The University of Vermont

ANNUAL REPORT 2017

UNIVERSITY OF VERMONT EXTENSION & VERMONT AGRICULTURAL EXPERIMENT STATION

THE UNIVERSITY OF VERMONT
AGRICULTURE & LIFE SCIENCES

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IN THIS ISSUE

ADVISORY BOARDS

ON THE COVER

Last year, more than 1,200 K-12 students from 22 schools learned about local waterways and current water quality stressors from the **UVM Watershed Alliance Program**. Armed with knowledge and skills gained from the program, 60 Edmunds Middle School students conducted a year-long stewardship project at the Burlington Intervale to improve water quality along the lower Winooski River.
(Photo: Brian MacDonald, www.brianmac.co)

CREDITS

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DEAN'S MESSAGE

The College of Agriculture and Life Sciences (CALS) is home to both the Vermont Agricultural Experiment Station (VTAES) and UVM Extension. Dedicated experts in VTAES research and Extension outreach continue to innovate, collaborate, apply knowledge, and develop solutions to issues faced by Vermonters. Federal and state funding, and competitive grants support these activities.

Our work is interdisciplinary and addresses needs in agriculture, economic, environmental, nutrition and food systems, and youth development areas. This year's report highlights specific, targeted programs in the areas of climate change and water quality, maple and forest agricultural business viability, youth post-secondary education preparedness, food security, dairy herd health, and forest management and protection.

We take pride in our stewardship of the environment and natural landscape through ongoing efforts to improve water quality in Lake Champlain and other watersheds. Working with dairy farmers, forest products and maple producers, we support and strengthen signature Vermont products industries such as maple and artisan cheese, and help grow the next generation of leaders and entrepreneurs through 4-H and other youth development programs. Climate change is the global challenge of our time, threatening food production, water supplies, and plant and animal species — and our experts continue to seek answers to these threats.

The CALS, VTAES and Extension common mission of research-based service and educational outreach continues to focus on contemporary problems, needs and challenges of a changing state and world. As always, we welcome your comments, perspectives and feedback.

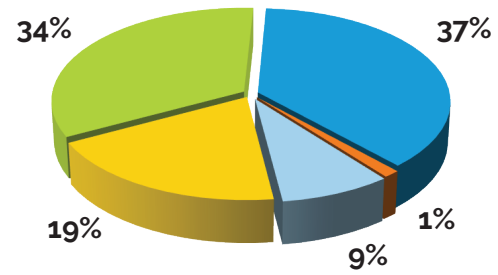
Thomas C. Vogelmann

Dean, College of
Agriculture and Life Sciences,
and UVM Extension

BUDGETED DOLLARS BY NATIONAL GOAL AREA FY 2017

Our work is fundamentally a partnership with our federal funder, USDA-NIFA (United States Department of Agriculture National Institutes of Food and Agriculture). Effort is applied in a number of national goal priority areas as illustrated in the charts below.

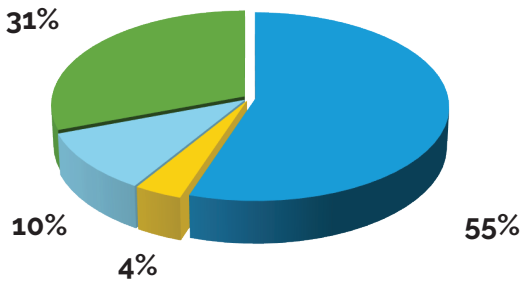
VERMONT AGRICULTURAL EXPERIMENT STATION



- Global Food Security & Hunger $2,061,038
- Food Safety $1,851,646
- Climate Change $1,060,004
- Childhood Obesity $469,054
- Sustainable Energy $68,227

