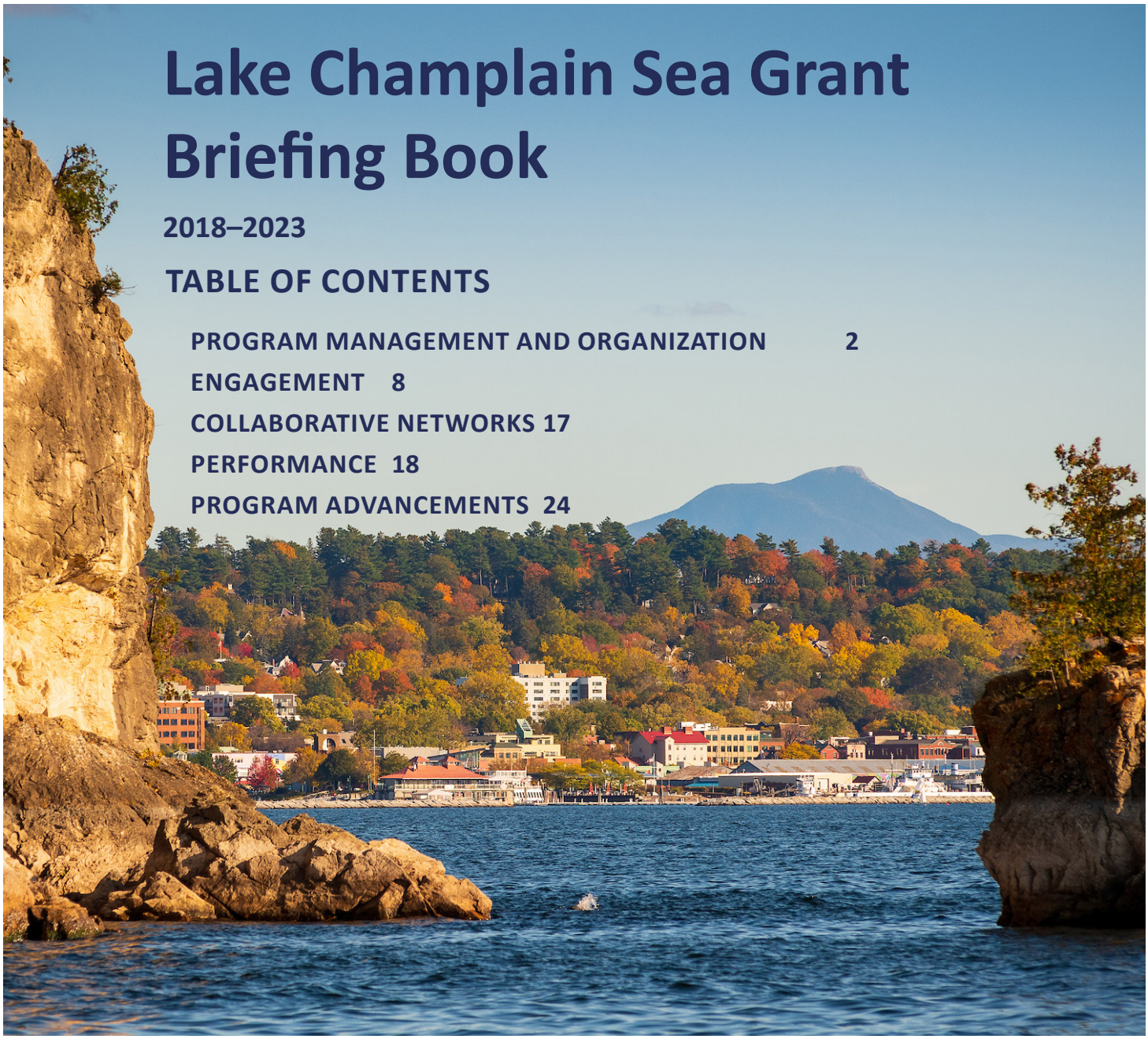
Lake Champlain Sea Grant Briefing Book

2018–2023

TABLE OF CONTENTS



During the 2018–2023 period, Lake Champlain Sea Grant (LCSG) demonstrated the ability to identify needs, work with partners, provide outreach and education, run research competitions, obtain matching funds, and deliver products that have meaningful outcomes for our partners, target audiences, and the environment and economies of the Lake Champlain basin (Basin) and beyond. We have carefully stewarded funds entrusted to us to develop and deliver science-based information to benefit the environment and economies of the Basin so that its communities are able to anticipate and enable change for long-term ecosystem health and sustainable economic development. In the sections that follow, we document how LCSG efforts during 2018–2023 addressed the specific Standards of Excellence identified by the National Sea Grant College Program. We also document how our efforts allowed us to achieve the goals of our strategic plan across three focus areas: Environmental Literacy and Workforce Development, Healthy Coastal Ecosystems, and Resilient Communities and Economies.

Program Management and Organization

ORGANIZATION

Management Team

LCSG's management team facilitates a viable and productive Sea Grant program. The LCSG Director (Dr. Breck Bowden [retired 2022], Dr. Anne Jefferson [2023–present]) is an endowed faculty member of the Rubenstein School of Environment and Natural Resources (RSENR) at the University of Vermont (UVM). Dr. Jefferson is also the director of the Northeastern States Research Cooperative and the Vermont Water Resources and Lake Studies Center. She is on a 9-month contract that includes teaching and research expectations. LCSG has two Associate Directors. The New York-based LCSG Associate Director (Dr. Tim Mihuc) is a Distinguished Service Professor within the College of Arts and Sciences at SUNY-Plattsburgh (SUNY-P). Dr. Mihuc also directs the Lake Champlain Research Institute. The Vermont-based Associate Director (Dr. Kris Stepenuck) is an Extension Associate Professor within RSENR at UVM and serves as the Extension Leader to develop and coordinate Sea Grant Extension activities within LCSG. Her appointment is 80% extension and 20% research or teaching. The LCSG research program and fiscal management are led by a senior staff member in RSENR (Elissa Schuett [2018–9]; Julianna White [2019–23]; Dr. Gretchen Nareff [2024–present]). This leadership team ensures overall programmatic fiscal responsibility, programmatic direction and coordination, staffing, and staff support.

Advisory Board Membership

Steering Committee

An MOU defines the leadership and advisory structure and responsibilities of LCSG. In recognition of our bi-state partnership, Steering Committee members include the Vice President for Research at UVM (Dr. Kirk Dombrowski) who serves on behalf of the UVM Provost; the Dean of the Rubenstein School of Environment and Natural Resources at UVM (Dr. Peter Newman); the Dean of the UVM College of Agriculture and Life Sciences (Dr. Leslie Parise); and the Director of the SUNY-Plattsburgh Research Foundation (Mr. Michael Simpson), who serves on behalf of the Provost at SUNY-P. The LCSG Director maintains personal contact with each Steering Committee member, consulting them regularly for high-level guidance and approval of programmatic direction. The Director also convenes the committee at least annually. The committee's charge includes promoting the vision, mission, and values of LCSG, aiding in negotiation of matching funds, and identifying new opportunities and resources to help grow capacity of the program.

Program Advisory Committee

Our Program Advisory Committee (PAC) advises our leadership and staff to help us fulfill our vision and mission. The PAC identifies current and future needs and opportunities in the Basin that relate to our three focus areas. PAC members help us inform and refine research priorities and extension efforts. Members meet once or twice a year. We defined written guidelines for PAC member expertise areas and representation in response to Recommendation #1 from our 2019 site review: "to develop a rubric/systematic approach to PAC representation and make that process publicly visible." We posted these guidelines on our website. Our PAC is comprised of both New York and Vermont representatives including those from businesses, state and federal agencies, watershed organizations, academic entities, indigenous tribes, and the public. PAC members represent many ways of knowing, levels of experience, and areas of expertise.

Recommendation 1

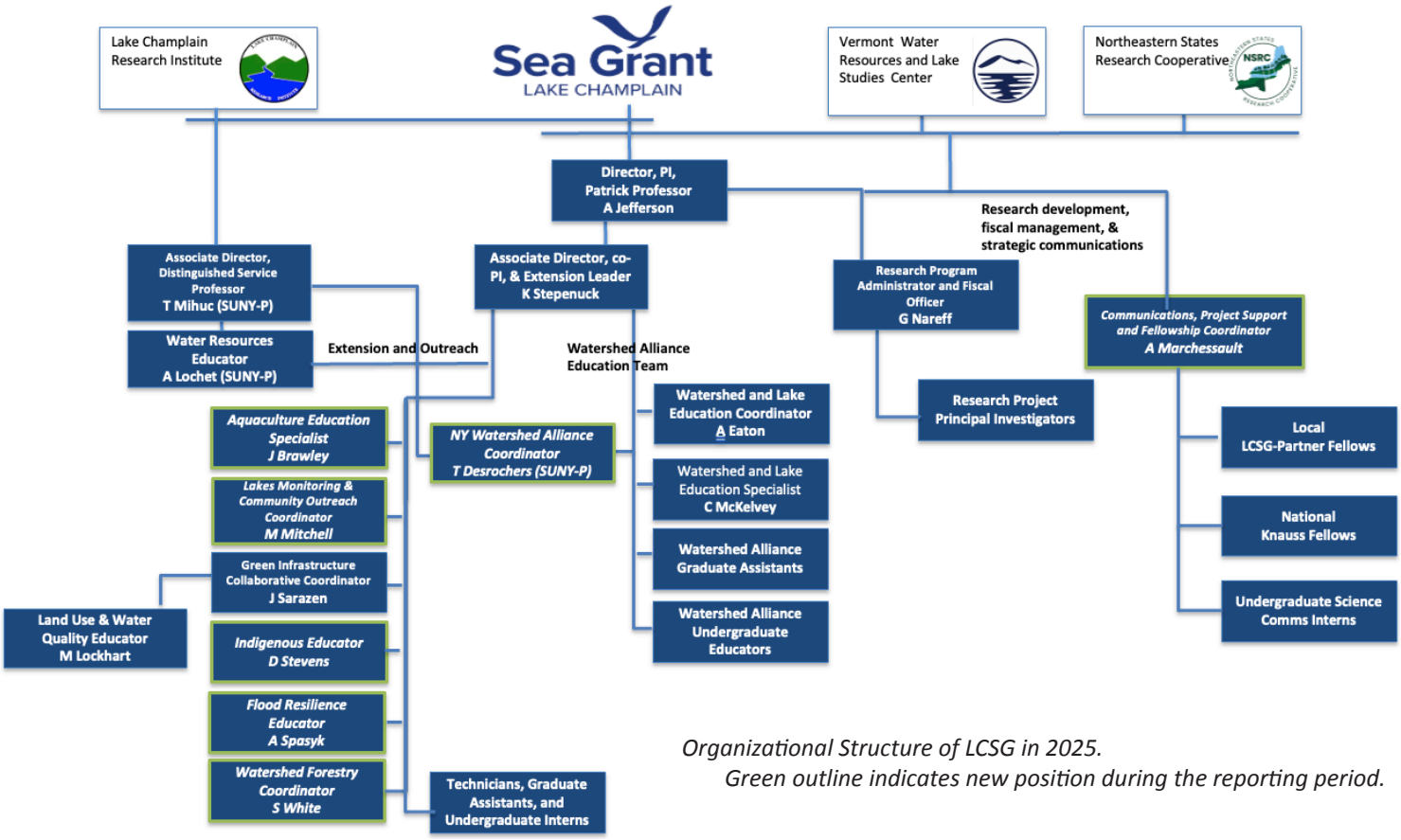
LCSG staff aboard the R/V Marcelle Melosira for a staff retreat and training

In this reporting period, the PAC was integral in the development of both 2018–23 and 2024–28 strategic plans. They also reviewed our draft omnibus proposals for both of these periods and provided editorial and content recommendations that improved our final proposals.

