Purdue Extension
2018 Annual Accomplishment Report to USDA NIFA
Impact Statements by Planned Program

The Purdue Extension and Research outcomes and impact statements are organized into these seven Planned Programs:

- Childhood Obesity
- Climate Change
- Food Safety
- Global Food Security and Hunger
- Human, Family, and Community, Health and Well-being
- Natural Resources and the Environment
- Sustainable Energy

Outcomes provide the metrics that our Educators and Specialists report across research and Extension program efforts. The impact statements shared highlight a program or project addressing the outcomes and provide narrative on the issue, what has been done, and the results. There are impact statements for research projects, for Extension programs, and for integrated research and Extension activities.

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Natural Resources and the Environment

Title
Soundscape analysis for biodiversity, behavioral patterns of animals, dynamics of weather and climate, and human activities

Research
Bryan Pijanowski, Forestry and Natural Resources

Outcome
21 - NRE 1.2 # New relevant databases, monitoring systems, and inventories managed or under development

Issue
Understanding the impacts that humans have on ecosystems is challenging. Central to this challenge has been the inability of researchers to develop a universal measure of both ecosystem health and human activities for a place. Soundscape measures have the potential to capture a locations' biodiversity, behavioral patterns of animals, the short-term and long-term dynamics of weather and climate, and various human activities simultaneously. Past work in the area of acoustics has focused on how animals use sound to communicate or how noise impacts human health and behavior. This work will characterize, for the first time, how soundscapes vary across time, space and human disturbance intensities. This will lead to better understanding of ecosystem dynamics, spatial variability of ecosystems and potentially how humans might affect ecosystem quality.

What has been done
The research project focused on 1) converting soundscape recordings to acoustic metrics that reflect the diversity and intensity of sounds occurring at a location; 2) using these metrics to analyze spatial-temporal patterns that are reflective of human disturbance (e.g., land use patterns) at a location and 3) providing this information to potential users via online database management tools. Within ecosystem and across ecosystem analyses formed a majority of the research proposed here. The impact of this work can be summarized by focusing on three main target audiences that our project has focused on: a) the general public; b) the scientific community and c) natural resource managers. Goal 1 (metrics) focused on the scientific community, goal 2 (application of our metrics) focused on natural resource managers and goal 3 (provide information to users) focused on all three. These goals were accomplished through a) creation of high quality educational materials such as an IMAX film, citizen science project, summer camp program and online learning web site;

b) development of new software tools that are provided to researchers in a hands-on workshop environment and c) the formation of partnerships with parks and research facilities around the world that use information for management decisions.

Results
Through a citizen scientist app, there are now over 2500 users that upload their soundscapes and sentiment data to the website for use in a) building an understanding of the importance of listening/observing our surroundings and b) for the team to understand the linkages between the types of sounds people hear and their emotional reaction to them. The website contains millions of recordings which are available online for people to listen to and this is an easy to use, easily accessible form for many to connect to our research. The team's work has also been showcased on major news media outlets during this reporting period, including CNN, New York Times Magazine, Science News, Business Week, Nova, NPR Science Friday, BBC World News Service, and NBC Today Show as well as numerous online news outlets (e.g., Wired Magazine, Huffington Post). Our IMAX film, Global Soundscapes: A Mission to Record the Earth is now in 14 theaters in the U.S., Canada and Germany. An outside evaluator has ranked the film second among 12 assessed in the area of science education. More than 10 journal articles have been published per year on various aspects of soundscape dynamics and their linkages to natural (e.g., hurricanes) and anthropogenic stressors (e.g., deforestation). This team is helping to define this very new field in terms basic and applied areas of research. Publication venues are top tier in the field, including: Landscape Ecology, Global Environmental Change, Ecological Informatics, Freshwater Biology, Auk, Journal of Biogeography, Biotropica, International Journal of Science Education, Journal of the Acoustical Society of America, among others. Over 7 keynote addresses have been delivered during this reporting period that summarize the work. We have also hosted 11 hands-on workshops that have involved over 117 scientists from 15 universities in the US, Canada, Costa Rica, Brunei, Australia and Mongolia. Natural Resource Managers. We have now partnered with over 25 natural resource parks and protected areas around the country and world. These include: Hustai National Park (Mongolia), Chingaza Natural National Park (Colombia), Le Selva Research Station (Costa Rica), Chiricahua National Monument (Arizona), Crane Trust (Nebraska), and the Wells National Estuarine Research Reserve. Our partnerships have also included those in national or regional offices of the National Park Service and NOAA and some national/international conservation groups (Conservation International, Institute Alexander von Humboldt, Colombia). These partnerships have evolved into many separate projects including some that are not Purdue driven (thus they adopt the technologies and paradigms) and this to us represents a change in behavior which we sought.