Total: $5,509,969

UVM EXTENSION



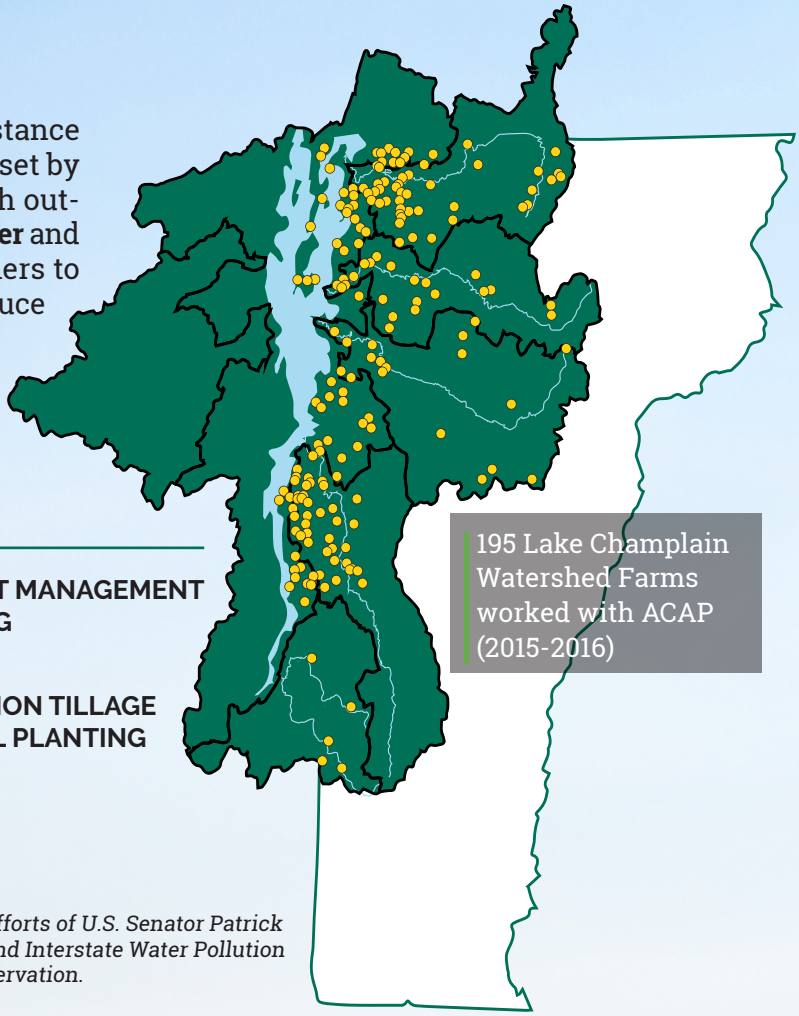
- Global Food Security & Hunger $6,623,836
- Community Development $3,686,884
- Childhood Obesity $1,260,367
- Climate Change $444,673

Total: $12,015,760

AGRICULTURE

ACAP: A Positive Impact on Water

UVM Extension's Agronomy and Conservation Assistance Program* (ACAP) assists the state in meeting goals set by Vermont's Clean Water Act (Act 64) in 2015. Through outreach and technical assistance, Agronomists **Jeff Carter** and **Heather Darby** and their colleagues work with farmers to identify and implement conservation practices to reduce soil and nutrient runoff from entering nearby water. Since the program's 2011 start, 421 farms have made changes benefitting the Lake Champlain Watershed.



195 Lake Champlain Watershed Farms worked with ACAP (2015-2016)

ACAP IMPACT SINCE ACT 64

10 MAJOR RIVER WATERSHEDS

195 FARMS

57,498 ACRES IMPROVED

ACRES OF PRACTICES IMPLEMENTED

46,235 NUTRIENT MANAGEMENT PLANNING

5,297 CONSERVATION TILLAGE AND NO-TILL PLANTING

4,036 COVER CROPPING

*Funded in part by the Great Lakes Fishery Commission through the efforts of U.S. Senator Patrick Leahy and awarded by the Lake Champlain Basin Program, New England Interstate Water Pollution Control Commission and Vermont Department of Environmental Conservation.

COVER CROPPING: HELPING VERMONT FARMS AND WATERWAYS

Cover cropping is one of many conversation practices used to reduce soil loss to waters and improve soil health. To demonstrate new methods of implementation, UVM Extension's Northwest Crops and Soils Team (NWCS) purchased two pieces of equipment: an interseeder and highboy seeder.** Previously unavailable in New England, this technology allows for more flexibility in cover crop implementation in northern climates and has already seeded 3,500 acres of fields not previously cover cropped in Vermont.