All LCSG PAC members since 2018

* indicates current member

Name	Organization
*Dan Albrecht	Chittenden County Regional Planning Commission
Jill Arace	Vermont Association of Conservation Districts
*Dr. Roy Beckford	UVM Extension Director
Dr. Brenda Bergman	The Nature Conservancy
*Tom Berry	Ex Officio (Sen Leahy), Great Lakes Fisheries Commission
*Emily Bird	Water Quality Division, VT ANR
Dr. Joshua Brown	NSGO Program Officer
*George Burill	Retired
Jonathan Carman	Ex Officio (Rep Stefanik)
Brooke Carney	NSGO Program Officer
Becca Certner	NSGO Program Officer
*Annie Costandi	Essex VT
*Owen Doherty	Rep Balint
Kari Dolan	Vermont Legislature
*Rebecca Ellis	Sen Welch
Lori Fisher	Lake Champlain Committee
Steven Frederick	Clinton Community College
Dr. Phelan Fretz	ECHO Lake Aquarium and Science Center
Heather Furman	The Nature Conservancy
*Dr. Curt Gervich	SUNY-Plattsburgh
*Ethan Hinch	Ex Officio (Sen Sanders)
*Dr. Eric Howe	Lake Champlain Basin Program
Jim Jutras	Village of Essex Water Quality Superintendent
Dr. Daniel Kelting	Paul Smiths College Adirondack Watershed Institute
*Nidhi Konnanur	UVM undergraduate
Dr. John Kowal	Clinton Community College
*Ted Lawson	ECHO, Leahy Center for Lake Champlain
*Kara Lenorovitz	Colchester (VT) High School
Dr. Dan Lerner	UVM Extension
Dr. Jon Lilley	NSGO Program Officer
*Crea Lintilhac	Lintilhac Foundation
*Melody Mackin	Atowi Project
*Mark Malchoff	Retired LCSG
Ishan Maratha	UVM undergraduate
*Courtney Meisenheimer	City of Plattsburgh
*Hallee Metzer	NSGO Program Officer
*Lyn Munno	Watershed United Vermont
*Chris Navitsky, PE	Lake George Association
*Jessica Nordhaus	Ex Officio (Rep Balint)
*Sonal Patel-Dame	Plattsburgh (NY) High School
Hayley Pero	Ex Officio (Sen Sanders)
Thomas Renner	Ex Officio (Rep Balint)
*Alyssa Senecal	North Country Chamber of Commerce
*Zoë Smith	Paul Smiths College Adirondack Watershed Institute
Chief Don Stevens	Nulhegan Abenaki Nation
*Dr. Kelley Tucker	Ausable Freshwater Center
*Ahren Von Schnell	Ex Officio (Rep Stefanik)
*Erin Vennie-Vollrath	NYS Department of Environmental Conservation
Leigh Walrath	NYS Adirondack Park Agency
Jill Witkowski Heaps, JD	Vermont Law School
Thea Wurzburg	Ex Officio (Rep Welch)
*Jillian Zajac	Clinton County Soil and Water Conservation District

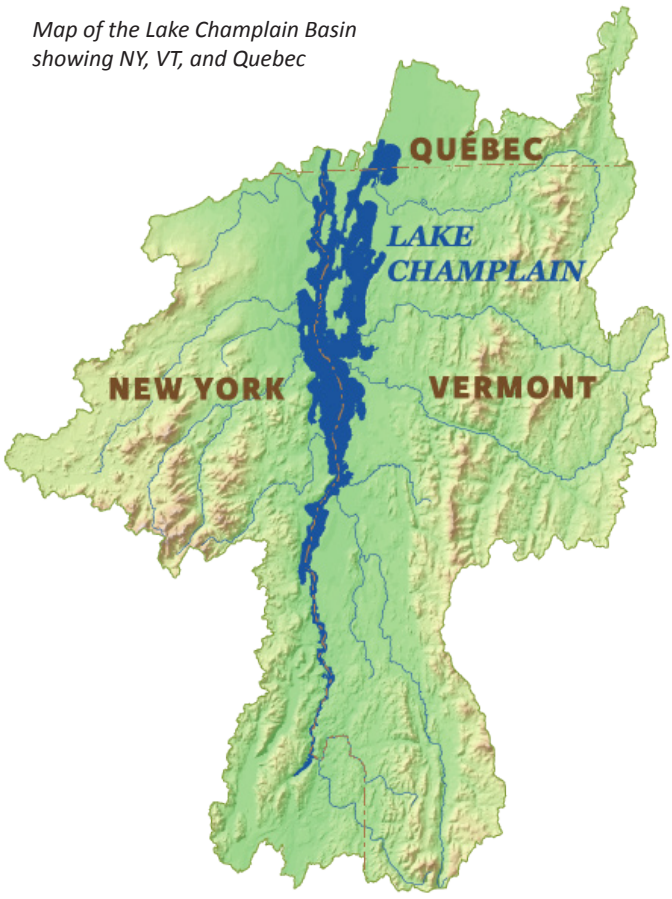


Organizational Structure of LCSG in 2025.
Green outline indicates new position during the reporting period.

REPORTING STRUCTURE

In addition to the leadership team, 13 full-time staff and two part-time staff facilitated outreach programming, reporting, and communications in the reporting period. Administrative oversight of staff was led by the leadership team. Additionally, senior level staff members provided functional supervision to staff within their programming areas. Seven LCSG staff positions were new in the reporting period. We funded these through increased base and merit funding, partnerships, and competitive awards. Our faculty and staff were supported by graduate student assistants and undergraduate student interns each year.

Map of the Lake Champlain Basin showing NY, VT, and Quebec



PROGRAM SETTING

Following enactment of the Great Lakes Critical Programs Act of 1990, which included the Lake Champlain Special Designation Act, New York Sea Grant (NYSG) offered educational programming to Basin residents in New York. Subsequently, the 1998 Sea Grant Reauthorization Act established an LCSG outreach project as a "basin wide coordinated effort." LCSG was designated as a Sea Grant Coherent Area Program in 2012 and was elevated by the National Sea Grant Advisory Board to institutional status in May 2018. Today, LCSG continues to follow a multijurisdictional model.

UVM and SUNY-P are our primary hosts, and we maintain key partnerships to effectively address needs and challenges across a lake catchment that includes two states and the Province of Quebec in Canada.

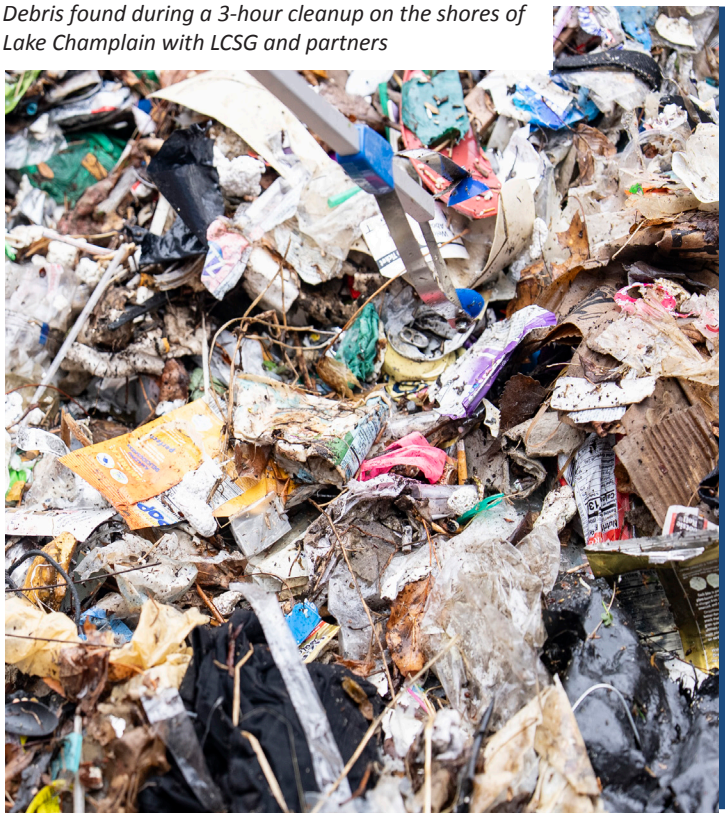
Our faculty and staff are situated in multiple offices across the Basin. UVM staff are housed in three offices in the Burlington, Vermont area, and two staff co-funded by the Vermont Department of Environmental Conservation (VTDEC) have access to shared workspace in Montpelier, Vermont. In New York, faculty and staff have offices at the Lake Champlain Research Institute (LCRI) at SUNY-P in Plattsburgh. Early career fellows were based with our partners at various locations throughout the Basin.

REQUEST FOR PROPOSALS (RFP) PROCESS AND PRIORITIES

We expanded and strengthened our research program between 2018 and 2023. We issued three RFPs, with research priorities centered around our focus areas. Within each RFP, we identified priority topics aligned with our six goals, based on input from our PAC, topical advisory groups, and a survey of constituents. We required principal investigators (PIs) to submit a letter of intent (LOI) prior to developing full proposals. In full proposals, we asked PIs to describe broader societal impacts and required them to include outreach plans. These elements were included as review criteria. RFPs were distributed via social media, our monthly newsletter, email lists to researchers at all 13 institutions of higher education in the Basin, and to watershed groups, consulting firms, and others through our advisory program listservs. All proposals were reviewed by external technical experts and a panel comprised of PAC members and other constituents that assessed the proposals for relevance to our strategic plan. Reviews for each proposal were discussed by the panel. Final funding decisions were made by the LCSG Director. We received 15 LOIs (12 proposals) for 2018-2020, 11 LOIs (7 proposals) for 2020-2022, and 14 LOIs (11 proposals) for 2022-2024. Submitted proposals were led by researchers at 13 unique institutions. We funded 14 research projects from 7 institutions. Four PIs were funded on more than 1 project. No continuing projects were funded. In comparison, we received 6 proposals and funded 5 projects from 2 institutions in the previous review period (2014-2017). This is a 400% increase in proposals and a 250% increase in funded institutions. Additionally, we funded 5 early career partnered fellows through a similar RFP process and 3 graduate research assistants investigating outcomes of our watershed education programming, to address a suggestion from the last review.

