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Climate impacts, water quality and citizen science in coastal southern Connecticut: A review of factors supporting practical public health engagement - A qualitative study on citizen science & climate change.

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The degree for which the thesis is submitted in partial fulfilment of a Ph.D. by Retrospective Publication.

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Declaration

I, Michael Anthony Pascucilla, declare that this document is a product of my own effort.

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"For there is no Rank in Natural Knowledge of equal Dignity and Importance with that of being a good Parent, a good Child, a good Husband, or Wife, a good Neighbour or Friend, a good Subject or **Citizen**."

- Benjamin Franklin, 1760

The withering tree has potential to be revived – Heather Soroko

"Once we start to act, hope is everywhere" **–** Greta Thunberg, 2019

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Abstract

Reflecting trends across the United States and globally, Connecticut's coastal communities are facing climate change impacts. There is an agreed need to prepare for further, more substantial effects of climate change, including water quality impacts in Long Island Sound. This thesis examines citizen science's effectiveness in addressing local climate change and water quality impacts on shoreline communities. Through a retrospective analysis, the dissertation examines and extensively scrutinises five study outputs plus one U.S. Patent in order to explore the best strategies for community understanding and participation. The thesis discusses established public health frameworks and models and associated themes. It moves on to investigate linkages between stakeholder participation and education, and examines the relationship between community engagement on the one hand and successful public health practical epidemiology and academic work on the other hand. Through an inductive approach, this qualitative research also investigates a range of root cause strategies for creating public interest and building community resilience in a transparent and trustworthy manner, in the context of addressing climate change impacts and improving water quality. An exploratory approach examines best practice models and frameworks within the public health literature with the aim of explaining and understanding the relationships between successful public health implementation and the challenges and barriers faced. Study results demonstrate the use and capacity of citizen science, where using innovation is an effective collaborative approach that can empower local communities to address environmental concerns such as climate change and water quality issues. The thesis takes account of the boundaries and limitations to community engagement work, both as observed within the study outputs and as cited in academic literature.

Keywords: citizen science, climate change, community engagement, water quality, public health practice

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Preface

Climate change science is a leading, expanding field and perhaps the most debated global conversation with innovative opportunities and adaptive strategies aimed at softening impacts. Human activities within our cities are part of the climate change problem, but they also offer a key resource toward meaningful solutions. With nearly half the world's population living in urban areas, taking 60-80% of world energy consumption, urban climate public health policies can include real zero emissions, improved quality of life, pioneering cost savings, increased energy security, and infrastructure metropolitan improvements. These policies have been deeply vetted, including at the most recent 2022 United Nations Climate Change Conference (COP27) meeting, with research and development activities at the core of environmental innovation. Academia can also facilitate codified knowledge that can be shared to educate and problem-solve through green technology; integrated thinking means that an all-inclusive comprehensive response is essential (Kamal-Chaoui and Robert, 2009; Falk et al., 2022). Local to international scale public health scientific communities have made substantial contributions to understanding, via careful exploration of the planet's climatic history and analysis of past environmental field science, as demonstrated through climate change anthropogenic scientific research and data analysis of deep-sea sediments and ice cores (Antonella And Carey, 2017; Ball, 2021).

With respect to citizen science, the core thread for all the outputs within this thesis has evolved. In fact, a review of the literature indicates that citizen science has undergone many transformations over time and continues to transition with political and social norms. A brief history of citizen science - A newer term was first used by 1979 New Scientist Magazine in 1979 (Oberg, 1979) – citizen science can be argued to be as old as science itself (Miller-Rushing et al., 2012). While Western science dates back to Aristotle (Lo Presti, 2014), citizen science transcends this history and can be found throughout the world in some form. Japan, the U.S., and the U.K. have some of the strongest roots in modern practice (Kobori, et al. 2004). Recent times have seen a growing impulse toward engaging

residents and communities in science, especially at the local level. The earliest U.S. recorded citizen science dates to the mid-1600s and to George Washington, Thomas Jefferson, and Benjamin Franklin (Hirshon, 2022; Cohen, 1943). Projects ranged from tracking the weather for the good of the armed forces, to amateur astronomy, birds and butterfly migration counts, improving water quality, and providing clean beaches.

Former United States President, Barack Obama, enacted the Open Government Access Plan in 2013, encouraging agencies across the nation to embrace citizen science for agency operations: this was followed by the scientific community supporting volunteerism and advancing these instruments. With assistance from European partners, the Ten Principles of Citizen Science were incorporated by the U.S. Federal Community of Practice for Crowdsourcing and Citizen Science in 2015, summarised into three principles – *Data Quality, Openness, and Public Participation* (Robinson et al., 2018). These steps led to the 2016 enactment of the Crowdsourcing and Citizen Science Act, with bipartisan political support permitting federal use of funding to support such activities (Wyeth et al., 2019). These U.S. milestones transformed citizen science, significantly expanding it. While the foundations of phenology, astronomy, and migration patterns of birds, insects, and sea life continue, technology, social media, and innovation have pushed citizen science evolution, which can be differentiated into pre- and post-internet and smartphone phases. Before computer technology, old-school data collection methods were limited to simple tools such as still photos, clipboards, paper, and pens, with delays in samples, data, and information sharing. Today's citizen scientists are furnished with smartphones with high-quality cameras, videos, media-sharing apps, and GPS capabilities, all backed up by real-time data collection and communication. Participants are also empowered with real-time knowledge from research journals and other sources – previously available only to professionals with academic access. Innovative technologies have also proven useful in bringing a large range of divine actors together for a common cause.

Through the process of producing five peered-reviewed publications and registration of a U.S. Patent over the last decade, I have advanced my research skillset and training towards doctoral-level competency. This includes the selection of suitable journals with high

impact factor ratings, the submission and resubmission processes as the leading (last) author – including dealing with rejection – the costs of open access publication/patent application, and joining a community of scholars as a peer member. The foundation for this thesis for a Ph.D. by (Retrospective) Publication is a critical appraisal of my research questions, goals, and aims. This critical analysis reflects my progressive involvement in citizen science, and an academically informed understanding of and commitment to significant open and honest stakeholder participation grounded in trust and transparency. The foundation of my published outputs was partnerships, reflecting both formal and informal networking. Failures and setbacks, as much as success, furnished learning opportunities. While my early research outputs may not have explicitly framed the issues as citizen science and directly named climate change, they emphatically addressed stakeholder engagement and climate impacts. Over time, a common thread of citizen science and deep-rooted, community partnership and collaboration emerged. This work embraces innovation in the sphere and context of community-based practice public health resolutions aimed at solutions to climate change and water quality challenges that have direct impacts upon local quality of life.

To better understand this thesis, and the connection among the outputs, a literature review of several frameworks and models was analysed through a perspective of citizen science engagement and climate change. This review process covered both research publications and results-based practical policy outcomes. As the last and corresponding author for these publications, I designed the research methodology in ways that best served practical public health outcome objectives. All these publications have resulted in – or have documented – positive measurable community-based impacts on quality of life, while also meaningfully advancing the knowledge base of professional public health practice. Deep stakeholder engagement created an investigative roadmap of data to explore 'root cause' health analysis as well as a unified approach toward practical strategic solutions that are scientifically sound and results-oriented and verifiable through measurements of indicators such as water quality. At the same time, both the literature review and research outputs acknowledge the knowledge gaps and limitations within both climate change science and citizen science.

Disagreements within and around the optic of climate change science are carefully noted and discussed.

This thesis develops a systematic executive framework that pulls together the citizen science literature from each study/patent output as to how water quality is impacted by our ever-changing climate – its intent is to provide a comprehensive review clearly identifying the research limitations, gaps, and complications and the opportunities for successful, practical-based public health policy implementation. Each output has evolved through an assessment informed by the academic literature and a robust methodology. All policies, including a public health tangible asset – an innovative vessel are scrutinized for their merit and practicality and have been implemented in collaboration with stakeholders at all levels. Each output has contributed to measurable local, community-based quality-of-life outcomes and formed the basis of this thesis research.

Examining the Southern Connecticut research thesis outputs has overgone a thorough and methodical review to flush out the distinctive commonalities that thread them together into one cohesive, collective intellectual web. The critical appraisal carefully yet systematically is demonstrated as each output led to published research, with positive, practical public health policy community outcomes – this is the heart of the evidence-based practice. The study research process of the published reports/patent through their connectivity of themes outlined within the thesis – climate change and water quality improvements through the implementation of holistic citizen science - including the research output strengths and weaknesses, as well as the thesis limitations. Lastly, and of significance, the studies were evaluated for credibility through model and framework analysis to determine their study meaningfulness. This is also evident as each output has undergone published peer review.

Introduction

Background

The outputs considered in this thesis are grounded within public health, with a focus on five public health studies over the course of a decade, including a U.S. Patent. Each study contains an environmental health research-supported literature review from well-respected, high-output public health academic sources and has undergone a full peer review process. Each report has also been accepted for publication and lies within the public domain. The U.S. Patent is also supported by public health research, both via the nature of the process – years of research, design, and implementation, peer-review across different disciplines from concept to "fruition" – and via links and support from international research assessments and publications.

Climate change within the U.S. and worldwide, despite significant research, is still misunderstood by many in the electorate and even the governmental decision-makers (Reynolds et al., 2010). The issue has become politically polarised, especially in the U.S. – although solid, tangible effects on daily life are apparent and impactful. The public can have diverse and highly incorrect understandings of science, despite local and worldwide creditable research (Lee et al., 2022; Office of the Surgeon General, 2021; OECD, 2020). The main linkages between the successful research outputs and the subsequent practical public health interventions and policies grew out of several common themes that evolved, with the foundational thread entrenched within citizen science, sometimes known as crowd-sourced science. Community participation strengthens and links these studies, which progressively demonstrate the importance of the design phase of stakeholder engagement, where trust building, transparency, and innovation are foundations for every successful public health outcome, especially at a local community level. This thesis also validates the significance claimed for relationships and networks as the root cause

differentiation between successful public health policy and research implementation and those barriers that lead to project failure.