Title
Beneficial Reuse of Residuals and Reclaimed Water: Impact on Soil Ecosystem and Human Health

Research
Linda Lee, Agronomy

Outcome
11 - NRE 1.3 # Viable technologies developed or modified for detection and characterization

Issue
Biosolids can be extremely beneficial to enhance soil quality and soil fertility. Use of these organic materials, derived from wastewater treatment operations, for agriculture, raise concerns among public and regulatory community. Sound science is needed in order to properly evaluate the risks to the ecosystem and human health so that biosolids may continue to serve a beneficial purpose rather than be destined for landfills. Our ability to assess such risks is often hindered by a lack of data typically used for evaluating risk or an inappropriate use of the data typically used because the behavior of many potentially toxic inorganic trace elements, and pharmaceuticals and personal care products (TOrCs) do not follow previously used paradigms for predicting risk. The primary goal of this research is to optimize the use of municipal biosolid for land reclamation and provide the needed environmental fate data (leaching, persistence, and plant uptake) on the trace organics towards enhancing risk assessment protective of human and environmental health.

What has been done

An evaluation is being conducted of the short- and long-term chemistry and bioavailability of nutrients, potentially toxic inorganic trace elements, and pharmaceuticals and personal care products (TOrCs) in residuals, reclaimed water, and amended soils in order to assess the environmental and health risk-based effects of their application at a watershed scale. 2) The team also evaluated the uses and associated agronomic and environmental benefits for residuals in agricultural and urban systems. The team conducted an evaluation on the fate of perfluoroalkyl acids (PFAAs) in waste-based fertilizers including biosolid-based materials and composted city wastes (yard trimmings, food wastes, food packaging, etc.). PFAA occurrence was quantified in numerous waste-based fertilizers. The concentration of PFAAs present in the pore-water that can be transported or taken up by plants was quantified. 3) Additional pot studies were initiated this past year with basil, green bean, kale, Swiss chard and turnip grown in soils mixed with a subset of composted materials and analyzed for azithromycin (antibiotic), carbamazepine (anticonvulsant), miconazole (antifungal), triclocarban and triclosan (antimicrobials) and some selected PFAAs.

Results
On the fate of perfluoroalkyl acids (PFAAs) in waste-based fertilizers: On average about 50% or more of the PFAA present in the fertilizers was found in the pore-water. PFAA pore-water concentrations were generally proportional to the initial concentration in the fertilizer. 2) As to how PFAA levels change with different post treatment processes: PFAA concentration tended to be decrease in fertilizers where biosolids were blended with other materials, most likely due to a dilution effect. Fertilizer exposed to either composting or heat-treatment appeared to have increased PFAA concentrations after the treatment process. 3) In the pot studies initiated this past year with basil, green bean, kale, Swiss chard and turnip, a preliminary greenhouse study showed that for the five trace organics targeted, (all personal care products and pharmaceuticals), all were taken up into all of the edible parts of plants to some extent at a high application rate (8X recommended rate). Of the four compounds targeted, only triclosan degraded substantially with a half-life of approximately 115 days. The other compounds showed little or essentially no degradation within the 180-day period. Preliminary comparisons with previous literature suggest that the biosolids matrix limits the bioavailability, thus microbial degradation, of these compounds relative to systems where the compounds of interest is added artificially.

