the agencies identified as key partners in the proposal. The intent is to provide an opportunity to think collectively about the needs of the various stakeholders in order to collaboratively conduct appropriate future research in National Forest communities. A concerted planning effort would help to define a larger project and future funding requirements, as well as outline a plan for execution of the idea.

Defining the scope of research and extension activities to be performed within such a collaborative, multi-state program will help to clearly plan for effective partnerships, funding requirements, and roles and responsibilities of key national, state, and local personnel. The output of this activity would be useful for other regions of the U.S. interested in developing recreation economies through a similar collaborative planning and development process.

IV. Explanation of Roles of Team Members

Project Leader / PI – Doug Arbogast will assume the role of project lead. This role will provide central organization of the activities of the project including meeting logistics, facilitation and communication. The lead will also be responsible for project financial administration.

Meeting Organizing Committee – A subset of the Project Team tasked with planning for an effective and successful first meeting. Tasks will include supporting the project lead with logistics and planning as well as co-authoring a meeting agenda and white paper intended to foster discussion on the topic.

Project Participants – The entire team listed on the cover page will be considered project participants. This is the cohort who will be solicited for input during active visioning and brainstorming sessions. Members of this group will also be encouraged to identify other faculty in their organization with interest in future participation and grant proposals as well as carrying the team's ideas into a formal proposal for funding to NIFA-AFRI or other funding sources by the appropriate grant deadlines.

V. Timetable for Completion of the Planning Activities and Preparation of a Competitive Proposal

December 2017	Finalize schedule, location and attendance for visioning meeting. Identify organizing committee.
January 2018	Hold in-person meeting. Project leader to consolidate input and distribute summary and revised white paper.
February 2018	Hold web-conference to finalize project vision, scope and proposal outline. Identify working committee to finalize proposal.
April 2018	Team review of proposal.
May 2018	Submit AFRI proposal

VI. Budget for Planning Activities (travel, meeting expenses, etc.) not to exceed $4,000

TRAVEL: 8 attendees, 2 round trip flights from OR and 3 from WV, 2 rental vehicles, mileage	$2,350
LODGING: 8 attendees, one night accommodation, 1 meeting, $100 per room	$800
MEETING SPACE: 1 in-person meeting, central location, $626	$626
MEALS: Breakfast, lunch, & dinner, 2 days ($76.50 per person/day, 8 people)	$1,224
Total NEED-NERA Request	**$5,000**

VII. Leveraging Resources

Resources being leveraged toward this project will likely be indirect. The team will initiate this activity by sharing results of separately funded work either past, current or proposed. In some cases travel and other expenses associated with the planned activity may be covered under other project funding available to participants. The proposed budget above is intended to ensure attendance by a core number of participants regardless of availability of other funding. However, other funding will likely enable increased attendance and enrich the discussion resulting in a better proposal and identification of additional funding sources for project implementation.

VIII. References

Outdoor Industry Association. (2012). *The outdoor recreation economy*. Boulder, CO. Retrieved from https://outdoorindustry.org/pdf/OIA_OutdoorRecEconomyReport2012.pdf

Recreation Economy Resource Guide (2017). United States Department of Agriculture

American Recreation Coalition. (2016). *Outdoor recreation outlook*. Prepared for TTRA 2015 Marketing Outlook Forum. Retrieved from http://www.funoutdoors.com/files/Outdoor%20Recreation%20Trends%202016.pdf

IX. APPENDIX A - CV of Team Leader – As an appendix (two page maximum) demonstrating track record of leading cross-disciplinary and/or multi-institutional collaborations

Douglas W. Arbogast Curriculum Vitae (abbreviated)

701 Knapp Hall, PO Box 6031, Morgantown, West Virginia 26505
304.293.8686 doug.arbogast@mail.wvu.edu

EDUCATION & LICENSURE

2005	MS - Recreation, Parks, and Tourism Resources. West Virginia University. Morgantown, WV
2001	B.A. - Environmental Geo-Science, West Virginia University. Morgantown, WV
2004	Ecotourism Planning and Management Certificate, Humboldt State University

ACADEMIC AND PROFESSIONAL EXPERIENCE

2012-Present	Extension Specialist, Rural Tourism Development, West Virginia University, Morgantown, WV
2007-2012	Principal, Travel Green Appalachia, Fayetteville, WV.

PUBLISHED INTELLECTUAL CONTRIBUTIONS

Eades, D. C., Arbogast, D. W., Kozlowski, J. C. (2017). Life on the 'Beer Frontier': A Comparative Case Study of Sustainable Craft Beer Tourism in West Virginia. C. Kline, S. Slocum, & C.T. Cavaliere (Eds.), Craft Beverages and Tourism, Volume 1 – The Rise of Breweries and Distilleries in the United States.. Basingstoke: Palgrave MacMillan.2013 C. Callahan and H. Darby. A Mobile Hops Harvester: User-based, Public Domain Design and Shared Infrastructure in an Emerging Agricultural Sector. 2014 ASABE Annual Meeting presentation and subsequent publication.

Arbogast, D. W., Smith, M. (2016). Investigating Differences in Generational Travel Preferences: The Case of New River Gorge, West Virginia. Journal of Tourism and Leisure Studies, 16(4), 19-29. http://ijk.cgpublisher.com/product/pub.337/prod.16

Deng, J., McGill, D. W., Arbogast, D. W. (in press). Perceptions of challenges facing rural communities: An importance-performance analysis. Tourism Analysis.

Arbogast, D. W., Smaldone, D. A., Balcarczyk, K. (2015). Evaluating the West Virginia Interpretive Guide Heritage Steward Program. Journal of Interpretation Research, 20(2), 34-40.

Maumbe, K., Arbogast, D. W. (2015). Relationship between visitor motivations, destination evaluation and future behavior intentions: The case of West Virginia. Tourism, 63(4), 465-478.

Balcarczyk, K., McKenney, K., Smaldone, D. A., Arbogast, D. W. (2013). West Virginia interpretive guide training: a collaborative effort. Journal of Extension, 51(6).

Bender, M., Deng, J., Selin, S. W., Arbogast, D. W., Hobbs, R. (2008). Local residents' attitudes toward potential tourism development: a case of Ansted, WV. Tourism Analysis, 16(5).

PRESENTATIONS (selected)

Arbogast, D. W., Northrop, A. (Presenter), National Association of Community Development Extension Professionals, "How your work impacts tourism: connecting with colleagues and resources," Burlington, VT. (June 28, 2016).

Arbogast, D. W., Ford, S. (Presenter), National Association of Community Development Extension Professionals, "West Virginia Welcome: Improving the Skills of Frontline Hospitality Employees through Online and Classroom Training," Burlington, VT. (June 27, 2016).

Arbogast, D. W., Eades, D. C., Nichols, A. H., National Association of Community Development Extension Professionals, "Implementing the First Impressions Program: A Hands-On Practicum Pre Conference Workshop," Burlington, VT. (June 26, 2016).

Arbogast, D. W., West Virginia Master Naturalists Annual Educational Conference, "Interpretive Guide Training and Master Naturalists," West Virginia Division of Natural Resources, North Bend State Park, Ritchie County, WV. (June 10, 2016).

Arbogast, D. W., WV Small Farms Conference, "Tourism trends and opportunities for West Virginia," Charleston, WV. (February 26, 2016).

GRANTS & CONTRACTS

2016 Arbogast, D. W., Eades, D. C., Butler, P. M. I., Faulkes, E., Deng, J., "Participatory planning and social design for cultural tourism in Tucker County, WV," Sponsored by Benedum Foundation, Private, $60,000.00. Trans-disciplinary Team Leader

2016 Arbogast, D. W., Eades, D. C., Kozlowski, J. C., "Life on the Beer Frontier: a Case Study of Craft Beer and Tourism in West Virginia," Sponsored by West Virginia University Extension Service, West Virginia University, $2,000.00. Co-PI.

2015 Arbogast, D. W., Singh-Knights, D., "Agritourism initiative training in Monroe, Pocahontas, and Greenbrier counties," Sponsored by WVU Community Engagement Grant, West Virginia University, $4,585.00. Co-PI

2015 Arbogast, D. W., Eades, D. C., "Sharing Scholarship and Innovations in the First Impressions Program," Sponsored by Northeast Regional Center for Rural Development, Federal, $10,000.00. Co-PI

2014 Arbogast, D. W., Eades, D. C., "The Face of Change," WVU Faculty Research Grant. $15,478.13. PI.

SERVICE

2017	Co-Chair National Extension Tourism Design Team
2015-Present	Program Coordinator – WVU Rural Tourism Design Team

X. APPENDIX B - Proposed Meeting Agenda

Participants and Affiliations per Organizing Committee Roster

Location: Vermont

Date: Fall, 2017

9:30 – 10:00	Introductions & Meeting Logistics
10:00 – 12:00	Research, Extension, Education and Problem Statement Summaries from participating researchers, extension educators. Eight committee members @ 15 minute summaries with Q&A and breaks. Summary of (1) current activity/business summary, (2) progress/findings of note, (3) research questions/key challenges, (4) key partners are their roles in developing recreation economies.
12:00-13:00	Lunch
13:00 – 15:00	Facilitated brainstorm session on development of multi-state sustainable recreation economies criteria and performance indicators. Purpose, Vision, Mission, Goals and Objectives to be established. Initial research questions to be explored and review of collaborative funding proposals. Rough outlining of plan for AFRI proposal based on discussion.
15:00-16:00	Identification of roles and responsibilities for next meeting to assist in identification of demonstrated needs in further developing and implementing the recreation economies development process and completing funding proposal(s). Identification of working team for proposal drafting and logistics. Plan for follow-on meeting schedule.

2017-18 Planning Grants Program

Project Title: Increasing Local Food Production with Value-Added Processing in the Northeast

Team Members:

Name	Discipline	Institution/Agency/Other
Amanda Kinchla (Confirmed)	Food Science: food safety, HACCP, food safety education, food product development, application research	Extension Assistant Professor/ Food Science Department, **University of Massachusetts (MA)**
Dan Lass (Confirmed)	Resource Economics: econometrics, regional farm operation decisions	Professors, Resource Economics **University of Massachusetts (MA)**
Jason Bolton	Food Science: food processing, food safety, extension, application research	Assistant Professor, **University of Maine (ME)**
Jill Fitzsimmons (Proposed)	Resource Economics: supply chain analysis, imperfectly competitive markets, regional food systems	Agricultural Marketing Specialist / PhD Candidate **USDA Agricultural Marketing/ University of Massachusetts (MA)**
Miguel Gomez (Proposed)	Economics: Community, Local, and Regional Food Systems	Associate Professor, Dyson School, **Cornell University (NY)**
Erbin Crowell (Proposed)	Association of over 30 food co-ops; sustainable regional food system and community enterprises	Executive Director, **Neighboring Food Co-Op Assoc. (VT)**
Eric Stocker (Proposed)	Food distribution center	Owner, **Squash Inc. (MA)**
John Waite (Confirmed)	Regional food processing facility	Executive Director, **Franklin County Community Development Corporation, Food Processing Center (MA)**
Sean Buchanan (Proposed)	Food distribution center: operations management, business expansion, business sustainability	President **Black River Produce (VT)**
Kenneth Foppema (Proposed)	Vegetable production	President/ Farmer, **New Eng. Vegetable & Berry Growers Association (MA)/ Foppema Farm**
Dale Riggs (Proposed)	Vegetable production	President/Farmer **New York State Berry Growers Association/ The Berry Patch (NY)**
Andy Fellenz (Proposed)	Organic fruit and vegetable production	Coordinator, **NOFA-NY**
Mike St. Clair (Proposed)	Urban retail sales	General Manager, **Harvest Coop Markets (MA)**

Team Leader Contact Information:

Name: Amanda Kinchla
Address: University of Massachusetts, 102 Holdsworth Way, Chenoweth Laboratory, Amherst, MA 01003
Phone: 413-545-1017; Fax: 413-545-1262
Email: amanda.kinchla@foodsci.umass.edu

Mission and Goals of the Proposed Program

Food systems entrepreneurs have an opportunity to meet strong consumer interest for local and regional foods by expanding local food production through value-added processing, however, limited research and extension technical support are currently available for successful implementation. This proposal seeks financial support for an in-person meeting of multi-state partners, within and outside of the northeast extension network, to build an integrated research agenda and funding strategy that is mutually beneficial to relevant food processing supply chain players. ***The goal of this meeting is to develop an integrated research agenda and funding strategy to address the challenges of developing and disseminating information required to determine the profitability/ viability of a local value-added supply chain for key supply chain actors: farmers, processors, distributors, and retailers.*** This meeting is aimed at sharing current knowledge, research and outreach capabilities of the Extension network, establishing a broader research agenda and a focused strategy to address this critical need with stakeholders and to promote regional collaboration for future funding.
The planning strategy will specifically focus on:

- Identifying a centralized data management system among the partners (research, extension and industry) to share research information.
- Develop a research agenda and approach for conducting consumer market research studies and food product development research to promote economic viability for local producers.
- Build a strategy for future grant funding to provide the technical resources to further support northeast producers and processors
- Identify resources to further enhance regional programming and training to meet the needs of northeast processors.

Justification for the program relative to stakeholder needs and potential for sustained external funding

It is anticipated that sales of fresh produce will increase 18% by 2019(Mintel, 2014). Furthermore, according to Mintel, consumers are more inclined to source locally grown fresh produce (64%)(Bloom, 2014). This is because consumers value the freshness of locally sourced foods and there is a strong interest in supporting local economies (Bloom, 2014). The industry research firm Business Insider reported that local food sales in the U.S. grew from $5 billion to $12 billion between 2008 and 2014, and estimates that sales will continue to grow to $20 billion in 2019, faster than total food and beverage sales (Hesterman, 2017). Small and medium scale growers in the northeast are challenged to offer year round products due to the shorter agricultural season. There is a strong need to conduct research and provide technical support through extension programming specific to regional-scale value-added processing. Value-added processing for local produce is an approach to help improve the local economy, increase the viability and sustainability of local agriculture, and provide consumers with local food options year round. However, market opportunities for local produce products have not been assessed to better understand the true value of local including product attributes such as “local”, “healthy” and “environmentally friendly” that are valued by consumers and impact their buying preferences. Conducting the research that assesses the market opportunities (market research and product development) will help farmers focus on specific produce varieties and determine if value-added products have economic impact in the northeast. Furthermore, building a strategy that helps to identify a research and development strategy alleviates the financial burden of business development for individual growers and capitalizes on maximizing regional outreach for technical support.

This group will foster collaboration that promotes integration of research and extension aimed to 1) share the working knowledge collected in this area, 2) discuss the application challenges in-field, 3) build an integrated research approach that leverages the capabilities of the collaborative partners, 4) addresses the stakeholder needs within the northeast.

Program Sustainability

Over the past several years, the northeast region has been able to utilize NEED/NERA funded support as a means to establish collaborations, identify strategic approaches and secure funding to help better address the regional needs of the northeast. Most recently, a 2015 NEED/NERA facilitated coordination of the Northeast Postharvest Research and Extension Service Hub (NE-PHRESH). Through this established and collaborative network, the team was able to coordinate, submit and receive $1M funding from the FDA for the Northeast Center to Advance Food Safety (NECAFS). The legacy of previous planning support has demonstrated historical success and sustainability. The requested funding aims at leveraging new food system collaborations that will include a diverse group of disciplines (extension, researchers, retail, producers and processors) to help to foster relationships with new partners that can further provide agricultural support with a focus on value-added production. The goals of this project align with AFRI Foundational Program and other initiatives. Through continued NECAFS activity, we have supportive data that identifies the need and funding streams would support these efforts. However, we need the initial funding to support the planning efforts to build a solid and cohesive strategy. Many funding opportunities call for research and outreach education among multi-state teams. This project will allow collaborators to have a mechanism in place prior to a "request for applications" and allow for a more successful approach to obtaining external funding. Examples of relevant funding that would be alignment with the mission of this project include: Sustainable Agriculture Research & Education, USDA AFRI Rural Entrepreneurs and Communities Grant, USDA AFRI Economics, Markets and Trade and/or USDA AFRI Small and Medium-Sized Farms. All have an anticipated submission date of June/July 2018.

Activities to be engaged in by Team Members

This proposal intends to engage team members representing cross-disciplinary stakeholders, such as academic and extension researchers and educators, food producers, food retailers, distributors and processing facility staff who play a role in supporting local food systems. This will allow team members to discuss opportunities and barriers to growth of food production and encourage and promote collaboration. Through the organization of an in-person meeting, team members can begin the process of defining and prioritizing regional research and educational needs and establishing a mechanism for obtaining external funding. PI-Kinchla is well versed in remote meeting software and centralized data management systems and will leverage existing resources to facilitate the communication channels for this project (i.e. GoToMeeting: Online meetings; Box.com: online file sharing and content management service).

Explanation of Roles of Team Members

Project Lead/PI- Amanda Kinchla will manage the overall planning coordination activities of the project including meeting logistics, managing outputs and deliverables, communication efforts, managing the budget and travel reimbursement administration. **Team Members**– All participating team members (please see cover page) will be responsible for input during conference calls and the face-to-face planning sessions. In addition, team members are also encouraged to help identify other contributors that would help to expand the network of collaboration. **Proposal Committee-** A subset of the Project Team will work to formalize the output of this meeting into a cohesive proposal for

funding and the continuation of collaborative efforts.

Timetable for Completion of Planning Activities and Preparation of a Proposal

Timeline	Activities
Q1: *Assumed* Jun-Aug	• Initial "Kick-off" meeting with the team via phone to review mission and assign tasks • Coordinate centralize literature review on wash water sanitizer research • Investigate grant opportunities (continuous process) • Secure planning details for the 2-day meeting tentatively planned in Amherst, MA
Q2: Sept-Nov	• Conference calls: plan meeting, discuss research methods and writing proposal • Field 2 day: face-to-face meeting to share/discuss project goals, objectives, methods and measurable impacts • Issue meeting minutes and project summary report (PI-Kinchla) • Identify Proposal Committee
Q3: Dec-Feb	• Web-conference to finalize the project vision, scope, and proposal outline.
Q4: Mar-May	• Prepare proposals to NIFA/AFRI or other appropriate source • Report on the final outcome of this project.

Budget for Planning Activities (travel, meeting expenses, etc.): ~$5,000

Travel to Meeting Site	Lodging	Meals	Meeting Supplies	Conference Room Rental	**TOTAL**
$2,000	$1,000	$1,125	$375	$500.00	**$5,000**

Leveraging Resources

The funding requested is primarily to support the collaboration of the contributing team. The team intends to leverage resources where appropriate to maximize efficacy and efficiency. The collaborating team has been thoughtfully crafted to include a diversified group of expertise including food safety, vegetable production, resource economics, food distribution, retail markets, producers, processors, and extension educators. Having a cross-sector of expertise is intended to further leverage existing resources for future grant funding. Furthermore, indirect contributions will be utilized by the PI including online conferencing (GoToMeeting) and data sharing software (Box.com) to facilitate remote meetings to help facilitate with the goals of the project.

Appendix A – CV of Team Leader

Demonstrating track record of successful external funding and leading cross-disciplinary and/or multi-institutional collaborations.

References

Bloom, B. (2014). The locavore: Attitudes towards locally sourced foods. (No. 680572). http://academic.mintel.com/display/680572/ : Mintel.