Examination of Core Themes

The research questions investigate the link between climate change and citizen science and evaluate the six research outputs' cohesiveness for themes and demonstrated intellectual development. Outputs 1-4 and 5-6 may, on the surface, appeal distinct; however, their originality and harmonious relationship are interconnected, by both themes and by thesis title.

Both climate change and citizen science frameworks and models were examined for associative linkages and for cross-references with the six outputs. Citizen science is recognised as an established means to involve, especially empower, communities to resolve local environmental concerns; while trust and transparency, plus the use of innovation are essential strategies for effective public health governance in a world of rapid change and scientific scepticism.

Critical Aims/Research Objectives

To develop a systematic executive framework that pulls together the citizen science and climate change literature from each of the submitted study/patent outputs, with the goal of providing a comprehensive review that will identify both research limitations and gaps, plus opportunities and strategies for successful, practical-based public health policy implementation.

The following research questions were explored:

- How can governmental agencies earn local community trust towards improved public health policies that can, through citizen science, lead to better quality of life outcomes?

- What approaches can governments take to harness and mobilise the energy of scientific “boots on the ground” localism to improve specific environments and address climate change concerns, promoting both public health initiatives and local research?
- How can innovation and creativity in public health solutions inspire and engage local communities to offer support?

Public Health Methodology

Research Approach

Public health is a complex and much-misunderstood topic (Den Broeder et al., 2018). Various studies, polls, and focus groups over decades, including the COVID-19 pandemic experience, indicate that the general public still cannot properly define ‘public health’; the profession itself also often confuses the public health discipline with medical care for individuals, rather than macro-level population health intervention outcomes (Castrucci, 2021). Studies agree that there is a strong association between successful policy execution and community involvement and support, leading to better health outcomes (Vohland et al., 2021).

The qualitative approach adopted for this study involved a review of the body of research from the past 10 years centred around the human relationships implicated in local communities and successful public health policy. The research strategy uses an inductive approach to explore the research outputs for community perceptions on how to effectively use citizen science. Specifically, in every study under review, the public health district faced a local risk factor requiring further epidemiologic investigation within a neighbourhood or town, with the desired outcome being that of resolving the problem systematically and democratically, using stakeholder transparency and a series of open, sincere, conversational and trustworthy interactions. The outputs’ various research methods included observational materials, interviews, focus groups, fundraising outputs, and surveys. The intention is to draw upon the knowledge base, explore lessons learned from each of the outputs, and understand the underlying themes those successes noted.

Research Analysis

This analysis utilised a well-established framework within the U.S. known as the 10 Essential Public Health Services (EPHS), which is also aligned with the three core functions of public health – assessment, policy development, and assurance. This framework is mandated within the General Statutes by the CT DEEP, for local public health departments to adopt as outlined in Figure 1. This thesis's fundamental research philosophy, grounded in the EPHS framework, explored the relationship between trust and transparency, rooted in the articulation and fostering of clear communication and intended impacts. This analysis includes a focused and layered critical appraisal of each study, associations, and themes across the entire body of research. The studies demonstrate a progressive maturing and development of knowledge about, and analysis of, the workings of citizen science. The studies mature, not only in terms of research agendas, but also by the degree of attention paid to stakeholder engagement, informal preparation/groundwork, and networking, especially at the local community level. This was implemented in the face of a lack of widespread understanding of citizen science and public health – an underlying unfavourable environment: the framework is not widely embraced within local governance for environmental policy change, but limited to field activities and sample collection (Turbé et al., 2019). As such, the work was highly innovative.

Research Design

This work uses qualitative research methodology, a well-established foundation widely used in health-related study design (Busetto et al., 2020). The highly granular investigation exposed common linkages and identified barriers to successful outcomes and unintended consequences.

This thesis design aims towards better understanding and investigation of some common threads within citizen science interventions around climate change, in the specific context of local policies relating to water quality. An inductive logic research approach emerged as the best option for review of the six outputs. A central theme emerging revolves around community behaviour concerning local public health governance interventions – such

interventions stand front and centre as regards public health outcomes and indicate paths towards solutions.

Figure 1: *The EPHS (Source: CDC Website)*

Literature Review

Framework/Models

This thesis literature review, therefore, extends into the field of public health (including environmental epidemiology) and relevant themes relating to the fields of climate change and citizen science. While the primary framework is drawn from public health, complementary frameworks from different disciplines support the discussions of climate change review and citizen science.

Public Health Framework

As a leading public health agency, the CDC works worldwide and has a solid record of achievements in improving public health within over 60 countries strengthening global public health security (Tappero et al., 2017). In 1994, the role of public health was clarified in the U.S. under CDC leadership and its partners. This model included and supported the nation's three-core functions of public health – assessment, policy development, and assurance. The model serves as the gold standard and road map for how public health services are delivered by every public health authority in the U.S. (Castrucci, 2021). The model, as outlined and recommended by the National Association of Country & City Health officials (the leading local public health professional association in America), acknowledges that local-level factors make each local health department unique. The EPHS model also references volunteer participation and connectivity across all ten essential services towards developing and implementing work that addresses climate change (Frumkin et al., 2008). The EPHS strategy is core in every local public health framework for planning and implementing a response to community concerns and is required for science-based decision-making (Frumkin et al., 2008). Volunteerism and climate change both appear within the model's content, as explored below.

Climate Change

Climate change has been extensively researched. There is a lack of agreement across models and studies both globally and regionally (Hulme, 2009). However, across all

research and platforms, one underlying concerning trend is demonstrated: climate change is impacting all-natural ecosystems and humankind's quality of life (Steffen et al., 2015; Hansen et al., 2013). An international authority is the Intergovernmental Panel on Climate Change (IPCC), recognised as the world's most reliable source of information on climate change and its causes. While internet speculation around IPCC's credibility exists, an extensive literature review found no trustworthy scientific research that challenged IPCC. The IPCC is highly regarded, while those claims that the IPCC is an alarmist organisation are not supported by evidence, nor are there any indications that the opposition can scientifically demonstrate their position of challenge. In fact, not only are the IPCC's findings supported by credible research, the Asymmetry of Scientific Challenge suggests that the IPCC reports are "likely to understate climate disruptions" (Freudenburg et al., 2010). Accordingly, the IPCC model was selected as the first cornerstone.

Citizen Science

Defining Citizen Science

Citizen science is cited and cross-referenced in the literature in many ways: volunteer monitoring, community science, crowd science, crowd-sourced science, etc. The concept may also hold distinctive meanings within various professions. In its simplest terms, it refers to everyday persons participating in public scientific research (Groot and Abma, 2022). Regardless of how it is defined or implemented, in the spirit of authentic citizen science, a person's contribution needs to be relational, inclusive, engaging, and transparent, with a mutual understanding of trust in working toward the same common goal (Haklay et al., 2020). Citizen science projects, like all partnerships and networks, require participants being invested and having a seat at the table; in successful projects – citizen scientists are entrusted, respected stakeholders. This framework is clearly articulated within the European Citizen Science Association's 10 principles. These recognise differences in disciplinary and cultural contexts and provide rules for exclusion and inclusion, rooted in principles that are grounded in a flexible concept, acknowledging diversity while fostering

an adaptive structure, to meet citizen science's rapid expansion. The principles afford a supportive development of the field, being designed to support all participants in enhancing further maturity, independence, creativity, and underwrite the boots-on-the-ground/bottom-up nature of citizen science (Robinson et al., 2018).

Citizen Science Evolution in the U.S.

There are clear and outcome-specific benefits as well as pitfalls and challenges to community engagement. The literature is not conclusive regarding the net benefits of citizen science. In general, citizen science is considered a best practice for community engagement with demonstrated value in improving science and building value-added policy. The literature in almost every study also makes it apparent that, while the method has its positive benefits, there are limitations; the framework itself is not without controversy – with some research even questioning its use at all in legitimate science (Stilgoe et al., 2014; Stilgoe, 2016). A research article that takes a deeper review of these concerns discusses how these different activities embody different epistemic practices, each with a distinct genealogy – where citizen science embodies concerns that science acknowledges that it is context-sensitive and becomes more democratic (Strasser et al., 2019). In a more direct manner, another research study evaluating U.K. and U.S. material ends by questioning the use of crowdsourcing practice “[these citizen science] examples will serve as the basis for a normative analysis, discussing the potential ethical and social ramifications of this rhetoric”; "In thinking holistically about participation, engagement, and governance, one can further consider what bearing each “citizen science” initiative has on a citizen’s rights and duties, on definitions of “societal good,” on the powers of government, and on which interests should hold sway over others” (Woolley et al., 2016). This position merits consideration; a separation between citizen engagement and governance authority and decision-making for the greater good of society must be

balanced. A useful way to depict the balance between the three concepts of participation, engagement, and involvement is best demonstrated in Figure 2 (Woolley et al., 2016).