Recommendation 3

Debris found during a 3-hour cleanup on the shores of Lake Champlain with LCSG and partners



PROGRAMMED TEAM APPROACH: PLASTIC POLLUTION IN LAKE CHAMPLAIN

Microplastics have garnered attention across the world for their potential to leach harmful chemicals into the environment and adhere to heavy metals. Fish and birds often consume the microplastics, which can then carry the toxins up the food chain. LCSG funded research in 2016-2018 identified the scope of the problem in Lake Champlain. In response, LCSG revised its lab-based K-12 student education program to engage students in dissecting fish stomachs to look for the presence of microplastics. Additionally, LCSG was subsequently awarded two competitive grants to engage in research that aims to quantify and identify the sources of microplastics in tributaries to the lake, and that establishes a marine debris community action coalition focused on foam pollution, which is a major component of marine debris along Lake Champlain beaches.

PROGRAMMED TEAM APPROACH

LCSG uses an effective programmed team approach that addresses needs of Basin communities. Our research was directly relevant to the key issues in the Basin and to our strategic plan. Throughout the funding period, we maintained understanding of the wide variety of research needs in the Basin through deep involvement with numerous local, state, regional, and national committees that develop research priorities (see Leadership). Our research informs decision making and improves the ability of state and municipal leaders and staff, watershed professionals, community members, and visitors to act to protect the quality of Lake Champlain waters and other natural and cultural resources. This is evidenced through the inclusion of LCSG-funded research findings in management practices (e.g., ceasing lake trout stocking; floodplain deposition dataset being integrated within a decision-support system; see PIER report) and guidance documents (e.g., green stormwater practices). To help increase accessibility of research results, we maintain a Zotero Library of all Basin-related peer-reviewed papers focused on water resources, economics and the environment. Our education programs sustained businesses (e.g., real estate professionals), enhanced the ability of teachers to engage their students in real world science (e.g., learned through a Watershed Alliance longitudinal evaluation), and increased student knowledge of watershed science. The research we funded was extended by our outreach staff and by partner organizations (e.g., road salt research findings). Our Extension staff incorporate research information into programs (e.g., lab education dissecting fish stomachs to look for microplastics), products, monthly webinar series, and published research. Our communications team shared products and outcomes of our work to a broader audience.

To ensure high-quality grant administration practices and compliant reporting, UVM integrated department research administration as a component of the central sponsored projects administration in 2021. This streamlined pre- and post-award support and afforded better access for PIs and fiscal managers to expense accounting. In 2022, LCSG expanded our capacity for grants administration and reporting by creating a program support position. This position has lead responsibility for reporting, which critically supports our programmed team approach.

PROGRAMMED TEAM APPROACH: STORMWATER MANAGEMENT, FROM THE LAB TO THE CLASSROOM

LCSG-funded research informed updates to the Vermont Stormwater Management Manual and the Vermont Guide to Stormwater Management for Homeowners and Small Businesses. This reporting period, we incorporated those research findings into the Rain Garden Manual for Vermont and the Lake Champlain Basin, which we released in 2021. Further, we developed the Soaking Up Stormwater curriculum for middle and high schools informed by these resources. We also developed a credit-bearing course at UVM, Stormwater Education Methods. We initially offered this in the fall of 2019 and have subsequently taught it three times. We introduced 27 in-service teachers, pre-service teachers, and watershed professionals to principles of nature-based stormwater management. In turn, they used the curriculum with hundreds of students. One school installed a garden designed to catch roof runoff. In 2022, our Green Infrastructure Collaborative Coordinator (Sarazen) used standards and guidance from the BLUE BTV Basis of Design to provide technical assistance related to several small-scale stormwater infrastructure practices designed to manage rooftop runoff at a high school (see PIER report). Our education staff (Eaton) and interns also use the Soaking Up Stormwater curriculum to support our partnership with the VTDEC and GreenPrint Partners to promote nature-based solutions and stormwater education through the Vermont Green Schools Program (see Education Programs).

PROGRAMMED TEAM APPROACH: ROAD SALT MANAGEMENT

During a study led by the Lake George Association (LGA) and funded by LCSG, researchers observed groundwater sources that released chloride into streams and wells. In response to surface and groundwater contamination by road salt in this area, a NY state law established a special task force to address the issue. LCSG Extension Leader (Stepenuck) was appointed to that task force by the NY Governor. Concurrently, we shared results of the Lake George area study and another LCSG-led study of commercial salt applicators (Sparacino et al. 2024. https://doi.org/10.1016/j.jenvman.2023.119957) at Salt Summits that were collaboratively hosted by LCSG, LGA, Adk Action, and other partners. Each of these organizations also hosted complementary education programs and developed educational resources (e.g., Salt Savvy Champlain website) to share impacts of road salting and sustainable practices that can be implemented by snow and ice management professionals. These Summits and education programs resulted in adoption of a variety of sustainable salting practices by municipalities over thousands of lane miles (see PIER report, also see Relationships).

Truck spreading salt during the winter using LCSG best practices

SUPPORT

LCSG met its non-Federal matching obligations through a rich combination of institutional, state, and private collaborations and donations. SUNY-P provided critical non-federal matching support through its Research Foundation. At UVM, a significant portion of non-federal match came from forgiven overhead. LCSG used a 25.7% indirect rate while UVM used a 56% rate. The difference was offered by UVM as non-federal match on NOAA funds. Core non-federal matching funds were also provided by RSENR to support the Director through the Robert and Genevieve Patrick Chair for Watershed Science and Planning. RSENR also provided partial support for the Associate Director and Extension Leader (Stepenuck), a range of business services (e.g., budget summaries and human resources support), and office space. UVM Extension also provided substantial support for the Extension Leader and the UVM Extension Watershed Alliance coordinator (Eaton). UVM Extension also provided key match for the coordinator of the Watershed Forestry Partnership (Adams 2020–2022; White 2023–present). Match for this position was also supported through donations from three private individuals and organizations directed to UVM through American Forests.

We also developed shared staff and fellowship positions that offered significant additional match. Two of our advisory services positions were 50-50 partnerships with VTDEC. These focused on Green Infrastructure for stormwater management (Companion 2018–2021; Sarazen 2021–present), and volunteer lakes monitoring (Mitchell). VTDEC also offered additional match through partial support (10%) for the Watershed Alliance program coordinator (Eaton) to facilitate the educational components of the Green Schools program. Our newly established flood resilience education position (Noyes 2023–2024; Spasyk 2025–present) was supported in part by The Nature Conservancy (TNC) of Vermont.

All research projects that we funded provided 50% non-federal match. Organizations hosting early-career fellowships and LEAP internships provided 100% non-federal match, and several UVM departments provided matching support for our Sea Grant scholars program.

We ensure adequate and stable funding through formal MOUs (e.g., with UVM Extension), contracts (e.g., with VTDEC), and by continually nurturing productive relationships. This is, in part, fulfilled by demonstrating sound management of funds with which we are entrusted. We develop Logic Models that describe intended activities, outputs and short-, mid-, and long-term outcomes, provide deliverables on time, and we follow up to assess progress by evaluating our programs and sharing outcomes with partners. We also strategically plan for future collaborations with existing and new partners.

Engagement

LCSG built and sustains strong partnerships with federal and state agencies, tribes, communities, businesses, schools, and watershed organizations. Between 2018 and 2023, we worked with 370 partners (see PIER report). Some of these relationships developed into long-term collaborations. Below, we highlight a few key partnerships related to our research, advisory services, and education and training efforts.

KEY PARTNERS

SUNY-Plattsburgh

SUNY-Plattsburgh is co-host to Lake Champlain Sea Grant and essential partner in this Sea Grant program. As highlighted throughout this briefing book, SUNY-Plattsburgh plays a variety of pivotal roles in the existence and success of Lake Champlain Sea Grant. SUNY-P staff help ensure that LCSG functions effectively and meets goals of our strategic plan. In recognition of this essential role, SUNY-P is represented on both our Steering Committee and our PAC.

UVM Extension

UVM Extension is another essential partner of Lake Champlain Sea Grant. Our UVM Extension supported faculty and staff function equivalently as faculty and staff within UVM Extension (e.g., through reporting, attending staff meetings, contributing to committees). Accordingly, the College of Agriculture and Life Sciences at UVM (within which UVM Extension sits) is represented on our Steering Committee, and UVM Extension is represented directly on our PAC.

Vermont Department of Environmental Conservation

LCSG works closely with state agencies to define priority research needs and opportunities for advisory services.

One of our strongest relationships has been with the VTDEC. Key executive staff in the VTDEC serve on our PAC, helping to define our research RFPs and to evaluate proposals. Two of our most important collaborations are 50:50 shared positions with VTDEC to manage the Green Infrastructure Collaborative and the Vermont Lakes Lay Monitoring Program. The former includes coordination of the Green Infrastructure Roundtable, a multi-agency effort to coordinate adoption of green infrastructure approaches across all of the state's activities. The latter is a new partnership formed during this reporting period that enables LCSG to play a key role in providing advisory services to engage community members in collecting critical data about lakes to extend a long-term dataset used to inform management decisions by the State of Vermont. We also work closely with VTDEC Rivers Program staff to implement our flood resilience education program and have collaborated to host workforce development trainings with the Clean Water Initiative Program.

Natural Resource and Soil Conservation Districts and Watershed Groups

LEAP interns working on a property along the shore of Lake Champlain

In this reporting period, we expanded the Lake Education and Action Program (LEAP). This highly unique and meaningful partnership with collaborator Poultney Mettowee Natural Resource Conservation District (VT) affords high school and college students science, technology, engineering and math-focused internships. In these internships, youth and young adults learn about and provide education to lakeshore and riparian homeowners about best land use practices to protect water quality and build flood resilience. We developed new collaborations with Essex County (NY) Soil and Water Conservation District, Missisquoi River Basin Association (VT), and Friends of the Winooski River (VT) to expand the LEAP program to new areas within the Basin. These interns provided education to more than 350 property owners and installed nature-based solutions across hundreds of feet of shoreline during the reporting period (see PIER report). LCSG staff met at least annually with leaders of these organizations to plan and carry out this program. We also hosted lake exploration days for LEAP interns to introduce limnology principles to them, to share

ongoing research at UVM, and to build relationships with these youth and young adults. These new collaborations also afforded matching funds on our federal funds. They also addressed a suggestion from our 2019 site review, which was to replicate programs with high impact around the lake (e.g., LEAP), and to develop potentially new relationships and collaborations.

Lake Champlain Basin Program

Partners at LCBP at a collaborative Fishing Education Workshop

The Lake Champlain Basin Program (LCBP) works with New York, Vermont, and Quebec governments, watershed organizations, municipalities, and individuals to coordinate and fund initiatives to understand, protect, and improve water quality, aquatic life, recreational opportunities, and cultural resources. LCBP regularly supports LCSG with leveraged funding. For instance, LCBP funds about 40% of our Watershed Alliance staff position in New York. LCSG staff also collaborate regularly with LCBP staff to carry out numerous outreach and education programs. This includes Watershed for Every Classroom, a year-long professional development course for in-service teachers. This is offered through the Champlain Basin Education Initiative, a consortium of environmental and place-based education groups in the Basin. With LCBP and the Vermont Boat and Marine Association, we host an annual meeting of marina operators. With other partners, and with support of a National Sea Grant Office travel grant, LCBP and LCSG hosted a Lake Champlain Research Conference in 2022. This brought together more than 200 researchers, students, nonprofits, and outreach professionals from across the Basin. In addition, in 2019, LCSG funded watershed groups that engaged in stormwater education on individual properties to come together to determine how to best collaborate across programs. This resulted in development of a stormwater education resources library, and a request to LCBP to support additional funding to allow more in depth planning to unify these education programs. This resulted in LCBP developing a competitive RFP to support this work ($150,000 over three years). LCSG and LCBP have led the effort among watershed groups to develop a design and implementation plan to carry out common property site assessments, and it is anticipated that LCBP will support nearly $550,000 in its next round of funding to allow this unified stormwater program to be implemented across the Basin.