Hesterman, O. H.,D. (2017). The demand for 'local' food is growing — here's why investors should pay attention. Retrieved from http://www.businessinsider.com/the-demand-for-local-food-is-growing-2017-4

Mintel. (2014). Segment performance - fresh produce. Retrieved from http://academic.mintel.com.silk.library.umass.edu/display/707535/?highlight#hit1

2017 NEED/NERA Expense Budget

Project Title: Increasing Local Food Production with Value-Added Processing in the Northeast

Budget Item	Cost	Justification
Travel to Meeting Site	$2,000	Assuming average car travel is 467 miles round trip w/ 2017 mileage rate 0.535/mile
Lodging	$1,000	Assumes lodging for 8 People @ UMass Hotel $125/pp
Meals	$1,125	Assuming meeting meals: 13 participants for 2 breakfast ($8.50), 2 lunches ($15.25), 1 dinner ($22.50) plus 7% MA tax + 21% auxiliary service fees
Meeting Supplies	$375	Overhead rental @ $175/day + print materials + other office supplies
Conference Room Rental	$500	UMass Campus Center Meeting Room Fee, Aux Services @$250/day
	$5,000	**TOTAL**

AMANDA J. KINCHLA

BIOGRAPHICAL SKETCH

PROFESSIONAL PREPARATION

Institution	Location	Major	Degree & Year
University of Massachusetts	Amherst, MA	Food Science	BS, Food Science 1998
Rutgers, The State University	New Brunswick, NJ	Food Science	MS, Food Science, 2005

PROFESSIONAL EXPERIENCE

Position	Department	Institution	Location	Year(s)
Associate Scientist	R&D/Food Safety	Kraft Foods	Tarrytown, NY	1998-2002
Scientist	R&D/Food Safety	Kraft Foods	Tarrytown, NY	2002-2005
Senior Food Scientist	Research & Development	ConAgra Foods	Turners Falls, MA	2005-2009
Manager	Research & Development	ConAgra Foods	Turners Falls, MA	2009-2010
Product Development/Food Safety Specialist	n/a	Kinchla Food Consulting	South Deerfield, MA	2010-2012
Assistant Extension Professor/ Extension Specialist	Food Science	University of Massachusetts	Amherst	2005-Present

PUBLICATIONS, PEER-REVIEWED (within the past four years)

- Xu, F., Pandya, J., McClements, D.J, Kinchla, A. Plant-based Emulsions as Delivery Systems for Tocotrienols: Formation, Properties and Simulated Gastrointestinal Fate, 2017 (submitted).
- Wong, K., DiStefano, G., Toong, K., Decker, E. Autio, W., Kinchla, A. Utilizing Mushrooms to Reduce Overall Sodium in Taco Filling Using Physical and Sensory Evaluation, 2017 (submitted).
- Yang, T; Zhao, B.; Kinchla, A.; Clark, J.; He, L. Investigation of Pesticide Penetration and Persistence on Harvested and Live Basil Leaves using Surface-Enhanced Raman Scattering Mapping. Journal of Agricultural and Food Chemistry, 2017, accepted jf-2017-00548m.R1.
- Yang, T., Zhao, B., Hou, R, Zhang, Z., Kinchla, A.J., Clark, J.M., He, L., Evaluation of multi-classes pesticide penetration in fresh produce using surface-enhanced Raman scattering mapping. Journal of Agriculture and Food Chemistry, 2016, Vol. 81, No. 11, Pages 2891 - 2901).
- Zhang, Z., Guo, H., Carlisle, T., Mukherjee, A., Kinchla, A.J., White, J.C., Xing, B., He, L., September 2016. Evaluation of Postharvest Washing on AgNPs Removal from Spinach Leaves. Journal of Agricultural and Food Chemistry. 64(37):6916-22.
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SERVICE & OUTREACH

- Council Member, Massachusetts Food Policy Council (2012 - current)
- Chair, UMass Internship Committee (2012 - current)
- Food Science Undergraduate Advisor (2013 - current)
- Hosting Undergraduate Researchers for independent study research
- Food Safety training: Preventive Controls for Human Food, Better Process Control School, Instructor Lead Hazard Analysis of Critical Control Points (HACCP), and Produce Safety (Produce Safety Alliance)
- Technical Advisor to the Western MA Food Processing Center, Commonwealth Kitchen, MA Food Safety Education Partnership, and MA Dept. of Agriculture.
- Co-Chair for the Northeast Center to Advance Food Safety (NECAFS). This is a collaboration among the 12 states (CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VT, WV) and the District of Columbia that make up the Northeast region which aims to jointly advance understanding and practice of improved food safety among the region's small and medium sized produce growers and processors.
- Professional Memberships: ASM, ACS, IFT, IAFP

NE_TEMP1020: Multi-state Coordinated Evaluation of Winegrape Cultivars and Clones

Status: Under Review

Duration 10/01/2017 to 09/30/2022
Admin Advisors: [Bradley Hillman]
NIFA Reps:

Statement of Issues and Justification

STATEMENT OF ISSUES AND JUSTIFICATION:

Winegrape cultivar selection is among the most important components of vineyard and viticulture industry management. Prior to the turn of the 21st century, most U.S. states produced few to no winegrapes, primarily because of limitation in cold hardiness and disease resistance of the *Vitis vinifera*, the European winegrape species that comprises most commercial cultivars grown in the U.S. in traditional production regions. The introduction of new, interspecific hybrid cultivars has allowed for the development of grape industries in regions not previously considered possible. At the same time, continued evaluation of *V. vinifera* and hybrid cultivars and clones is critical to maintaining the winegrape industries in non-traditional regions. The major *V. vinifera* cultivars grown worldwide were selected over decades or even centuries for best suitability in European regions, and were then spread to California's and other arid western U.S. states. As new winegrape industries emerge, continued growth, and the economic impact that comes with it, is dependent on improving quality and quantity of grapes and wine produced. Continued discovery, development, and evaluation of winegrape cultivars and clones is critical for maintaining growth within this emerging agricultural sector.

Needs Identified by Stakeholders

NE-1020 project members include research and extension faculty from institutions across the U.S. that regularly solicit stakeholder input for continued development of their programs. Consistent responses from stakeholders include support not only for continued cultivar development and evaluation, but also for developing best management practices to improve consistency, quantity, and quality of crops from evaluated winegrape cultivars and clones. There is also a need to evaluate new and emerging cultivars and clones across a wide range of environments. For example, in Colorado, intermittent extreme cold winter temperatures in the past ten years have repeatedly decimated *V. vinifera* cultivars, and caused industry to realize the need for more well adapted cultivars with better winter hardiness. In the most recent, industry-wide survey of research priorities in viticulture conducted by the Colorado Wine Industry Development Board (which is part

of the Colorado Department of Agriculture) done in 2014 the number two priority was “varietal selection", ranked after “responding to cold injury”. Those topics are not unrelated, as many Colorado vineyards have responded to recent losses from cold injury by increasing plantings of cold hardy hybrids identified in recent NE-1020 work. Of currently ongoing research projects "suitability of grape varieties for Colorado (cropping reliability, cold hardiness)" was ranked number 1. In a survey of Vermont growers, “weather-related damage” was rated as the greatest potential threat to their industry, followed by “canopy management”, “disease management”, and “availability of suitable cultivars” [1]. NE-1020 research in Vermont and surrounding states has addressed all of those topics, and cold-hardiness and disease management in particular have been addressed through evaluations of cultivar susceptibility to cold damage and disease [2-4]. Growers in NJ have cited ‘information on cultivar performance’ as their number one research need in a recent stakeholder survey. For cold-climate regions, there is a need for cultivars that mitigate high acidity to produce different wine styles, since the *Vitis riparia*-based cultivars presently grown in the region have very high titratable acidity that requires significant winemaking effort to reduce [5-14]. In the Dakotas, realizing survival under extreme winter conditions and sustained productivity is an issue. Throughout the new production regions, resiliency to weather-related injury including mid-winter lows and spring and fall frosts is an issue [10, 15-20].

In 2015, the American Vineyard Foundation, a national grape and wine industry-funded research organization, conducted a survey of the most important research needs for grape and wine producers. Plant material selection including clonal and cultivar selection was ranked third, with 25.1% of respondents ranking it within their top two goals [21]. However, the two higher-rated research areas, “production efficiency & profitability” and “disease & insect control”, are included in NE-1020 objectives and its supporting projects’ evaluations of clones and cultivars and the best management practices for growing them.

Importance of the Work and Consequences If It Is Not Done

Since the NE-1020 project started in 2004, grape production east of Pacific-coast states has continued its expansion beyond traditional eastern production areas (NY, PA, MI, and VA). For example in NY, wineries and grape production have expanded to 49 of the 52 counties in the state, and production has moved beyond the limited regions where *V. vinifera* and other interspecific hybrid cultivars have been grown for decades. There are now wineries in all 50 states. As of 2015, cold-hardy grapes have been planted on an estimated 7500 acres in 12 northern-tier midwestern and eastern states, a 28% increase from a 2011 survey [22] and a 100% increase from virtually no production in the region prior to 1995. Emerging wine industries in northern tier states had an industry economic impact (for cold-hardy cultivars alone) of $539M in 2016, up from $401M in 2011 (34% increase over 4 years) [22]. Growers in these states look to viticulturists to provide data-based recommendations about suitability and potential profitability of these new cultivars.

Grapes have a high establishment cost of $20-30K/acre and delayed returns during a 3-4 year establishment period [23]. Profitability and sustainability depends upon reliable productivity and resilience to inevitable climate-related injury. A recent case study in Vermont indicated that, given optimum management and selection of a cultivar suited for the site, climate and market that would not require replanting, typical break even on net cash occurred in year 7 for a 15 acre vineyard, and year 17 for a smaller 5 acre vineyard, and positive net present value of the enterprise occurred after twenty years [24]. While this appears to put grape production in a particularly risky category, such time periods to attaining profitability are similar to apples [25], and considerations for both of those crops assume wholesale, commodity markets for fruit. However, winegrape production has the unique characteristic of substantially greater value for the finished product (wine), which increases overall value of the raw commodity within the industry. Despite that, vineyards must be profitable on their own before winemaking considerations are accounted for, and delays in production from poorly-performing cultivars, crop losses from cold or disease damage, or poor quality cultivars with low crop price will delay or even prevent net vineyard profitability.

Cold winter temperatures; short, cool growing seasons; and humidity that is conducive to disease development limits the production of traditional *V. vinifera* cultivars in most emerging winegrape regions, and novel cultivars may be more suitable even in regions where *V. vinifera* cultivars may thrive. Cultivar selection is the primary method for reducing losses from cold injury in vineyards, and the relatively new development of cold-hardy winegrape cultivars suitable for the eastern U.S. and other emerging regions is only beginning to be optimized.

Grape breeding programs in NY, MN and AR, have successfully evaluated and released new cultivars [10, 26-28]. A new evaluation program in ND is screening germplasm for ultra-cold hardy traits that are adapted to ND's short growing season and extreme cold winters [29]. Private breeders have also been important in developing emerging cold-climate grape cultivars which require evaluation across diverse regions and climates [30, 31]. In addition, novel *V. vinifera* and other hybrid cultivars from Europe and other areas are of interest to growers in regions where cold hardiness is less of an issue, but the number of available selections is daunting for individual vineyards to evaluate and could result in years of lost revenue unless public, long-term evaluation of cultivars and clones is conducted to reduce evaluation time prior to commercial planting.

Testing of new cultivars and clones is typically limited a few areas. Coordinated multi-state testing is needed to evaluate adaptation in a variety of environments. With changing climate and increased weather variability, cultivar adaptation, including physiological hardiness and robustness to changes in insect and disease pressure will be an increasing issue. This multi-state project will

leverage substantial investments made in breeding programs, and help evaluate genotype x environment interactions. Sustaining these efforts over several years is a requirement to fully evaluate winegrape cultivars and clones over the life cycle of a typical vineyard and across multiple years of weather occurrences. This is especially important for inland 'continental climate' regions, which are more subject to extreme swings in temperature than more maritime-influenced climates. Availability of grapes adapted to these continental climates has greatly increased interest in grape growing, as has the emergence of the farm winery segment in the East. However, planting a poorly-adapted cultivar in the wrong place is a costly mistake. Vineyards can face expensive replanting and retraining costs after winter injury. Even if a cultivar produces adequate yields, poorly adapted cultivars may ripen inconsistently, and produce inferior wines.

University and Agriculture Experiment Station (AES) researchers are uniquely and best suited to conduct this research. Among the participants in this project are numerous researchers with land, staff, equipment, and facilities capable of conducting comprehensive and objective field research. The support of the AESs received by each cooperator does not represent simply a plot of land on which to plant their vineyard. The support systems and expertise of University and AES researchers include statistical support, computing hardware and software, basic and field laboratories stocked with modern equipment, field research stations with suitable land, equipment, and technical staff, and faculty colleagues who may provide ad hoc support and review of projects. Research and intellectual properties protections in-place within the University and AES systems ensures that all parties including breeders, nurseries, growers, wineries, and researchers themselves will be adequately protected, and ensure that research is conducted in a thorough and objective manner.

Technical Feasibility

The NE 1020 project has developed a network of sustained collaboration of viticulture and enology specialists across multiple states since 2005. Presently, participants from 15 states have active plantings, and partners from several other states who do not have formal NE-1020 plantings contribute expertise to the project (Table 1). The existing team has the expertise to plan new plantings, apply appropriate viticultural practices, and collect data to evaluate new cultivars and clones. Objectives from the initial phase of this project were intentionally limiting so as to develop a trial with maximum applicability across multiple regions and robust statistical design. However, the limitations built into the original methodology, including establishment of a single NE-1020 planting design implemented in 2008 on specific rootstocks, training systems, and management programs, was deemed too restrictive by several participants, who dropped out of the project as a result. As the project moves forward, NE-1020 researchers will adopt a more flexible model, allowing for more rapid evaluation and testing and continued planting of new cultivars and numbered selections and reducing limitations on individual collaborators to conduct cultivar evaluations that do not fit into a single national model. Successful collaboration over past years provides the foundation for this new model and continued success. While the robust, multi-site evaluation of cultivars within specifically defined climatic regions has not been conducted to date due to unforeseen differences

in data sets, loss of collaborators, and vine loss in certain regions due to weather or management-related events, several plantings have resulted in published cultivar comparisons that are establishing performance benchmarks in the literature [4, 11, 29, 32-38].

Advantages of a Multi-state Effort

Multi-state efforts capitalize on university faculty expertise for cultivar and breeding line evaluation where infrastructure exists for grape management. Evaluating cultivars in multiple growing environments in a coordinated and collaborative fashion makes data collection, analysis, and reporting more efficient and useful. Coordinated effort shortens the time to evaluate cold-hardiness and environmental adaptations by having many locations experiencing diverse weather events. In addition, as many of the states represented in the project have new wine and grape industries, likewise, many of the represented Universities have faculty new to viticulture. In several cases, faculty with small or tree fruit pomology experience have transitioned some or all of their attention to viticulture-related activities. In other states, agronomists have transitioned into the field. Additionally, new faculty have been recruited into novel programs with no history of a position in grape or wine production. The shared professional comradery among NE-1020 participants has allowed programs in each state to optimize their effectiveness by identifying gaps in knowledge, infrastructure, and experience, and has facilitated collaborations that address those shortcomings within a particular institution or program. The current project has allowed sharing of winemaking expertise for processing grapes from several plantings (e.g., multiple states have contributed grapes to Cornell and MN winemaking projects; several states have utilized differential thermal analysis chambers housed at other universities). This leverages the winemaking and other expertise in states that do not have University winemaking or other specialized facilities.

Collaboration among participants in the NE-1020 project has provided an opportunity and tools for securing funding for two Multi-state SCRI projects totaling over $8.9 million in funding: *Northern Grapes: Integrating viticulture, winemaking, and marketing of new cold-hardy cultivars supporting new and growing rural wineries;* and *Improved grape and wine quality in a challenging environment. An Eastern US model for sustainability and economic vitality*. Current participants in NE-1020 indicated a total of over $1.7 million in complementary funding from federal, state, and private sources, in addition to SCRI and Hatch funds available from participating AESs (Table 2).

Likely Impacts

Notable Impacts of the Current project:

Among the primary impacts resulting from the first phase of this project have been an increase in grape production in non-traditional regions and a shift in cultivar selection to less risky cultivars in light of recent cold damage and other environmental threats. During the research period of the current project, severe cold events in the central and eastern U.S. including the 'Polar Vortex' winter of 2013-2014 and other unseasonably cold winters of 2008-2009 and 2014-2015, and early winter freezes in 2008, 2009, 2012, and 2013 tested both commonly-grown and newly adopted cultivars in many states. For example, in CO, IN, MI, NC, NJ, and OH growers are planting cultivars trialed in NE-1020 plantings, including *V. vinifera* and hybrid cultivars as a direct result of this research because those cultivars have shown good cold tolerance and potential for making high quality wine. In CO, where 15-20% of *V. vinifera* cultivars were removed after substantial winter-kill in the past three years, vineyards were replanted to cold-hardy cultivars tested in the NE-1020 project. In IN, 'Chardonel', 'Cayuga White', 'Valvin Muscat', 'Noiret', 'Marquette', 'La Crescent', have been planted in commercial vineyards and, just as important, several cultivars have been ruled out as unacceptable, thus saving growers substantial investment and lost productivity. In OH, 'Regent' and 'Gamay noir' have been selected as cultivars adapted to that state's conditions. Through the Northern Grapes Project, information on performance and management of MN and other cold hardy cultivars from ND south to IA and east through MI and to VT was collated and presented to growers to evaluate adaptation of 'Marquette', 'Frontenac', 'La Crescent', and 'St. Croix' [39, 40].

In PA, NE-1020 is credited with: increasing collaborations between researchers and industry; facilitating research in improved winemaking practices; identifying and characterizing viticultural microclimates; and increasing undergraduate learning opportunities around viticulture and enology [41]. In CT, research in NE-1020 vineyards facilitated: increased yield for top wire cordon trained hybrid cultivars which prompted growers to consider changing their trellising system; identification of Virginia creeper and wild grapes as reservoirs for powdery mildew inoculum which inspired better vineyard sanitation by growers; and early scouting of disease onset was immediately passed on to growers alerting them to take appropriate action [42, 43]. Development and evaluation of regionally-adapted cultivars is critical to increasing growth within emerging winegrape industries. Between 2005 and 2014, winegrape acreage in non-traditional grape production regions increased by 47.5%, and the number of wineries by 81.2% (Table 3).

Expected Future Impacts:

Under our new model, we expect to be able to screen and test more candidate cultivars over a shorter amount of time by conducting efficient evaluations, and by establishing continual plantings

over the course of the project. Continued release of new cultivars (e.g. Itasca, Verona, and Crimson Pearl released from cold-climate breeding programs in 2016 alone) and pre-release trialing of promising selections (e.g. the highly disease resistant red wine selection NY06.0514.06) requires continued, objective evaluation under the NE-1020 project. Successful testing and education will result in more informed growers who make better planting decisions, and suffer fewer losses from planting a poorly-adapted cultivar in the wrong site. Multi-state, interdisciplinary evaluation will allow for assessment of other attributes (e.g. insect, fungal disease, phytotoxicity of agrichemicals, unique juice characteristics) to maximize potential productivity and quality of this new germplasm. Under this project, we expect that wine industries in our region will continue to grow, with an average increase in acreage and wine value of 25% during the project period.

Flexibility within future NE-1020 trial plantings will be the strength of the new, continued project. The specific requirements of the 2008 plantings, while well-intentioned, limited researchers' efforts and resulted in a loss of participants in the early production years of trial vineyards. Some individual states' industry support groups and AESs did not support restrictive and overly time-consuming evaluation standards that limited rapid evaluation of emerging cultivars. Also, riskier, less cold-hardy or more disease-prone cultivars which failed in experimental plantings left holes in vineyards and datasets which compromised overall project integrity. By establishing tiered evaluations of promising clones, cultivars and germplasm material in Objectives 1 and 2, we will allow for the rapid assessment of pre-release and emerging cultivars as well as more thorough evaluations of those deemed to have horticultural and commercial potential in U.S. vineyards and which require assessment in diverse climatic production regions.