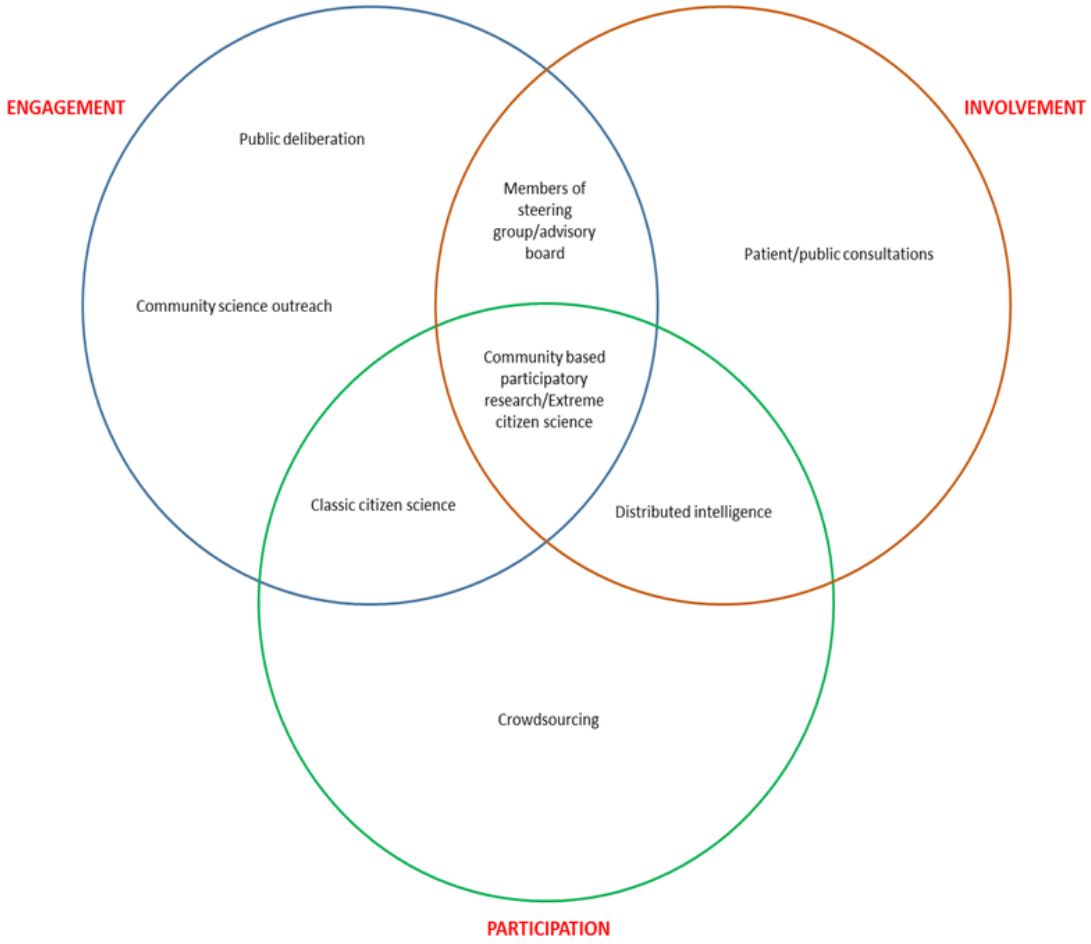


Figure 2: *Three Concepts - Engagement, Involvement and Participation (Source: Woolley et al., 2016)*

One careful analysis compares three empirical concepts, to conclude – First, as science ceases to be a closed domain reserved for an expert elite, scientific work will accelerate, new research practices will emerge, and, perhaps, new questions will be asked that are more aligned with the public interest. Second, as scientific research becomes accessible to anyone, a new kind of citizen will emerge, one who brings their working knowledge of science into the realm of liberal-democratic politics and participation (Baudry et al., 2022). This analysis both acknowledges the evolution in 'science', while highlighting the balance

between amateur and professional scientists – a key observation with the thesis outputs. While this model simplifies citizen science, a deeper dive into Figure 2 highlights the relationship between "engagement and involvement, which at its core is community empowerment. At the same time, participation relates to data, both directly or indirectly, derived from some aspect of their lives or community as a whole.

A review of Woolley model provides a profound reflection on how community participatory science impacted the outputs within this thesis - I must acknowledge and emphasize that there were significant times of tension evolving around citizen science and transparency. While it was experienced with all the studies to some level, this was particularly apparent with Output 4, and to some degree, the foundational research of Output 1 & Output 3, as the community citizen scientists wanted unlimited access to live, unverified, scrubbed raw data results. It should be noted, as a general leading practice, that public health authorities do not release preliminary data unless the information has been thoroughly analyzed and approved by leadership so as not to cause undue harm to population health Specifically, data sharing, especially preliminary findings with the community, tested the relationship boundaries, causing power and control conflicts between governance and citizen scientists. It also impacted relational trust issues between the community and governance that fostered healthy debates and perhaps a clash of intelligent minds at times. However, data-sharing debates did fuel lots of dialog on anti-science trust attitudes that necessitated the health agency to be flexible and considerate while balancing our public health responsibilities, to that end, the process led to strengthening community trustworthy relationships.

Exploring different frameworks for CS, a few emerged as exemplary. One leading organisation, that sets an adaptable benchmark, is the European Citizen Science Association. Their easily understood framework of the 10 Principles of Citizen Science is provided in 26 languages and shaped the U.S. agenda on citizen science (Robinson et al., 2018). Another deep-rooted innovation model, developed in 2016, is "Doing-It-Together Science" (DITO). Initially from the European Union, with 50 participants from across science, communication, government/business, civil society, and arts communities, the

DITO model is widening the concept and deepening public engagement across many arenas including public health, laboratory technology and environmental science (Göbel et al., 2019). The DITO's Plan, with a 100-page plan encompassing over 1.7 million people with over 45,000 direct participants, is widely respected (DITO's Consortium 2016). Most importantly, is the six objectives that are effectively, and widely communicated to all persons involved in DITO's activities (Figure 3).

***Figure 3**: Dito's Six Objectives (Source: Consortium, 2016)*

The third significant model emerging in the literature review and actively used in Connecticut and throughout the U.S. derives from September 11, 2001, events. The Medical Reserve Corps (MRC), which motivated Americans to volunteer in mass numbers, was initially focused on public health preparedness; but the role of the nearly 200,000 U.S. volunteers has expanded. The MRC continues to grow, not just in numbers, but also across different fields. The MRC is not only strengthening local public health systems but is also actively shaping policy in the field of how citizens can work within local governments across the U.S. (Doran et al., 2022; MRC Network Corps, 2020; Errett et al., 2013).

Internationally, citizen science continues to gain popularity and become more widely accepted, with several professional associations being founded – the U.S.-based Citizen Science Association, the European Citizen Science Association, and the Australian Citizen Science Association (Heigl et al., 2019).

To assess this, one can understand science as an academic process in its complex and fundamental design. Not every project can or will be successful (Westreicher et al., 2021). While engagement is largely positive with high social relevance impacts, in nearly every study reviewed there were not only project limitations, but also failures. Failure must be acknowledged as an integrated/necessary part of scientific advancement. Unsuccessful science experiences are rarely publicly communicated in scientific publications or conference presentations, providing the wider community with false and unrealistic, project aspirations (Westreicher et al., 2021). This concept of 'project failure' among some citizen scientists is ripe for re-framing. Projects perceived as failures often offer failed advancements toward better understandings and more effective solutions – as demonstrated in output 3. For example, within environmental health research, epidemiologic investigations of disease causation are not always apparent and can be quite complex. Within epidemiologic research, there are type 1 (false-positive) and type 2 (false-negative) errors; a professionally trained/seasoned researcher knows that the first step in a scientific process is not mere observation, but the generation of a hypothesis which needs to be critically tested (Banerjee et al., 2009). Hence, there can be a perception that the project 'failed' when in fact, the results are highly productive, providing useful information via elimination of causes. A trained scientist knows this well, as "research limitations". Limitations/setbacks are featured in all my outputs. This is especially evident in output 3 where our Microbial Source Tracking (MST) research with DNA was quite challenging, and not easily understood by volunteers and policymakers alike. Citizen scientist training appears in the literature as essential to project success, especially within epidemiology (Froeling et al., 2021), public health's most basic science (Thacker, 2006).

The best intentions to use citizen science must be planned/well-designed. The three-step dimensional model (Figure 4) offers a logical and systematic approach consisting of three phases: problem identification; policy formation; and implementation (including compliance assurance).

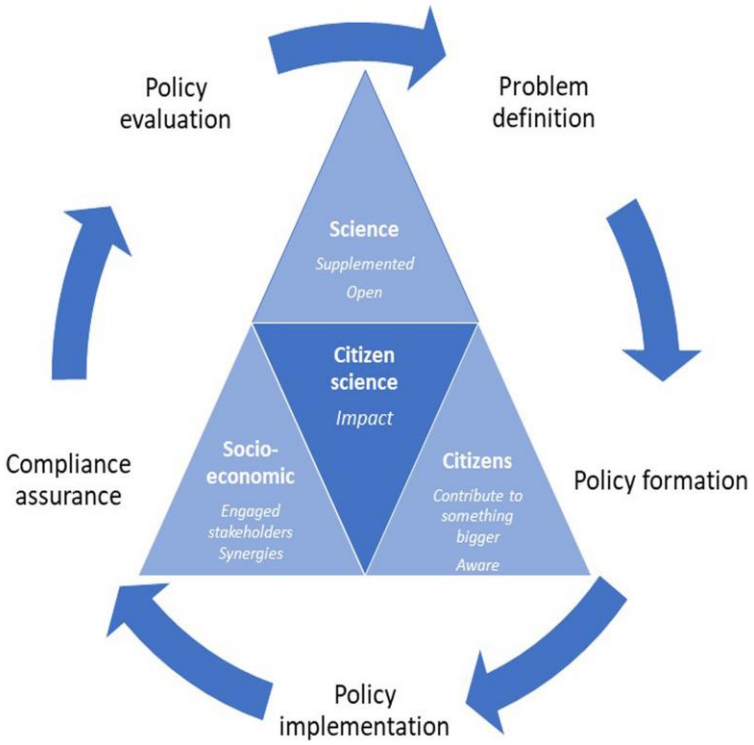


Figure 4: *Citizen Science: Three Key Dimensions (Source: Turbé et al., 2019)*

One meta-study stood out within the review. An assessment across 503 projects undertook in-depth analysis of 45 projects with environmental policy relevance. Generally, projects were successful, but a significant finding emerged: projects involving governance, especially within local authorities, encountered significant resistance to change, as well as scepticism from decision-makers and governmental officials (Turbé et al., 2019). This mega review also identified that communication and feedback to participants were key, while the pressing challenge to designing successful environmental-related projects was identified as lying within its links to policy structure. This works when citizen science is firmly integrated into all processes – including policy evaluation (Turbé et al., 2019). This

level of policy interaction requires public administrators to legitimise and be vulnerable to feedback, hence often encountering resistance. However, open engagement fosters opportunities for citizen science to improve policy, social innovation, trust, transparency, and the individual well-being of all stakeholders. Such high levels of positive organisational change demand multi-faceted approaches to avoid discontent, resistance and sabotage. Human relations and cultural change require more process-oriented schemes, such as outlined below (Beer, 2017; Alvesson & Sveningsson, 2015):

1. Mobilise energy for change.
2. Develop a new compelling direction.
3. Identify organisational barriers to implementing the new direction.
4. Develop a task-aligned vision.
5. Communicate and involve people in implementation.
6. Support behaviour change.
7. Monitor progress and make further changes.