Kindergarten-12 Grade Schools and Libraries

Our partnership with UVM Extension and LCBP enabled LCSG to host our Kindergarten–12th grade watershed science education program, called Watershed Alliance (see PIER report; also see Education Programs). We partnered with at least 40 schools during the reporting period. This included establishing our NY-based Watershed Alliance program and reaching 11 schools within the Basin in NY. Each spring and fall, LCSG staff and undergraduate interns visit classrooms to facilitate field-based learning and stewardship activities in collaboration with teachers. Schools support participation through busing and complementary in-class education based on our Stream Monitoring and Stewardship Handbook, which was completed in this reporting period. In addition, LCSG offers educational programs aboard the UVM research vessel. During the COVID-19 pandemic, LCSG quickly pivoted its educational programming, offering a series of 32 Zoom-a-Scientist webinars that allowed 9,000 students to engage from home in remote learning with scientists from 15 organizations and both MS and PhD student researchers (see PIER report). Additionally, LCSG developed a Watershed Explorer Challenge Booklet and partnered with 34 libraries in Vermont and New York to distribute this booklet and an equipment kit with funding from LCBP (see PIER report). At least 53% of participating libraries had patrons check out the kits after they were distributed.

RELEVANCE

In the development of LCSG and program-level strategic plans, we conduct needs assessments with our PAC and/or topical advisory committees. For each new program developed, we also carry out needs assessments to ensure the work we do addresses needs of the target audience. As a result, LCSG's research and outreach are relevant to local, state, regional and national watershed challenges

and opportunities. In fact, all of the issues that we face in this Basin are international issues. In particular, our work on nutrient enrichment, road salt, flooding, mercury in fish, and crude oil transport relate to national priorities for water resources management (see PIER report).

Non-Point Source Pollution

Lake Champlain's shoreline is 587 miles long and its watershed is 19 times larger than the lake itself. This land-to-water ratio is much larger than in the Great Lakes where such ratios are about 2:1. This amplifies the impacts of land use management on water quality. As a result, Lake Champlain is heavily impacted by nonpoint sources of pollution carried in stormwater including phosphorus, suspended sediments, nitrates, and chloride. These have significant environmental and economic impacts. For instance, property values decreased along portions of the lake due to cyanobacteria blooms and decreased clarity. Multiple actions on the land are needed to improve water quality. Vermont's Clean Water Act and Total Maximum Daily Loads for phosphorus have identified and prioritized projects to reduce phosphorus loading to the lake. Agricultural and forested lands dominate the Basin, but developed lands contribute the second highest load of phosphorus to the lake. Numerous organizations focus their efforts to address agricultural issues, but fewer focus efforts on urban and suburban lands.

★ **LCSG Response:** LCSG, with advice from our PAC, has strategically targeted our outreach efforts towards suburban and urban areas as a result. LCSG funded five research projects related to non-point source pollution reduction, supported two staff positions focused on stormwater management and homeowner/real estate professional water quality education, and ran community based social marketing campaigns about best lawn care practices.

Hazardous Materials Transport

A rail line runs along the entire western edge of the lake, sometimes within a few feet of Lake Champlain. A spill of hazardous materials transported along it could wreak havoc on the aquatic ecosystems and would put thousands of people's drinking water at risk of contamination. Emergency management planning and preparation training for lakeshore communities and businesses is essential to ensure quick action can be taken in the event of a spill.

★ **LCSG Response:** In this reporting period, LCSG hosted an oil spill workshop for 20 marina owners, emergency managers, and fire department personnel (see PIER report), launched a scientific support network for emergency response, and partnered with other Great Lakes Sea Grant programs in Hazardous Material Transport Outreach Network (HazMaTON) actions (see PIER report).

Flooding

The frequency of extreme precipitation events has increased in recent years within the Basin, resulting in both inundation and erosional flooding with immediate and long-lasting impacts to homes and businesses. For instance, in July 2023, many Vermont communities faced catastrophic flooding following an extreme summer event. The costs associated with this flooding event are estimated at $1 billion. Widespread flooding occurred again in the Basin in December 2023 and July 2024. Estimated costs of damages for these flooding events were tens of millions of dollars. While the Federal Emergency Management Agency (FEMA) produces inundation maps, 60–70% of flood-related damage in Vermont is due to fluvial erosion that occurs outside FEMA flood hazard areas. Consequently, development within river corridors, and stream channel alterations have resulted in property and infrastructure damage and loss due to flooding. Without additional guidance and investment, these damages are likely to continue.

Drone imagery of the Vermont state capital, Montpelier, after devastating July floods in 2023

★ **LCSG Response:** In this reporting period, LCSG funded research on visualization tools to communicate riverine erosion hazards and improve flood resilience (see PIER report) and hired a flood resilience educator to provide municipal education. Workshops on flood hazard resilience help municipal leaders and homeowners better understand how to retrofit existing development and plan for new development that will be resilient to the changes in

precipitation and flooding that are likely to occur in the future. Our work with Plattsburgh, NY earned the city a bronze certification from the New York Climate Smart Communities program (see PIER report).

Mercury in fish

Mercury deposition and transport to Lake Champlain is of critical importance due to its toxicity as it is transformed through biological processes and its subsequent bioaccumulation as it moves up the food chain. There is a need to understand both current levels of mercury contamination in all levels of aquatic biota in the lake and to understand awareness of the problem among those who fish and eat the fish they are catching from the lake.

★ **LCSG Response:** In this reporting period, LCSG funded research on winter mercury and methylmercury concentrations in biota, water, and sediment. LCSG also funded research on drivers of contaminant exposure risk among angling communities. Through leveraged funding, LCSG hosts ongoing communications among health department officials in VT, NY and QC, to share results of this research and ongoing efforts of each government to update fish consumption guidelines and to identify outreach needs to best communicate guidelines to anglers.

Road Salt

Within the Vermont portion of the Basin, six streams are listed as impaired for chloride due to intense use of sodium chloride and other chloride-based deicers during winter snow and ice management. Chloride levels in all 14 major tributaries to Lake Champlain have increased in the past decade, and chloride levels also increased within the lake.

★ **LCSG Response:** A research project leveraged by LCSG found that deicing materials leached from storage facilities in Basin communities have potential to impact drinking water wells. In New York, particularly within the Adirondacks, groundwater wells are already contaminated and the natural cycling of Mirror Lake in Lake Placid, NY, is impacted due to salt runoff. We funded and carried out research, developed resources, provided trainings, and served in leadership roles to address this emerging contaminant in the Basin (See Box Programmed Team Approach).

ADVISORY SERVICES

LCSG staff develop, implement, and evaluate programs to provide knowledge and resources that help community leaders, municipal staff, business leaders, state agencies, and property owners make informed decisions about important issues facing Lake Champlain and its basin. In addition to incorporating input from PAC members and other stakeholders through interactive listening sessions and surveys to inform our strategic plans, LCSG staff conduct needs assessments, serve on partner organizations' boards and advisory committees, and host topic-specific listening sessions with key audiences to inform their outreach programming and activities.

Municipalities and State Government

Vermont Lay Monitoring Program

The Vermont Lay Monitoring Program has operated with support of the Vermont Department of Environmental Conservation since 1979. Volunteers at more than 100 locations on Lake Champlain and on inland Vermont lakes monitor water clarity, chlorophyll a levels, phosphorus, and caffeine on a bi-weekly basis during summer months (see PIER report). During the pandemic, the State of Vermont sought partnership of LCSG to co-host the program to ensure its continued ability to generate important data that inform natural resource managers, Lake Watershed Action Reports, State of Vermont impaired waters lists, and lake association plans.

LCSG staff member, Mark Mitchell, sampling a lake with the Lay Monitoring Program

LCSG's Mitchell led analyses showing conflicting trends between Secchi depth and phosphorus concentrations in some lakes, possibly because of internal phosphorus loading from anoxic bottom sediments. Following a pilot study in 2022, the state adopted new sampling protocols in 2023. This change in sampling protocol allows for separate assessment of epilimnetic conditions compared to hypolimnetic and metalimnetic conditions that may differ depending on in-lake processes.

Green Stormwater Infrastructure

LCSG is a leader in green stormwater infrastructure (GSI) research and extension throughout the Basin. Stormwater management is one of the most pressing issues for resource managers in our cold climate, increasing rainfall frequency and intensity, and with challenges of managing nutrient runoff from developed lands. LCSG funded research focused on subsurface gravel wetlands (SGW), to evaluate if SGWs that are being permitted under the Vermont Stormwater Management Manual design standards perform as expected for flow attenuation and phosphorus reduction. This research led to soil media testing guidance and design standards for both SGW and bioretention practices to increase nutrient reduction performance and reduce costs. These recommendations have been taken up by the state of Vermont.

Another element of the robust programmatic leadership by LCSG includes partnership with VTDEC to lead a statewide Green Infrastructure Roundtable and email listserv for sharing relevant information. Professionals from academia, design consulting firms, non-profit organizations, state agencies, and municipalities gather to discuss persistent stormwater management concerns and new green infrastructure methodologies to address them. We typically hosts one event per year in partnership with a local municipality to highlight GSI success in Vermont and encourage collaboration amongst professionals working in this space (See also Programmed Team Approach Box).

Community Hazard Resilience

LCSG helped five communities to build resilience through their adoption or implementation of hazard resiliency practices that helped them prepare for or to minimize coastal hazardous events. LCSG provided technical assistance on the design and implementation of a berm that directs flows of stormwater away from washing out a gravel road and parking areas at a lake beach access area. This built hazard resilience within the City of Burlington, VT. In addition, in follow up to the previous omnibus cycle during which LCSG staff led community workshops to build understanding of river corridor protection bylaws and the science behind the importance of protecting river corridors from development, four communities in the Basin adopted river corridor protection bylaws. This included Brandon, Proctor, and Pawlett, in Rutland County and Johnson in Lamoille County. These were reported in 2022 as it took several years from the workshops (held in 2017) for the communities to work through and to pass bylaws while working cooperatively with regional planning commissions that co-hosted the workshops with LCSG.