Related, Current and Previous Work

Related, Current, and Previous Work:

The original experimental design for NE-1020 evaluation vineyards was based on a coordinated planting to be completed in 2008 in all states, with an exception for one vineyard that required installation in 2007 to comply with funding availability. In annual meetings of project cooperators from 2005-2007, specific objectives, experimental design, and data collection procedures were developed. Because collaborators had differing land, staffing, and facility resources, plantings were designed to be flexible in terms of the number of cultivars or clones evaluated, however, each planting had the following common characteristics: a common two 'sentinel cultivars' that would remain consistent in each planting in a similar climate zone; randomized complete block replication; six replicates of each cultivar; cordon and spur pruning; low-wire cordon (VSP) trained vines for *vinifera*, high-wire cordon training for hybrids; grafted to 101-14 rootstock for *vinifera* and tender hybrids unless local conditions prohibited, own-rooted for cold-hardy hybrids; required guard vines or rows; all vines planted within one year of one another (e.g. dead vines were allowed to be replanted in year two only); and consistent targets established for yield and vine growth. Vine orders were centrally coordinated and funded by grants from the (now defunct) CREES Viticulture

Consortium or from individual investigator's own research funds. In total, NE-1020 trial vineyards were established in 19 states in 2007 or 2008, however several cooperators left the project prior to completion and two established their plantings after 2008. Presently, twenty plantings in 13 states are actively used in the project (Table 4). Additional states joined the group but were not able to install 'official' NE-1020 vineyards because protocols for inter-state comparisons required all vineyards to be planted at the same time, and those states have maintained membership in a collaborative capacity.

Restrictive protocols for the original NE-1020 plantings, while designed to allow for robust comparisons between sites and cultivars, actually discouraged interstate comparisons because allowances were not made for vineyards that failed completely due to weather or other crop damage. In several states, severe winter cold decimated plantings early in the project; in others, herbicide drift or phytotoxic pest management sprays damaged plantings beyond their ability to provide consistent data. Retirements and other personnel changes among participants, and withdrawal from the program by some AES directors further reduced participation in the formal trials.

However, collaborators within the NE-1020 project have consistently attended annual meetings where results from project plantings have been discussed. Separate from, but complementary to the initial NE-1020, trials have been substantial multi-state collaborations between NE-1020 members and other participants that would not have been possible without collaboration and networking derived through this project. Collaborative projects derived from NE-1020 participation and often including NE-1020 vineyards as primary data sources and educational sites include:

- Improved grape and wine quality in a challenging environment: An Eastern US model for sustainability and economic vitality. USDA SCRI 2010-51181-21599. PD A. Wolf, Virginia Polytechnic Inst. $3,796,693. http://cris.nifa.usda.gov/cgi-bin/starfinder/0?path=fastlink1.txt&id=anon&pass=&search=R=39155&format=WEBLINK (see resulting publications & outputs, Appendix 1).

- Northern Grapes: Integrating viticulture, winemaking, and marketing of new cold-hardy cultivars supporting new and growing rural wineries. USDA SCRI 2011-51181-30850. PD T. Martinson, Cornell Univ. $5,139,193. http://cris.nifa.usda.gov/cgi-bin/starfinder/0?path=fastlink1.txt&id=anon&pass=&search=R=47150&format=WEBLINK (see resulting publications & outputs, Appendix 1).

- Midwest grape production guide. Dami, I., Bordelon, B., Ferree, D., Brown, M., Ellis, M., Williams, R., Doohan, D. The Midwest Grape Production Guide was compiled by Extension specialists at Ohio State University and Purdue University. Its comprehensive topics include: planning your vineyard; grapevine anatomy and propagation; integrated pest management; pruning, training, and canopy management; vineyard maintenance; and harvest and marketing. http://articles.extension.org/pages/63522/midwest-grape-production-guide

The outputs associated with the above projects, in addition to citations listed at the end of this report, highlight significant effort and progress toward addressing the goals of NE-1020. Continued effort under the NE-1020 project will build upon the successful collaborations fostered under the current project, and will address shortcomings discovered in the original protocols. The focus of the project will continue to be on the evaluation of new or emerging grape germplasm with the intention of identifying superior cultivars that meet the needs of regional sites and production systems.

Objectives

1. •Screen the viticulture characteristics of clones, cultivars and elite germplasm with significant potential throughout the USA.
2. •Evaluate the viticultural and wine attributes of promising emerging cultivars and genotypes based on regional needs.
3. •Conduct explorations of new germplasm and lesser-known cultivars that may have economic potential for the US wine industry.

Methods

Objective 1

Trial vineyards will be designed for relatively rapid evaluation of novel cultivars or advanced selections. Advanced selections identified under Objective 3 are encouraged for inclusion in these plantings. Planting will include six or more cultivars and may not necessarily be replicated across multiple states. For each advanced selection evaluated, a minimum of three replicates will be included. Vines will be planted in either a completely randomized or randomized complete block design depending on space needs. Vine training and management will follow standard protocols for the region. Vines will be evaluated for a maximum of five years for metrics of: cold hardiness, annual vine growth, crop productivity, and juice quality. Optional data will include disease and insect pest incidence. All protocols will follow standard procedures [4, 35, 38]. Data may be analyzed descriptively for individual cultivars, additionally, comparative ANOVA may be performed when robustness of datasets justifies but that is not the intention of this objective. Results will be reported annually to NE-1020 members to guide future replicated trials.

Objective 2

Replicated cultivar evaluation vineyards will be established according to present NE-1020 protocols [4, 35, 38], with minor changes to allow for flexibility among individual cooperators. Expected plantings will be proposed at least one year in advance at NE-1020 meetings in order to allow additional cooperators to establish and conduct replicated trials at multiple sites. Specific rootstock, training, and management guidelines will follow local recommendations for a particular site but will be held constant within a planting. Plantings may occur in any year, but must be evaluated over a minimum of five and a maximum of ten years. Data will be subjected to ANOVA analysis with appropriate corrections made for multiple comparisons and/or imbalances in data (e.g., if vines die and generate missing data). Results will be reported annually to NE-1020 members and published in peer-reviewed journals at completion.

Objective 3

All NE-1020 participants can recommend ‘new’ cultivars and clones as part of this germplasm discovery objective. Grapevine germplasm evaluation will include advanced selections from breeding programs, newly identified clones, newly introduced (imported) cultivars, or underexplored/planted cultivars. Public breeding programs at MN, ND, AR, and NY, as well as private breeders (e.g. T. Plocher, E. Swanson) will be invited to participate in Objectives 1 and 2. The breeders will establish material transfer agreements with each planting site and coordinate the propagation and planting of advanced breeding selections. NE-1020 project participants will make recommendations to respective agencies to acquire and import germplasm for evaluation as needed. The results of Objectives 1 and 2 will be used by the breeders in making decisions for cultivar release.

Measurement of Progress and Results

Outputs

- At least six refereed articles will be published based on NE-1020 coordinated regional research trials.
- Four new winegrape cultivars will be introduced from U.S. breeding programs under the guidance of NE-1020.
- NE-1020 research results will be communicated in 10 papers at scientific conferences and in 25 presentations to grower audiences.
- A central website, NE1020.org, will be developed in year 1 to act as a clearinghouse and index for published information stemming from NE-1020 activity.

Outcomes or Projected Impacts

- Under our new model, we expect to be able to screen and test more candidate cultivars over a shorter amount of time by doing efficient evaluations, and continual plantings. Continued development of new cultivars (Itasca, Verona, and Crimson Pearl in 2016) requires continuation of NE1020 project. Successful testing and education will result in more informed growers, who make better planting decisions, and suffer fewer losses from planting a poorly-adapted cultivar in the wrong place. Multistate testing will allow for evaluation of other attributes (e.g. insect, fungal disease, phytotoxicity of agrichemicals; training systems) to maximize potential productivity and quality of this new germplasm. Successful vineyards lead to successful wineries and agritourism that stimulates local economies.
- NE-1020 recommendations and educational programs will guide the planting or replanting of 1000+ acres of winegrapes in the next 5 years in participants’ states.
- Winegrape growers in emerging regions will see increased net income per acre, and more consistent income and yield as a result of adopting regionally-adapted cultivars.
- Wineries that utilize fruit evaluated through NE-1020 projects will see increased profitability based on improved wine quality and reduced grape market volatility.
- By providing a means to field-test advanced grape selections developed using genomic and phenomic tools, NE-1020 will help to reduce the time from initial cross to released cultivars by five years.
- • Cumulative state and federal investment in the research programs of NE-1020 collaborators will total $5 million during the life of this renewal

Milestones

(**2017**):Objective 1 milestone. At NE-1020 annual meetings, a session will be reserved for discussion of promising cultivars or selections from breeding or other programs that may be of interest to PIs. Interested PIs from similar regions will be invited to include selection in their home evaluation vineyards.

(**2018**):Objective 1 milestone. Five cooperating sites will establish screening sites for new or promising cultivars or selections. Inclusion of new selections will occur on a rolling basis. Protocols for screening will be finalized by NE-1020 cooperators.

(**2019**):Objective 1 milestone. Cultivars will continue to be planted (or removed, if appropriate) in screening vineyards. Fruit evaluation will begin in year three after planting, and final screening occur in year five. Data and results from screened cultivars will be published to NE-1020 website immediately following year 5.

(**2018**):Objective 2 milestone. Review status or original 2007-2008 plantings at annual NE-1020 meeting. Identify pitfalls, problems with methodology. Update methods for future/continued projects. Solicit initial plans for replicated plantings from stakeholders. Prepare plantings for spring 2019 establishment.

(**2019**):Objective 2 milestone. Establish plantings on a rolling basis in accordance with a specific guidelines for each if replicated across sites. Cultivars may continue to be planted in year 2. Growth and bud hardiness data collected beginning year 2. Fruit evaluation will begin in year three after planting. Wine production and evaluation, if available, will begin year 4. Data and results from evaluated cultivars will be published to NE-1020 website and appropriate journals immediately following year 5 with final report publication in year 7-10.

(**2017**):Objective 3 milestone. At annual NE-1020 collaborators' meeting, identify germplasm discovery participants including breeders, germplasm repositories, and collectors. A subcommittee will determine the number of lines to evaluate. Material transfer agreements will be drafted.

(**2018**):Objective 3 milestone. Propagate and receive cuttings for plantings at collaborator sites.

(**2019**):Objective 3 milestone. Establishment and preliminary disease resistance data will be collected. Replant as necessary. Continued replacement/replanting of new selections ongoing.

(**2020**):Objective 3 milestone. Initiate fruit evaluation. Replant as necessary. Continued replacement/replanting of new selections ongoing. Publish data in NE-1020 data repository and present to participants. Offer advanced selection to screening or, if appropriate, evaluation trials.

Outreach Plan

Outreach under the present NE-01020 project has been conducted through existing websites, newsletters, blogs, and listservs of individual project affiliates. Project outputs will continue to be distributed through those channels. A record of previous outputs is included in Appendix 1. In addition, a central website, NE1020.org, will be developed under the renewal of this project to collate and summarize outputs from individual participants.

Organization/Governance

The NE-1020 project will be governed by a rotating executive committee voted annually at the project meeting by meeting attendees. Although all offices will be elected in each year, it is expected that an officeholder will begin in the Secretary position and rotate through to the chair position. Offices thus include: Secretary, Vice-Chair, and Chair (host). Thus, the Secretary is expected to host the meeting two years following, and the vice-chair the following year. After an annual meeting, the secretary shall submit meeting minutes to the meeting chair within 30 days, and the chair will submit the annual report within 60 days of the annual meeting. Reports will be submitted to the NERA Administrative Advisor who will submit reports to NIMMS. Following the annual meeting, the vice-chair (now chair of the following year's meeting) will begin preparation for the following meeting and will assist the secretary and chair in compiling the annual report if needed.

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Land Grant Participating States/Institutions

MN,MI,WY,IA,PA

Non Land Grant Participating States/Institutions

Participation

Participant	Is Head	Station	Objective	Research						Extension	
				KA	SOI	FOS	SY	PY	TY	FTE	KA

Combined Participation

Combination of KA, SOI and FOS	Total SY	Total PY	Total TY
201-1131-1080	0.03	0	0
202-1131-1080	0.03	0	0
204-1131-1080	0.03	0	0
212-1139-1102	0.05	0.1	0.1
216-1139-1102	0.05	0.1	0.1
211-3110-1130	0.1	0	0.1
203-1131-1080	0.1	0.1	0.5
202-1131-1080	0.1	0	0
202-1131-1080	0.1	0.1	0.5
202-1131-1081	0.1	0	0
203-1131-1020	0.03	0	0
204-1131-1020	0.03	0	0
205-1131-1020	0.03	0	0
203-1131-1020	0.03	0	0
204-1131-1020	0.03	0	0
Grand Total:	**1.50**	**0.30**	**1.20**

Combination of KA, SOI and FOS	Total SY	Total PY	Total TY
205-1131-1020	0.03	0	0
502-1131-1020	0.1	0	0
204-1131-1060	0.5	0	0
Grand Total:	**1.50**	**0.30**	**1.20**

Program/KA	Total FTE
0	0
212	0.03
211	0.03
203	0.03
0	0
0	0
0	0
203	0.03
204	0.03
205	0.03
0	0
0	0
0	0
Grand FTE Total:	**0.4**

NE_TEMP1962: Outdoor Recreation, Parks and Other Green Environments: Understanding Human and Community Benefits and Mechanisms

Status: Under Review

Duration 10/01/2017 to 09/30/2022
Admin Advisors: [Frederick A. Servello]
NIFA Reps:

Statement of Issues and Justification

Research reveals that outdoor recreation, parks and other green environments improve quality of life, promote environmental stewardship and enhance community well-being. However, there are important research and educational gaps in understanding about the extent of and means by which these human-nature outcomes occur. Similar voids exist in knowledge of the dynamics that motivate, constrain, and sustain outdoor recreation activity among various population groups. Furthermore, the role of outdoor recreation, parks and other green environments need additional examination in the context of the socio-ecological systems in which they are embedded. Equally as important, implications of existing research have not permeated the policy arena, community planning or professional training programs.

Quality of life is highly dependent on good health, yet Americans are less physically active today than in the past, a trend that is related to the obesity epidemic. In a 2009 literature review, Godbey found that only a quarter of adults in the United States engaged in recommended physical activity levels and 29% reported no regular physical activity during leisure time. Only half of those aged 12-21 said they regularly participated in vigorous physical activity, and 25% reported no vigorous physical activity at all. The challenge is particularly acute among US youth as one third of US children are overweight and one sixth are obese (Accessed May 14, 2012 from http://prevention.nih.gov/healthtopic_obesity.aspx). Obese children have 2-3 times more risk of being hospitalized. Recent scientific research suggests that the mere act of being outdoors can lead to healthier, active lifestyles for people of all ages. Being outdoors decreases the health effects of pollution from indoor spaces, reduces the chance of overeating, increases physical activity and lowers stress. Studies document that physical activity increases among families that have access to parks, trails and other green environments (e.g., Sallis & Bauman, 1998; Sallis, Hovell, & Hofstetter, 1990, Giles-Corti et al., 2005).

Intuitively, increased outdoor recreation and contact with nature improves environmental literacy. Conversely, a widespread assumption is that contact with nature, particularly among youth, is declining and, in turn causing environmental literacy to decline. While some research exists to support this supposition, the results are scarce, contradictory and mostly correlational. Nonetheless, governments are committing hundreds of millions of dollars in appropriated funds as if the assumption of a cause-effect relationship between outdoor recreation and environmental literacy was supported by empirical evidence. There are few guidelines directing the expenditure of these funds into nature-based recreational programs and infrastructure that bolster environmental literacy, particularly among youth. Early childhood experiences with nature are associated with environmental awareness, advocacy and entry of young people into natural resource careers. If

contact between youth and nature is on the decline, it is important to know the consequences related to concern for the environment at a time when global climate change is impacting human systems. A rising research area is focusing attention on the interrelationships among environmental education, environmental conditions, environmental literacy and citizen science group dynamics. One aim of this emerging research effort is the development of effective climate change policies and environmentally responsible behaviors.

Beyond improved individual health and increased environmental literacy, outdoor recreation spaces contribute to community vibrancy and resilience. Natural amenities promote vibrant communities by attracting visitors, new residents and businesses, as natural amenities are correlated with population growth, augmented property values and increased economic prosperity in these communities (Crompton, 2000; Wainger & Price, 2004; Crompton, 2007). The resilience of human communities is linked to the health of ecological systems. Population growth and adverse environmental impacts can affect the qualities (i.e., natural amenities) that attracted new residents and businesses. Understanding of the role of outdoor recreation, parks and other green spaces in developing and sustaining vibrant and resilient communities is still in its nascent stages.

According to the United Nations population division, Homo sapiens became an urban species in 2008. By 2030, around 70% of humans will live in urban settings, most of which are becoming less influenced by natural features and increasingly marked by human objects and human-made climate. Little is known about the negative consequences associated with diminished contact with nature. Even less is known about the mechanisms by which positive effects occur. The purpose of this Multi-State project is to augment understanding of the extent and means by which outdoor recreation, parks and other green environments connect individuals to nature and lead to healthier people, natural resources, and communities.

Importance and Consequences if Work is Not Accomplished

This research will lead to improved understanding of the links between parks and green spaces, outdoor recreation, health, environmental literacy and community vitality. Knowledge from this research will provide the basis for evidence-based practices and policies at national, state and local levels. Such policies will result in lower healthcare costs by providing preventative methods and infrastructure. A 2012 study released by the Centers for Disease Control and Prevention (CDC) projects that the proportion of Americans who are obese will rise from 35% to 42% by 2030, resulting in $550 billion in obesity-related health care costs. According to CDC studies, childhood obesity, also on the rise, is strongly related to adult obesity. One of CDC's recommended remedies is to improve access to parks and playgrounds. An outcome of the proposed research is decreased national health care costs related to obesity and allied illnesses. Further, promoting active and healthy lifestyles among children will improve future generations' quality of life. Studies show that children who spend time outdoors are more physically active than their indoor counterparts, but little research addresses children's outdoor play time as it relates specifically to health outcomes and environmental literacy. This project will attempt to fill the research void by examining the extent to which diminished contact with nature contributes to increases in childhood obesity and allied illnesses, and decreases in environmental literacy.

Quality of life will also be promoted from this research by enabling professionals to design outdoor

recreation opportunities where green infrastructure serves to not only retain and sustain ecosystems but also provides ecological services upon which human health is dependent (Smith, Case, Smith, Harwell, & Summers, 2013). Furthermore, green infrastructure promotes vibrant and resilient communities by attracting young families and tourism businesses. Third, advancing new, participatory approaches to environmental literacy will meet the long-term goal of public adoption of behaviors that will help address environmental challenges, such as climate change. Increasing environmental literacy will also increase citizens' and policy makers' ability to make responsible informed decisions about the environmental future.

Executive Order in 2002 (Exec. Order No. 13266) mandated land management agencies to promote the use of outdoor recreation areas for improved health. Since then, federal land management agencies have moved forward in a variety of ways to address health issues. For example, the National Park Service (NPS) established a “Health and Wellness Steering Committee” to explore the role of national parks in promoting health and implement health-related initiatives (US Department of Interior, National Park Service, 2010.). Since, the NPS added national initiatives that link parks to public health, such as, “Healthy Parks, Healthy People” (HPHP), “Parks Prescriptions” (ParkRx), and “Every Kid in a Park” (O’Dell, 2016). In addition, the USDA Forest Service has estimated the caloric expenditures of recreation activities on Forest Service lands (Kline, Rosenberger & White, 2011). The role of outdoor recreation for a healthier US is recognized as an important study area in the Outdoor Recreation Research and Education strategic plan (USDA CSREES, 2007). More generically, this project addresses a McIntire-Stennis strategic plan (NAUFRP, 2010) priority to understand human behavior and attitudes related to natural resources.

By integrating extension specialists and field educators, the project will guide the next generation of park planners and recreation practitioners via curricular changes and enhancements, trained undergraduate and graduate students, and practitioner outreach.

Technical Feasibility of the Research.