Another notable model of the dynamic and interactive relationships between citizen science and governance is offered by Göbel and colleagues. This analysis, drawing on Science and Technology Studies (STS) and political science, names the phenomenon as DITO. DITO projects actively aim to achieve policy engagement with multi-stakeholders for over three years, engaging more than 1.5 million participants (Göbel et al., 2019).

The DITO model explores the increasing role citizen science plays within governance, and how its use is becoming a focal point for public policy. Within traditional governance, one of the greatest concerns is information access, and data sharing, especially preliminary and confidential information. Göbel et al. (2019) reviewed the relationship between governance and citizen science and acknowledged that using volunteers can therefore become restrictive and limiting, especially in environmental degradation projects.

Figure 5: *MRC volunteer at a Public Health Community Clinic (Source: MRC Network Profile, 2022)*

The Connecticut MRC was supportive during the COVID-19 response, helping to reduce morbidity and mortality (Figure 5); the MRC is regularly used in public health community-based activities across all five Connecticut counties (ASPR, 2020). MRC volunteers comprise of medical, non-medical and people with public health backgrounds who donate their time and skills to their communities for public/environmental health focus activities/projects. They foster resilience and improve health locally. The integration and expansion of the MRC network continues to evolve across the U.S. and have proven effective in fostering communities' growth and resilience. MRC efforts are directly translated to workforce savings and strong returns on local investment (Doran et al., 2022).

Climate Change – Global to Local Trending

One of the most comprehensive reviews of climate change research worldwide – and the largest assessment exercise in history – is being conducted by the IPCC, comprising independent working groups examining peer-reviewed publications and grey literature. The IPCC provides a holistic analysis, including uncertainties and emerging issues (Woodward et al., 2014).

The IPCC's systematic review of the applicable published literature and the assessment reports for the public and policymakers is clear – "It is unequivocal that human influence has warmed the atmosphere, ocean, and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere have occurred, and humankind activities have altered our planet's ecosystems, and every fraction of a degree of warming comes with more dangerous and costly consequences (Figure 6)*"* (IPCC, 2021, p.4). IPCC's most recent research indicates that the world is on track to reach the 1.5ºC level within the next two decades if drastic cuts in carbon emissions are not immediately implemented (IPCC, 2022).

Within scientific communities, the nine planetary boundaries model provides another summation of creditable international research (Steffen et al., 2015) as referenced in Figure 7. This framework, developed in 2009 by Johan Rockström and Will Steffen, provides an easily understood matrix on a safe operating threshold for humanity on planet earth (Rockström et al., 2009). Based on this model, it is apparent that climate change has crossed one of the planetary boundaries to a point that human global sustainability's balance is at

risk – or perhaps even has crossed over the tipping point, from prevention to damage control. While ongoing additional data inputs are needed to refine the earth limits, the model offers an agreed-upon methodical starting point for calculating a limit. This framework's main use to date has been impacting local, national, and international policy, as framework continues to be updated and evolves to better define boundaries and "science-based targets" (Biermann & Kim., 2020).

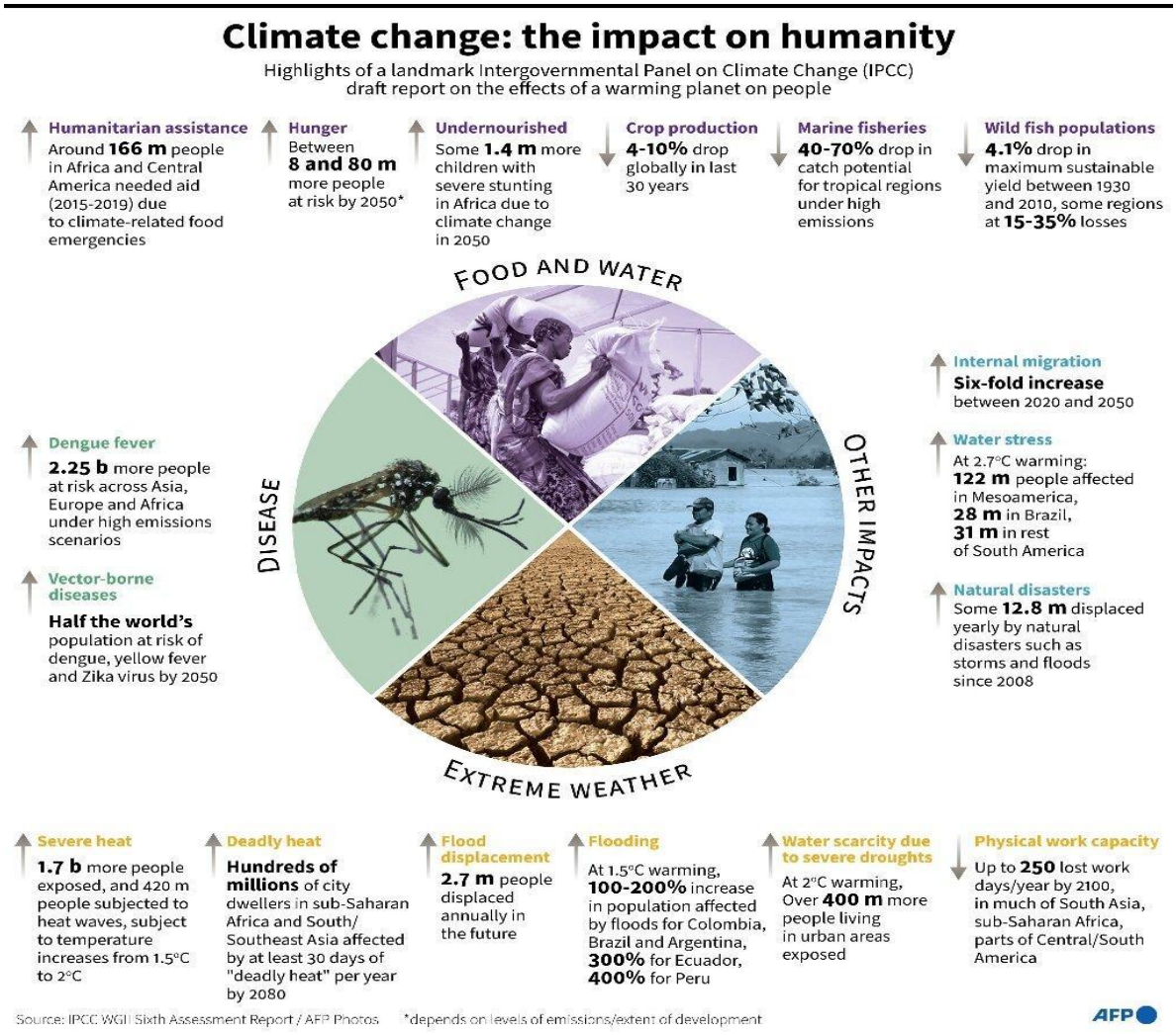


Figure 6: *Highlights of a landmark IPCC draft report (Source: IPCC Sixth Assessment Report, 2021)*

Unfortunately, another milestone was recently observed. In May 2022, the earth recorded the highest daily level average of carbon dioxide (CO2) –- 420.8 parts per million (ppm) within the atmosphere –- since records have been documented. In May 2021, the level was recorded at 418.95 ppm, according to the Scripps Institute of Oceanography at the University of California. Gas levels continue to rise, with a nearly 1.9 ppm increase in a year, inching us closer and closer towards a threshold and thus the planet's limitation (Borenstein, 2022). Careful and effective climate change science is our best way to explain the narratives and the uncertainty within the frameworks.