Franklin County municipal officials explore how rivers behave and respond to human impact

Communities across the Basin are impacted by flooding due to topography, risky settlement patterns, and increased precipitation. However, many municipalities across the region do not have the staff expertise or technical capacity to take appropriate actions to mitigate natural hazards and prepare for flood events. To better understand the concerns and needs of municipal officials as related to natural hazards in the Basin, LCSG staff distributed a survey to community leaders in 2021. They found that small towns in particular faced limits in budget, personnel, and expertise. This leaves them less resilient to extreme weather. Further, towns lack capacity to know about and respond to available funding opportunities meant to help them increase hazard resilience. In response, LCSG staff held a series of webinars to educate municipalities about flood and hazard resilience, including topics such as navigating flood resiliency funding and avoiding damage from flooding. Prior to 2023, these adaptation and resilience efforts were carried out by three LCSG staff, each with part-time responsibilities focused on hazard resilience. With coastal resilience competitions offered by the NSGO, LCSG was able to hire a full-time staff position dedicated to this work in 2023. This position was in partnership with and partially supported by match from the Nature Conservancy of Vermont. This position is dedicated to developing and delivering educational programming and tools intended to improve the ability of municipal leaders to take proactive steps to protect their communities during flood events.

Professionals

Riparian Forest Restoration Professionals

The Watershed Forestry Partnership facilitates research,

communication, collaboration, and implementation of forest restoration and management practices that protect water resources in the Basin. This initiative was developed during the early part of this reporting period, led by UVM Extension. This is a collaborative of practitioners, researchers, agency representatives, and others, who share best practices, new information, and coordinate efforts around funding opportunities and Basin-wide restoration strategy. Efforts are focused on riparian forest restoration as a key strategy to protect and improve water quality, provide terrestrial and aquatic wildlife habitat, and reduce the impacts of flooding. Since its inception, a resource library, who's who database, website, listserv, and podcast to share cutting edge research in an easy to access format for practitioners have all been developed. We also developed a pilot program to address a shortage in native tree stock (see PIER report). This strategic initiative was established, in part, to fill a gap in coordination of riparian forest restoration practitioners in the Basin as well as to identify critical research needs and to identify and pursue funding to address those needs.

LCSG's Shawn White addressing the audience at the Watershed Forestry Partnership annual meeting

Environmental Professionals

To support workforce development of environmental professionals in the Basin and sometimes across the nation, often with leveraged financial support from partners, LCSG hosted or co-hosted a variety of professional development trainings for watershed professionals:

- Two facilitation trainings with the NOAA Office of Coastal Management (2018);
- Research webinar series (2018–present);
- A series of webinars to share knowledge and resources to ensure safe operations during the pandemic for volunteer water monitoring programs (2020; see PIER report; Stepenuck and Carr. 2022. https://doi.org/10.1111/1752-1688.13043);
- An interactive actor-led training on recognition of implicit bias (2021);
- 11 watershed-science focused videos for Vermont State Parks staff and inn staff (2020-1);
- A three-part online education program called "Water Words That Work" (2022); one year after the training, 35% of participants had simplified messages in educational materials and communications;
- A panel discussion of four Abenaki leaders who shared perspectives about water with Vermont DEC (2022);
- A community-based social marketing workshop to help practitioners understand how to plan behavior change campaigns that identify key target audiences and aim to break down barriers and build up benefits for that audience to encourage buy-in to the proposed behavior change (2022).

Businesses

Marinas

LCSG partnered with the Vermont Boat and Marine Association (VBMA) to provide education for and aid Lake Champlain basin marinas in sustaining their operations. To help ensure that marina staff are well informed about development of safety plans, actions to take in the event of a spill, and how and when it is appropriate to use equipment to prevent further spread of a spill before professional services arrive to remediate it, an LCSG-mentored UVM graduate student who was serving with the US Coast Guard facilitated a hands-on spill response training for marina owners and operators. In 2020, this student developed a Scientific Support Network database to gather people and resources near Lake Champlain with expertise that could aid in swift response to a spill. Since then, LCSG has annually updated and distributed to emergency response leaders. During the pandemic, marinas faced possible restrictions on opening that put their livelihoods at risk due to short boating seasons and constricted time to get boats in the water each spring. LCSG and VBMA co-hosted a series of meetings and crafted language for a safe opening and COVID-19 response plan. The plan was accepted by the Vermont Governor, and marinas were able to open in time to operate during 2020 (see PIER report).

Aquaculture Businesses

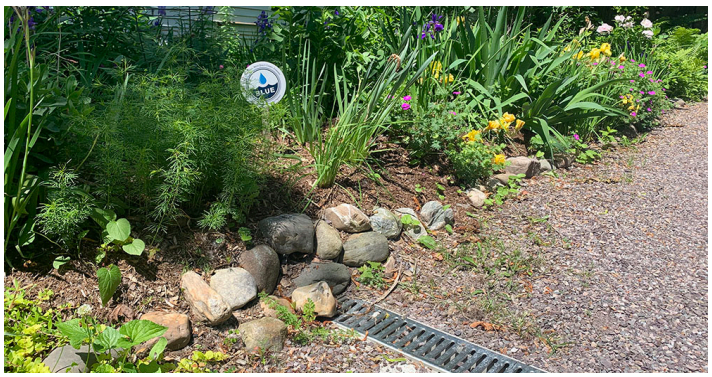
Along with state-run fish hatcheries, Vermont has a small, but growing, industry of private, land-based aquaculture businesses. LCSG hired its first aquaculture educator to provide technical assistance to these local aquaculture farmers. Our educator worked directly with seven producers to help them organize into an association, increase knowledge about aquaculture methods and business opportunities, and advance practices and techniques used

to grow fish locally. Aquaculture producers in the Basin co-produced videos and outreach materials with LCSG. One video was featured by national (Washington Post, Eating Well magazine, and Yankee magazine) and local (Seven Days free weekly periodical) media, increasing profile and sales for the aquaculture business (see PIER report).

Members of the Public

BLUE

In partnership with the City of Burlington, Fitzgerald Environmental Associates, Just Water Consulting, and UVM Department of Agriculture Landscape and Environment, LCSG took leadership of and began offering free property site assessments focused on stormwater management through a program called BLUE. LCSG and partners updated site assessment protocols and educational materials, developed the BLUE BTV Basis of Design, and completed over 100 assessments. Follow up surveys reveals that these in-person site visits helped Burlington residents address stormwater issues, understand the impact of run-off on local waterbodies, and adopt beneficial practices. Nine homeowners installed practices recommended during the assessments (see PIER report).



BLUE BTV property who installed a trench drain after a site visit

Indigenous Outreach

LCSG has nurtured a partnership with the Abenaki community of Vermont. Early in our relationship building with the Nulhegan Abenaki tribe, we collaborated to produce a a short film, Nebi: Abenaki Ways of Knowing Water. (see PIER report) The film, which features chiefs and tribal elders from three of four Vermont-recognized tribes, gives LCSG the opportunity to share indigenous knowledge and values about water from people whose ancestors have been stewards of the environment here for more than 9,000 years. It also supports the Nulhegan tribe to preserve their creation story of Lake Champlain. The film supports our education and advisory services, particularly our public and school trips on Lake Champlain. Debuted on Earth Day 2019, it has been viewed more than 6,400 times. Surveys indicate viewers intend to protect Basin resources through personal actions.

Still from the Nebi film showing Odziozo waking up from his sleep.

Our partnership with the Abenaki evolved when we partnered with Shelburne Farms to host an indigenous educator (see PIER report). We now partner with the nonprofit of the Nulhegan tribe, Abenaki Helping Abenaki, Inc., to host the position. These partnerships have allowed us to share indigenous ways of knowing through such events as Indigenous Peoples' Day, fall harvest, maple sugaring, and winter "snow snake" games. This position also reflects our successful efforts to address a recommendation from the 2019 site review to create opportunities for underrepresented and underserved communities in the Basin, including tribes.

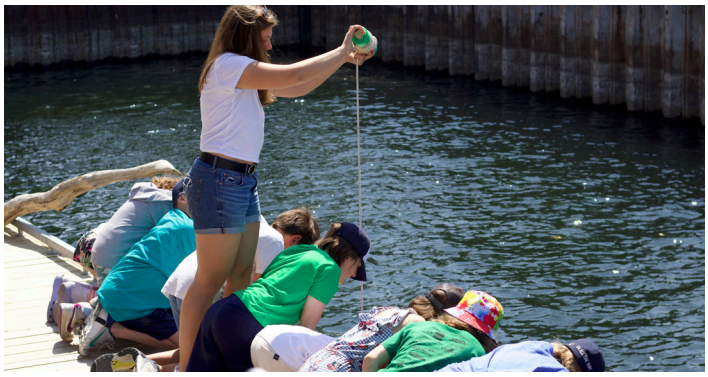
Recommendation 2

ecoNEWS Vermont

The results from academic and government research can be difficult to access and requires time and effort to understand. In 2014 we launched ecoNEWS VT to highlight and translate ecological research relevant to the Basin. An online archive publishes around 10 research articles per year, and quarterly emails are sent to a list of 410 subscribers with the latest featured scientific reports. The target audience is users who want to keep up with relevant research, such as state and municipal employees, conservation commissioners, local watershed organizations, and community members. The initiative is led by the LCSG Communications team. Partners include RSENR, Northeastern States Research Cooperative, Vermont Water Resources and Lake Studies Center, the Vermont Center for Ecostudies, Audubon Vermont, the Water Resources Institute at the University of Vermont, the Forest Ecosystem Monitoring Cooperative, and more.

EDUCATION PROGRAMS

Formal education provided through LCSG is relevant to local, state, regional, and national needs. Our flagship youth and teacher education program is UVM Extension Watershed Alliance. In addition, LCSG offers the only continuing education programming for real estate professionals in the Basin that is focused on water resources, flooding, and natural ecosystems. These have resulted in more than $22 million in economic benefits for these businesses.



LCSG Graduate Assistant demonstrating how to use a plankton tow with students.

UVM Extension Watershed Alliance

UVM Extension Watershed Alliance (WA) provides K-12 students in Vermont and the Lake Champlain basin of New York with hands-on watershed education. WA provides curriculum, equipment, and instructors to schools and youth groups participating in programs. During 2018-2023, Watershed Alliance grew its staffing to add a New York-based educator. Our NY-based educators (Trachte 2019-2023, DesRocher 2023-present) aligned the Stream Monitoring and Stewardship Program activities with New York standards and cultivated relationships with schools (see PIER report). Collectively, WA staff reached 12,462 K-12 students and 1001 K-12 teachers while providing education in streams, on Lake Champlain, and in classrooms across both NY and VT (see PIER report). Lessons are led by program staff, graduate student teaching assistants and undergraduate interns who are hired to support the program through our Watershed Educator Program. We hired the graduate student assistants to support WA staff to provide youth education. Hiring these students as teaching assistants addressed a suggestion from our 2019 site review to allow education staff planning and reflection time. These graduate students not only supported staff to operate the WA program, but they gained hands on experience facilitating youth watershed educational programming.

Suggestion 6

WATERSHED ALLIANCE: PANDEMIC RESPONSE

Our educational efforts usually take place in the classroom, in streams, and on Lake Champlain. With the pandemic, meeting in person became impossible. The LCSG education team demonstrated its nimbleness and ability to identify opportunity among needs by developing a series of free virtual learning programs. These included offering a series of webinar-based education programs through which scientists shared their knowledge (see Zoom a Scientist in PIER report), developing and distributing a Watershed Explorer Challenge booklet in partnership with libraries (see Schools and Libraries in Key Partners), and offering several virtual learning options including a fish dissection that allowed students to observe the sampling techniques fisheries scientists use in their research.