There is a cadre of qualified researchers at land-grant institutions, other public and private institutions, federal agencies, state agencies, and nongovernmental organizations contributing to research efforts related to the scope of this project. There are few technical limitations in outdoor recreation research. Advanced study designs utilizing such systems and procedures as GIS, photo elicitation, psychometric scaling, modeling, behavioral and physiological monitoring devices, cognitive concentration tests, experimental designs and qualitative and mixed methods techniques are being employed. The challenge and opportunity is coordinating across states and projects to effectively share projects, methods and results to achieve the intended outcomes and impacts. Standardization of methods, assessing reliability across populations and strong leadership will enhance success project outcomes. Coordinated research that establishes common metrics will enable replication and expand the generalizability, thereby advancing recreational research and creating synergies not yet realized.

Value of a Multi-State Approach.

A Multi-State effort, will allow (a) the assessment of many more settings, which will reveal patterns

in outdoor physical activity, literacy and community resilience according to geographic region, place characteristics and demographic groupings, (b) replication in different environments to assess the robustness of results, (c) establishment of baseline data for the tracking of trends, (d) multidisciplinary research, including the fields of health, public health, nutrition and geography and (e) understanding of the extent to which outcomes generalize to broad classes of mechanisms and experiences.

A Multi-State initiative will allow assessment of many more physical activities and outdoor recreation areas at a wider geographic scope (local, state and national) than could be obtained by an investigator in one state. The utility of the research is directly proportional to the number of observations, and since much outdoor recreation activity is concentrated in the warmer months, the number of observations that can be made by any one research team is limited. To illustrate, if each participating college or university investigates three outdoor play environments for level of activity, there may be as many as 60-70 samples to assess. Also, a Multi-State effort will foster the study of more types of possible mechanisms (immune system functioning, physical activity, etc.) by which contact with nature impacts human health.

Research on the relationships between environmental education, childhood and adult experiences with nature and environmental literacy has been largely sporadic and piecemeal. There has been no coordinated effort directed at refuting or substantiating causal connections. As environmental education efforts, requirements and integration with learning standards vary between states, a Multi-State project will allow assessment of environmental literacy that can determine causal links between contact with nature, environmental literacy, and pro-environmental behaviors. Cross comparison between states will help in identifying critical exposure time frames, optimal contact settings, and the most fundamental environmental knowledge. A coordinated effort will also enable replication across environmental settings to assess the robustness of environmental literacy determinants, as well as the long-term implications of nature contact and environmental literacy.

Given the multiple recreation-related indicators of community vibrancy and resilience, there is a need for a coordinated effort to solidify the role of parks and other green spaces on community-level outcomes. In other words, a Multi-State effort would enable more quantitative assessments to identify the influences that park and recreation services have on promoting community vibrancy and resilience. To complete such a complex task, a coordinated effort is needed to develop, refine and employ instruments that can consistently measure the role of parks, green space, and recreation services on community vibrancy and resilience. Once key measures of community vibrancy and resilience are determined, a Multi-State project will further enable replication to determine the robustness of the measures.

This research will be coupled with extension efforts in each state that will disseminate results to recreation, health, educational and community professionals through workshops, presentations, and publications. Results will be widely disseminated through synthesis articles, centers and institutes, land grant outlets at colleges and universities, professional organizations (NRPA, SAF, IANSR, etc.), and Cooperative Extension. A coordinated approach will facilitate the incorporation of extension efforts during research design, data collection and generation, and interpretation of results. This will facilitate the practical application of the Multi-State effort.

Expected Impacts

We expect this work to lead to improvements in the health of Americans, which will in turn decrease national health care costs due to the prevention of illnesses known to be associated with obesity, lack of physical activity and diminished contacts with nature. Promoting active and healthy lifestyles and environmental literacy among youth will improve future generations' quality of life. Quality of life will also be promoted from this research by supporting vibrant and resilient communities, in which outdoor recreation opportunities and green infrastructure serve not only to protect and sustain ecosystems but also to provide ecological, economic, social, physical and psychological services upon which human health depends. We expect this work to have broad positive effects on human, community and ecological health.

Related, Current and Previous Work

Recreation and Health.

Research on outdoor recreation-associated health benefits has been increasing but typically focuses on specific risk factors (e.g. physical inactivity) rather than preventative measures and outcomes (e.g. healthy weight), and most of the previous research in this area has focused on physical health. Kaczynski and Henderson's (2007) review of 50 empirical studies examining associations between physical activity and park and recreation services found mixed results: 20 studies positive, 20 mixed, 9 no significant associations and one negative. Still, research asserts the positive association between proximity to parks and trails and physical activity across age groups (Boone-Heinonen, Casanova, Richardson, & Gordon-Larsen, 2010; Cohen et al., 2007; Frank, Kerr, Chapman, & Sallis, 2007; Roemmich, et al., 2006).

In terms of health outcomes (beyond specific risk factors), the limited research reveals no statistical association between indicators of recreation opportunity and healthy weight among youth (Potwarka, Kaczynski, & Flack, 2008) or between a neighborhood's access to open space and Body Mass Index (Witten, Hiscock, Pearce, & Blakely, 2008). However, Bell, Wilson, and Liu (2008) reported that greenness was generally associated with a reduction in body mass index in children. Healthy weight and BMI are two physical health outcomes. The 2014 report card on physical activity for U.S. children and youth indicates overall low physical activity indicators with grades of C- to F. The exception was a B- grade for 84.6% of children and youth (aged 6-17) living in neighborhoods with the presence of at least one park or playground. Disparities exist however by ethnicity, socioeconomic status, sidewalk and bike path accessibility, usage, perceived neighborhood safety and the parks availability of quality programming (Dentro, Beals, Crouter, Eisenmann, McKenzie, Pate,... & Katzmarzyk, 2014).

Physical health is just one aspect of health, however, and a growing body of research is beginning to explore connections between parks, green space, and other components of health (Hartig et al., 2014; Larson et al., 2016), including the contributions of ecosystem services to multiple aspects of health and well-being (Jennings et al., 2016). For example, Larson et al. (2016) used a holistic measure of subjective well-being that included physical, mental, and social components to demonstrate significant associations between parks and health outcomes in over 40 U.S. cities. In

a recent literature review focused on parks and other green environments, Kuo (2010) summarizes rigorous, interdisciplinary and global evidence that persons living in greener neighborhoods have better social, psychological and physical health outcomes that those who do not, even when controlling for socioeconomic and other possibly competing variables. Of particular relevance to this project, contact with nature has been shown to reduce ADHD in children (Faber Taylor & Kuo, 2009). Kuo concludes that nearby spectacular scenery and/or physical activity alone are not necessary for achieving positive health effects. Healthy human functioning is sustained as well by the sensory experience stimulated by views of trees and vegetation and/or a walk in a green setting. Other research supports positive links between green space and psychological health (Beyer et al., 2014; Bratman et al., 2012; Cohen-Cline et al., 2015), cognitive functioning (Dadvand et al., 2015), and social development and interactions (Holtan et al., 2015; Zelenski et al., 2015), suggesting that benefits associated with green space and time in nature transcends extend well beyond physical activity promotion.

Studies involving self-reports tend to be in the positive direction regarding park access and health benefits. Local park and recreation users studied by Godbey et al. (1998) reported fewer visits to a physician for purposes other than check-ups than did non-park users, and active park users had better self-reported health and other indicators of good health than did passive users and non-park users. More recent literature reviews confirm these findings (Ho, Payne, Orsega-Smith, & Godbey, 2003; Maller, Townsend, Pryor, Brown, & St. Ledger, 2005). The majority of outdoor recreation and health research focuses on communities or neighborhoods. When examined at a larger geographic scale, research related to park proximity and health beyond is similarly inconsistent as found in Kaczynski and Henderson's (2007) review. The four published studies at the macro-level reveal stronger connections exist between state level outdoor recreation opportunities and physical activity than between outdoor recreation opportunities and obesity (Edwards et al., 2011; Rosenberger et al., 2005; Rosenberger et al., 2009; West et al., 2012). Larson, Jennings & Cloutier's (2016) recent study on urban parks quality, quantity and accessibility as a predictor of five elements of human well-being provide insights in parks contribution to public health.

Much work has focused on urban parks, however Kline, Rosenberger, and White (2011) found that national forest lands significantly contribute to physical activity among the U.S. American public. Children with closer access to recreational facilities and programs have been shown to be more active (e.g. Cohen et al., 2007). However, studies reveal as many as half of park users are sedentary (Floyd, Spengler, Maddock, Gobster, & Suau, 2008; Shores & West, 2008).

Regardless of proximity or access, constraints to outdoor recreation intervene to prevent interest, participation and subsequent benefit attainment (Jackson & Scott, 1999). Initially, Crawford and Godbey (1987) identified three types of constraints: intrapersonal constraints (e.g., perceived lack of skill), interpersonal constraints (e.g., no one to go with), and structural constraints (e.g., lack of time/money). The latest evolution of constraints research differentiates structural constraints into four sub-categories: natural environment, social environment, territorial, and institutional (Walker & Virden, 2005). Structural constraints are of primary interest as they appear the most manageable. Understanding how and to what extend different populations enjoy the health benefits associated with green space is a central component of this project.

Recreation and Environmental Literacy.

Finding strong associations between various components of environmental literacy (e.g., knowledge and awareness) and behavior has proven to be elusive. The oldest and simplest models of pro-environmental behavior proposed the following relationship, which was shown to be wrong (Bruyere, 2008; Kollmuss & Agyeman, 2002): Environmental knowledge à Environmental attitude à Pro-environmental behavior. Simply put, increases in knowledge and positive attitudes were found not to lead to pro-environmental behavior. More advanced theories, models and methodologies have been proposed to clarify the complex relationship between attitude and behavior measurement (e.g., Ajzen & Fishbein, 1980; Hines, Hungerford & Tomera, 1986; Hungerford & Volk, 1990; Stern, Dietz & Karlof, 1993; Hsu, 2004; Wells & Lekies, 2006). However, discovering a single framework or model that captures the complexity of the forces that shape environmental behavior has also proven to be elusive (Goodwin, 2016; Mcbride, Brewer, Berkowitz, & Borrie, 2013).

Instead of trying to find the all-encompassing framework, some researchers have focused their attention on the factors that are thought to influence pro-environmental behavior (Kollmuss & Agyeman, 2002). Gender and years of education are consistently linked to environmental attitude, knowledge and willingness to change. Age and income have also been studied, but results are mixed and context-specific (Barr, 2003; Cottrell, 2003; Larson et al., 2011). Consistent with previous studies, most researchers find that environmental knowledge accounts for only small amounts of variation in pro-environmental behavior (e.g., Kempton et al., 1995; Maitney, 2002; Morrone et al., 2001; Siemer & Knuth, 2001; Stables and Bishop, 2001). Early childhood experience was not studied to any systematic extent prior to 2002, but recent evidence is reviewed below. Direct links between environmental attitudes and pro-environmental behavior have yielded mixed results, with level of association increasing as the specificity of the attitude matches the specificity of the targeted behavior. Kollmuss and Agyeman (2002) conclude their review of various models and factors by arguing that establishing new behavior requires practice and enough persistence until it becomes a habit.

Maitney's (2002) research provides evidence for the centrality of emotional involvement and direct experience in sustaining pro-environmental values and behavior. In congruence with Maitney, Siemer and Knuth (2001) found that fishing programs with direct fishing experience, the teaching of fishing skills and mentoring were more likely to influence antecedents of responsible behaviors in 12-14 year olds than fishing education programs without these elements. Other researchers have found an association between (a) outdoor recreation participation and environmental sensitivity (Palmer, 1993; Tanner, 1980) and (b) outdoor recreation and environmental knowledge and concern (Kellert, 1985).

Morrone, Mancl and Carr (2001) argue that ecological knowledge is a necessary, but insufficient, component of environmental literacy. Through a review of the literature and the use of experts, Morrone et al. (2001) developed an instrument that measured eight critical dimensions of ecological knowledge. In a study of Ohio residents, they found their instrument to be compatible with the theoretical literature and capable of discerning important group differences and similarities, including minority and nonminority variation.

Nisbet, Zelenski, and Murphy (2009) proposed a nature relatedness construct to describe the

connectedness individuals experience with the natural world. This construct encompasses an individual's feelings for and appreciation of nature, as well as an understanding of the importance of nature. Findings suggest that individuals with higher nature relatedness spent more time outdoors participating in nature-related activities, were more often involved in environmental groups and pro-environmental behaviors such as sustainable consumption, and had stronger views about ecological problems.

The concept of action competence may also be related to the idea of environmental literacy. According to Jensen and Schnack (2006), action competence comprises both the analysis of environmental problems and the ability to envision and act on alternate environmental developments. Gooch et al. (2008) found that the development of "action-oriented" unit lesson plans could be effective in empowering students to act environmentally. Chawla and Cushing (2007), in their review of the findings of studies on action competence, found multiple factors to influence pro-environmental behaviors, including: experiencing nature as a child, having role models, participation in environmental organizations, and the development of action skills.

Research based on place-based learning likewise offers potential in expanding knowledge of environmental literacy (Johnson, Duffin, & Murphy, 2012). Kudryavtsev, Krasny and Stedman (2012) found that programs involving youth in environmental stewardship, recreation, environmental skills development, and environmental monitoring increased ecological place meaning, but did not strengthen students' place attachment.

In terms of research on youth and lifespan development, Wells and Lekies (2006) provide a review of the scholarship in three areas: outcomes of outdoor play and access to nature, environmental education program efficacy, and role of significant life experiences in adult environmental commitment. As to outdoor play and access to nature, studies have found evidence of short term links between contact with nature and children's emotional and cognitive well-being (Faber Taylor, Kuo, & Sullivan, 2001; Faber, Taylor, Kuo & Sullivan, 2002; Kellert, 2002; Wells, 2000; Wells & Evans, 2003. A few studies have examined longer term associations with a variety of dependent variables. Bixler, Floyd, and Hammitt (2002) found support for the influence of childhood play outdoors on adolescent environmental preferences, outdoor recreation participation and outdoor occupations. Lohr and Pearson-Mims (2005) learned that childhood activities connected to plants (growing up next to a garden, picking vegetables, planting trees, etc.) and time spent outdoors with trees or in parks predicted adulthood beliefs about plants and the propensity to complete a gardening class.

Environmental education research has focused on the extent to which such programs result in knowledge, attitude or behavior change and typically utilize pre- and post-program measures over relatively short time spans (e.g., Armstrong & Impara, 1991; Kellert, 1985; Pooley & O'Connor, 2000; Ramsey & Hungerford, 1989). Significant life experiences research explores the association between childhood nature experiences and adult environmental commitment primarily among environmental professionals or activists. A major finding is that childhood experiences with nature create a pathway to environmentalism among the groups studied (Chawla, 1999; Corcoran, 1999; Sward, 1999). However, Wells and Lekies (2006) surmise that the generalizabililty of such findings are limited due to the almost exclusive focus on environmental activists or professionals. Wells and Lekies conclude that long-term effects of early childhood unstructured play outdoors on older adult

environmental knowledge, attitudes and behaviors have not been substantiated.

In an attempt to fill this research void, Wells and Lekies (2006) employed a long-term, life course perspective and structural equation modeling based on results from a large representative sample of 2,000 individuals, aged 18-90, who were also urban dwellers. Controlling for age, race, gender, income and education, they found evidence for a significant, positive association between childhood nature experiences and adult environmental attitudes and behaviors.

Recreation and Community Resiliency and Vibrancy.

According to the American Institute of Architects (AIA), vibrant public spaces encourage interpersonal interaction, collective engagement in community events and civic participation (AIA, 2007). In the outdoor recreation field, the vibrancy construct is not well developed but it is thought to foster resilience and promote sustainable communities (McManus et al., 2012). Resilience is a reflection of a system's overall health and sustainability (Cumming et al., 2005). In the context of coupled social-ecological systems, resilience has been defined as, the capacity of a system to absorb disturbance and reorganize while undergoing change so as to retain essentially the same function, structure, identity, and feedbacks (Forbes et al., 2009, p. 22041). The idea of resilience in a coupled social-ecological system is associated with adaptive renewal and sustainability rather than stability or a static, unchanging system (Gunderson and Holling, 2002).

Magis (2010) synthesized literature and convened a roundtable process with 60 natural resource and community development professionals to develop a definition of community resilience. They identified seven characteristics of community resilience (e.g., community resources, collective action, strategic action) and offered the following definition of community resilience.

"…The existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise. Members of resilient communities intentionally develop personal and collective capacity that they engage to respond to and influence change, to sustain and renew the community, and to develop new trajectories for the communities' future." (Magis, 2010, p. 402).

Community resilience is a process that occurs as individuals, communities, and institutions interact across natural and built environments. Based on a synthesis of literature defining the resilience concept, Burkes and Ross (2013) identified 9 community characteristics (i.e., knowledge, skills and learning; leadership; values and beliefs; social networks, engaged governance; positive outlook; community infrastructure; diverse and innovative economy, and people-place connections) that are "drawn into combined influence" (page 14) through community agency and self-organization, to create community resilience. They also note that, "the resilience of individuals and households is linked to that of the community" (Berkes and Ross, 2013, p. 15). They suggest that community service projects, which community members select and design themselves, can be considered as resilience-building strategies. Participating in such projects "… empower the group or community through a series of small successes and learning experiences. Such processes build cohesion and

a sense of community while achieving tangible outcomes such as infrastructure improvements and economic diversification …" (Berkes & Ross, 2013, p. 16). Thus, measuring the degree to which outdoor recreationists become involved in their communities may be a useful index of whether involvement in outdoor recreation is contributing to future community resilience.

Current work and previous work related to vibrancy and resilience in a few key areas are highlighted in the following subsections.

Communities and change.

A community's growth trajectory may change dependent upon unplanned (e.g., natural disasters) or planned events (e.g., policy change). Growth of a community or its ability to respond to change without negatively altering a desired growth pattern is at the heart of a vibrant community's resilience and ultimate survival and prosperity. The 21st century has illuminated that many natural resources are not renewable and can easily be compromised, placing the health and vibrancy of a community in jeopardy.

After examining U.S. rural counties, (Reeder & Brown, 2005) concluded that areas dependent on recreation and tourism fared better than other rural counties on key social-economic indicators. Counties located near metropolitan areas or significant natural resources heightened most impacts in a positive direction. Reeder and Brown, and others who study amenity rich communities, attribute population and economic growth to natural resources for recreation, tourism, and housing choices. Gateway communities or towns and cities in the wildland-urban interface enjoy many benefits attributed to the natural resources nearby. A growing society of retirees and more professions that enable off-corporate or campus work environments is piquing the interest of urban dwellers to live where the natural resources are plentiful and of high quality, thereby offering outdoor recreation activities and lifestyles (Crompton, 2007).

Economic vitality is a key component of change that is bolstered by green space. The distribution of urban green space can vary across neighborhoods and provides a reasonable proxy for a community's socio-economic status (Bruton & Floyd, 2014; Vaughan et al., 2013). For example, green space projects can revitalize communities by creating green jobs, increasing property values, and improving public health (Branas et al., 2011; Kondo et al., 2015; Schilling & Logan, 2008). A study in Philadelphia found that views of local greened lots significantly decreased heart rates when compared to non-green lots, implying that reducing neighborhood blight can minimize stress and enhance human health (Kondo et al., 2015). Local property values also illustrate the economic impact of urban green spaces (Cho et al., 2006; Kovacs, 2012). In as study of property values in northern Los Angeles, Conway et al. (2010) observed that home prices in older urban communities were higher in neighborhoods with greening programs. They also recommend that future studies expand their analysis to include more attributes and values of green space—not just those centered on housing prices. A similar study in New York City compared neighborhood property values within multiple distances of community gardens. They found that gardens have significant positive effects on property values, especially in disadvantaged neighborhoods (Voicu & Been, 2008). These studies suggest that economic stability is closely associated with green space and outdoor recreation opportunities, cultivating a relationship that can lead to better community health outcomes.

Communities that recognize and plan for change are more likely to be resilient. Scientists and community outreach specialists, however, need to identify case studies and indicators that describe the substance of communities. They also need to model the processes by which change was managed and vibrancy and resilience were achieved (Bosselman, Peterson, & McCarthy, 1999).