One third of the 90,000 acres of corn in Vermont use cover crops.

McKenzie Brook Farm Spotlight

UVM Extension helped an Addison County dairy farmer select and plant cover crops, and later plant corn with a no-till roller-crimper on 30 acres of land. By adding cover crops to this field, the farmer reduced erosion by at least two tons per acre, preventing 60 tons of soil from entering nearby surface waters of the McKenzie Brook watershed.

**Funded in part by USDA Natural Resources Conservation Service (NRCS) Conservation Innovation Grant Program.

Vegetation Filtration

A system of "bioretention cells" captures and filters runoff from rooftops and paved and dirt roads at Miller Farm *[background]*. "Low-phosphorus" compost and switchgrass are used to clean stormwater on site. Area before bioretention cells were installed *[inset]*.

REDUCING RUNOFF INTO VERMONT WATERSHEDS

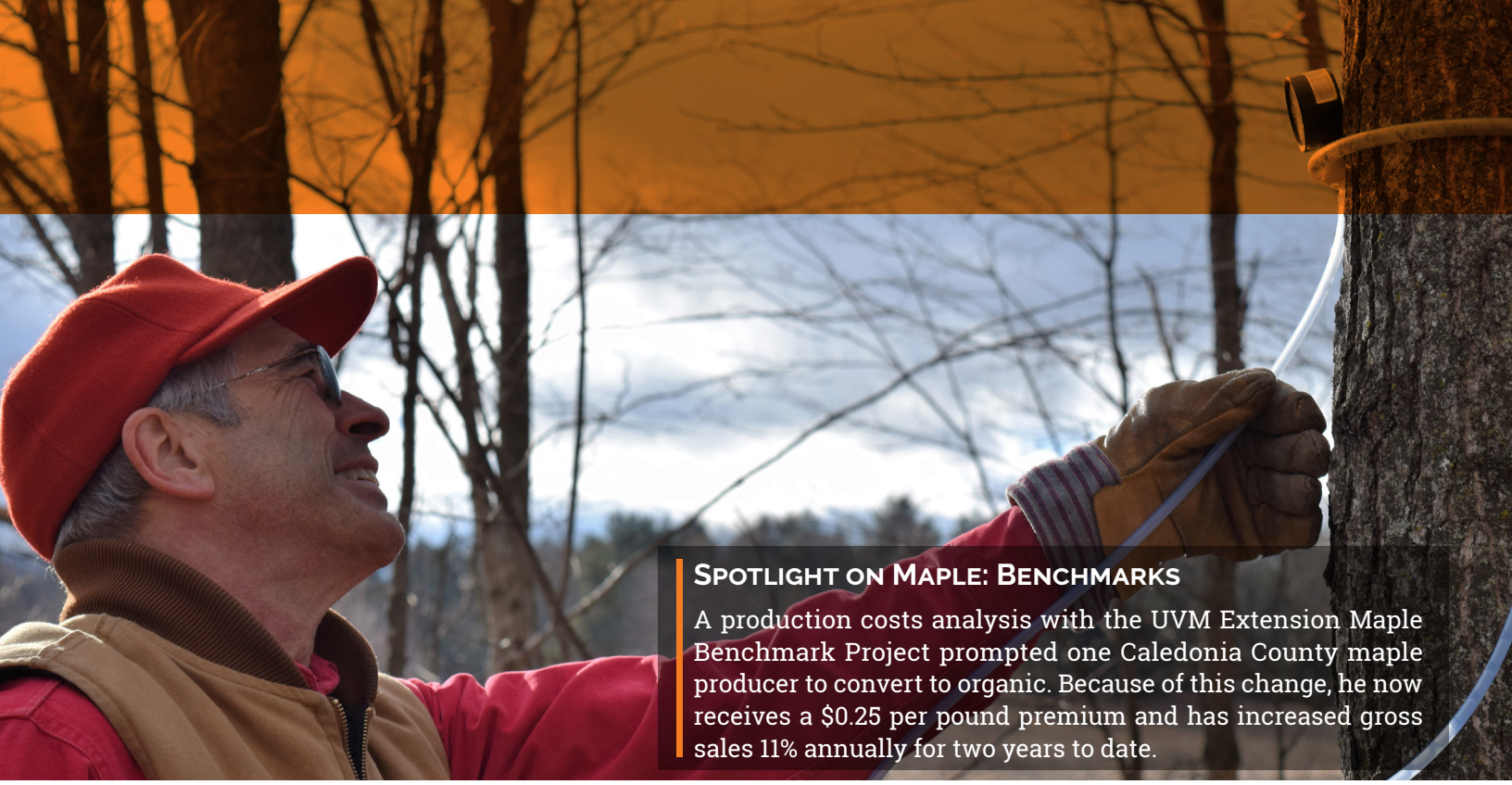
Stormwater runoff from impervious surfaces (paved and dirt roads, rooftops, parking lots) and areas where farm operations occur adversely impacts the water quality of rivers, lakes and other receiving waters. **Dr. Stephanie Hurley**, Assistant Professor of Landscape Design in the UVM Department of Plant and Soil Science, researches bioretention: the use of soil and vegetation media to detain runoff, promote infiltration and groundwater recharge, and filter pollutants from stormwater. Dr. Hurley's storm water treatment design and monitoring projects include sites in urban, suburban and agricultural settings.