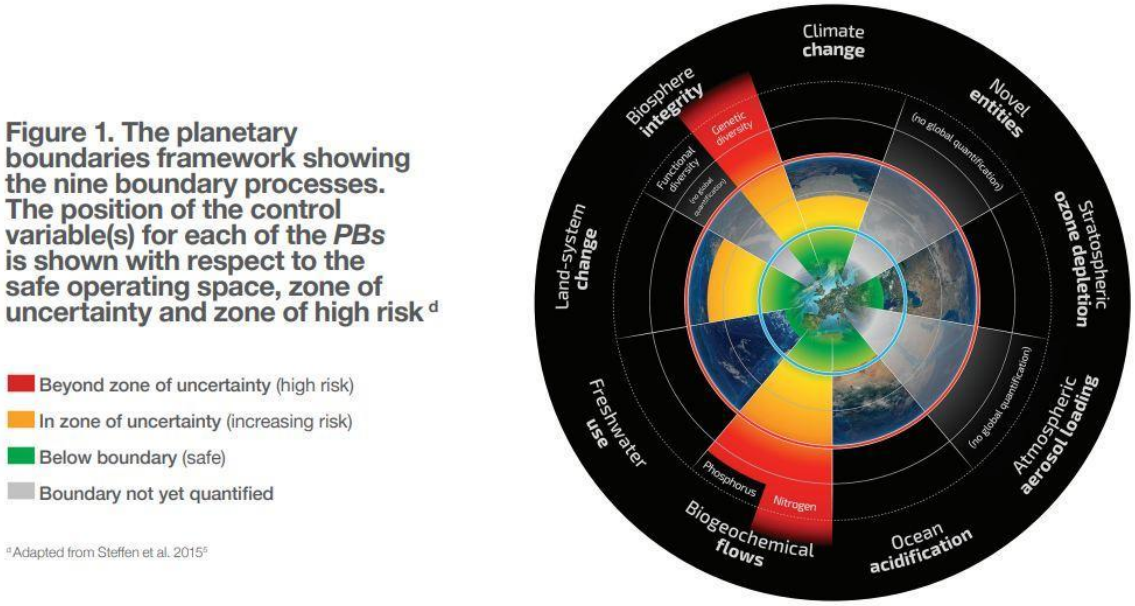


Figure 7: *Nine Planetary Boundaries Framework (Source: Steffen et al., 2015)*

A more micro-focused data review, specific to Connecticut, aligns both IPCC and the planetary boundary models. A 2020 Yale University report assessed 19 indicators related to climate change and health in Connecticut. Selecting temperature as an example, globally, temperatures are increasing; the global average temperature increased by about 1.7 F from 1901 to 2016 (Dupigny-Giroux et al., 2018). Connecticut temperatures have increased by 3.0 – 3.5 F (1.67 – 1.944 degrees Celsius) from 1895 to 2019. Six of the ten hottest years (i.e., highest average temperature) since 1895 in Connecticut have been recorded since the year 2005; in order, they are: 2012, 2016, 2010, 2006, 2011, and 2017 (Bozzi & Dubrow, 2020). Another key finding discusses extreme events, such as heavy rainfall with

cumulative precipitation of three inches or more, and trend consistent with an 8–9-inch sea rise, associated with increases in the number of high-tide flooding incidents since 1880 (based on local tide gauge data). Other indicators include: increases in infectious diseases from mosquitoes and ticks; and a drop in air quality from ground-level ozone, fine particulate matter, and outdoor allergens (mold and pollen) (Bozzi & Dubrow, 2020).

A deeper appraisal of local, town-specific climate change issues involves several other studies and reports. These include: The Nature Conservancy Plan 2011-12, A Salt Marsh Advancement Zone Assessment of Branford (Ryan & Whelchel, 2014), Connecticut 2014,

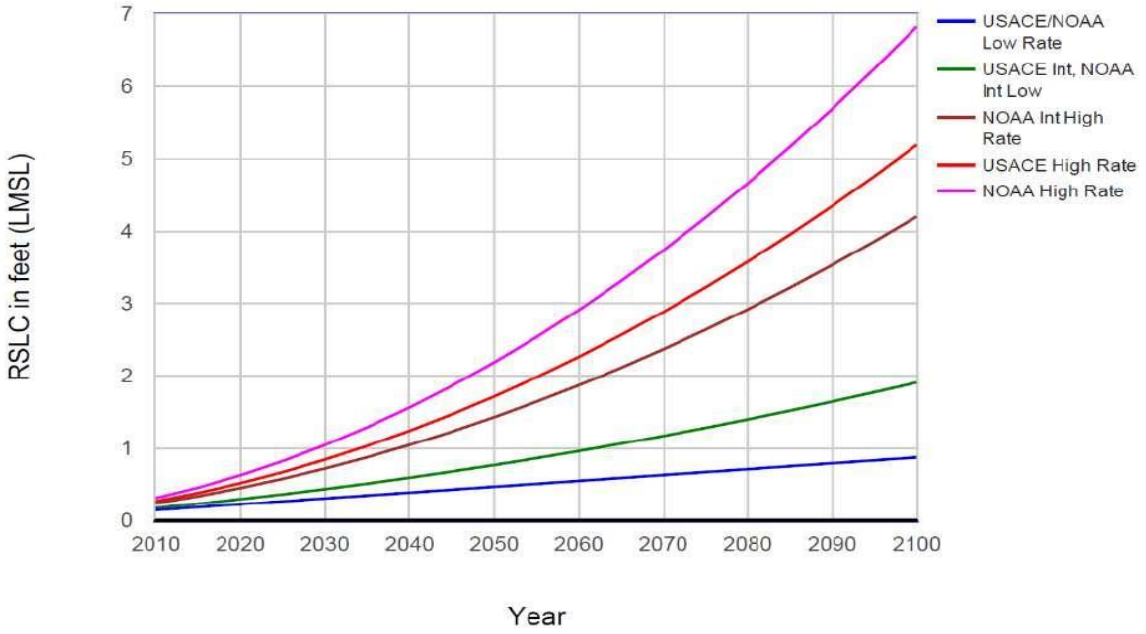


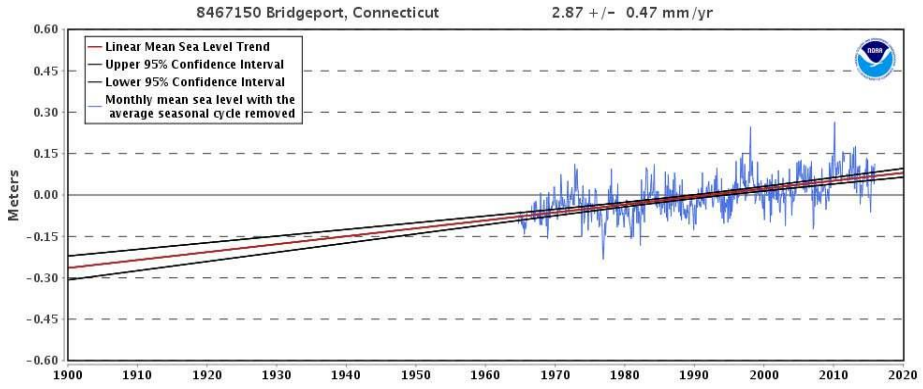
Figure 8: *Relative Sea Change Projections Gauge 8467159, Bridgeport, Connecticut (Source: NOAA)*

Connecticut Coastal Design Project 2014 (Whelchel et al., 2014), and the Town of Branford Coastal Resilience Plan 2016 (Town of Branford Coastal Resilience Plan, 2016)

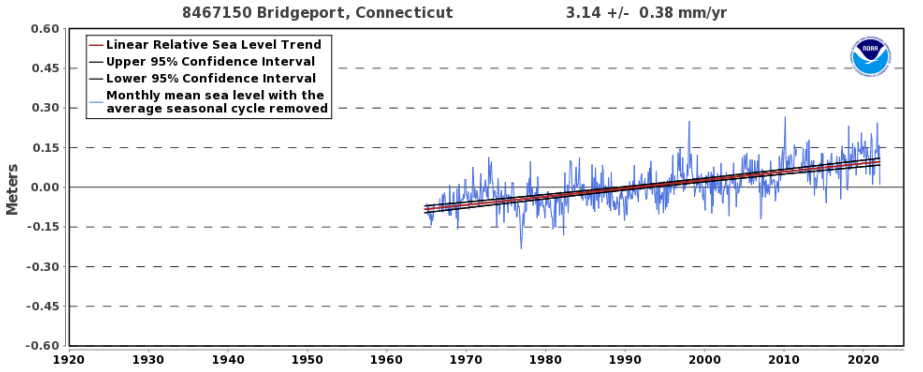
These research projects discuss the hazards of local coastal environmental impacts and emphasise a context of risk, with increases in vulnerability and frequency. Local consequences include increased high-tide flooding and storm events – including storm surges, sea-level rise, intense rainfall events, and runoff. Shoreline municipalities are at significant risk, with many vulnerable infrastructures and residential populations. A single tide gauge was operated by the National Oceanic and Atmospheric Administration

(NOAA) in Branford, Connecticut, from June to November 1989. The gauge was located in the Branford River, east of Branford Point. Data collected by this gauge (available online at tidesandcurrents.noaa.gov), indicates the mean sea level (MSL) in Branford Harbor is negative (-) 0.28 feet, or 0.28 feet below the North American Vertical Datum of 1988 (NAVD88). The average maximum elevation of high tide ("mean higher-high water, or MHHW") is 3.25 feet above the MSL, or 2.97 feet elevation (NAVD88). This trend will vary along Branford's coastline. A review of updated 2021 data from NOAA confirms that the rising sea level pattern has changed since 1989 and indicates how this is occurring. Figure 8 (above) also demonstrates modelling within ranges to relative sea-level rise.

Another compelling example of a trending climate change pattern is demonstrated below :



Based on tide gauge data collected at that station between 1964 and 2014, MSL has been increasing at a rate of 2.87 millimeters (0.11 inches) per year, which is equivalent to a rise of ***0.94*** feet over 100 years



The relative sea level trend is 3.14 millimeters/year with a 95% confidence interval of +/- 0.38 mm/yr. based on monthly mean sea level data from 1964 to 2021 which is equivalent to a change of ***1.03*** feet in 100 years.

Figure 9: *NOAA Tidal Gauge Data 2014-2021 in Bridgeport, Connecticut (Source: NOAA, 2013)*

(Figure 9), based on the nearest operational tide gauge to Branford, Connecticut. This gauge verified this trend, and recorded that, in just the last 6 years (from 2014 to 2021), the tidal gauge has documented an increase of 0.09 inches (2.286 millimetres).