Civic ecology and conservation recreation.

As noted by Leopold (1938) and others (e.g., Scott, 1958), participation in outdoor recreation in and of itself is no guarantee that conservation will be accomplished, and could instead result in ecological damage and even loss of social capital through exclusion of some potential participants. Tidball and Krasny (2010) defined conservation activities that include a civic purpose as civic ecology practices (p. 1). They noted that, although often viewed as initiatives to improve a degraded environment, [these practices] also foster social attributes of resilient social-ecological systems, including volunteer engagement and social connectedness (Tidball & Krasny, 2010, p. 1). Civic ecology practices such as tree planning, habitat restoration and community gardening can occur across the rural-urban continuum (Krasny & Tidball, 2010, 2015; Krasny et al., 2014). Within the universe of civic ecology practices is a subset of nature-based activities that might be defined as conservation recreation activities.

Conservation recreation occurs when participation in nature-based recreation activities foster broader outcomes purported to arise from civic ecology practices, including individual, community and ecological well-being. Cooper et al. (2015) highlight connections between nature-based recreation and one of these broader outcomes – participation in pro-environmental or conservation-oriented behavior. They found that individuals who engage in wildlife-dependent recreation activities were significantly more likely to engage in various forms of pro-environmental behavior, including supporting conservation policies, donating to conservation causes, enhancing wildlife habitat on public lands, and participating in environmental groups. Similar patterns have been observed in other studies (Larson et al., 2011; Teisl & O'Brien, 2003), highlighting the growing need for research that examines why these connections exist and how they can be promoted and leveraged to support healthy and sustainable communities.

Sense of place.

The phrase "sense of place" encompasses a group of cognitions and affective sentiments people hold regarding a particular geographic locale (Farnum, Hall, & Kruger, 2005; Jorgensen & Stedman, 2001, 2006). A conceptual framework integrating place-based concepts is emerging from the literature (Manzo & Devine-Wright, 2014). Two key components of sense of place are place meanings and place attachment. Place meanings are cognitive, descriptive, or symbolic statements about what kind of a place a setting represents. Place meanings can be derived from a variety of sources including interaction with the environment and the interconnectedness of environmental features, psychological developments, and sociocultural processes. Place attachment as the psychological, affective bond that an individual forms with a particular setting (Kudryavtsev et al. 2012b). These bonds are influenced by the values people ascribe to a place (i.e., place meanings). Anecdotal information suggests that outdoor recreation in a specific place can contribute to place meanings and subsequent place attachment. Quantitative research is

needed to confirm the veracity of this belief in various context for outdoor recreation.

Having urban community open spaces has been associated with reports of a strong sense of community, or perceptions of a healthier community among community residents (DeGraaf & Jordan, 2003; Furnham & Cheng, 2000; Kesebir & Deiner, 2008; Kweon, Sullivan, & Wiley, 1998; Peters, Elands, & Buijs, 2010; Francis, Giles-Corti, Wood, & Knuiman, 2012). There is evidence to suggest that people tend to prefer green spaces over paved spaces (Coley, Kuo, & Sullivan, 1997), but the reasons for those preferences are not well understood. Research is needed to document the full range of benefits that neighborhood parks and natural areas provide, both as catalysts of social cohesion, and as providers of ecosystem services.

Parks, natural areas, and other types of open space have the potential to create a sense of place that yields psychological and environmental stewardship benefits. Several studies have found a positive association between sense of place and pro-environmental behaviors (Vaske & Kobrin, 2001; Stedman, 2002; Walker & Chapman, 2003; Ryan, 2005; Halpenny, 2010; Hernandez et al., 2010; Scannell & Gifford 2010), leading to the research hypothesis that pro-environmental behaviors can be encouraged by getting people engaged in activities that elevate sense of place and place attachment (Walker & Chapman, 2003).

Repurposing outdoor spaces.

Through the community change process, many remnants or overused parcels of land fall into disuse and may be left aside with diminished value. Community planners and park and recreation professionals are viewing sites formerly developed as housing, military installations, industrial corridors, landfills, or transportation lines as opportunities for redevelopment and the creation of new places for outdoor recreation and tourism. These redevelopment sites have been shown to revitalize natural habitats, sometimes with the original species, and mitigate urban sprawl by infilling in the core of a community rather than the edges. Repurposing of natural resources may be one of the prime examples of sustainable development and systems thinking.

Johnson, Glover, & William (2009) studied a landfill-to-park redevelopment through the views of a nearby neighborhood. The research illustrates that community planning is necessary to create sense of place in an abandoned site that is a threat to human health and quality of life. Klenosky, LeBlanc, Vogt and Schroeder (2008), along with Forest Service scientists and park managers, have studied several repurposing brownfields in Midwest and Eastern cities. These spaces integrate nature's resiliency with the human desire to recreate in a variety of outdoor spaces. Rail corridors converted into bike and walking trails is another example of repurposing industrial landscapes. Research has profiled the nature and level of use, as well as the importance of rail-trails to foster active transportation and physical exercise for residents and tourists of all ages.

Scholars also are beginning to investigate how outdoor spaces undergo spontaneous, unplanned repurposing, and what those changes imply for land stewardship and community vibrancy and resilience. Creation of outdoor spaces and sacred places (OSSP) is often the result of spontaneous, self-organizing acts that are motivated by stewards' sense of community and need for healing rituals, and are expressed through myriad relationships with nature (Roberts, 2002;

Svendsen & Campbell, 2010; Tidball et al., 2010). As such, the emergence of OSSPs is part of a socio-ecological process of disturbance and resilience (Berkes & Folke, 1998, 2002; Stedman & Ingalls, 2013). Stewards use their immediate landscape act as a mechanism to foster collective resilience in the aftermath of a crisis (Tidball 2010; Tidball & Krasny, 2013). This "adaptive capacity" of environmental stewards is essential to a healthy society and to overall ecosystem function (Folke et al., 2003; Gallopin, 2006; Tidball and Krasny, 2007).

The act of local OSSP creation and stewardship is an act fundamental to the healing process of those involved (Tidball et al., 2010). Studies of environmental volunteers find that stewardship activities help to lessen feelings of isolation and disempowerment and can strengthen neighborhood attachment (Townsend, 2006; Svendsen & Campbell, 2006; Comstock et al., 2010). Research on urban greening has shown that different benefits from these projects are derived at the individual, organization, and community levels (Westphal, 2003, 1999; Wolf, 2008). Studies of community gardeners have found that at the individual level, stewardship can promote relaxation, mitigate stress, create self-confidence, and strengthen sense of control and self-efficacy; at the collective level it can help to establish trust, strengthen social cohesion, share knowledge, and leave a legacy (Baker, 2004; Dow, 2006; Glover et al., 2005; Saldivar-Tanaka & Krasny, 2004; Svendsen, 2009; Teig et al., 2009).

Furthermore, studies have pointed to the therapeutic and symbolic value of trees, treescapes, and other aspects of nature (Anderson, 2004; Jones & Cloke, 2002; Miller, 1997; Perlman, 1994; Tidball 2014). Plants, as well as interacting with plants (e.g., through gardening, tree planting), appear to aid in resistance and resilience through psychophysiological effects (Hartig et al., 1991; Heerwagen, 2009; Korpela & Ylen, 2007; Kuo, 2001; Kuo & Sullivan, 2001; Kweon et al., 1998; McCaffrey et al., 2010; Wells, 2003). Nature is also a crucial resource for communities recovering from disaster (Hull, 1992; Ottosson & Grahn, 2008).

The purpose of extending this project (NE1962) is to provide evidence for the role of and mechanisms by which parks and other green environments support human well-being in three areas (health, environmental literacy, community vibrancy/resilience) and extend the knowledge gained to practitioners and other affected groups.

Objectives

1. 1. Demonstrate and expand the evidence for the role of park and outdoor recreation services in promoting physical activity and associated preventative health benefits, particularly among youth.
2. 2. Demonstrate and expand the evidence for the role of park and outdoor recreation services in promoting environmental literacy among youth, and document the long-term influences of early lifespan connections with nature.
3. 3. Demonstrate and expand the evidence for the role of park and outdoor recreation services in promoting community vibrancy and resilience.

Methods

Objective 1: Demonstrate and expand the evidence for the role of park and outdoor recreation services in promoting physical activity and associated preventative health benefits, particularly among youth, as well as constraints to this activity.

A variety of methods have been and will continue to be used for understanding physical activity and outdoor activities, as well as constraints to outdoor activities. Surveys, interviews, direct observation and GIS examine not only the amount and type of physical activity by various age and ethnic groups, but also constraints to such activity and the key role of proximity. Expanding this systems-based approach to account for a broader array of socio-ecological forces and interactions is needed.

Auditing and assessment tools (e.g., SOPLAY-System for Observing Play and Leisure Activity in Youth; and NEWS-Neighborhood Environment Walkability Scale) are furthering the evidence and information, as is photo elicitation. Photo elicitation was used by Montanez et al. (2012) to explore children's perceptions of places to be physically active. Behavioral monitoring devices, such as pedometers and accelerometers are used to measure volume and intensity of activity associated with various types of outdoor facilities and amenities.

Concentration performance tests, clinical depression diagnostic tools, physiological measures using standard medical instrumentation and protocols (blood pressure, pulse, nerve and brain wave activity, blood cortisol and glucose levels, immune cells, etc.), experimental designs and large scale studies with statistical controls have been and are being employed in separate studies across the US and in other countries. The linkage between outdoor physical activity and longer-term well-being has yet to be established. Discovering evidence for such a linkage will require cross-sectional, longitudinal and experimental designs.

Determining the validity of the assumption that the amount of outdoor physical activity is declining across broad segments of the population will require establishing a baseline for comparison purposes. Meta-analyses of previous published research and identification of unpublished data are two methods for establishing a baseline. Subsequently, monitoring in multiple states for comparison purposes using a variety of behavioral (e.g., accelerometer) and direct observation procedures should be implemented; settings should also be varied (private residences, city streets, schoolyards, city, state and national parks, forests, and open space, etc.).

Objective 2: Demonstrate and expand the evidence for the role of park and outdoor recreation services in promoting environmental literacy among youth, and document the long-term influences of early lifespan connections with nature.

Research on the correlation between reduced outdoor recreation, contact with nature and reduced environmental literacy is primarily based on single case studies and anecdotal evidence popularized by Richard Louv and the Nature-Deficit Disorder concept. The majority of research has been quantitative studies of specific environmental education programs that are short term, rely mostly on retrospective self-reports, and lack longitudinal programmatic evaluations (Wells and Lekies, 2006). Studies providing evidence for short-term associations between childhood nature contact and adult environmental outcomes are fairly numerous, but they are 10 to 15 years old and mostly correlational. The study by Hsu (2004) is more recent, but again only provides results related to short-term impacts (two months). In addition, the results were based on a sample of college students who took a formal environmental education class. There is still much to learn about the effect of childhood experience with nature and unstructured outdoor play on adult environmentalism (literacy and behavior).

Despite the lack of long-term experimental evidence, researchers have developed theoretical frameworks necessary to begin experimental and longitudinal research (Tidball & Krasny, 2011; Wimberley, 2009). These theoretical frameworks encourage nested research that studies humans within larger social and environmental systems. Additionally, researchers have developed instruments to assess the impacts of environmental education efforts on environmental quality (Duffin, Murphy, & Johnson, 2008; Short, 2009). Thus, one group of scholars is calling for a current and sustained research effort focused on establishing causality, utilizing experimental or quasi-experimental designs and prospective, longitudinal designs.

Others disagree (Courtney-Hall & Rogers, 2002; Maiteny, 2002), arguing that the behavior-modeling, causality approach creates epistemological problems. Instead of relying on positivistic, deterministic approaches to understanding environmental literacy, Courtney-Hall and Rogers (2002) emphasize the need for more interpretive research approaches and equal use of qualitative procedures. Thus, other scholars are interested in taking advantage of emerging methodologies that utilize a mixed methods research approach. Through the use of research techniques such as interviews and surveys, these researchers will be able to explore elements related to contact with nature and environmental literacy, and then quantify these elements. Concepts identified in interviews and findings of previous studies on environmental literacy (Wells & Lekies, 2006; Ewert, Place & Sibthorp, 2005; Lohr & Pearson-Mims, 2005; Roth, 1992) will be used to develop survey instruments; demographic questions and questions about the type of environmental settings primarily experienced during childhood (e.g., urban, rural) will also be included.

Objective 3: Demonstrate and expand the evidence for the role of park and outdoor recreation services in promoting community vibrancy and resilience.

In addition to traditional quantitative and qualitative methods, research and engagement methods in this category could include community-based participatory research methods, such as Becker, Harris, McLaughlin and Nielsen's (2003) Interactive Community Forum, or participatory modeling strategies similar to those described by Chase et al. (2010). Researchers could also include economic analyses, using input/output and counterfactual models designed to assess the development of tourism-based industry in rural locations. Past examples include assessments of development adjacent to high amenity resources, such as gateway communities to national parks (Krannich & Petrazelka, 2003), and regional economic indices developed by Eschker (Humboldt State University) and Lee (Plymouth State University).

Researchers who examine the roles of green environments in urban communities are using unique, non-survey procedures. For example, researchers in Illinois have documented negative correlations between natural areas and crime through methods such as photo elicitation (Kuo, Bacaicoa, & Sullivan, 1998) and comparing aerial photography and crime reports (Kuo & Sullivan, 2001). Additionally, The Trust for Public Land documents the willingness of community members to be taxed for parks and green space preservation through its analysis of ballot initiatives. GIS applications are becoming common within community-based recreation research to visually identify the links between community indicators and parks, recreation resources, and other green environments. Systems-based approaches are also being seen as essential in order to adequately explain the influences of a broad array of socio-ecological forces and interactions.

Still needed are research designs that clarify interconnections between outdoor recreation activity and indicators of resilience. Resilience is a multi-dimensional concept, so a range of resilience measures need to be applied in an outdoor recreation context. Human contributions to community resilience can be measured at an individual (psychological) or a collective (social) level. New indicators are being developed to address some research questions under the broad umbrella of community resilience. For example, Larson et al. (2015) developed indicators of pro-environmental behavior (PEB) that can be applied in a recreation research context. Cooper et al. (2015) applied those indicators to demonstrate a connection between wildlife-dependent outdoor recreation and expression of pro-environmental behaviors.

Measurement of Progress and Results

Outputs

- General Outputs Comments: -Regular meetings with multistate group, including annual in-persona gathering and virtual interactions throughout the year -Centralized location (e.g., Multistate Research Project website) that serves as hub for information sharing, including repository for research studies, instruments, and measures related to parks, outdoor recreation, health and well-being, environmental literacy, and community resiliency. -Project Synthesis papers and presentations for professional associations, such as the Society of Outdoor Recreation Professional (SORP) & National Recreation and Park Association (NRPA) and for dissemination to practitioners. -Standardized 1-2 page factsheets on study findings that will be distributed to recreation program managers at various government agencies (local, state and federal) and nongovernmental organizations. -Workshops, symposia, or conference sessions that connect researchers, extension specialists, and practitioners to present the mechanisms by which parks and other green environments support (1) human health, (2) environmental literacy and (3) community vibrancy and resiliency, as well as fostering continued and new engagement in this Multistate Research Project. -Increased student participation and engagement in the Multistate Group to enhance networking and professional development opportunities -Generate external funding from agency, foundation, and/or corporate sponsors to support Multistate research efforts and objectives
- Health & Well-being Comments: -Development, implementation and refinement of reliable and valid scales that measure different types of park, recreation, and nature-related health outcomes across diverse populations -Peer-reviewed publications and professional conference presentations that document the role of parks and outdoor recreation service in promoting associated preventative health benefits across diverse populations.
- Environmental Literacy Comments: -Development, implementation and refinement of reliable and valid scales that measure the diverse ways that children and adults think about and engage with nature, including environmental literacy, knowledge, attitudes and pro-environmental behaviors. -Peer-reviewed publications and professional conference presentations that document the role of park and outdoor recreation services in promoting environmental literacy among youth and adults
- Community Vibrancy & Resiliency Comments: -Development, implementation and refinement of reliable and valid scales that measure the different components and contributors to community vibrancy and resiliency, including economic development, governance, civic ecology, conservation recreation, sense of place, environmental stewardship, and related concepts. -Peer-reviewed publications and professional conference presentations that document the role of park and outdoor recreation services in promoting community vibrancy and resilience, particularly as it relates to transformative communities, economic development, sense of place, and repurposing outdoor spaces. -Peer-reviewed publications and professional conference presentations that document long-term influences of early lifespan connections with nature, particularly in relation to environmental literacy and pro-environmental behaviors, including policy support and stewardship engagement.

Outcomes or Projected Impacts

- General Outcomes (short-term) -Enhanced national coordination and scientific capacity to address contemporary problems in parks and recreation by applying and revising state-of-the-art knowledge. -Creation and cultivation of relationships with potential research funding partners, including federal agencies, non-governmental organizations, and foundations -Forecasts for park use and recreation visitor volume and trends, and plans for appropriate recreation management responses.
- Health and Well-Being Outcomes (short-term) -Increased understanding of the multifaceted health benefits of recreation in parks and other green environments. -Increased understanding of the mechanisms through which health benefits, particularly in relation to healthy human habitat, occur. -Increased understanding of how these benefits are experienced across diverse populations.
- Environmental Literacy Outcomes (short-term) -Documentation of trends in unstructured outdoor play (i.e., amount of time spent in unstructured outdoor play). -Increased understanding of the strength of relationships between unstructured and structured (i.e., environmental education programs) contact with nature and environmental literacy. -Identification of critical developmental points that are more important than others in terms of childhood engagement with nature. -Increased

understanding of the role of outdoor recreation on enhancing cognitive development and school performance among youth.

- Community Vibrancy & Resiliency Outcomes (short-term) -Increased understanding of the ecological, economic and social contributions of recreation to community vibrancy and resilience. -Awareness among researchers and providers of standardized methods and instruments to measure community vibrancy and resilience related to outdoor recreation, parks and other green environments. -Development of recreation planning documents incorporate resilience, vibrancy and recreation. -Increased understanding of outdoor recreations role in larger socio-ecological systems in terms its contribution to human health, environmental literacy and community vibrancy and resilience.
- General Impacts (long-term) -Transformative research that positions parks, green spaces and outdoor recreation as key components of a sustainable and healthy future -Creation and cultivation of relationships among researchers, government agencies, non-governmental organizations, and foundations to help support sustainable park and outdoor recreation systems -Effective education, communication and promotion of the value of parks, green spaces and outdoor recreation across diverse populations.
- Health & Well-being Impacts (long-term) -Increased public awareness of active recreation opportunities and relationships to personal health. -Increased participation rates in active outdoor recreation, particularly among youth. -Infrastructure that supports healthy lifestyle choices, such as increased pedestrian and bicycle transportation coordinators to schools. -Improved health and quality of life across diverse populations. -Reduced strain on healthcare costs and the healthcare system via integration of nature-based health promotion strategies. -Inclusion of outdoor recreation in health education requirements. -Enhancement of school-based recreation programs to promote healthy lifestyle choices.
- Environmental Literacy Impacts (long-term) -Public awareness of environmental and ecosystem processes. -Public awareness of ecological footprint (individual consumption), including recreation-related footprints and impacts. -Citizens engage with natural resources, including participation in environmental education, interpretation and conservation stewardship programs. -National education curriculum includes experiential environmental education. -Greater support for environmental policies and natural resource conservation. -Development of environmental and outdoor programs targeted towards specific youth populations.
- Community Vibrancy & Resiliency Impacts (long-term) -Enhanced sense of place and public attachment to natural environment. -Awareness among community leaders and entrepreneurs of the role of park and outdoor recreation services in promoting community vibrancy and resilience. -Outdoor recreation enterprises contribute to communities' economic stability. -Awareness among citizens of role of natural resource amenities and recreation service delivery systems on tax revenues. -Improved social networks and community ties from increased contact with community members during outdoor recreation. -Increased work productivity. -Youth who become responsible outdoor recreationists and resource stewards. -Sustainable and accessible outdoor recreation environments that lead to resilient communities and high quality of life. -Citizens engage in pro-environmental behaviors. -Increased public engagement and participation in park and natural resource-related decision making and policy development.