This project, funded by USDA Hatch, studies three soil media and plant combinations for agricultural operations runoff treatment using bioretention cells: 1. layers of stone and sand only, with no vegetation; 2. layers of stone and sand with switchgrass (*Panicum virgatum*); 3. layers of stone and sand with switchgrass and a "low-phosphorus" compost amendment placed at the roots of each switchgrass plant.

(left to right) Dr. Stephanie Hurley and Dr. Joshua Faulkner investigate silage leachate runoff treatment from a Vermont dairy farm.

Water is sampled during storm events to compare the quality of the inflow to the outflow, and to measure performance of the three different bioretention cells. Preliminary results indicate that the planted bioretention systems (cells 2 and 3) retained more runoff than the unplanted cell 1. For cell 2, although plant biomass was lower in the absence of compost in the first growing season, plant survival was the same as in cell 3. In the second growing season, biomass was nearly identical in the two vegetated bioretention cells, with and without low-phosphorus compost. Season one water quality results showed reductions by all three bioretention cells in total and dissolved phosphorus, and in total nitrogen, but increased nitrate in the outflow of all three bioretention cells. Data from season two are currently being analyzed.

Another project investigates treating silage leachate runoff from bunkers on dairy farms. The leachate is potent and acidic, and a nutrient-laden source of pollution to downstream waters. In collaboration with **Dr. Joshua Faulkner,** UVM Extension Farming and Climate Change Coordinator, this innovative research treats leachate using a sequenced process, including aeration tanks and woodchip-filled "bioreactors," to physically, chemically and biologically improve water quality. Water quality is tested at each phase of treatment.



Spotlight on Maple: Benchmarks

A production costs analysis with the UVM Extension Maple Benchmark Project prompted one Caledonia County maple producer to convert to organic. Because of this change, he now receives a $0.25 per pound premium and has increased gross sales 11% annually for two years to date.

AGRICULTURAL BUSINESS: STRENGTHENING FOREST-BASED INDUSTRIES

Beyond Maple: Forest Products

UVM Extension Forest Business Educator **Chris Lindgren** provided in-depth coaching to nine forest products businesses.* All nine improved their ability to manage the business, which led to $275,000 in approved loans. Financial support and individualized education like this grows the Vermont forest products industry and businesses.

VERMONT'S FOREST INDUSTRY CONTRIBUTES

$861M

IN ANNUAL SALES

(FOREST PRODUCTS, MAPLE SYRUP AND CHRISTMAS TREES)

Business Is Sweet on Benchmarks

UVM Extension's Maple Benchmark project provides business management education to maple producers.** Led by Farm Business Specialist **Mark Cannella**, the program also established the first maple business benchmarks available to the public in decades. Producers now have region-specific industry metrics to make informed decisions about their business.

A Valuable Tool for the Maple Industry

UVM Extension Maple Specialist **Mark Isselhardt** led the design of an off-flavor syrup reference set. The tool helps producers identify off-flavors in maple syrup so only high-quality, properly graded syrup will reach consumers. The set includes three 1.7oz bottles of naturally off-flavored maple syrup and was first made available for the 2017 season with 1,600 produced.