The overall trend appears consistent from global to local models: human activities have been making – and continue to make – negative impacts upon local ecosystems and the world order of all ecologies (Grimm & Jacobs, 2013).

In synchronisation with this research, observational data from local health department environmental complaints and concerns were also analysed. Data came to light during climate resilience projects and community conversations as early as 2010, before the 'Nature Conservancy Plans' of 2011 and 2014. Local climate change consequences observed included negative impacts on infrastructures and populations from flooding, storms, intense rainfall and runoff.

Following initial grant-funded studies in 2011, governance and community conversations were shadowed by two back-to-back extreme and historically significant weather events in the U.S. northeast, New England: Tropical Storm/Hurricane Irene from August 27 to September 1, 2011, and Hurricane/Superstorm Sandy from October 27 to November 8, 2012. These were the most impactful climatic events in Connecticut in nearly a century. Among their effects, Tropical Storm Irene downed about 1–2% of the state's trees and left 800,000 customers without power for up to 12 days. The following year, Hurricane Sandy caused significant destruction, particularly along the southwestern coastline: 5,000 people were evacuated from their homes, patients were evacuated from hospitals and nursing homes, and five people died (Bozzi & Dubrow, 2020). Another storm within two months of Tropical Storm/Hurricane Irene, and of extraordinary consequence (nicknamed the Halloween Nor'easter), occurred in October 2011, bringing a combination of snow and tropical-storm-force winds. This caused significant infrastructural damage and left more than 750,000 residents without power for up to 11 days (Barnard & Nir, 2011). This storm broke snowfall records with 24 inches of snow, was responsible for 10 deaths and resulted in $90 million being given in Federal Emergency Management Agency public assistance

– the largest amount for a single storm in Connecticut's history. It resulted in the cancellation of Halloween – a nationally deep-rooted tradition within the U.S., especially in New England (Lu & Stephenson, 2011).

Community-based climate resilience studies, disseminated through the coastal resilience plans (Town of Branford Coastal Resilience Plan, 2016), charged local public health systems to respond, investigate and address environmental conditions as legal statutory obligation, under the U.S. 10 EPHS. Climate change would fall within all 10 ESHPs.

A Local Response Initiative

In collaboration with stakeholders, notably academic partners, the local health district initiated a research-based strategy to implement the following actions: 1. Generate awareness of coastal risks; 2. Research and assess coastal vulnerabilities, risks, and opportunities; 3. Identify options or choices for addressing risks; 4. Develop and implement an action plan to pursue selected options; and 4. Conduct community surveys, open conversational formats, and focus groups among key stakeholders.

As a key partner and agency deeply infused within the multi-step process and its solutions, the public health plan focused on hazard mitigation and creating a strategy to address community vulnerability and risk assessment (Figure 10). A key component not addressed within this plan – as in similar plans – was the long-term action needed, or a well-defined roadmap towards community engagement beyond a grant-centred study. When grant-funded projects ended, no funding was available to implement the plan's recommendations; there were no plans to engage the community and build upon connections already made; and given the political cycle of elections, there was no succession or continuance of operation plan.

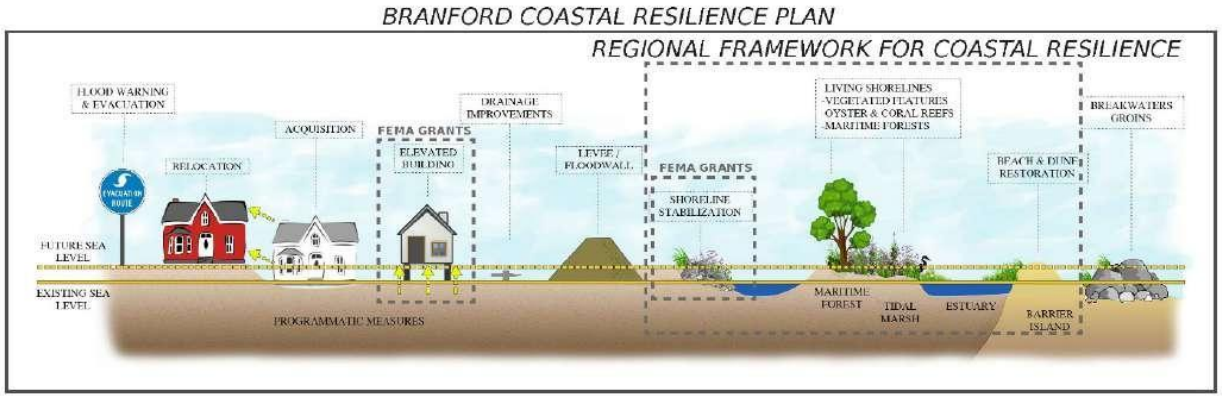


Figure 10: *Community-Based Solutions to Local Climate (Source: Town of Branford Coastal Resilience Plan, 2016)*

With this scenario, it was the local health department in partnership with the local community, that embarked on a mission to focus on climate change concerns specific to public health. The research outputs addressed public health environmental concerns as a priority, where the role of local public health was defined as two-fold: 1. Reactive: there were substantial concerns throughout the communities around significant public health impacts; 2. Proactive: working with vested stakeholders to address and mitigate climate change impacts via an all-inclusive community-based and innovative holistic approach. Initial coastal resilience awareness community study endeavours (2011 through 2016 local climate resilience projects), accompanied by increasing climatic events, served as a stimulus to build the cohesive body of research. Subsequent practical policies and projects were formulated to address climate change and embraced the community engagement initiated during the initial emergency. Output 1 (the Farm River Watershed Assessment - Brooks et al. 2012) also served as a benchmark for the process of how to promote engagement while foresight around the health promotion challenges and relationship development needed to advance public health solutions. These themes were increasingly elaborated as expertise in community engagement grew, and as it became better defined – notable in subsequent outputs, 2-6. The will for community climate change and environmental participation was later reinforced through the *Yale Program on Climate Change Communication Survey of Southern Connecticut's New Haven County*. Specifically, based on the survey questions regarding global warming and the statement

"Citizens should do more to address global warming", 68% of local respondents agreed more needs to be done in Connecticut, 3% higher than the national average of 65%, as shown in Figure 11 (Leiserowitz et al., 2021).

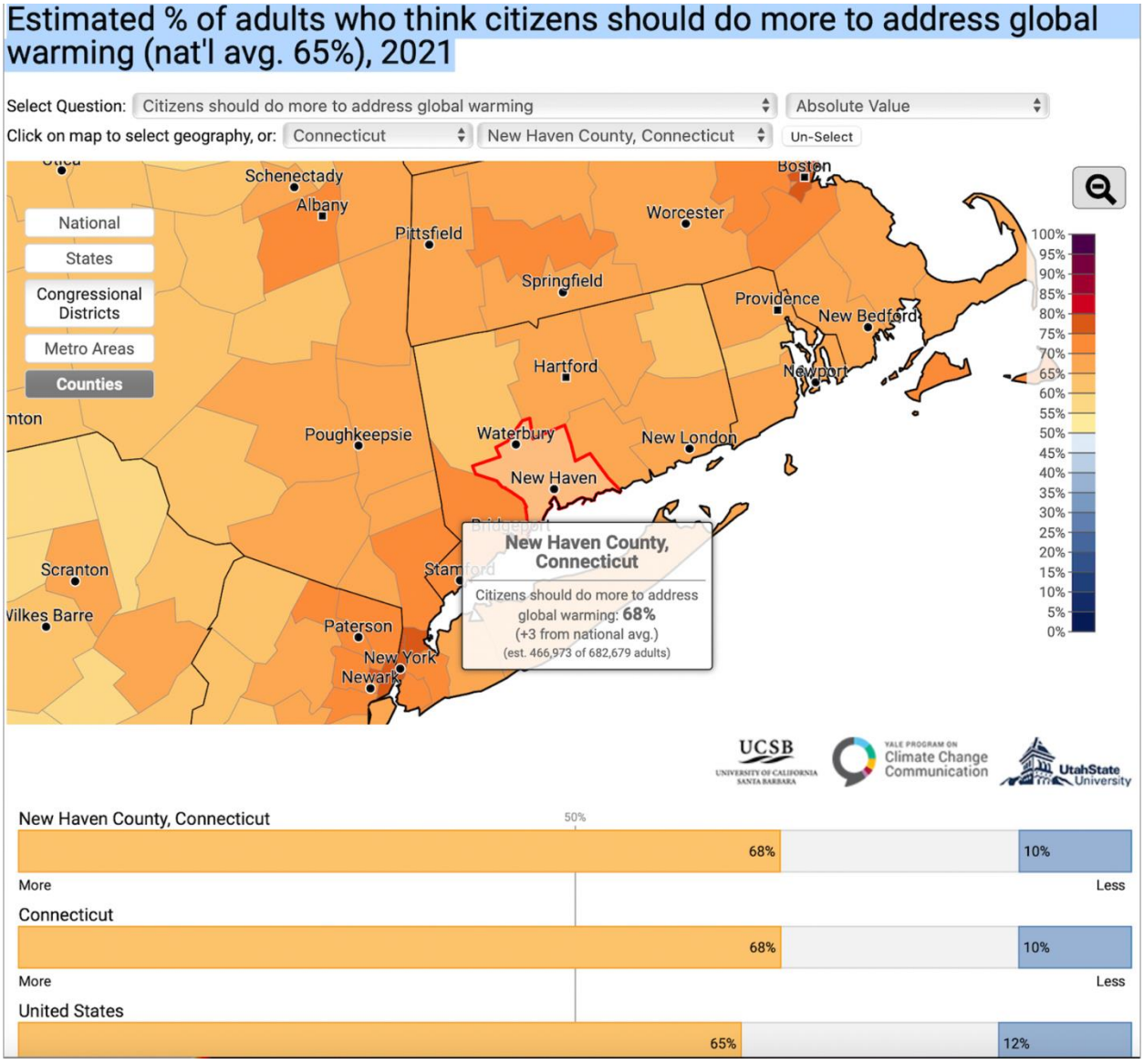


***Figure 11**: Yale Program on Climate Change Communication Survey 2021*

Further review of local resident and business concerns regarding environmental health was demonstrated through outputs 5 and 6, with the solar-electric pump-out vessel research, design, and implementation. Funding for this innovative vessel from U.S. FWL and the CT DEEP had two-fold objectives, to reduce operating costs plus environmental impacts. This

project demonstrated a cost saving of $3,150.00 per year on average (US $3,220.00 per year for electric boats versus US $5,370.00 per year for gasoline-powered boats).