Milestones

(**2018**):• Creation of NE1962 Multistate Project website that serves multiple functions including categorized inventory of ongoing projects across multistate partners, documentation of contributors/partners and project-related resources, communication forum, and recruiting tool for new collaborators. • Development of formal and coordinated grant proposal process for NE1962 partners to prepare for future grant submissions • Increased NE1962 engagement and participation (including annual meeting and other virtual meetings throughout the year) • Identification of collaborative research and funding opportunities • Annual meeting in Washington, DC •Investigate possibility of future NE1962 annual meetings to be held in Mountain or West Coast location to increase western states' participation

(**2019**):• Continued coordination of group efforts and ongoing research, including development, implementation and refinement of instruments and scales for assessing key outcome variables. • Publication of ongoing research. • Coordinated pursuit of research and funding opportunities. • Outreach and information dissemination of existing projects, including resources for extension specialists on project website. • Coordinate conference session and/or panel discussion that highlights NE1962 Multistate Project and outcomes related to at least one project objective • Annual meeting (location TBD)

(**2020**):• Continued coordination of group efforts and ongoing research, including development, implementation, and refinement of instruments and scales for assessing key outcome variables. • Publication of ongoing research. • Coordinated pursuit of research and funding opportunities, with successful acquisition of at least one collaborative, externally-funded grant • Outreach and information dissemination of existing projects, including resources for extension specialists on project website. • Annual meeting (location TBD)

(**2021**):• Continued coordination of group efforts and ongoing research, including development, implementation and refinement of instruments and scales for assessing key outcome variables. • Publication of ongoing research. • Coordinated pursuit of research and funding opportunities, with successful acquisition of at least one collaborative, externally-funded grant • Outreach and information dissemination of existing projects, including resources for extension specialists on project website. • Coordinate conference session and/or panel discussion that highlights NE1962 Multistate Project and outcomes related to at least one project objective • Annual meeting (location TBD)

(**2022**):• Continued coordination of group efforts and ongoing research, including development, implementation and refinement of

instruments and scales for assessing key outcome variables. • Publication of ongoing research. • Coordinated pursuit of research and funding opportunities, with successful acquisition of at least one collaborative, externally-funded grant • Outreach and information dissemination of existing projects, including resources for extension specialists on project website. • Annual meeting (location TBD) • Future planning for renewal of Multistate Project

(**2023**):• Continued coordination of group efforts and ongoing research, including development, implementation and refinement of instruments and scales for assessing key outcome variables. • Publication of ongoing research. • Coordinated pursuit of research and funding opportunities, with successful acquisition of at least one collaborative, externally-funded grant • Outreach and information dissemination of existing projects, including resources for extension specialists on project website. • Annual meeting (location TBD) • Renewal of Multistate Project

Outreach Plan

Research results from NE-1962 are of interest to academic audiences as well as various publics including community and youth leaders, policymakers, K-12 schools and organizations. During the first year of this project, efforts will be made to invite Extension faculty and specialists to integrate formal outreach programming into the project. NE-1962 members will make research results available through scientific journals, Extension publications, fact sheets, popular press news articles, and appropriate websites and social media outlets. In addition, NE-1962 members will present at national and international conferences as well as regional and local workshops and meetings. A listing of publications by NE-1962 members will be updated annually and posted on the official NE-1962 website. Internal communication related to NE-1962 will be facilitated by the annual meeting, official website, and google group.

Organization/Governance

The organization of project NE-1962 was established in accordance with the Manual for Cooperative Regional Research. A Technical Committee will be formed that grants voting membership for elections. One representative from each participating organization, agency or institution can serve on the Technical Committee, with appointments made through appropriate administrative channels of the organization, agency or institution. In year one, a Chair will be elected and will serve a one-year term. Primary duties of the Chair include: scheduling and organizing the annual meeting, managing participant contact information lists, and managing the communication network. A Chair Elect will be elected in years 1, 2, 3, and 4, serving a one-year term before serving as the Chair in the subsequent year. Duties of the Chair Elect include: serving as secretary and drafting and submitting the annual report. All appointments (chair, chair-elect, and technical committee) will be annual with terms beginning October 1. Each year a 1-2 day annual meeting will be held, in a location chosen by the chair and with in-person participation only.

Projected Participants

- Peter Fix - University of Alaska, Fairbanks;
- Taylor Stein - University of Florida;
- Kristi Lekies - The Ohio State University;
- Alia Dietsch - The Ohio State University;

- William Siemer - Cornell University;
- Keith Tidball – Cornell University;
- Sandra De Uriste-Stone – University of Maine;
- Lincoln Larson - North Carolina State University;
- Myron Floyd – North Carolina State University;
- Amy Villamagna – Plymouth State University;
- Brian Eisenhauer – Plymouth State University;
- Kathleen Scholl - University of Northern Iowa.

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Land Grant Participating States/Institutions

Non Land Grant Participating States/Institutions

Participation

Participant	Is Head	Station	Objective	Research						Extension	
				KA	SOI	FOS	SY	PY	TY	FTE	KA

Combined Participation

Combination of KA, SOI and FOS	Total SY	Total PY	Total TY
Grand Total:	**0**	**0**	**0**

Program/KA	Total FTE
Grand FTE Total:	**0**

NEtemp1231: Collaborative Potato Breeding and Variety Development Activities to Enhance Farm Sustainability in the Eastern US

Status: Under Review

Duration 10/01/2017 to 09/30/2022
Admin Advisors: [Frederick A. Servello]
NIFA Reps:

Statement of Issues and Justification

STATEMENT OF ISSUES AND JUSTIFICATION

Importance of work - This multidisciplinary research project helps small-, medium- and large-scale potato growers supply high quality, highly nutritional products to customers, while maintaining economically and environmentally sustainable production practices. We will provide farmers new potato varieties to solve production problems and meet industry and consumer preferences. These varieties will have better yields, enhanced fresh market, processing or value-added traits, and better pest and abiotic stress resistances resulting in improved productivity and/or reduced chemical inputs. We have a solid track record in producing new potato varieties that have been commercially accepted. For example, the varieties Lamoka, Caribou Russet, Reba, Keuka Gold, Lehigh, Pike, Andover, Harley Blackwell, Waneta, Peter Wilcox, Sebec, Strawberry Paw, Pinto Gold, and Marcy have enjoyed recent success in the marketplace and most are produced on significant acreage in the east. Additional advanced breeding clones in our evaluation pipeline have the potential to provide significant benefits for potato producers. We propose to continue developing improved potato breeding and phenotyping technologies using our collaborative multidisciplinary regional approach to breed, select, and develop improved potato varieties to enhance marketing opportunities and reduce farm dependence on costly agricultural chemicals. This will lead to a more economically and environmentally sustainable potato production system.

Importance of potato production to the Eastern US - Research benefiting the Eastern potato industry impacts markets associated with over half of the US population. Consumers benefit from the release of new potato varieties that provide high quality products, facilitate efficient production, and provide improved pest resistance resulting in less pesticide use. From a farm economy perspective, potato ranks among the top three vegetable crops produced in FL, ME, NC, NY, OH, PA and VA. Cash farm receipts for eastern potatoes are ca. $500 million annually (USDA NASS) with economic multiplier effects many times this amount. However, achieving this level of productivity in the East is difficult as production occurs under a wide range of environmental conditions, ranging from the winter crop in southern FL, to out-of-field marketed summer and fall

chipping crops in NC, VA, and elsewhere, to the fall storage crops of ME, NY and PA. This creates diverse variety needs. Fresh market production remains a significant part of the industry (e.g. 15, 25, 50, 60% of ME, NC, OH, PA's crops, respectively); however, 43 percent of U.S. chip production occurs in the east (NPC Potato Statistical Yearbook). Processing, primarily for French fries, accounts for 60% of ME utilization (USDA NASS). ME and NY maintain high quality seed potato industries that service most of the East's seed potato markets.

Needs as indicated by stakeholders **-** All Eastern potato breeding programs utilize direct input from growers, processors, and industry groups (e.g., National Potato Council and Potatoes USA, state grower associations, processors, large-scale corporate farms, and individual growers, etc.) to provide input and establish priorities for their breeding efforts. These groups typically provide over $300,000 in annual matching grant support to this research effort. Our grower and industry stakeholders have consistently indicated that they need improved varieties for both fresh and processing markets. New varieties resistant to abiotic stress, diseases, and insects are high priorities. Stakeholders have always played a key role in defining the objectives of our potato breeding, evaluation, and variety development efforts and we recognize that variety adoption is impossible without active interaction between researchers, extension, growers, and industry.

Stakeholders place a high priority on the development of new red-skinned and specialty varieties. A premium-priced market exists for red-skinned and novelty varieties. For reds, the skin color needs to be bright and stable in storage. Resistance to skinning, netting, and silver scurf are especially important. Novelty varieties (e.g., fingerlings, purple-skinned, and multi-colored-flesh types) are growing in popularity in the high-value, direct-sale market. Better-adapted novelty varieties would offer new marketing opportunities to many Eastern growers, especially small-scale growers that specialize in direct sales to consumers. New varieties containing desirable market quality along with multiple resistances to insects, pathogens and stress would provide better performance without chemical inputs in the growing organic industry.

Two distinct marketing opportunities exist for chip potatoes in the Eastern region. Potato producers from the mid-Atlantic and southern areas (e.g. FL, NC, VA, MD, NJ, and southeastern PA) sell their processing potatoes to chip factories directly following harvest. The variety requirements for these regions stress earliness, chip quality from the field, high tuber dry matter content, and tolerance to high temperatures during bulking. The cultivar Atlantic has dominated commercial production in these areas for many years; however, it is very susceptible to internal heat necrosis (IHN), a serious quality defect throughout many of the Eastern-coastal and Southeastern states. Stakeholders have made developing an improved variety to replace Atlantic a top priority and several recent releases and advanced selections from our programs are being evaluated for this purpose. Contrasted with the south, processing growers from the northern states (PA, NY, and ME) store most of their crop before it is sold. These growers need high yielding, high specific

gravity varieties with low defect levels and the ability to process into chips or fries from long-term cold storage. Snowden has been the standard storage chipping variety in northern regions for about 25 years. It combines high yield potential and specific gravity with reliable chip color through mid-term storage; however, it has weaknesses (e.g., scab susceptibility, stem and vascular defects, taste panel concerns, and poor chip quality from long-term storage). As a result, stakeholders have made developing an improved potato variety to replace Snowden a top priority.

Most of the russet- and French fry-type varieties developed in the western and mid-western states are poorly adapted to the East, as is the standard variety, Russet Burbank. A major goal is to develop russet varieties with high yield, improved disease resistance, uniform long tuber shape, high specific gravity, low internal and external defects, and acceptable fry color under Eastern growing conditions. This is critical for Maine's French fry markets and could allow expansion of French fry processing into other Eastern states.

In all market sectors, disease- and insect-resistance are needed for the Eastern potato production system. Foliar fungicide applications for control of late blight (*Phytophthora infestans*) and early blight (*Alternaria solani)* account for approximately 80% of the pesticides applied to Eastern potatoes during a typical growing season. These applications are costly to growers and may result in chronic environmental degradation and/or health problems for agricultural workers. Potato virus Y (PVY) has become more difficult to manage as new recombinant strains have been introduced from other production areas. This pest has been very costly for eastern seed potato producers. Likewise, new challenges have developed in managing bacterial soft rot (*Pectobacterium* and *Dickeya* spp.) throughout the eastern region. Improved varietal resistance would benefit growers as they deal with this challenge. Golden nematode (*Globodera rostochiensis*) is highly destructive to the potato crop and its spread is controlled by quarantine regulations. Once it becomes established in a production area (e.g. parts of NY, Canada, and Europe), potato production is impossible without varietal resistance. Cosmetic diseases of the potato tuber such as common scab (*Streptomyces spp.*), silver scurf (*Helminthosporium solani*), black scurf (*Rhizoctonia solani*), and powdery scab (*Spongospora subterranea*) can result in a crop that is unmarketable for seed or table use. Once the crop is in storage, storage decay caused by a range of pathogenic organisms (e.g., *Pectobacterim, Phytophthora erythroseptica, Pythium spp, Fusarium spp*., *P. infestans*, and *A. solani*) can cause complete and devastating losses to growers. Colorado potato beetle (CPB, *Leptinotarsa decemlineata)*, aphids (e.g., *Myzus persicae and Macrosiphum euphorbae*) and leaf hoppers (*Empoasca fabae*) are commonly encountered insect pests that increase costs and reduce yield and quality in the East. Concerted efforts are needed to identify new genetic sources of resistance and incorporate them into productive *S. tuberosum* clones. Disease and insect resistant varieties provide an economical and environmentally sound alternative to pesticide use.

Advantages of a collaborative, multistate research project - This project is a highly

collaborative effort involving seven states and four breeding programs in the East (see figure in Appendix 2). Our project promotes collaboration and communication among researchers and stakeholders – all with the aim of enhancing farmer's ability to provide a safe and nutritious supply of potatoes to consumers in an environmentally sustainable manner that enhances profits and rural America. It addresses the needs of the small- medium- and large-scale growers, marketers, processors of the Eastern potato industry through a collaborative process of potato breeding, selection, evaluation, and variety release. Our overall goal is to develop an array of attractive, high yielding, disease- and insect-resistant, tablestock, processing and/or specialty-type potato varieties that can be produced by potato farmers in the East for this exceptionally diverse consumer base. Within this context, it is important to recognize that the Eastern US region is not only linked geographically, but is also closely linked through potato seed sales (from northern production areas), production (north and south), and product marketing (north and south). Thus, regional communication among scientists, farmers and industry members is critical for the variety development process.

A regional approach for potato breeding makes sense because potato production in the East spans a wide range of day-length, temperatures, soils, humidity, and moisture conditions. These conditions have dramatic effects on the performance and acceptability of potato breeding lines and varieties (Tai et al., 1993). Genotype by environment interactions must be evaluated to select new varieties with improved adaptation (Hill, 1975; Souza et al., 1993; Zobel et al., 1988). In addition to breeding, this project conducts collaborative selection and performance trials under diverse environmental conditions and a wide array of disease and pest pressures so that new potato varieties can be selected that are adapted to varying conditions of the East. Our research network facilitates the coordination of potato breeding and genetics research across seven states, two Canadian Provinces, and two federal agencies (two USDA-ARS laboratories and the AAFC research center in Fredericton, NB, Canada). Central to the project's function are multi-site testing of breeding materials under diverse environmental conditions, sharing of breeding materials, and exchange of trial results.

Hybridization and selection are conducted within the region's four breeding programs (ME, NC, NY, USDA-ARS). Each breeding program shares seedling populations as botanical seed or as seed tubers providing extensive germplasm exchange. Two to four selection cycles are conducted by each breeding program at their field sites; however, the diverse environments provided by regional cooperators are increasingly used to supplement the selection process via simultaneous early-generation selection in multiple environments. This facilitates selection of both broadly and specifically-adapted plant materials for the diverse eastern environments. As superior progeny are identified and more seed is available, they are evaluated for other traits under a wider range of environmental conditions. To accomplish this, selected clones are entered into the eastern regional potato variety trials to subject them to diverse growing conditions and learn more about their strengths and weaknesses, geographical adaptation, yield stability, and durability of their pest and disease resistance. The most promising lines are entered into commercial-scale demonstration trials to begin the final assessment for commercial potential.

The regional approach allows evaluation and selection of new potato varieties for diverse environments and markets that could not occur otherwise. It enables us to evaluate stability of performance over varieties and genotype x environment interactions. Broadly adapted, stress tolerant new varieties will be advantageous as climate change continues to unfold. Identification of highly productive, broadly adapted new potato varieties is the most desirable goal; however, identification of new varieties that perform well under specific, unique environmental or marketing conditions can also be valuable. Our approach addresses both of these needs.

Our project also provides a mechanism for screening regional selections for specific characteristics at a single location (e.g., early blight, late blight, and powdery scab resistance in PA; golden nematode resistance in NY; scab and viruses in ME) and multiple locations (e.g., chip quality in ME, NY, PA, and NC; internal heat necrosis resistance in NC, VA, FL, PA, NY). This collaborative evaluation system makes efficient use of scientific expertise available in the region, and results in more efficient release and adoption of new potato varieties. We have a robust project website and have developed a user-friendly web-based variety database that has become a model for the rest of the U.S. potato variety development programs (http://potatoes.ncsu.edu/NE.html).

Related, Current and Previous Work

RELATED, CURRENT AND PREVIOUS WORK

The NE-1231 Project and its predecessors have played a central role in Eastern potato variety development for many years. Appendix 1 summarizes the seventeen (seven fresh market, seven chipping and three russet/long-tuber types) potato varieties released from 2002 to 2016.

By way of example - two new chipping cultivars (Waneta and Lamoka) were released by NY in 2011. Both were extensively tested within NE-1231 and both were found to have chip color comparable to or better than the current industry standard, Snowden, as well as moderate to good resistance to common scab (Snowden is susceptible). Both are also resistant to golden nematode race Ro1 (Snowden is susceptible). Because Waneta and Lamoka performed well in NE-1231 environments and because growers heard NE-1231 evaluators speak favorably about them, industry interest in these two varieties has been remarkably high. Commercial seed growers have not yet been able to meet demand.

Adoption and seed multiplication takes considerable time in the potato industry, in part because vegetative multiplication is slow, and in part because growers need several years before they can determine whether a promising new variety will work for them (many agronomic practices need to be adjusted for any new variety to achieve optimal performance). Thus impacts occur over a long time period. Despite these limitations, recent Eastern releases were grown on 2,382 ME and NY seed acres during 2016 with a seed value of ca. $7.2M. The resulting seed crop has the potential to plant 23,823 acres in 2017 with a ware value estimated at $71.5M. Nationally, varieties produced by our long-term project were grown on 4,793 seed acres during 2016 with an approximate seed value of $14.4M Several varieties developed though our collective efforts are currently in the top 100 U.S. varieties for seed acres, including (acres, rank): Lamoka (2367, 10), Waneta (713, 29), Pike (359, 50), Lehigh (260, 57), Reba (170, 66), Caribou Russet (143,71), Keuka Gold (106, 79), Eva (95, 83), and Andover (74, 98).

NE-1231 productivity extends to research as well: over the past five years NE-1231 scientists have published 29 peer-reviewed articles. Each year the NE-1231 team also leverages regional funding to attract additional funding from the federal government and potato industry. During the last five years, NE-1231 scientists shared funding included $1,357K from the USDA-NIFA Special Grant for Potato Breeding Research and attracted an additional $1,528K from industry stakeholders.

The objectives and activities of related projects, such as NRSP-6 (introduction, preservation, distribution, and evaluation of *Solanum* species), NCCCR-215 (potato genetics), and WRCC-27 (potato variety development) are complementary to this project. NE-1231 scientists interact with these projects through exchange of promising germplasm, meeting participation, and sharing trial results as well as peer-reviewed research. There is a need for good communication between regions to take advantage of widely-adapted germplasm and share knowledge. Several NE breeders routinely attend the annual NCCCR-215 meeting in Chicago.

The National Coordinated Chip Trial (NCPT) and National Fry Processing Trial (NFPT) supported by Potatoes USA and SNAC International are new, industry-driven, nationwide initiatives to coordinate the development of new chip and French fry varieties. Both started in 2010 and are directed at speeding the development of improved varieties for these markets, while assuring that germplasm is widely evaluated at the national level. NE-1231 scientists contribute clones to these trials and host trial sites in NY, NC, ME and FL. NCPT and NFPT have proven useful in two important respects. First, they allow originating breeders to identify broadly-adapted clones much earlier than was possible before. Second, they provide publicity to the best clones – when a good clone is identified, the entire processing industry knows about it, not just the scientists in the region

that developed it.