Title
Fire effects within group shelterwood systems on regeneration response and residual timber quality

Research
Michael Saunders, Forestry and Natural Resources

Outcome
7 - NRE 1.4 - # Viable prevention, control and intervention strategies

Issue
Oak species have been on the decline for several decades due in part to harvesting practices, failure of nut production (mast), increased wildlife pressure (deer), land-use change, and invasive species. Many scientists have concluded that we are dangerously close to the large-scale loss of oak species by more shade-tolerant tree species such as maple species and American beech. Silvicultural systems have been developed to successfully regenerate oak in uniform age distributions. While these systems are effective, they are often done in areas that go beyond the spatial scale of management activities on many private holdings. New regeneration systems that can be applied at smaller, sub-stand-level spatial scales and that may be more attractive to private landowners are needed. Hybrid silvicultural systems based on natural disturbance dynamics, may be one such alternative. One such hybrid system, an expanding group shelterwood system, is commonly used in Europe for oak regeneration, has been successfully applied to Northeastern mixed-conifer forests, and is now being utilized in several parts of the eastern oak forest by the U.S. Forest Service and other researchers. However, none of these efforts include the use of prescribed fire, which is a key ecological process that promoted oak dominance in these stands over the past two centuries, but has been generally avoided by private landowners because of liability concerns and misinformation regarding its effect on stand timber values.

What has been done
Two ongoing long-term, forest management experiments, NWSC Crane experiment and the Hardwood Ecosystem Experiment, are incorporating the use of prescribed fire to not only track regeneration response to prescribed fire, but

also quantify the damage to overstory trees resulting from its use. In addition, over 100 U.S. Forest Service stands, from Missouri to eastern Kentucky, have been inventoried in a retrospective study of prescribed fire on overstory timber volume and value.
The team has been 1. Comparing the interacting effects of prescribed fire and expanding gap-based harvesting on short-term tree regeneration response; and 2. Monitoring the influence of prescribed fire, used as a regeneration tool, on residual overstory tree timber quality within shelterwood regeneration systems; and 3. Developing empirical models of expected damage to timber value with increasing prescribed fire intensity and/or frequency.

Results
1) Early results suggest that the combination of prescribed fire and gap-based harvesting techniques hold promise to increase regeneration of oak species, but the benefit will depend highly upon site conditions. The technique is likely to be more successful on dry sites, often with south- or west-facing aspects, than more moist north- or east-facing sites, and regeneration response will vary spatially. Competitive oak regeneration, in the short-term, is likely not going to occur inside gaps, but on the northern, western and eastern flanks of gaps. Prescribed fires offer an additional benefit to create understory conditions that favor germination of acorns from small mammal caches, which could lead to more oak recruitment in the long-term with repeated burnings.
2) In total, over 200 overstory trees are now being monitored across 16 sites that have had a single prescribed fire. There has been comprehensive analysis of the short-term effects, although the study design has been published and analysis for two sites has been completed. Those results suggested that there was minimal damage to overstory trees, as none died or received a reduction in U.S. Forest Service tree grade.
3) For empirical models of expected damage to timber value with prescribed fire, losses to overstory timber volume and value is likely to vary regionally with edaphic factors and the prescribed intent of the surface fire. Inventories from the Hoosier National Forest in Indiana suggest that prescribed fire will wound up to 50% of the trees, but the relative volume loss is <3% and grade changes are 2-7%. In the Mark Twain National Forest in Missouri (Mann, M.S. thesis, in prep.), prescribed fires are more intense leading to higher wounding rates (up to 70%) and grade loss (up to 45%). Economic damage is likely in this system, but further work is needed to verify patterns seen "on the stump" to actual lumber recovery and value at the timber mill.

Title
Forest Management for the Private Woodland Owner - Helping landowners connect to forestry information and assistance

Extension
Lenny Farlee, Ron Rathfon, Brian MacGowan

Outcome
43 - NRE 1.13 - # Projects focused on understanding of the roles of humans, plants and/or animals

Issue
It is always good to know how programs impact actions and outcomes over time. Because forest management often happens over long timelines, many landowners will not immediately implement management practices after attending a course, so follow-up surveys, which may contact people several years after attending the course, provide a picture of the knowledge change and actions taken by attendees.