MAPLE BENCHMARK PROJECT SUCCESSES

430 MAPLE WORKSHOP ATTENDEES

272 MAPLE BENCHMARK REPORT DOWNLOADS

32 DETAILED FINANCIAL ANALYSES COMPLETED

RESULTS BASED ON WORK WITH 10 PRODUCERS

7,500 NEW MAPLE TAPS (2017)

$45,665 NEW MAPLE SALES (2017)

$1.34M PLANNED/PROPOSED INVESTMENTS

*Funded in part by the Vermont Housing and Conservation Board.
**Funded in part by a Vermont Agency of Agriculture, Food and Markets Specialty Crop Block Grant.

ECONOMY

IMPROVING DAIRY COW FERTILITY

Vermont's dairy industry is the largest agricultural sector in the state, annually generating $2.2 billion in economic activity. Animal reproduction is a critical component of each dairy operation. It is the source of replacement stock to maintain the herd and ensures a continuous supply of milk for consumers. Despite great improvements in the efficiency of milk production through genetic selection of superior animals, overall fertility in dairy cows has declined in the last few decades.

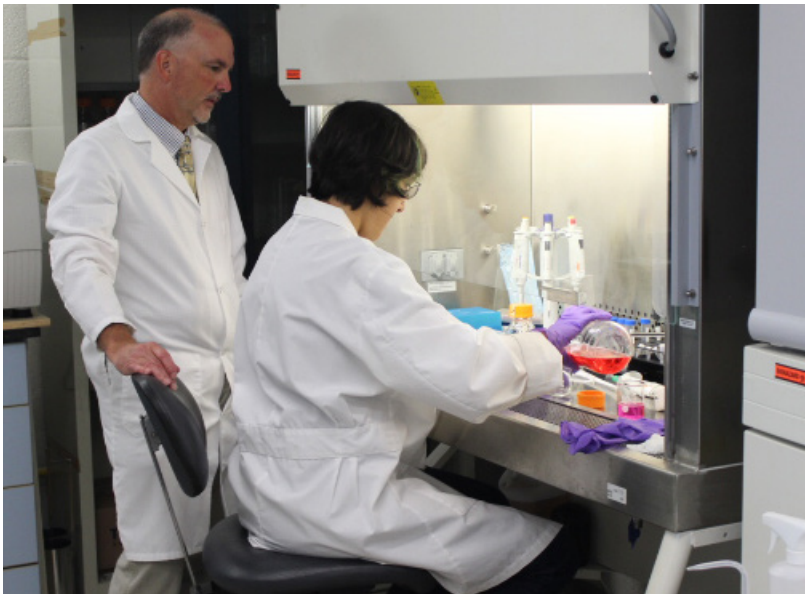
Vermont's dairy industry annually generates $2.2 billion in economic activity.

Dr. David Townson, Professor of Animal and Veterinary Sciences, studies whether existing reproductive strategies can be improved to increase fertility in older, high-lactation cows. Recent management approaches to synchronize reproductive cycles and implement timed artificial insemination (TAI) of younger dairy cows have improved fertility. However, the efficacy of these approaches in older, higher-lactation cows is unclear. Dr. Townson and graduate student **Allie Lundberg** are currently conducting research on a 500-cow milking herd located in St. Albans, Vt., and the project is anticipated to be ongoing for the next few years. This on-farm research includes regularly scheduled ultrasound monitoring and blood sampling of cows to evaluate ovarian function, ovulation and the establishment of pregnancy. This work is supported by USDA/Hatch funds through the UVM Agricultural Experiment Station as part of Multistate, Regional Project NE-1227.

Another question concerns the prevalence and impact of environmental pollutants, also known as endocrine disrupting compounds (EDCs), which are both natural and manufactured substances (e.g., phytoestrogens, pharmaceuticals, pesticides, plasticizers), on cows' ovarian function. Apprehension about infertility and EDCs is shared among dairy farmers and the Vermont population in general. This has led, in part, to further investigation of the impact of EDCs in both human and cow fertility.