In addition, we estimated that gasoline-powered pump-out boats emit approximately 7.7 kg CO_2 eq. per pump-out, whereas solar-electric pump-out boats will emit between 0.7 and 5.4 kg CO_2 eq. per pump-out, depending on their electricity source (Hemez et al., 2020). The local health department bridged a $50,000.00 funding gap to build the vessel. This led to initiating a new strategy of fund-raising events, with stakeholders. Fundraising was successful and exceeded our expectations while building community buy-in and support.

The Research Projects & Outputs

Climate Change & Public Health Community Engagement

A review of the U.S. 10 EPHS model, including a thorough examination of the three-core functions of public health – assessment, policy development, and assurance – provides understanding of how climate change intervention functions within the model (Figure 12 below) (Frumkin et al., 2008).

Service	Climate Change Example
1. Monitor health status to identify and solve community health problems.	Tracking of diseases and trends related to climate change
2. Diagnose and investigate health problems and health hazards in the community.	Investigation of infectious water-, food-, and vector-borne disease outbreaks
3. Inform, educate, and empower people about health issues.	Informing the public and policymakers about health impacts of climate change
4. Mobilize community partnerships and action to identify and solve health problems.	Public health partnerships with industry, other professional groups, faith community, and others, to craft and implement solutions
5. Develop policies and plans that support individual and community health efforts.	Municipal heat-wave preparedness plans
6. Enforce laws and regulations that protect health and ensure safety.	(Little role for public health)
7. Link people to needed personal health services and ensure the provision of health care when otherwise unavailable.	Health care service provision following disasters
8. Ensure competent public and personal health care workforce.	Training of health care providers on health aspects of climate change
9. Evaluate effectiveness, accessibility, and quality of personal and population-based health services.	Program assessment of preparedness efforts such as heat-wave plans
10. Research for new insights and innovative solutions to health problems.	Research on health effects of climate change, including innovative techniques such as modeling, and research on optimal adaptation strategies

Source. Public Health Functions Steering Committee.[71]

Figure 12: *The 10 EPHS and Climate Change Association*

Within the core values of citizen science implementation, the fundamental concept for effectiveness rests within the task of forging relationships between individuals and

communities, and the sponsoring entity – public health. One model of interactive relationships between citizen science and governance is described by Göbel and colleagues – the DITOs framework. DITO projects actively aim to achieve policy engagement with multiple-stakeholders, as evidenced by the over three years of DITO's projects engaging more than 1.5 million participants (Göbel et al., 2019). This framework for citizen science engagement was embedded within all phases – planning, research design, research, publication, policy implementation of all the research discussed in the outputs, more especially in the later body of research. Profound stakeholder engagement is apparent in the DITO model and offered the projects I worked on a reliable investigative roadmap of data to explore 'root cause' health analysis and to create a unified approach toward practical strategic solutions.

Figure 13: *Volunteer collecting water samples (Photo: ESDHD)*

Capital investments in community and stakeholder engagement, while beneficial, do pose risks and can have potentially negative impacts on public health policy implementation. A

cost-benefit balance of these outputs, however confirmed favourable outcomes and positive interventions that would have never come to fruition without stakeholder involvement and support. For example, in the Short Beach research (output 4), significant water quality field investigation and sampling were necessary. Limited public health resources hampered field investigations and water sampling, especially during random wet weather events when short-notice data collection was required outside public health agencies' established working hours. Engaging vested, local, long-time residents within the neighbourhood of concern has proven fruitful, generating real-time field environmental field sampling and in-kind local resources otherwise unavailable. Likewise, town records on outfalls were minimal/non-existent, making local residential knowledge of the township invaluable to research project outcomes. Local neighbourhood knowledge directed the team to sample outfalls that were unknown to town records, where high levels of bacteria were subsequently identified. While community engagement was significant and beneficial, volunteer involvement also created a set of project management challenges, including employee-like relationships, (involving neighbour disputes) and increased political scrutiny. Output 1, the thesis's foundational research study, the Farm River Project and Clam Dig, offers another example of where support for the research and project was significantly amplified by stakeholders. While public shellfishing beds are open to the general township through a small permitting fee, in many areas parking is limited and/or not available. In many cases, this planning design is intentional, underpinning a town-sponsored and funded shellfish area for a small neighbourhood association; however, parking access limits restrict residents living outside nearby neighbourhoods from partaking in this recreational activity (Vickey, 2003). When the health district wanted to hold a public clam dig event in an approved, public shellfishing area; the small, local neighbourhood immediately voiced concern against having a clam dig, not only in this area but at any approved shellfishing area within the town. They cited traffic, trash, and litter concerns, with some people being quite bold in stating they didn't want "strangers" on their beach, despite its public rights access. Initially, this resulted in political pressure to cancel the event. Notwithstanding this resistance, the community as a whole rallied behind the local public health department, and with business intervention and other stakeholder input

(plus negotiation and flexibility), the event enjoyed substantial support and was quite successful.

A review of the solar-electric pump-out vessel patent and research (outputs 5 & 6) reveals that the project involved significant stakeholder participation for both the state and federal grant, but also private donations to move the project from concept to reality. In the U.S., federal funding for state and locally administered pump-out programs is allocated through the Clean Water Act and managed by the U.S. FWL. A pump-out vessel has a suction pump and large holding tank to “pump out” recreation vessels' untreated sewage from their holding tanks into approved sewage treatment systems. Pump-out vessels that release untreated sewage negatively affect human health by exposing swimmers and beachgoers to pathogens and inhibiting access to coastal resources (Hemez et al., 2020). In 2015, it was determined that the area’s current pump-out vessel needed to be replaced. With the support of the health district’s board of directors, I undertook the research, design, development, and construction of a zero-carbon emission replacement vessel, complementing the electric/hybrid automobile fleet of our public health agency. While the cost was twice as much as a traditional gasoline-powered vessel, with grant funding covering only 75% of the total cost, the funding gap was bridged via research and deep community engagement – the total cost of the vessel was estimated at $200,000.00. While the local community was widely supportive, some local stakeholders were less so, with the project investment becoming the target of political scrutiny. When the local community rallied behind our agency, private funding and donations moved the project forward through a marketing and branding campaign. The campaign undertook a programme of funding and grassroots public health education, emphasising a local climate change call to action. Eventually, in 2018, the christening and launch of the world’s first full-size solar-electric pump-out vessel took place as a town and state-wide celebratory event raising wider awareness. Local, state and national leaders praised the climate change milestone of no carbon vessel emissions, with media coverage held throughout the state, nation and international communities. Thanks to this innovative vessel, several U.S. States have reached out to me over the past few years, as they are in the funding and design phase of

building the next generation of this vessel for their CVA pump-out programs. I am sharing the open-sourced patent design and research (lessons-learned) to better improve the next initiation of the vessel. This experimental pump-out vessel was also nominated by the U.S. FWL for the U.S. State Organization of Boating Access for the 2022 Presidents Award and was selected for the most prestigious national honour within the boating world. The award plaque notes – "For their groundbreaking project to put an environmentally sustainable, solar-electric powered pump-out boat into service while assessing the benefits beyond keeping sewage out of the water".

Figure 14: *World's First Solar-Electric Pump-out Vessel (Hvizdak Photographer)*

Citizen Science & Innovation

A review of the 10 EPHS model refers to citizen science and innovation across several functions, directly referenced as follows –- EPHS No. 4 states "Strengthen, support, and ***mobilize*** communities and ***partnerships*** to improve health" whereas, EPHS No. 9 states "Improve and ***innovate*** public health functions through ongoing evaluation, research, and continuous quality improvements". Within this framework, the study outputs offer significant post-research impacts and public engagement outcomes, both with the utilisation of citizen science and the use of innovation. Each original study has led directly to a design and practice-based policy execution addressing public health problems and issues, with wider follow-on impact. This includes cutting-edge implementation of experimental, non-approved EPA methods, using Deoxyribonucleic acid (DNA) water quality identification and source tracking of human and animal fecal contamination (outputs 1, 3 & 4) to further advance the research and development of this public health tool (Brooks et al., 2022; Esenther et al., 2022). While some limitations were initially encountered with the process of using DNA analysis to conduct animal species identification from E. coli contamination isolates, in recent years this methodology is now gaining traction and is being used for root cause identification of fecal bacteria in recreational water bodies (Ballesté et al., 2020).

The Short Beach Citizen Science Project (output 4), was the first-ever in Connecticut to utilize MTS with DNA markers to assess the water quality, including mapping of current direct and indirect sources flowing from the neighbourhood within the Farm River Watershed (Kramer, 2019). Several of the project volunteers reported that the opportunity to learn and use cutting-edge technology was a draw to the project, along with the satisfaction of knowing that their neighbourhood was among the first to get to use the technology.