In the initial months of the pandemic, it was particularly challenging for organizations to provide safe options for in-person education. In response, LCSG sponsored summer youth education at the Lake Champlain Maritime Museum and the Community Sailing Center. We sponsored 600 youth to participate in place-based water education programs. Following participation, 89% of these youth reported increased knowledge about the lake's environment or other topical focus of their education program. This included knot tying, SCUBA, and remotely operated underwater vehicles.

Recommendation 3

Concurrently, these students carried out research related to LCSG watershed education programs, which addressed a recommendation from our 2019 site review to publish about our education programs. One research project is complete and a paper in review. Another thesis is being finalized now.

In this reporting period, following participation in WA programs, teachers facilitated students to carry out at least 49 outreach and stewardship projects to address local water quality issues and improve the health of the Basin. A longitudinal program evaluation in 2019 revealed that the most common types of stewardship projects classes carried out were river clean ups, tree planting or other type of shoreline seeding, and invasive species removal projects.

In addition to these programs, WA staff supported summer youth education through a summer science camp for girls in partnership with the Community Sailing Center, a snorkeling education program leveraged through a grant received by the Lake Champlain Maritime Museum, and through a partnership with the Vermont Migrant Education program.

Teacher Professional Development

Our staff also partner to develop and offer formal credit-bearing education for pre- and in-service teachers to support this program, including Stormwater Education Methods (See Programmed Team Approach), the Champlain Research Experience for Secondary Teachers (CREST; see PIER report), and Watersheds for Every Classroom through the Champlain Basin Education Initiative (see Key Partner LCBP). A Watershed for Every Classroom is a year-long graduate level teacher training program that provides curriculum for teachers to incorporate into their classroom. Watershed for Every Classroom is a cooperative effort with LCBP (see Key Partners) and Shelburne Farms.

CREST

Teachers about to board the R/V Marcelle Melosira

Teachers in Vermont must take continuing education credits. They also see opportunities to enhance place-based educational opportunities with their classes. LCSG implemented the CREST Program, which engages grade 7-12 teachers in an exploration of Basin research through investigations alongside scientists, graduate and undergraduate students, teachers, and teacher educators.

In the summer of 2023, 16 teachers took the course for credit. Thus, 16 jobs were retained at a salary of $62,320 each and a benefits rate of 34.1%, totaling $1,337,137.92 in value of jobs retained (see PIER report).

TRY 4H2O

Teens Reaching Youth (TRY) is a 4-H teen mentorship program with four environmental themes. One of the environmental themes is a water-focused program called 4-H20. Between 2018 and 2023, LCSG educated 70 middle and high school students to use the curriculum. In turn, these teen educators then taught younger students about watersheds using the curriculum. The teens educated 367, 3rd and 4th grade students in Vermont. These teen teachers gained leadership and public speaking skills while the younger students increased their knowledge about connections between land use and clean water (see PIER report).

Two undgergraduate Watershed Educators in the lab

MEET OUR WATERSHED EDUCATORS

Internships can reduce barriers into the fields of watershed science as well as increase the toolboxes these individuals have upon entering the workforce. To aid in professional growth before graduation, LCSG created the Watershed Educator internship program. This program trains and engages undergraduates to educate youth about watershed science. Over the 6 years, we supported 74 interns at the University of Vermont and SUNY Plattsburgh. These interns are provided a full day professional development trainings plus weekly education team meetings each spring and fall. After graduation, 64% of alumni secured full or part-time positions in fields related to watershed science (see PIER report).

Four graduate student teaching assistants assisted with Watershed Alliance program implementation and gained valuable environmental education knowledge and experience.

Green Schools Initiative

LCSG partners with the VTDEC and GreenPrint Partners on the Green Schools Initiative. This program aims to reduce stormwater runoff and pollution entering Lake Champlain from public school grounds. Funding and technical assistance are made available to help public schools and state colleges meet Vermont's Three-Acre General Permit stormwater regulation. LCSG provides stormwater education and outreach to school communities. This includes providing training for students, teachers, and watershed organizations. In addition, LCSG helped schools identify ways to maximize benefits of green stormwater infrastructure (GSI) projects. LCSG led an informational webinar for 33 professionals and school administrators to raise awareness of permit requirements, educational opportunities, water quality impacts, and GSI. LCSG also partnered with St. Albans Town School to coordinate stormwater education for grades 5-12, reaching 133 students. LCSG also led education for two other schools that installed GSI practices.

Real Estate Agent Continuing Education

Real estate agents are an important professional audience that is sensitive to environmental issues affecting their business interests and with the potential to influence homeowner actions (see PIER report). LCSG developed a series of continuing education courses for real estate agents focused on the function and values of floodplains and shorelines, how to use online mapping tools, septic design and maintenance, shoreland regulations, and other topics. Between 2018 and 2023, these programs provided 542 participants with state-certified professional education credits and resources that informed their work in guiding property owners towards responsible stewardship choices. A new course for NY real estate professionals was developed and certified in 2022. The economic value of these course is significant.

In one year alone, based on the number of real estate professionals who participated in credit-bearing course, we estimated the economic value to be about $22 million per year.

Our Land and Water Quality Educator also shared this program model and outcomes with other Extension educators through a peer-reviewed journal article (Patterson, Halik, and Stepenuck. 2024. https://doi.org/10.34068/joe.62.04.24).

Collaborative Networks

COLLABORATION

LCSG provides leadership in watershed science and outreach, working closely with local, state, regional and federal agencies, business and industry, and other educational institutions (see Relationships). We also work collaboratively with other Sea Grant programs.

During this reporting period, we collaborated on six of the 10 national visioning exercises, playing a leadership role for two of the visions. This included the community response to flooding (co-led); reaching broad audiences, climate and weather resilience, water resources, environmental literacy, and citizen (participatory) science (co-led) visions. LCSG team members have continued to contribute meaningfully to efforts that have developed from these visions. This includes active participation in the broadening participation working group. In follow up to the community response to flooding vision, LCSG nurtured partnerships with Illinois-Indiana, New York, Michigan, and Pennsylvania Sea Grant programs, and the Great Lakes – GLERL liaison, and co-led a sharing session focused on community resilience efforts of Sea Grant programs at the 2023 Great Lakes Networking meeting.

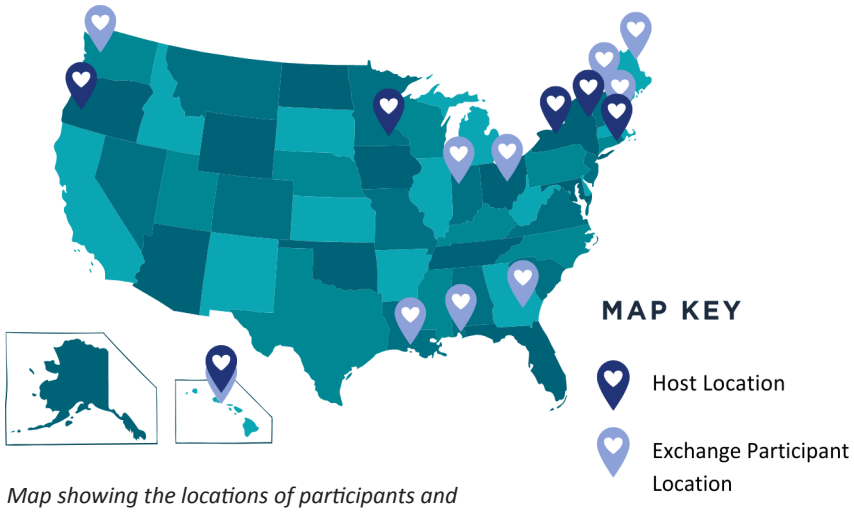
Participatory Science Liaison, Liz McQuain

LCSG co-led development of a successful competitive proposal to support a national level community (now participatory) science liaison in partnership with Louisiana Sea Grant, NOAA Office of Fisheries, NOAA Office of Education, the US Environmental Protection Agency (EPA) Office of Water, EPA Office of Research and Development, and the US Geological Survey. LCSG played an integral role in this project, which developed a website and online tools, and conducted research and developed fact sheets, workshops and webinars that increased the ability of practitioners to reach broad audiences. LCSG also participates in the Sea Grant Participatory Science working group established during visioning.

LCSG was awarded three NSGO competitive travel awards. LCSG staff led collaborations among Sea Grant Educators' Network to develop a successful NSGO travel award application. This award enabled Sea Grant educators to travel to other Sea Grant programs for immersive experiences with one another's education programs, bringing lessons learned and valuable teaching techniques back to their own programs (see PIER report). In addition, in 2020, NSGO funds helped to support travel to a state and Basin-wide green infrastructure operations and maintenance summit that more than 100 practitioners attended. In 2022, the NSGO travel grant supported participation of underserved audiences at a Basin-wide research conference co-hosted by LCSG and partners.

LCSG actively participates in the Great Lakes Aquaculture Collaborative (GLAC). With COVID-19 response funding, we established our first aquaculture education specialist position as part of our resilient communities and economies efforts. Our first educator initiated collaborations with Great Lakes aquaculture specialists and engaged in GLAC efforts. Both he and his successor pursued competitive funding for continued support to collaborate with Great Lakes partners. This allows these specialists to share knowledge and address common challenges facing land-based aquaculture across the region.

To promote better coordination among Sea Grant programs, and as harmful algal blooms (HABs) have become more prevalent, LCSG led an effort of the Great Lakes Sea Grant Network to share information about HABs outreach and research across programs. An initial meeting of this network was held at the 2019 Great Lakes Networking meeting and LCSG hosts a regional listserv for HABs resource sharing.



Map showing the locations of participants and hosts for the Sea Grant Education Exchange

With other Great Lakes Sea Grant programs, LCSG supports a MN Sea Grant staff position focused on transport of hazardous materials. This position leads the Hazardous Material Transport Outreach Network effort. LCSG helps to facilitate webinars and trainings to build understanding and resilience as related to materials transport along Lake Champlain and the Great Lakes.

LCSG also hosted the National Sea Grant Academy in fall 2019. LCSG staff served on the advisory committee for the following Academy.

RELATIONSHIPS

LCSG's close ties with many partners allow us to reach broad audiences while addressing relevant issues and assisting others to develop research and management competence. See the Engagement / Key Partners section for descriptions of some of our most significant partnerships. Other partnerships are mentioned throughout the briefing book. Below are some of the many other examples of our active partnerships and associated activities that demonstrate these collaborations.