Dr. Townson collaborates with lead investigator **Dr. Catherine Combelles** of Middlebury College to investigate the accumulation of EDCs in urine, blood and ovarian follicles of cows and the effects on egg quality and fertility. Advanced-detection techniques are used to measure specific EDCs in cows' tissues, which is thought to accumulate from the environment. Cell culture methods are used to evaluate the effect of EDCs on egg growth and maturation.

The results of these studies are anticipated to provide greater understanding of the underlying issues that challenge fertility in older, high-lactation cows, a practical approach to potentially improve ovulation synchronization and pregnancy rates in these cows, and insight about the effects of EDCs on fertility.



Dr. David Townson supervises undergraduate student Julia Weisz with aseptic technique and cell culture methods in the laminar flow hood.

GROWING VERMONT FORESTS

Vermont Urban and Community Forestry

The Vermont Urban and Community Forestry (UCF) Program, a partnership between UVM Extension and Vermont Department of Forest, Parks and Recreation (FPR), has worked at the grass roots level for 25 years to plant, promote and protect urban trees and community forests. With financial, educational and technical assistance from UVM Extension UCF team members **Kate Forrer**, **Gwen Kozlowski**, **Elise Schadler** and **Meredith Whitney**, cities and towns in Vermont are properly caring for and managing this valuable asset.

Small Forests are a Big Deal

The Backyard Woods Online Course was developed by UVM Extension and partners to serve Vermont's growing population of forest owners. Open to landowners of 25 acres or less, the course engaged 40 participants with their property last year and helped 29 of them to develop a personalized backyard woods action plan. From managing invasive species to attracting pollinators, participants are making changes to support the health and well-being of Vermont's forests – one backyard at a time.

Educating Forestry Professionals

More than 500 forestry professionals participated in a monthly webinar series developed by UVM Extension. The series was created in response to Vermont's Forester Licensing and Regulation Law (Act 166) enacted in 2016. Foresters can earn 11 of the required 24 continuing education credits through the program and learn about the latest research, management techniques and resources for keeping Vermont's forests healthy.

Dan Singleton, FPR's Forest Health Specialist (right), leads a forest walk for participants in UVM Extension's Backyard Woods Program.