What has been done
The Forestry and Natural Resources Extension team surveyed 296 past participants (2007-2015) of the Forest Management for the Private Woodland Owner workshop presented by Ron Rathfon and Lenny Farlee. The workshop provides a broad overview of forest biology, management and sources of information and assistance for landowners. The course is composed of 8 three-hour evening sessions and two half-day field tours. Over 180 responses were received from past participants.

Results
As a result of taking the course in previous years, participants self-reported increases in: 1) knowledge about their woodlands (53%), 2) awareness of groups and organizations that offer information (80%), 3) understanding of where to

find professionals who can help manage their woodlands (74%), 4) extent their woodland management decisions are informed by long-term planning (53%), and 5) trust in Purdue Extension as a source of information (34%). Three out of four respondents controlled invasive species on their woodlands in the previous 5 years. 97% indicated the course influenced them to control invasive plants in their woodlands with over half strongly influenced. Similarly, the course influenced 82% to some degree to use the services of a professional forester. Responses included: Participation in the Forest Management for the Private Woodland Owner course was important in helping me determine management objectives for my woodlands (Somewhat agree=35.7% Strongly agree=46.5%). Management of my woodlands improved because of what I learned in the Forest Management for the Private Woodland Owner course (somewhat agree=34.6% strongly agree=41.6%). In the last 5 years, these activities occurred on the woodlands they owned: 1) Hiked/walked (94.67%), 2) Viewed wildlife (90.53%), 3) Controlled invasive species (73.37%), 4) Applied herbicide, pesticides or fertilizers (56.8%), 5) Wildlife/fish habitat improvement projects (e.g., constructed brush piles, planted native shrubs or wildflowers) (53.25%), 6) Prepared land and/or planted trees (49%), 7) Conducted a timber harvest (25.44%), 8) Fished (23.67%), and 9) Controlled/prescribed fire (10.65%). Comments included: 1) This was a very good program for the beginning forest owner. We have learned a great deal from it and the materials that we received. Thanks! 2) The class I attended in Rochester, IN was excellent and the instructor was terrific. He did a great job. I give him an A+. 3) I would like to receive Indiana Woodland Steward and the class last year was excellent! 4) We really enjoyed this course. Our place is just a get way for us. All of the woods are on a hill. 5) I would eagerly attend more short classes on forestry management. 6) I am interested in returning my entire farm to woodland. 7) I now have the resources and renewed interest in maintaining our forest and passing that information on to my son and grandson. 8) I would recommend this class to other landowners. 9) Extremely grateful for this class. If I had to register a complaint it would only be that I felt the whitetail deer was given a lot of blame for tree damage. If I had to put a value on this class I would say I've got $1000 worth. Thanks again.

Title
Conservation Partnership Tree Planting Training

Extension
Lenny Farlee, Brian Beheler, Stephen Boyer

Outcome
220 - NIFA CC 2.3 - # of participants adopt recommended adaptation strategies for natural resources management

Issue
USDA programs provide incentives and planning assistance for landowners wishing to implement conservation practices like tree planting, forest stand improvement, and invasive plant species management. USDA Natural Resources Conservation Service and Soil and Water Conservation District employees are often the first contact and a primary source of technical advice and assistance to these landowners. Providing training in science-based management techniques and strategies for these practices may improve the success rate for these practices, and provide the employees more confidence to recommend these practices to landowners. Extension educators also are a primary contact point for local landowner questions regarding natural resource management. Providing training to extension educators expands their knowledge base and provides them with contact points to refer clients to sources of professional assistance.

What has been done
Purdue Forestry and Natural Resources Extension has provided natural resources management training to Indiana Conservation Partnership members for several years. In 2018, two Conservation Tree Planting training days were held at Martell Forest and NEPAC for Conservation Partnership members.

Results
68 Conservation Partnership members participated and 47 returned program surveys. 83 to 94% of participants indicated they planned to speak with landowners about information provided during the program. 100% indicated the program was useful or somewhat useful for making decisions or taking action on conservation tree planting. 33 to 35% reported improved knowledge for tree planting topics including site evaluation and preparation, planting techniques,

weed control, and post-planting management. Comments included: 1) hands-on tree planting was a valuable learning experience, 2) hands-on tree planting was helpful and beneficial, 3) this was a fantastic training, 4) A+ it was great hands-on!!1