LCSG's Ashley Eaton leading a lesson on the Northern Star ship in Lake Memphromegog through partnership with the Lake Memphromegog Association

Examples of LCSG partnerships

PARTNERS	ACTIVITIES AND PARTNERSHIPS
NOAA Cooperative Institute for Research to Operations in Hydrology (CIROH)	LCSG Director Bowden coordinated UVM's suite of proposed projects for the first year of CIROH and served as institutional lead. LCSG Director Jefferson partners with CIROH on flood communications focused research projects.
NOAA National Weather Service; Great Lakes Environmental Research Laboratory	In 2016-17, LCSG supported establishment of a research buoy in Lake Champlain. Data collected from that buoy were used during the current assessment period by NOAA National Weather Service to inform its lake condition forecasts. These forecasts, issued twice daily, are commonly used by boaters on Lake Champlain. The buoy data were also used by NOAA Great Lakes Ecological Research Laboratory (GLERL) scientists to inform an International Joint Commission Lake Champlain-Richelieu River Flood Study. Additionally, the buoy data are used directly by Lake Champlain boaters (see PIER report).
Environmental Protection Agency	LCSG supported pass-through funded research on application of drinking water treatment residuals in green stormwater infrastructure for enhanced phosphorus removal (see PIER report). Separately, we partner with EPA (as well as NOAA and USGS) to support water-focused participatory science nationwide.
Natural Resource Conservation Service (USDA NRCS)	The NRCS was a sponsor of the fledgling Watershed Forestry Partnership in 2020, offering salary support for the coordinator and leveraged funding.
New York State Education Department	NYSED works with LCSG through sponsorship of our professional development programming. They offer CLTEs (continuing education credits) for our educator programs, which are required for NYS teachers.
New York State and Vermont Departments of Health, municipalities, and nonprofits	LCSG partnered with both New York State and Vermont Departments of Health along with municipal beach managers, LCBP, LCC, and the Health Disparities Cultural Competency Council to develop plain language and icon rich warning signs to alert beachgoers about possible or actual presence of cyanobacteria blooms. The Vermont Department of Health also hosted a Sea Grant Scholar as a summer intern, providing career experience in public health that influenced the undergraduate's career pathway.
Fitzgerald Environmental Associates (FEA), Just Water Consulting, and City of Burlington	The BLUE Stormwater Program is a Public-Private Partnership that helps the City of Burlington achieve education and outreach objectives for their Municipal Separate Storm Sewer (MS4) Permit. FEA receives funding from the City of Burlington, some of which is subawarded to UVM and Just Water Consulting. Just Water Consulting and UVM provided technical knowledge to develop the Basis of Design. FEA provides stormwater practice design assistance and rebates for installation of stormwater practices. LCSG leads property site assessments and education of landowners.
Marinas	LCSG works with the Vermont Boat and Marine Association and LCBP to host an annual meeting of marinas and provide educational materials for clean boating. LCSG partnered with the San Francisco Bay Estuary Partnership to populate the Pumpout Nav App with Lake Champlain sewage facilities. We also introduced this resource to Florida Sea Grant (see PIER report). Florida now lists 515 boating facilities and sewage disposal units in the app.
Commercial road salt applicators	LCSG provided trainings and developed resources directed towards commercial road salt applicators (see PIER report). This included certifying 14 applicators as Smart-Salt Professionals, and developing educational videos and tools to inform use of sustainable practices.
Lake Champlain Committee (LCC)	Collaborated on "public awareness and action survey results and recommendations" report, Raise the Blade applied research and outreach (see PIER report), stormwater education curriculum, Lake Champlain Richelieu River flood study public advisory group (see PIER report), cyanobacteria bloom beach warning signs, and other projects
Lake Memphremagog Association	LCSG staff assisted Lake Memphremagog Association in establishing a Watershed Alliance-style program on Lake Memphremagog (located in the northeastern corner of Vermont, adjacent to the Lake Champlain Basin). We offered advice and provided hands-on training to help this lake's watershed education program get underway.
Adirondack Watershed Institute at Paul Smith's College	Partnered fellow (2022-2023) developed communications products such as the Mirror Lake Watershed Walk on Pocket Sights and the Aquatic Invaders game. AWI's Director serves on our PAC.

Performance

LEADERSHIP

LCSG is recognized as a leader in watershed science, education and advisory services in the state, region, and beyond. This level of respect was earned over time in response to the consistently relevant and high-quality research, education, and advisory services. The importance of LCSG's shipboard Watershed Alliance programming was recognized in the design of UVM's new Research Vessel (2019-2023), with a large interior lab and accessible teaching space, with vessel funding sources including the Great Lakes Fisheries Commission. LCSG funded research (2019-2021) on a woodchip bioreactor to remove nitrate from a town's wastewater won the Sea Grant Association's research to application award in 2022. LCSG funded research (2020-2023) underpinned the decision to end lake trout stocking in Lake Champlain (see Goal 6).

The leadership capabilities of LCSG are clearly expressed in the experience and capabilities of our faculty and staff who are actively involved a diverse array of committees and working groups that relate directly to the strategic interests of our program. State agencies, local community leaders, and regional NGOs regularly seek the involvement of our team on initiatives of mutual interest. At the state level, LCSG faculty and staff serve as the leader of Vermont Green Infrastructure Roundtable (Sarazen 2021-present; former LCSG staff 2015-2021), board member of Vermont State-Wide Environmental Education programs group (Eaton, 2019-2023), and board member for Watersheds United Vermont (Stepenuck, 2016-2022). At the regional level, LCSG staff serve on the LCBP Steering Committee (Bowden, 2018-2022; Jefferson, 2023-present), Lake Champlain Federal Partners Workgroup (Bowden, chair 2018-2022; Jefferson, vice-chair 2023-present), LCBP Technical Advisory Committee (Bowden, 2018-2022), LCBP Education and Outreach Committee (Stepenuck, 2015-present); and Adirondack Salt Reduction Task Force (Stepenuck, NY Governor appointed, 2021-2023). LCSG staff also lead nationally and internationally, with Stepenuck appointed US lead for the International Joint Commission's Lake Champlain-Richelieu River Flood Study Public Advisory Group and Malchoff as a member (2018-2022), and Jefferson serving on the Board of Directors for the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (chair-elect, chair, past-chair 2023-2025).

Within the National Sea Grant Network, Stepenuck was secretary and treasurer for the National Extension Assembly (2020-2022) and served as the Extension Assembly representative on the National Report to Congress committee (2023-2024). Eaton was secretary of the National Sea Grant Educators' Network (2021-2023) and incoming chair in 2023. LCSG faculty and staff also participate as members and rotating leaders of the Great Lakes, Northeast, and national directors, extension leaders, communicators, educators, fiscal officers, aquaculture, and research coordinators networks. Participation in these groups allows each person to focus in their specialty areas and affords LCSG strong interactions among professionals within the National Sea Grant Network and beyond.

PRODUCTIVITY

LCSG's productivity in 2018-2023 was exceptional, even in the face of a global pandemic and staff changes. LCSG documented over $46 million in economic benefits from our programming, 14 new tools or products, and 16 peer reviewed publications. In addition, LCSG leveraged $21,643,642 in support over the review period, almost 70% of which we managed. LCSG funded 19 research projects with $4,187,903, interacted with almost 40,000 professionals and members of the public, reached 12,462 K-12 students, and partnered with 370 organizations. We supported 181 graduate and undergraduate students through research and internships. All of our Knauss Fellows, partnered fellows, and the majority of our undergraduate educators were hired into relevant positions or attended graduate school following completion of their employment with LCSG (see PIER Report).

Partnered fellow, Cassie Wolfanger, who secured a full time position at Audubon Vermont after the fellowship.

Summary of Progress Towards National Performance Measures and Metrics

NUMBER	METRIC OR MEASURE
2,099	Acres of coastal habitat protected, enhanced, or restored as a result of Sea Grant activities
132	Resource managers who use ecosystem-based approaches in the management of land, water, and living resources as a result of Sea Grant activities
34	Communities that adopt/implement sustainable economic and environmental development practices and policies as a result of Sea Grant activities
5*	Communities that adopt/implement hazard resiliency practices to prepare for and respond to /minimize coastal hazardous events as a result of Sea Grant activities
29,259	People engaged in Sea Grant supported informal education programs
48	Sea Grant-supported graduates who become employed in a job related to their degree within two years of graduation
102	Sea Grant products that are used to advance environmental literacy and workforce development

*see Advisory / Community Hazard Resilience in briefing book

SIGNIFICANT CONTRIBUTIONS BY FOCUS AREA

Below, we share 1-2 examples of activities significantly contributing to progress in achieving each of our strategic plan goals. Other examples are found throughout this book.

RESILIENT COMMUNITIES AND ECONOMIES

Goal 1: Aquatic resources are sustained and protected to meet emerging needs of the communities, economies and ecosystems of the Lake Champlain basin.

LCSG partners with LCBP, the Vermont Fish and Wildlife Department, and the Health Disparities Cultural Competency Council (HDCCC; a group of cultural community leaders) to provide advisory services that meet emerging needs of communities, economies and ecosystems and help to sustain aquatic resources. When the pandemic began, food insecurity increased significantly in the Basin, and State of Vermont game wardens observed an increase in fishing violations by some cultural community groups. LCSG and these partners addressed this challenge by: 1) developing signs for public fishing access areas in Vermont that help anglers understand key fishing regulations. These are available in Arabic, Burmese, English, French, Kirundi, Nepali, Somali, Spanish, Swahili, and Vietnamese; 2) developing short educational videos in these languages to help people understand how to purchase a fishing license, how to use the Vermont fishing regulation guide, and how to identify fish; and 3) offering fishing education clinics for cultural communities, those without adequate housing, and others with limited resources. During these clinics, participants learn fishing regulations (in part by watching the videos), meet game wardens, learn and practice fishing skills, and receive fishing licenses, life jackets, and fishing poles. More than 350 individuals have been reached through 10 workshops. Efforts to reach these communities are meaningful to those communities who are often overlooked (see PIER report). This partnership has resulted in continued and expanded collaborations with the HDCCC (e.g., to develop cyanobacteria bloom warning and swimming area closed signs for beaches and LCSG-funded social science research to understand subsistence anglers' knowledge of safe fish consumption guidelines). This work addresses a recommendation from our 2019 site review to

Participants' children fishing at one of our fishing education workshops

"continue to create opportunities for underrepresented and underserved communities in the Basin region to identify and share their needs with respect to research, education, and outreach."

Through our Watershed Forestry Partnership program, two graduate students (one directly funded and one with leveraged funding through LCBP) completed research to address identified needs of the riparian forest restoration community. One student studied different management practices to assess which enabled best survival of native tree stems within the first two years post-planting in reed canary grass dominated riparian areas. The other focused on understanding motivations and barriers landowners faced when considering whether to establish riparian forests on their land.

Goal 2: Coastal communities and economies are resilient to changing environmental conditions.

LCSG played a leadership role in collecting and summarizing public input, and in sharing results of the International Joint Commission (IJC) Lake Champlain Richelieu River Flood Study between 2018 and 2022. This study focused on inundation flooding in Lake Champlain and the Richelieu River caused by record spring snowmelt and rains that kept conditions at flood levels for more than two months in 2011. Leveraging LCSG funding, our Extension Leader (Stepenuck) was appointed by the IJC as the US lead on the Public Advisory Group (PAG) for the study. In addition, an LCSG staff member (Malchoff) was appointed as a member of that group. The PAG developed a variety of outreach products including nine videos (available in both French and English) and several fact sheets. These were used to support public meetings the PAG held throughout the Basin over the course of the study. The feedback obtained through this series of listening sessions enabled the PAG to contribute meaningfully to study recommendations in the final report.