URBAN AND COMMUNITY FORESTRY PROGRAM IMPACT

25 YEARS OF SUPPORT

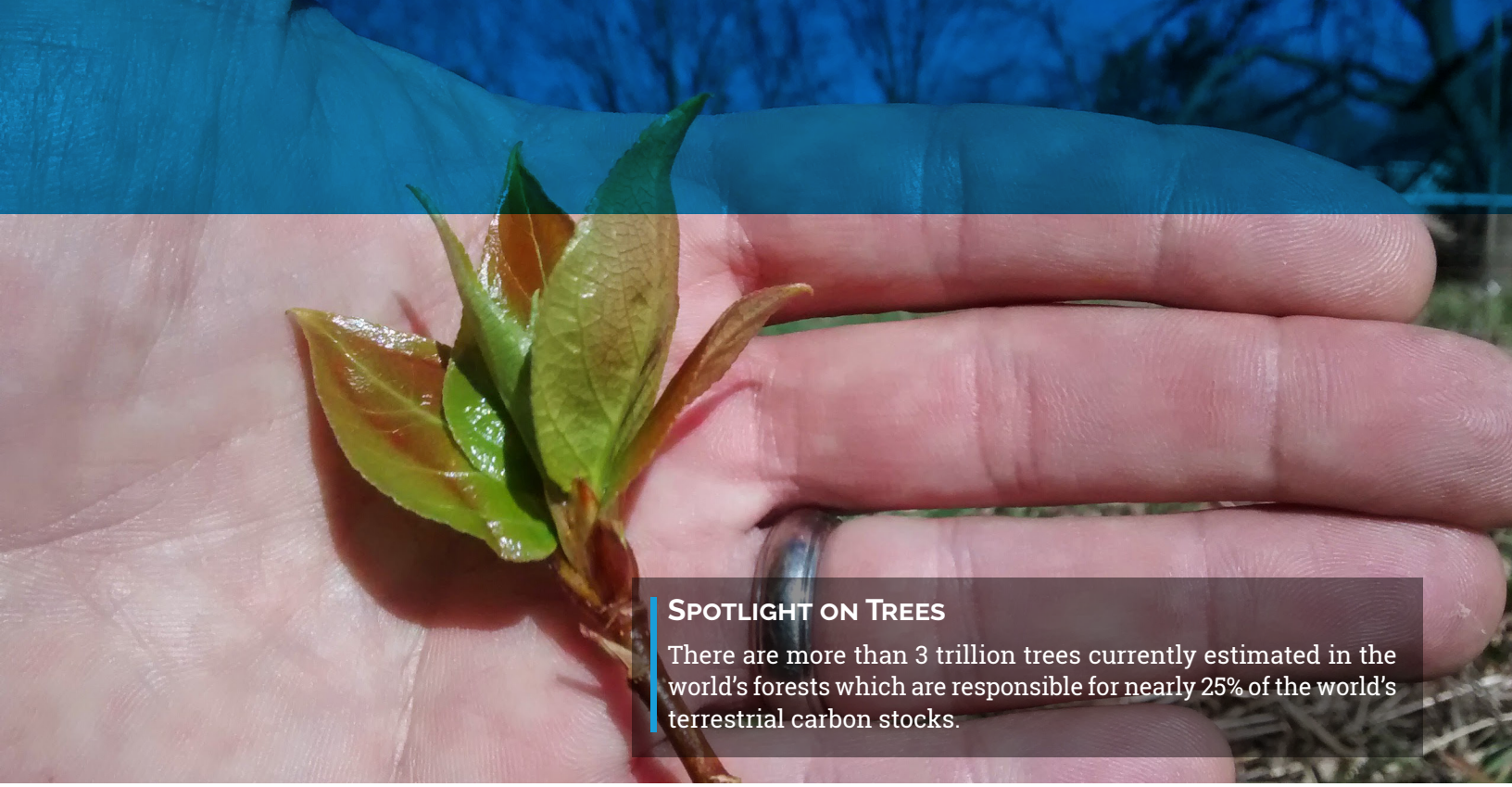
400,000 VERMONTERS BENEFITTED

16,673 TREES INVENTORIED *(since 2013)*

94 COMMUNITIES *(2016)*

5,000+ PUBLIC TREES PLANTED

15,800 VOLUNTEER HOURS *(2016)*



Spotlight on Trees

There are more than 3 trillion trees currently estimated in the world's forests which are responsible for nearly 25% of the world's terrestrial carbon stocks.

PLANT GENOMIC ADAPTATION TO ENVIRONMENTAL CHANGE

Global environmental change presents serious threats to ecosystems, in Vermont and across North America. These ecosystems are well adapted to local environments, providing essential wildlife habitat, as well as social and economic benefits to human communities. However, there is growing realization that genetically based evolutionary changes play a critical role in short- and long-term plant response to human alterations of the environment.

Dr. Stephen Keller, Assistant Professor of Plant Biology, investigates how natural and human environmental changes impact genetic diversity and adaptability of plant species. With funding from the National Science Foundation and the USDA, Keller's research employs powerful genomics technologies to measure how diversity of northern forest trees, primarily spruce and poplar, has been shaped by climate, and how variability and past adaptation provide a foundation for predicting future adaptation or migration of forest tree species.

(left to right) Jeremy Weiland, Brittany Verrico and Dr. Stephen Keller discuss experimental results from a freeze tolerance assay on red spruce.

Keller's work couples genetic mapping of adaptively important traits, such as spring leaf-out, water use, cold tolerance and disease resistance, along with predictive computer modeling of adaptation and dispersal capacity using DNA markers. His work demonstrates strong genetically based local adaptation of tree populations to climate, sometimes across spatial scales as short as a few kilometers. Understanding and minimizing the loss of adaptation is key to maintaining the productivity and health of forest ecosystems under future climates.

A second line of research investigates genetic variability in non-native invasive plants that are experiencing post-introduction hybridization. This work tests the hypothesis that species hybridization can result in dramatic increases in growth and reproductive fitness of invaders. This may be an important component of how some plant species that are benign members of their native ecosystems emerge to become problematic invaders.