To address specific Southern chipping industry needs Potatoes USA established the Early Generation Southern Selection Trial (EGSS) during 2017. This two-year screening trial will act as a precursor to the NCPT. Breeding programs have been encouraged to submit clones for evaluation earlier in their program selection schemes in order to reduce lose of genetic variation with the intention of identifying material more suitable for the elevated temperatures in the Southern US. NC was selected as the screening location for year 1. CA and NC will evaluate the best performing clones from this trial in year 2. Those clones surviving the year 2 evaluation in this trial will then be sent on to the NCPT for broader national screening in year 3.

The incorporation of disease resistance into varieties with desirable horticultural characteristics is of immense importance. The breeders in the NE-1231 Project have succeeded in incorporating disease resistance into many of the recently released varieties and clones now being tested. Priority disease and pest resistance breeding goals for our region continue to include resistances to: late blight, common scab, golden nematode, and potato virus Y. Although progress has been made in developing and introducing new varieties with combined disease resistance, favorable horticultural traits and desirable processing qualities, large-scale commercial adoption is hampered by marketing and seed production constraints. Our project intends to continue its focus on enhancing disease/pest resistance of potato while continuing to meet the diverse marketing needs of the Eastern fresh market (e.g., whites, reds, russets, organic and specialty varieties, etc.) and processing (French fries and chipping from field and/or storage) industries. We are also developing additional information and programs to enhance commercialization of new varieties (e.g., web-based information, variety profiles, licensing procedures, etc.).

Fresh Market and Specialty Varieties. Excellent appearance and cooking quality are essential for fresh market. Resistance to common scab and other diseases which cause external blemishes is extremely important. Resistance to mechanical damage during handling is critical. Unique tuber skin and flesh color (e.g., red, purple, yellow, etc.) can enhance appeal and marketing opportunities. Methods for breeding for improved yellow-flesh characteristics have been developed (Haynes et al., 1994; Haynes et al., 1996). Yellow-flesh intensity is highly heritable in the diploid hybrid *phu-stn* population, indicating that intense yellow-flesh color can be developed in this population (Haynes, 2000). Total carotenoid content of yellow-fleshed diploid *phu-stn* clones ranged from 3 to 13 times of that found in the yellow-fleshed variety Yukon Gold (Lu et al., 2001). However, when utilized in 4x-2x crosses, the carotenoid content of the resultant tetraploid progeny, although higher than what is currently available, did not reach the same levels as in their diploid parents (Haynes et al. 2011). Flavor and sensory components of cooked potato can be compared with various analytical methods (e.g., Oruna-Concha et al., 2001; Jensen et al., 1999; Ulrich, et al., 2000; Vainionopaa et al., 2000); however, these methods have not effectively

substituted for sensory evaluation. Our project routinely conducts sensory evaluation of advanced potato selections to assure that new releases meet the markets' rigorous quality demands. Potatoes are naturally nutritious and rich in vitamin C; however, introgression of yellow-fleshed diploid *phu-stn* hybrids into *S. tubersosum* will increase tuber concentrations of carotenoids, and other phytonutrients that would be highly beneficial to human health. Improving the nutritional quality of potato is a long-term goal. Over the past 10 years, eight fresh market and specialty varieties have been released by this project (Appendix 1). Continued improvement is needed in the quality and pest resistance of potato varieties available to Eastern growers so that marketing opportunities can be expanded and production can be more profitable, while minimizing negative environment impacts.

Chipping and French Fry Processing. Selection of clones that maintain processing quality during cool temperature storage is a high priority and is a viable approach towards reducing sprout inhibitor and energy use. Diploid potato species which have long-term cold storage chipping ability [*S. phureja* and *S. raphanifolium* (Hanneman, 1993)] and other germplasm with resistance to sugar accumulation in cold storage are being used to improve the genetic base of chipping potatoes adapted to the East. Adapted French fry processing clones are being selected from crosses conducted in ME and other states. New chipping varieties with high yields, high tuber dry matter, reduced susceptibility to bruising, and resistance to IHN are being developed by all Eastern breeding programs. Our research has shown that there is no significant correlation between susceptibility to IHN and either total yield or specific gravity in commercial potato germplasm (Henninger et al., 2000) and that the diploid hybrid population of *S. phureja* x *S. stenotomum (phu-stn)* can be used to expand the genetic base for chipping potatoes and reduce IHN problems for growers (Haynes et al., 1995; Sterrett et al., 2002). Research by McCord et al. (2011a, b) and Schumann (2015) identified quantitative trait loci (QTL) linked to IHN in a population developed from a cross between Atlantic and B1829-5. A SNP-based map of this population enabled us to identify QTL for IHN and other agronomic and quality traits. Using the SNP gene annotations and the potato reference genome we have tentatively identified a candidate gene involved in IHN, *vacuolar cation/proton exchanger 1a*, that was closely linked to a QTL for IHN susceptibility. Over the past 10 years, six chipping and/or French fry processing varieties have been released by this project (Appendix 1). The varieties Lamoka, Waneta, Pike, Andover, Harley Blackwell, Sebec, and Marcy have been successful in the chip processing marketplace, and early indications suggest that Caribou Russet will be useful for fry processing.

Potato Diseases Constraining Eastern Production. Bacterial and fungal diseases such as late blight, early blight, scab (common, acid, and powdery), verticillium wilt, rhizoctonia (stem canker and black scurf), silver scurf, pink rot, soft rot (e.g. *Pectobacterium* and *Dickeya* spp.), dry rot (*Fusarium* spp.) and virus diseases (leafroll, potato viruses X and Y, corky ring spot) reduce the yield and quality of the Eastern potato crop. All currently available potato varieties are susceptible to one or more of these diseases. Resistance to fungicides previously used for disease control [e.g., mefenoxam resistance to pink rot (Fitzpatrtick and Lambert, 2006)] makes development of improved genetic resistance particularly important. Breeding and selection for improved disease

resistance is a major focal area for the Eastern potato breeding programs and NE-1231. The impacts provided by successful development of high yielding, high quality and pest-resistant potato varieties are tremendous for Eastern growers (e.g., reduced costs, fewer losses, lower risk, etc.) and the public (e.g., less pesticide use, higher quality, etc.).

Insect Pests and Variety Resistance. Colorado potato beetle (CPB) continues to be the most serious insect threat to Eastern potato production because of the severe damage that it causes and because this insect has developed resistance to all insecticides deployed against it (Weber and Ferro 1994). Aphids, leafhoppers, fleabeetles, and other insect pests also cause significant losses. Research on resistance to insect pests in the East has focused on the incorporation of two complementary sources of resistance, trichome-mediated resistance from *S. berthaultii* (Bonierbale et al., 1992, 1994) and leptine-based resistance from *S. chacoense* (Sanford et al., 1997; Yencho et al., 2000). NY has made considerable progress incorporating glandular trichomes into useful varieties [e.g., NY released NYL235-4 as an insect resistant clone for use in germplasm improvement (Plaisted et al., 1992) and has released two insect resistant varieties for organic production (Prince Hairy and King Harry)]. Leptines, which are foliage-specific glycoalkaloids, also provide resistance against CPB. Leptines are coded by only a few genes (Sinden et al., 1986) and research to develop durable insect resistance by combining trichome-mediated and leptine-based resistance has been conducted in NC (Yencho et al., 2000).

Regional Evaluation and Modeling Efforts. Performance data obtained from collaborative trials in the NE-1231 project have provided a rich information source to carry out research on genotype x environment interactions in the East. The project has developed two sets of baseline data: one consisting of five industry standards that are grown at all sites; the other being "breeders choices" where each of the participating breeders indicates one to three advanced selections that are tested at all sites for that year. The analytical results provide considerable information on the interplay between genotype and environment. Tai et al. (1993) showed that linear regression was useful for evaluating the performance and adaptability of selections over a range of environments. AMMI (additive main effect and multiplicative interaction model)[Gauch, 1992]; BLUP (best linear unbiased predictor); and REML (residual maximum likelihood)[Genstat, 1993; Horgan, 1992] have been used to further analyze NE1231 trial data with the goal of better understanding genotype x environment interactions and helping us develop better selection tools for potato variety development in the region.

Objectives

1. Conduct multidisciplinary conventional and molecular marker-assisted breeding, germplasm enhancement, and early-generation selection research to improve potato productivity and quality for important Eastern U.S. markets.
   Comments: The overall goal of this project is to develop attractive, high yielding, disease- and/or insect- resistant potato varieties for fresh, processing, and/or specialty-type potato markets. Our research network involves eight states, four potato breeding programs and over 30 scientists in the Eastern US. Our project design encourages collaboration, pooling of regional resources, and increases communication among researchers and stakeholders. This highly collaborative, multistate variety development effort engages the scientific expertise available in the region as efficiently as possible, reducing the time

necessary for variety development and commercialization. Over-arching outcomes of this project will be the development of economically and environmentally sustainable farming systems in East and an abundant supply of high quality and nutritious potatoes for consumers.

2. Use novel and improved potato germplasm to reduce the impact of economically important potato pests and abiotic stress in the Eastern US.
3. Evaluate yield, quality, and pest and abiotic stress resistances of preliminary and advanced potato breeding lines in experimental- and commercial-scale trials at multiple Eastern locations to aid industry adoption of new varieties.
4. Provide timely and relevant information to stakeholders through various means including the maintenance of a project website and a web-based potato variety performance database for use by researchers, extension, potato growers, and allied industry members.

Methods

METHODS

Objective 1: Conduct multidisciplinary conventional and molecular marker-assisted breeding, germplasm enhancement, and early-generation selection research to improve potato productivity and quality for important Eastern US markets.

1a. Collaborative Potato Breeding, Selection, and Variety Development in the Eastern US.

Initial crossing and germplasm improvement will be conducted within the ME, NY, NC and USDA-ARS breeding programs (see Figure in Appendix 2). Parents, including wild or cultivated diploid germplasm, are selected for desirable yield, quality, and pest and abiotic stress resistance traits, as well as male and female fertility. Initial selection is done by each breeding program at their field sites. The diverse environments provided by regional cooperators are used to supplement the early-selection process and improve regional adaptation. For example, materials from the ME and USDA-ARS programs are screened in NC and FL for internal heat necrosis (IHN) resistance and materials from USDA-ARS are screened in PA for common scab resistance. Each program tests lines for 5 to 8 years and at multiple eastern sites to evaluate yield, quality, disease resistance, and other agronomic characteristics. Promising clones are entered into national trials (e.g. NCPT, NFPT) and the Eastern regional potato variety trials.

1b. Quantitative, molecular, genetic and biochemical studies to improve resistance to internal heat necrosis. Germplasm from the breeding programs will continue to be screened for IHN resistance in FL, NC, and VA. IHN screening methods have been outlined by Henninger et al. (2000), Sterrett et al. (2003), and Sterrett and Henninger (1997). Molecular markers linked to IHN resistance are being developed to facilitate breeding and selection. Research on QTL associated with IHN resistance will continue by testing these QTL and candidate genes in new populations segregating for resistance to IHN. The long-term goal is to develop markers for resistance to IHN

that can be used in marker-assisted breeding.

Identifying physiological processes involved in IHN development may enable identification of genetic markers linked to IHN. Candidate physiological processes are production of reactive oxygen species (ROS) and the ROS scavenging system (Davies and Monk-Talbot, 1989), cell wall thickening and suberization (Baruzzini et al., 1989) and programmed cell death. These processes and associated enzymatic activities will be evaluated in IHN susceptible and resistant lines grown under stress versus non-stress conditions (VA). Data will be collected from key factors involved in the ROS scavenging system [catalase, peroxidases, and superoxide dismutase (Davies and Monk-Talbot, 1989)] and the phenylpropanoid pathway (phenylalanine ammonia-lyase, and peroxidases) that are involved in cell wall suberization (Bernards and Lewis, 1998). Loss of membrane integrity (leakage) and tuber anatomical changes (microscopy) will be investigated and related to IHN incidence and severity.

1c. Improving the chip quality and long-term cold storage processing ability genetic base. Improved chip and fry processing are high priority industry traits. A multi-site, parallel-selection approach will be used by the ME, NY, and USDA-ARS programs to identify chipping clones for the mid-Atlantic and SE states. Potatoes USA sponsors the NCPT and the EGSS programs to rapidly identify chipping clones and speed their commercial testing. Our breeding programs provide chipping candidates for evaluation in both trials with FL, NC, and NY serving as NCPT screening locations and NS serving as the initial EGSS screening site. Promising NCPT clones advance to the industry-funded SNaC trials where advanced chipping clones are tested for three years across 11 states. The most promising NCPT, SNaC, and NFPT clones are fast tracked into industry-funded seed propagation and commercialization trials. Clones developed by our four breeding programs are major components to these national, industry-driven efforts.

ME uses its own russet germplasm plus USDA-ARS-Idaho, CO, WI, and ND seedling tubers to develop russet types that are adapted to the Eastern. Yield, appearance, tuber length and size, specific gravity, internal quality, French fry color (from 7 and 10^{o}C storage and reconditioned from 4^{o}C storage), French fry texture, and disease reaction are used to further select the lines prior to NE-1231 and commercial evaluation. The most promising fry processing candidates are entered into the industry-funded NFPT which tests promising French fry clones at six locations (ME, WI, ND, ID, OR, WA). NFPT is used extensively by the large-scale national fry processors to identify candidate French fry processing varieties.

Molecular genetic research focused on improved chip and fry quality will be continued in this

project. Recent genetic analyses have shown that alleles of vacuolar and apoplastic invertases are associated with cold-chipping ability in European germplasm (Draffehn et al. 2010). RNAi-mediated silencing of vacuolar invertase dramatically improves fry color (Bhaskar et al. 2010), suggesting that natural alleles with low expression are key to good fry color. Consistent with this, vacuolar invertase expression is very low in *S. raphanifolium* (Bhaskar et al. 2010). NY will characterize allelic variation of invertase genes to determine which alleles, including those previously introgressed from *S. raphanifolium*, are associated with good fry color. Assays to simplify tracking of desirable alleles will be developed to facilitate future breeding. An improved genetic base for long-term cold storage processing ability, including diploids from *phu-stn,* and hybrids with *S. gourlayi* has been developed by USDA-ARS. Crosses will continue and segregating families will be evaluated for ability to process after long-term storage.

1d. Improving the genetic base of fresh market and specialty potatoes. High-yielding, disease-resistant, fresh market lines will be intercrossed to produce seedling populations that will allow selection of superior fresh market varieties. Foremost among the selection attributes will be appearance (smooth skin texture, freedom from blemishes, and desirable color), tuber shape, yield, cooking quality (satisfactory texture, freedom from internal defects, after cooking darkening and sloughing), and pest resistance (see Objective #2).

Yellow-Fleshed Potatoes - USDA-ARS is developing yellow- and orange-flesh diploid potatoes for the 'baby' or creamer potato market. A primary objective is to lengthen tuber dormancy so they can be stored for several months without sprouting. Cooperators in FL and NM are participating in the early evaluations which will soon be expanded to include other NE1231 locations. All eastern breeding programs continue to include novel, yellow-fleshed clones in their crossing programs with the goal of developing yellow-fleshed potato varieties with improved market quality, pest resistance, and tolerance to environmental stress.

Red-, Purple-Skinned, and Other High-Value Novel-Colored Potatoes - The genetic base of red-skinned and other high-value, novel-colored potatoes will be improved through crosses and backcrosses between tetraploid and diploid lines with solid or patterned red or purple skin. Red- and purple-skinned clones will also be intercrossed with yellow-flesh clones to develop a population of colored-skin, yellow-flesh lines. Crosses will be made between tetraploid *tuberosum* and diploid *phu-stn* lines to add increased color variation and nutritional quality.

1e. Development of diploid inbred lines to facilitate breeding and genetic studies. In an initial survey of self-incompatibility *phu-stn* diploid population, 17/42 clones were found to be self-

compatible. USDA-ARS will identify more self-compatible clones from this population and sequence candidate genes involved in self-incompatibility. Crosses among self-compatible clones will be undertaken to combine favorable gene combinations for development of elite inbred lines. The self-compatible clones from the *phu-stn* population will be subjected to haploid production by anther culture or genome elimination crosses to develop a doubled-monoploid population. While the offspring of most diploids are low yielding and produce small tubers, the offspring of a cross between inbred diploids *S. chacoense* clone M6 and US-W4 produce high yields of large tubers (Jansky et al. 2014). NY will evaluate whether these two clones can form the basis for two heterotic groups, introducing alleles for better appearance and tuber uniformity from diploid clones developed over the career of H. De Jong (AAFC Fredericton, now retired).

Objective 2: Use novel and improved potato germplasm to reduce the impact of economically important potato pests and abiotic stress in the Eastern US

2a. Improve potato resistance to significant pests in the East. Late Blight – Screening for late blight resistance within NE-1231 is conducted in the field and greenhouse using natural infection and/or artificial inoculation. The most promising late blight resistant selections undergo further evaluation in PA, the key late blight screening site for NE-1231. Recently developed late blight resistant populations include resistance derived from *S. hougasii* (Haynes and Qu, 2016) and *S. bulbocastanum* (ME). The population developed from *S. hougasii* (a 6*x* species) may potentially harbor chromosome dosage variants. Therefore, genomic fingerprinting via the SolCap SNP-chip or Illumina sequencing will be performed to assess dosage variation within this population. The goal is to identify stable late blight resistant clones for developing late blight resistant varieties. A diploid *phu-stn* late blight resistant population has been developed by USDA and PA. Representative 4*x*-2*x* crosses will be made to incorporate late blight resistance into tetraploid germplasm. An interbreeding seed nursery will also be established to generate seed which will be released to the breeding community as late blight resistant germplasm. A late blight resistant x susceptible cross has been made and a mapping population generated. This population will be phenotyped in the field in PA and genotyped using the potato SNP array (Neogen Corporation and Michigan State University). Genomic loci significantly associated with late blight resistance will be identified using Tetraploid Map Version 2. The SNPs identified from this work can be developed into molecular markers for future selection.

A tetraploid population was developed from clone, B0692-4, which has shown excellent to late blight resistance, crosses with a susceptible clone. Late blight resistance of this population will be evaluated in field trials in PA. The population will be evaluated for up to three years to ensure resistance stability. Clones from this population will be genotyped using the SNP array. SNPs linked to resistance in B0692-4 will be developed into molecular markers for future selection.

Scab resistant germplasm - Our breeding programs extensively utilize common scab resistant parent material and select for resistance in inoculated and/or naturally-infected field experiments. Clones are tested over multiple years because of environmental effects on disease incidence and severity. PA provides a centralized screening site for early-generation materials from USDA-ARS, while ME and NY conduct their own early-generation screening. Powdery scab resistant parents will also be identified and used in programs to improve resistance.

Dry rot, pink rot, and softrot resistant germplasm -Fusarium dry rot (*Fusarium* spp.), pink rot (*Phytophthora erythroseptic*a) and soft rot (*Pectobacterium* and *Dickeya* spp.) resistance screening will be conducted using field (pink rot) or laboratory-based (soft rot and dry rot) techniques with the goal of identifying advanced clones and parents with improved resistance. Breeding populations will then be developed to allow further study of resistance and development of SNP-based markers.

Golden Nematode - Breeding efforts in NY have emphasized resistance to golden nematode Ro1; however, resistance to race Ro2 is also a priority. The NY program developed Ro2 resistance by selecting for adaptation within a collection of South American tetraploids and subsequent work has incorporated additional resistance sources from Europe to broaden the genetic base and provide resistance to *G. pallida*. Our other programs also use parental materials with nematode resistance. Progeny from crosses using resistant parents will be evaluated for resistance to both races of the golden nematode at the USDA-ARS in NY. Marker-assisted selection for golden nematode resistance (H1 marker; Galek et al. 2011) will be used to supplement traditional screening methods and provide earlier detection of resistant clones within selected breeding families. NY also has the ability to test for resistance to *G. pallida* in vitro.