ENVIRONMENTAL LITERACY & WORKFORCE DEVELOPMENT

Goal 3: An environmentally literate, engaged and diverse public is informed by lifelong formal and informal opportunities and implements innovative solutions to improve community well-being in the face of a changing Lake Champlain basin.

LSCG partners with LCBP and other organizations to promote the use of recommended lawn care practices through the "Raise the Blade" project. The recommended practices promote stormwater infiltration on-site, addressing a key water resources challenge in the Basin. With funding and editorial support from LCBP, LCSG led the development of short educational videos that were shared through social media, reaching 183,000 people to date. Annual surveys run by LCSG revealed that, on average, 41% of individuals (n = 335) reported adopting recommended practices after learning about them through the campaign. As part of the partnership, LCSG also led outreach to businesses and communities to promote adoption of practices. During the reporting period, nine municipalities and 12 businesses pledged to use recommended practices (see PIER report).

LCSG's Linda Patterson engaging with members of the public for the Raise the Blade campaign

Goal 4: A diverse and skilled workforce is engaged and enabled to address critical local, regional and national needs.

Fellowships and Internships

LCSG partnered with organizations in the Basin to support two-year fellowships. These unique early career training experiences for recent graduates focused on priority issue areas relevant to the LCSG strategic plan and aligned with interests and goals of partner organizations. For example, LCSG and Audubon Vermont partnered to fund a fellow to meaningfully advance each organization's missions through on-the-ground conservation and evaluation of techniques and to provide a training opportunity for a young scientist. At the end of the two-year fellowship, Audubon Vermont offered a continued contract, fully supported by that organization. We have also partnered with the Vermont Youth Conservation Corps, Ausable Freshwater Center (NY), Paul Smith College Adirondack Watershed Institute (NY), and the Vermont municipalities of South Burlington, Burlington, Shelburne, Colchester, Essex, and Essex Junction to host other early career fellows. A variety of outcomes have resulted for fellow's subsequent careers, and the environment and economies of the Basin (see PIER report).

In addition to our partnered fellows, we supported over 130

internships, working on environmental literacy, shoreline and riparian protection (LEAP), green infrastructure, and more.

We also supported four Knauss fellows who worked in the Legislative and Executive offices in Washington DC on ocean and marine policy (2020, 2022, 2023). Many of these interns and all of the Knauss fellows have been hired into related positions following their terms (see PIER report).

Sea Grant Scholars

During this reporting period, LCSG established a combined scholarship, internship, and professional development program for undergraduates (see PIER report). This Sea Grant Scholars program is intended to help sustain students' engagement in science, technology, engineering, math, and science communications degrees and careers. Seventeen students were supported through the program, with non-federal match support from campus departments. Follow up surveys suggested that Scholars gained insights into careers in environmental and other science-based fields and built relationships with professionals through this program. Some Scholars reported having increased knowledge about career options and skills to pursue intended pathways. These Scholars have gone on to careers with federal agencies and Legislators, earned Fulbright scholarships, and entered graduate school in STEM fields. This program addresses our 2019 site review recommendation to create opportunities for underrepresented and underserved communities.

Sea Grant Scholars on Lake Champlain with the Community Sailing Center

Recommendation 2

HEALTHY COASTAL ECOSYSTEMS

Goal 5: Habitat, ecosystems, and the services they provide are protected, enhanced, and/or restored.

The wastewater treatment plant in Bolton, NY lacked a unit process for denitrification and was a non-point source input of nitrate-nitrogen with potential to influence the presence of harmful algal blooms in Lake George, and cause negative human health effects. LCSG funded a woodchip bioreactor demonstration project to address this problem and monitoring to evaluate its effectiveness. Results suggest that the woodchip bioreactor is likely to provide long-term water quality benefits of nutrient reduction. This is significant for rural municipalities throughout the country which are burdened with older infrastructure and require a cost-effective process to improve wastewater treatment (see PIER report). This research project won the national research to application award through the Sea Grant Association.

The Lake Education and Action Program (LEAP) is a partnership between LCSG and 5 conservation districts/ watershed groups. Interns provide outreach to landowners and engage in stewardship activities such as planting trees and shrubs to restore or expand streambank or lakeshore vegetated buffers, installing infiltration steps that help protect shorelines and water quality, removing invasive species, or maintaining rain gardens. From 2018-2023, LEAP interns restored or enhanced 1.83 acres across >50 properties. While the amount of land is small, many interns and landowners also improve their environmental literacy.

Goal 6: Land, water, and living resources are managed by applying sound science, tools, and services to sustain ecosystems.

Researchers through an LCSG-funded research project tagged 31 lake trout with acoustic transmitters to track the spatial positioning of each fish within the lake to determine habitat use and behaviors (see PIER report). Fish caught give insight into the number of naturally produced (wild) lake trout in Lake Champlain. Twelve naturally produced (wild) adult lake trout were captured, confirming the survival of wild lake trout to maturity. This information was used by fisheries agencies to assist management decisions, especially stocking. The last stocking of lake trout in Lake Champlain was carried out in 2023, as the population was demonstrated to be self-sufficient through this research project and others by these researchers.

Lake trout caught on a trawling trip aboard the R/V Marcelle Melosira

Program Advancements

RESPONSE TO THE 2019 SITE REVIEW

Recommendation 1

Develop a rubric/systematic approach to PAC representation and make that process publicly visible.

We developed a systematic approach to PAC representation and posted it on our website. We have 24 members and 9 Ex Officio members representing a variety of organizations and expertise relevant to our vision, mission, focus areas, and goals. We continue to work towards building relationships with indigenous tribes in NY.

Recommendation 2

LCSG should continue to create opportunities for underrepresented and underserved communities in the Basin region, such as tribes and migrant workers, to identify and share their needs with respect to research, education, and outreach.

We created a variety of opportunities for underrepresented and underserved communities in the Basin to identify and share their needs with respect to research, education, and outreach. Examples of our efforts to address this recommendation are noted throughout this briefing book. They include our work with cultural communities, Sea Grant Scholars, and indigenous people (e.g., as sponsor of a listening session related to indigenous ways of knowing, by inviting indigenous representatives to serve on our research review panels, our PAC, and other advisory groups).

Recommendation 3

LCSG should collect measures of student/teacher knowledge, attitudes, values and behaviors as a basis for evaluating changes related to education programs and publish these results so others can use them for similar purposes of education and training.

We conducted a longitudinal evaluation of the Watershed Alliance program in 2019. We published highlights of results of that evaluation along with other information about LCSG activities in an invited guest perspective for the American Water Resources Association (Stepenuck, K. 2022. A "Pretty Good Lake:" Community Stewardship of Lake Champlain. Water Resources IMPACT. 24(2):10-13). We also prepared an article to share results and recommendations of that evaluation through a peer-reviewed journal. That article is in re-review with the Journal of Environmental Education (Eaton, A.E., Stepenuck, K. F., McKelvey, C.B., Immordino, M.A., and Spasyk, A.M. In re-review. A Model of Watershed Place-Based Learning for K-12 Students and Teachers. Journal of Environmental Education). Additionally, we allocated funding to hire graduate students who engaged in research about our watershed education programs. One student considered outcomes for undergraduate interns who served as watershed educators with Watershed Alliance. The MS thesis for this research is complete and a manuscript with results and recommendations is currently in review (Immordino, M.A., Stepenuck, K.F., Eaton, A.E., Spasyk, A.M., and Hasan, N. (In review). From Creek to Career: Exploring the Impacts of Watershed Education Internships on Career Pathways. Journal of Experiential Education). Another graduate student (Spasyk) assessed learning outcomes of students who participated in Watershed Alliance programming. That thesis is being finalized, and the student expects to defend in late summer 2025. She will submit her manuscripts for peer-review publication consideration in the fall.

Suggestion 1

LCSG should continue to support new faculty at other institutions in the Lake Champlain basin by prioritizing program development (PD) funds on emerging issues and soliciting letters of intent for this purpose.

PD funds were included in the 2024–2028 omnibus proposal, in years 2–4. A competition for those funds is planned for 2025. The number of institutions involved in our biennial research competition broadened from three (2014–2017) to 11 (2018–2023), with funded institutions increasing from two (2014–2017) to seven (2018–2023). Seven Assistant Professors were funded during this period.

Suggestion 2

LCSG should review existing Accomplishments reported in PIER and determine which could be elevated to Impacts. What would it take to accomplish that important step?

We did this in our May 2019 reporting and received useful feedback from NSGO that allowed us to continue to share impacts effectively in future reporting cycles.

Suggestion 3

Consider adding an educator to the PAC to represent early learners (elementary and family); also a member of the public.

We added two educators—one representing Vermont and the other New York. We also added a member of the public. However, we did not add a representative of early education learners due to lack of staff capacity to expand focus of programs to younger age groups and because youth under 8 cannot go aboard the research vessel for safety reasons.

Suggestion 4

LCSG should continue to translate science into a useful and accessible form, and to serve as the honest broker and source of credible information on high priority issues that include water quality and climate change impact projections to the Basin.

We continued to translate science into useful and accessible forms through our outreach programming and resources, research outputs, and communications products. This is evidenced in our PIER report and throughout this briefing book.

Suggestion 5

For programs that have high impact (e.g., LEAP), make sure they are replicated around the lake as well as possible to ensure ecosystem-level effects. This may require building new relationships and collaborations.

We expanded LEAP to new locations in the Basin, partnering with two to three watershed organizations each year in addition to our initial partner, Poultney Mettowee Natural Resource Conservation District. We also expanded our Watershed Alliance program to New York and funded two new fellows in collaboration with partners in New York (building upon the first three fellows having served in Vermont).

Suggestion 6

LCSG should consider how education and outreach efforts might be extended without the current intensity of personnel involvement. There is only so much time available, and some of it needs to be set aside for reflection, planning, and evaluation.

We set aside research funding and competitively hired graduate students to serve as teaching assistants with the Watershed Alliance program and researchers of that and other education and outreach programs. This afforded them professional development in a field that does not often offer paid graduate stipends and alleviated staff time both to provide educational programs and for organizational tasks (e.g., school scheduling).

LOOKING TO THE FUTURE

As we face uncertain times, we are working diligently to diversify our sources of funding by thinking strategically about opportunities within the Basin and beyond that align with our vision and mission, and by nurturing existing and cultivating new partnerships. Concurrently, we are working to support staff to advance within their careers while we build strong LCSG programs that continue to address relevant needs of the Basin. We will maintain a systematic approach to planning through involvement of our Program Advisory Committee and constituents. We will continue to conduct needs assessments within our programming areas over time, develop Logic Models that define activities, outputs, and short-, mid- and long-term outcomes, and evaluate our programs immediately and 6-12 months following to assess the impact our work is having. To support impactful research efforts, we will host listening sessions to identify emerging and priority areas of research need, and dedicate funding to support new PIs and partnered fellows conducting research.

Lake Champlain from the University of Vermont