This research will be directly applicable to current and future ecosystem restoration and management efforts that will seek to maintain the adaptation and productivity of forest ecosystems, and benefit the many species of game and non-game wildlife and plants that depend on them.

YOUTH DEVELOPMENT

SPOTLIGHT ON SPIN: CULINARY ARTS

4-H Educator **Allison Smith** teamed up with Fayston Elementary and Waitsfield's Tucker Hill Inn this year to offer a career-centered cooking project. Students used math and science to understand the mechanisms behind a successful dish. Culminating in a meal for 30 guests, students used this capstone project as evidence of achievement for their personalized learning plans.

4-H: DEVELOPING SKILLS FOR COLLEGE, CAREER AND LIFE

Youth who participate in 4-H are more likely to pursue post-secondary education. Of the 137 Vermont students who graduated from high school between 2015 and 2017 and participated in 4-H clubs, 66% went on to college compared to the state's 53%.

The UVM Extension 4-H Program, directed by **Sarah Kleinman**, provides experiential learning opportunities for youth through its clubs, short-term special interest (SPIN) programs and more. Children develop life and job skills – also known as transferrable skills – that complement the classroom, support Vermont's Flexible Pathways Initiative (Act 77) and prepare students for post-secondary education.

This year 815 youth demonstrated mastery of a transferrable skill like decision-making, communication or leadership because of their participation in 4-H clubs.

4-H SURVEYED GRADUATING HIGH SCHOOL SENIORS FROM CLUB PROGRAMS FOR THE PAST TWO YEARS:

SAY 4-H INVOLVEMENT HELPED THEM GET INTO COLLEGE

SAY 4-H HELPED THEM DEVELOP INTEREST FOR A FUTURE CAREER

4-H CLUB PROGRAMMING

14 COUNTIES

123 CLUBS

1,241 YOUTH ENROLLED

33,842 VOLUNTEER HOURS

18 USC 707

4-H PROGRAMMING BEYOND THE CLUB

275 EDUCATIONAL OPPORTUNITIES

5,538 YOUTH SERVED

48,768 EDUCATION HOURS DELIVERED

NUTRITION

DO CLIMATE AND REGULATORY CHANGE AFFECT FOOD SECURITY?

Farmers and our food system face unprecedented challenges from climate change and other environmental factors. How can we ensure future food security amid both environmental and regulatory uncertainty?

The impact of climate change on future food security is a focal point for researchers. For **Dr. Meredith Niles,** Assistant Professor in the Department of Nutrition and Food Sciences, an interdisciplinary food systems approach is critical to exploration of food availability in Vermont and beyond. Her research aims to understand how food security may be influenced by climate and regulatory change.

Dr. Niles' exploration of food security and climate change has focused on recent extreme weather events. She studied how Tropical Storm Irene affected local food supplies, and how communities dealt with those immediate challenges, finding that a community's social capital was critical for meeting short-term food needs. She is investigating how people in the U.S., and in Vermont specifically, use Twitter and other social media channels to communicate about food security during natural disasters.

Additionally, she has examined how rainfall variability affects the food security of small farmers in dozens of countries. She found that 80% of small farmers faced at least one month of food insecurity, and those in drought conditions were nearly a month more food insecure compared to those in wetter regions. Financial resources were the most effective in drought regions to positively impact food security, as compared to agricultural resources in wetter places.

Dr. Niles is also exploring how government regulation influences food security through farm viability. She interviewed Vermont farmers to learn how their businesses might be affected by new regulations, including time and cost impacts, and the consequences for Vermont livelihoods and landscapes. She has conducted similar work with farmers in California, exploring farmer perceptions of groundwater management policies. Other ongoing research examines food waste regulations in Vermont (Act 148), and the consumer and farmer behaviors that may result from its implementation.

Of one thing she is certain: agriculture and food systems are facing unprecedented changes, which could significantly influence food security and agriculture. To help adapt our food systems to future changes, we must understand both the environmental and the policy impacts that affect how we grow and distribute food. Understanding and predicting these impacts is a challenge, but assessing how and why people might change to adapt is an important first step.

Dr. Meredith Niles (right) meets with Samantha Lewandowski, CALS graduate student, to discuss her research.

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