Virus – All four breeding programs will continue to include virus-resistant clones as parents. Marker-assisted selection for potato virus Y resistance (Whitworth et al., 2009; Ry_{adg}, RYSC3, Kasai et al., 2000; Ry_{sto}, YES3, Song and Schwarzfischer 2008) will be used to supplement traditional screening methods and provide earlier detection of resistant clones. We will attempt to clone the Ry_{adg} gene using sequence capture followed by long-read sequencing to potentially provide a mechanistic understanding and additional molecular markers for this resistance trait.

Colorado Potato Beetle and Potato Leafhopper -NC has used the USDA-ARS-developed

tetraploid *S. chacoense* (2*n*=4*x*=48) potatoes crossed with *S. tuberosum* (Sanford *et al*., 1997) to develop CPB resistant germplasm. During 2006-2014, NC used several of the most promising advanced chc-based CPB-resistant lines in crosses with NY's *S. tuberosum x S. berthaltii* derived materials. The latter exhibit glandular-trichome-based insect resistance. Field evaluation of these materials will continue as part of the NE-1231 project.

2b. Improve the genetic base of potatoes for resistance to heat stress Potato plants subjected to heat stress have lower tuber yield and quality (e.g. tubers may form in chains, have internal heat necrosis, and/or heat sprouting). Potato production in the south and mid-Atlantic states frequently experiences high temperatures during the late tuber bulking. USDA-ARS, NC and FL will screen the *phu-stn* population for heat tolerance by comparing tuber yield and quality traits from early-season and late-season plantings. Several wild diploid potatoes species with reported tolerance will be screened for heat tolerance by USDA-ARS. Tolerance will be measured as the ability to form tubers under elevated temperatures. Those lines found to be tolerant will be crossed with both heat-tolerant and heat-sensitive *phu-stn* to take advantage of *phu-stn*'s ability to tuberize under long-day conditions. The inheritance of heat tolerance will be determined.

2c. Improve the genetic base of potatoes for nitrogen uptake efficiency (NUE). Commercial potatoes currently take up only 33 to 53% of applied nitrogen. The rest is lost to denitrification and nitrate leaching. One strategy for improving NUE is to introgress high NUE traits from wild species. FL and USDA-ARS have identified improved NUE in *chc* and crosses have been made to transfer NUE into a *phu-stn* population. A mapping population has been generated between a *phu-stn* clone with poor NUE and a *chc* clone with superior NUE. This population will be phenotyped for NUE by measuring yield and quality traits at USDA-ARS (ME) and FL under high and low N regimes and genotyped using the potato SNP array. Loci and SNPs linked to NUE will be identified and used as markers for future breeding to improve NUE.

Objective 3. Evaluate yield, quality, and pest resistance of preliminary and advanced potato breeding lines in experimental- and commercial-scale trials at multiple Eastern locations to aid industry adoption of new varieties.

3a. Evaluation of Promising Selections for Early Maturity, Quality, and Storage Potential.

Seed Increase for Standardized Regional Variety Trials - Advanced selections will be placed in the NE-1231 Project seed nursery at the University of Maine Aroostook Research Farm in Presque

Isle, ME to provide a uniform seed source for the project. The seed will be tested according to Maine seed certification regulations. This common seed source is a vital component for valid research and modeling of environmental characteristics, since performance of a clone varies widely according to the seed crop's quality, growing, and storage conditions.

Regional Variety Trial Procedures - All tablestock, processing and specialty market selections will be evaluated in replicated field trials in multiple locations (FL, ME, NY, NC, OH, PA, VA) using standardized NE-1231 evaluation techniques and descriptors. These techniques include observations on agronomic as well as internal and external quality data. Bruise susceptibility (Hunter and Reeves 1983; Pavek et al. 1985), and storage characteristics will also be measured (ME). Appropriate industry standards (e.g. Atlantic, Snowden, Russet Burbank) are included at each test site. Five standard varieties will be grown at all NE-1231 test sites to provide data for modeling environments and genotype x environment interactions (USDA-ARS).

Processing from Storage - Samples of NE-1231 selections will be stored at two temperatures (typically 7.2 and 10C). Weight loss will be measured to help select clones that do not require the use of chemical sprout suppression. Chip or fry color will be measured with an Agtron instrument or with USDA Chip or Fry Color Charts following storage for two to six months (ME, NY, PA, USDA).

3b. Evaluate Promising Selections for Resistance to Potato Pests.

All breeding lines will be evaluated under uniform conditions for resistance/susceptibility to major potato diseases. This assessment provides comparative information to help breeding programs, researchers, and the industry decide on the merits of new clones. Regional disease screening will be conducted for **golden nematode resistance** (USDA-ARS NY), **late and early blight** (PA), **common scab** (ME), **powdery scab** (PA), **potato virus Y** – PVY (ME), **potato leaf roll virus** – PLRV (ME), and **corky ring spot – CRS** (FL). Additional disease resistance screening is done by the respective programs to screen their breeding materials for disease susceptibility including **late and early blight** (USDA-ARS, ME), **common scab** (USDA-ARS, ME, NY), **powdery scab** (ME), **Verticillium wilt** (ME), **pink rot** (ME), **Fusarium dry rot** (ME), **bacterial soft rot** (ME), **potato virus Y** – PVY (ME, NY), and **potato leaf roll virus** - PLRV (ME). To insure they do not mask symptoms, all selections not showing PVY or PLRV symptoms will be tested for pathogen presence using ELISA (ME).

3c. Evaluate promising selections for sensory and nutritional quality.

NE-1231 clones and advanced ME breeding clones will be evaluated for boiling and baking quality by consumer panels (ME). Test lines will be compared to appropriate industry standards. Only lines with acceptable total glycoalkaloid (TGA) content will be evaluated (Asano et al., 1996; Baker et al., 1991; Friedman and McDonald, 1997). A hedonic scale (Peryam and Pilgrim, 1957) will be used for each of the baked attributes. Sloughing and graying of boiled tubers will be subjectively evaluated using sensory panels. The boiled potato evaluations will employ a 15-point intensity scale. After cooking darkening of boiled selections will also be evaluated objectively using a LabScan XE Hunter Lab Colorimeter (Hunter Associates Laboratory, Reston, VA). Selected fresh market varieties will be compared using conventional stovetop steaming, microwave steaming and oven roasting conditions. Promising clones will be screened for phytochemical content (ME). Total phenolics will be measured (Velioglu et al., 1998). Chlorogenic acid and gallic acid will be used to generate standard curves. The 2,2-diphenyl-1-picrylhydrazyl (DPPH) antioxidant method will be used to assess antioxidant activity (Herald et al., 2012). Red, blue and purple potatoes will also be assayed for their total anthocyanin content (AOAC, 2005). All assays will be performed in triplicate. Ascorbic and dehydroascorbic acid (vitamin C) will be determined by high performance liquid chromatography (HPLC) using a recently developed method (Hutt, 2015). Potassium content will be determined on 4 to 6 promising clones and compared to established standard varieties.

3d. Study cultural practices that optimize the performance of new potato clones and develop more sustainable agricultural systems. Optimized cultural practices need to be developed for new potato clones to increase the likelihood of commercial success. Cultural practice experiments will be performed to determine optimal management practices for new clones (FL, ME, NC, NY, OH, PA, VA). These studies typically include optimizing fertilization, harvest date, irrigation, plant spacing and other cultural practices.

Objective 4. Provide timely and relevant information to stakeholders through various means including the maintenance of a project website and a web-based potato variety performance database for use by researchers, extension, potato growers, and allied industry members.

Project cooperators will present project information to stakeholders through presentations, printed media, trade shows, and websites to inform them of promising selections and new variety releases. A long-term database for NE-1231 trials has been established to facilitate the data analysis and encourage collaboration among NE-1231 participants. Web interfaces to this database allow access for all project participants and are updated and improved as needed and new ideas emerge. The website also provides potato production information and project results in

an interactive, searchable potato variety trial database designed to provide access to the results of the trials coordinated through the Eastern potato variety development project.

Measurement of Progress and Results

Outputs

- Potato families that segregate for key quality, stress resistance, and pest tolerance traits will be developed and used to improve genome wide, marker-based selection strategies for key quality, stress tolerance, and pest resistance traits.
- The germplasm pool of high specific gravity, stress tolerant, disease-resistant, insect-resistant and/or nutritionally-enhanced clones available for breeding purposes in the US will be broadened.
- Our collective potato breeding efforts will result in new varieties, such as Lamoka, with favorable characteristics for chip, fry processing, and/or fresh market utilization.
- Potato breeders and allied scientists effectively communicate research results through meetings, websites, and published reports and will design improved regional breeding and selection strategies to more efficiently develop varieties for adaption to specific production areas as well as wide geographic areas.
- A project website and a web-based potato variety performance database for use by researchers, Extension, potato growers, and allied industry members will be refined, updated, and maintained to facilitate communication, information exchange and data analysis.

Outcomes or Projected Impacts

- New potato varieties with improved disease and insect resistance, resistance to IHN, improved processing or fresh market characteristics, and enhanced nutritional quality will be commercially evaluated and released, providing growers with better marketing opportunities, great profits, and/or improved resistance to pests.
- Farmers will learn how to successfully grow newly released potato varieties in different climates and for different uses.
- Adoption of new, high quality, pest resistant varieties will be more rapid, leading to increased profitability, greater worker safety, improved human diet, and reduced pesticide load.
- Strengthened communication and interactions among potato scientists located in the eastern U.S. and elsewhere will lead to greater productivity and collaboration.
- Web-based and traditional conduits for the distribution of timely and readily available potato variety production information to growers, allied industry members and consumers will be further developed and strengthened.
- Rural communities dependent upon Eastern potato production will benefit from the economic and environmental sustainability provided by adoption of improved new varieties.

Milestones

(**2018**):Incorporate disease and insect resistances, abiotic stress resistances, improved processing characteristics, and enhanced nutritional quality, from diverse diploid and tetraploid potato species into high quality, adapted germplasm (S. tuberosum)

(**2018**):Develop potato families that segregate for key quality, stress resistance, and pest tolerance traits and use them to improve marker-based selection strategies for key quality, stress tolerance, and pest resistance traits

(**2018**):Crosses and backcrosses made between tetraploid TBR and diploid PHU-STN lines with solid or patterned red or purple skin to increase color variation in regionally adapted clones and selections made

(**2018**):Improve our interactive and searchable potato variety trial database implemented in response to user feedback

Outreach Plan

The NE-1231 Regional Potato Variety Development Project currently conducts outreach activities in all participating states using techniques ranging from face-to-face presentations at grower and scientific meetings to providing web-based content for industry members and consumers. Typical outreach activities include:

1. Publication of project results in the NE-1231 annual publication, scientific journals, etc.
2. Development of applied publications and Extension materials targeted to growers in each participating state or province.
3. Multiple formal and informal presentations, demonstrations, trade show booths, and field days targeted to growers and industry in each participating state or province.
4. Providing web-based project information via the NE-1231 project website to enhance access to research results, variety profiles, variety summaries, and photographs (http://potatoes.ncsu.edu/NE.html).

Organization/Governance

ORGANIZATION AND GOVERNANCE

The regional technical committee is composed of all participating cooperators (see Appendix E), an administrative advisor (currently Dr. Fred Servello) appointed by the Northeast Agricultural Experiment Station Directors, and a NIFA Representative (Dr. Ann Marie Thro). The technical committee meets at least once each year to discuss progress of the research, review procedures, coordinate research and plan future research activities.

The regional technical committee will elect an executive committee composed of a chair, vice-chair, and secretary. A succession of officers will be maintained so that the vice-chair becomes chair, the secretary becomes vice-chair, and a new secretary is elected each year. The responsibilities of the executive committee members are as outlined in the Guidelines for Multistate Research Activities. The chair will preside at all meetings of the technical committee and is responsible for organizing the agenda of the annual meeting. The vice-chair will prepare the annual report for the project. The secretary will prepare the minutes of the annual meeting and any special meetings. The administrative advisor is responsible for distributing the minutes and submitting the annual report and minutes to the NIFA representative and other interested parties. Participation by Agriculture Canada, the Provinces of Quebec and New Brunswick, Maine Department of Agriculture, Cooperative Extension, and Industry representatives is at the invitation of the Technical Committee with the approval of the Administrative Advisor.

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Land Grant Participating States/Institutions

PA,NC

Non Land Grant Participating States/Institutions

Participation

Participant	Is Head	Station	Objective	Research						Extension	
				KA	SOI	FOS	SY	PY	TY	FTE	KA

Combined Participation

Combination of KA, SOI and FOS	Total SY	Total PY	Total TY
204-1310-1081	0.25	0	0.2
205-1310-1081	0.25	0	0.2
212-1310-1160	0.25	0	0.2
Grand Total:	**1.40**	**3.40**	**0.60**

Combination of KA, SOI and FOS	Total SY	Total PY	Total TY
216-1310-1160	0.25	0	0.2
201-1310-1081	0	0.4	0.4
203-1310-1081	0	0.4	0.4
204-1310-1081	0	0.4	0.4
211-1310-1081	0	0.4	0.4
201-1310-1081	0.13	3	0
204-1310-1081	0.13	3	0
212-1310-1081	0.13	3	0
Grand Total:	**1.40**	**3.40**	**0.60**

Program/KA	Total FTE
0	0
204	0.07
203	0.07
211	0.07
212	0.07
Grand FTE Total:	**0.4**

18421: Equine Clinical Studies

Status: Draft

Duration 10/01/2017 to 09/30/2022
Admin Advisors:
NIFA Reps:

Statement of Issues and Justification

The North Eastern United States is home to a strong equine industry, supported by equine research programs in veterinary colleges, and the animal and/or veterinary science departments of public universities. Increased collaboration and pooling of resources between basic scientists, teaching hospital clinicians, private industry, practicing veterinarians and their clients could be used to strengthen equine research by making possible larger clinical studies. In addition, it could assist product development by the animal biotechnology sector. However, such collaborative studies pose significant logistical and scientific difficulties.

Through the formation of the original Coordinating Committee on Equine Clinical Studies, under the guidelines of the USDA Multistate Research Activities program, we have begun to facilitate and encourage collaborative equine clinical studies in the North East. We have addressed pooling animal resources and developing research priorities to address equine wellness and disease. In the near term we have identified gastrointestinal health and the equine microbiome as areas of interest. In addition, through a survey of horse owners in the North East, we have documented stakeholder interest in further pursuit of this line of work (Coffin et al, Journal of the NACAA, accepted). We have also submitted a conference grant through the 2016 USDA/AFRI program.

We would like to continue the work of the equine clinical studies coordinating committee through pursuing multi-state activities related to the equine health, and especially the equine microbiome, hopefully leading to improved quality of life for horses in the North East.

Objectives

1. Foster development of new methods for diagnosis and therapy of equine diseases, and for improving equine gastrointestinal health
   Comments: Creating new tools to improve equine health is difficult for isolated industry sectors. Practitioners understand the need, basic researchers the technology, and industry the commercialization. Greater collaboration of these sectors could improve success in subsequent clinical trials. We therefore wish to encourage discussion between these groups early in the study design process.
2. Improve sample size in early phase equine clinical trials
   Comments: For academic researchers, early trials in vivo would provide raw material for peer-reviewed publication. Pooling resources (such as horses) between institutions can improve statistical power, strengthening grants and manuscripts. We therefore wish to improve collaboration during these early phase trials, and make generally available the statistical methods necessary to analyze data in trials replicated in multiple sites.
3. Increase number and power of randomized, double blinded equine clinical trials
   Comments: Peer-reviewed journals generally accept the randomized, double blinded clinical trial as evidence of a drug's efficacy (1). Epidemiological rigor is also expected in validation of diagnostic tests, and identification of disease risk-factors. To encourage such studies, we wish to improve collaboration between researchers, practicing veterinarians, farms and private industry. The goal would be to allow field trials to be replicated in multiple sites and across state lines.
4. Initiation of a new multistate research project -
   Comments: The committee's activities will encourage discussion between members who share a common goal of improving

equine health. We intend that the committee will generate at least one multistate research project, with objectives specific to equine diseases prevalent in the North East. Our priority currently is to develop a multistate project related to equine gastrointestinal health and the microbiome

5. Educate equine industry stakeholders regarding new methods of diagnosis and therapy arising from objectives 1 through 4 - Comments: To have impact, new discoveries and techniques need to be disseminated. We therefore wish to make available to all stakeholders, including veterinarians, horse owners, allied industry, state government etc, any new information generated by the committee's work.

Procedures and Activities

1. Continue committee, starting with current composition-The Coordinating Committee on Equine Clinical Studies currently consists of faculty interested in sharing research resources. Membership includes faculty in public institutions in the North East, but also collaborators in private institutions and institutions outside the North East. The committee may communicate with, and perhaps at length include, representatives of federal and state regulatory agencies, practitioner groups, and the equine and biotechnology industries.

2. Meet annually - Gathering of the committee on an annual basis has been invaluable in helping the committee to forge and maintain relationships and plan activities. The meeting site will continue to rotate through sites in the North East US, usually hosted by members of the committee at their home institutions.

3. Develop Research Capacity - Having established an inventory of shared resources, opportunities for increasing research capacity will be sought through purchase and/or sharing of equipment, pooling animal numbers, and shared use of other resources.

4. Reach out to animal feed, supplements, and biotechnology industry partners -The animal feed, supplements biotechnology industry will be essential collaborators, both in the development of products for testing, and in providing technical assistance and sponsoring outreach programs. It is hoped that successful commercialization of new products will result from the committee's work. This may include improved pre or pro-biotics and feed and supplements targeted to improve equine gastrointestinal health.

5. Reach out to practicing veterinarians - Practicing veterinarians will be the predominant end-users of new information generated by the committee, some playing key roles in implementing clinical studies. It will therefore be necessary to forge relationships with veterinarians so that successful clinical studies can be carried out, and new products created which are useful in the field.

6. Conduct regional outreach programs for all stakeholders - Coordinated outreach will be necessary to deliver new information to regional stakeholders (veterinarians, horse owners, animal feed and biotechnology industry, state government etc).

Expected Outcomes and Impacts

- Increased output of participating investigators and investigator-private industry partnerships. Comments: Additional

resources and greater sample size will increase number of grants funded and manuscripts published. This may include initiation of new multi-state research projects. In addition, involvement with private industry will strengthen public-private research partnerships.

- New animal health products brought to market Comments: Increased capacity to perform clinical trials will accelerate new product development and licensing. This may include new feeds, feed supplements, and pharmaceuticals.
- Improved animal welfare Comments: The greater power of clinical studies will improve diagnosis and therapy, and decrease incidence of equine disease.

Educational Plan

The coordinating committee will have a dedicated webpage, including profiles of participating members, inventory of resources available for pooling, plans for upcoming meetings etc. The annual meeting will include brief presentations by members of their work, with an annual report of the committee's activities. Nature and scope of outreach programs to stakeholders will be determined as part of the committee's initial deliberations. Because they are so dispersed, practicing veterinarians and lay groups can be difficult to access. Combining the annual meeting of the committee with a veterinary continuing education or equine industry conference may facilitate outreach on occasion. Additional methods to reach lay stakeholders groups will include non-technical bulletins distributed in print and online, targeted emails and the dedicated webpage. The use of video-conferencing and distance education technology may also be employed to solve specific needs of underserved stakeholders.

Organization/Governance

Governance will be standard with chair, chair elect, and secretary elected by committee members at the first annual meeting. Secretary will be elected at subsequent meetings; the outgoing secretary will assume the role of chair-elect and the outgoing chair-elect will assume the role of chair.

Literature Cited

Land Grant Participating States/Institutions

Non Land Grant Participating States/Institutions

Participation

Participant	Is Head	Station	Objective	Research						Extension	
				KA	SOI	FOS	SY	PY	TY	FTE	KA

Combined Participation

Combination of KA, SOI and FOS	Total SY	Total PY	Total TY
Grand Total:	**0**	**0**	**0**

Program/KA	Total FTE
Grand FTE Total:	**0**