In 2015, outputs 5 & 6 were produced, complementing outputs 1-4, centring on the research, design, and implementation of a solar-electric pump-out vessel. This involved the first nationwide survey of all pump-out vessel programs in the U.S. The survey examined

barriers to implementation and explored interest in expanding the concept across North America and beyond (Hemez et al., 2020). Within the follow-up research, the team discovered that this technology could be implemented in other governance areas, in private industry commercial vessel fleets, and recreational vessels. The technology not only met the design criteria but exceeded our expectations in terms of solar-battery power operations in the field (Hemez et al., 2020), but also nominated for several innovative awards.

Each of the studies was relational and served as a building block to develop knowledge and disseminate into international-level research and practice communities; each study led towards securing further funding towards investigation into the limitations identified via previous outputs. This demonstrates academic progression and maturity in the research and design programme paradigm. Later research identified limitations in bathing water methodology. With state and federal guidelines, and mobilising government-stakeholder partnerships, local pre-emptive beach closure policies (output 2) were implemented to backfill state and federal gaps in established recreational water quality policy (Colford et al., 2007; Morrison et al., 2003). Regulations and policies concerning beach closure at the U.S. federal and state level appear inadequate to protect public health, especially given the ways that clear and significant impacts of climate change-related alterations in weather patterns have exacerbated water quality issues in coastal urban areas, leading in turn to increased contamination of marine waters (Shehane et al., 2005; Heaney et al., 2014). Current laboratory testing procedures require 24-48~ hours between sample collection and reporting of assay results by the lab, during which time the potentially contaminated beach remains open. Beaches are closed if enterococci levels (a measure of fecal contamination) are found to be above a threshold value; however, due to the long turnover time for analysis, beach closures based on previous-day bacteria tests are accurate only 33% of the time – worse than random (Morrison et al., 2003). Output 2 led to policy change: pre-emptive beach closure policies across several communities within the local health district jurisdiction. The output also undertook the first Connecticut statewide survey to assess local health department beach closing criteria.

While Outputs 1-4 and 5-6 may, on the surface, appeal distinct; however, their originality and harmonious relationship are interconnected by both themes and by thesis title. Specially, all the outputs are linked by community participation (citizen science) as there are built on public interest and community resilience in addressing climate change impacts, specifically to improve water quality. This is carried out by deep stakeholder engagement and holistic citizen science that is present in all the research outputs, which progressively advances and is apparent over the years as the outputs are built on each other. Outputs 1-4 utilize some innovative, non-traditional water quality methodologically/public health tools:

- Creation of innovative and environmentally friendly tools for water environmental control,
- Performance of different techniques for detection of infectious water contaminants (e.g. E. coli) and human health implications,
- Use of innovative techniques (qPCR) and weather variables to detect and control water contamination and risks (DNA, non-approved EPA MST, pre-emptive beach closures)
- AND, the importance of organized, engaged, local stakeholders in protecting water quality /public health (Specially output# 4, as well as output 1).

Output 5 & 6, Linking broad sustainable and environmentally friendly technologies (low carbon footprint) and water quality control through vessel waste prevention, also addresses climate, as the research of output 6 supports output 5, the research, design, and implementation of the first of its kind, the solar-electric vessel. These outputs also involved grassroots fundraising and community engagement as well as stakeholder commitment. Prior community citizen output science projects energized not only neighbourhood-specific participation but rather galvanized multi-community commitment, including fundraising and, more importantly, political/civic environmental supportive role of citizens influencing governance.

Therefore, when analyzing these two groups of research outputs, as outlined within the title and the interlinkages of themes, whether a tangible project, an innovative pump-out

vessel, or the use of cutting-edge/innovative technology or policy, the outputs all are grounded in water quality resulting and relating to climate change, fueled by a true spirit of all-encompassing citizen science embracing form.

Discussion

Meaningful Community Participatory Science

The literature review offers a plethora of definitions, knowledge and opinions about citizen science, with global discussions drawn from print and digital media, respected and professional magazines, and peer-reviewed academic journals and books. In April, Global Citizen Science month, Discover Magazine featured, as its top story, “Citizen Science Month 2022: Turning Curiosity into Impact Around the Country”, highlighting 114 different events involving hundreds of thousands of participants (Discover, 2022). Science intrigues many people, making citizen science a fertile ground for public engagement. Within my investigation, and as I have personally observed, and as noted by Baudry and his colleagues, there are degrees of community participation, while the balance between amateur and professional scientists needs to be better defined within their spatial arenas (Baudry et al., 2022). Another source notes, "In thinking holistically about participation, engagement and governance…, [discusses] “societal good,” on the powers of government, and on which interests should hold sway over others” (Woolley et al., 2016).

An academic consideration of citizen science requires discussion of participation. These discussions of degree of participation often do not capture important subjective and context-relevant dimensions, such as credibility and trust (Wynne, 1992,;Wulfhorst et al., 2008), fairness (Rowe & Frewer, 2005; Cheng et al., 2008), responsiveness (Gaventa, 2004), relevance (Cumming et al., 2008), agency (Cleaver, 2004), and due diligence in the development of appropriate research strategies (Cheng et al., 2008). The research process and project outcomes need to be carefully considered with due diligence during research development, as they are key components of high-quality participation (Shirk et al., 2012). As Shirk and his colleagues articulated, and as I have learned first-hand within my work,

these context-relevant dimensions must be considered for proper project design and desired outcome, and require skills in negotiating relationships with community participants.

Within the public sphere, citizen science has a scientific purpose; it also adds value to the lives of individuals, the well-being and cohesion of communities, and processes of effective and democratic governance. Self-satisfaction from project engagement can lead to quality-of-life enhancement, but it is important also to note the limitations to citizen science participation, both at individual and community levels, as well as the boundaries within governance for making trusted, non-biased decisions within the public health jurisdictions served. Population health is a fundamental and core function of public health governance that focuses on the sum of the whole (community), and not just the sum of the parts (individuals) (Arah, 2009).

Figures 15 and 16 below outline necessary considerations before embarking on a citizen science endeavour. Successful projects need to be well-managed, with clear expectations, yet sufficiently flexible to prepare for the unexpected and the challenges. Clear boundaries and expectations between professional scientists and citizen scientists are important. Consideration must be given to the balance between professional scientist research and citizen scientist public interest, as these are not always in alignment (Shirk et al., 2012).

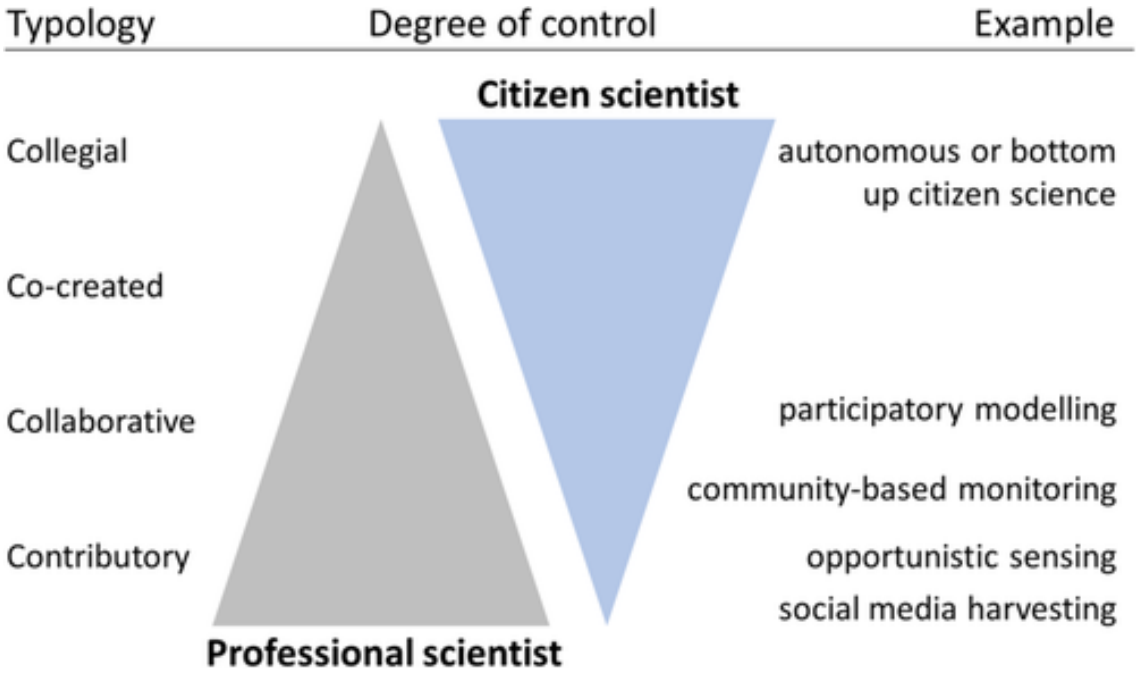


Figure 15: *The relative degree of control of citizens and professional scientists and project categorisation modeling (Shirk et al., 2012)*

The tradition of engaging public participation has value and can be instituted at all levels within public governance and beyond, as well as across several disciplines. While it may be challenging to manage citizens in a volunteer project, in general, the research suggests that the advantages far outweigh the challenges, along with bringing in long-lasting beneficial outcomes, provided the hosting institutional organisation is open-minded and is willing to support/learn from the citizens/community. However, we must acknowledge the human element and unpredictability of peoples interested in citizen science engagement. Volunteers are not employees and therefore, traditional labour-like rules do not apply. Considerations of liability and accountability must be managed and risk can be reduced through well-established training programmes, well-designed projects and roles, and clear written and verbal communication. Lastly, expectations need to be clearly outlined both for the participant and for the sponsoring organisation/agency. Not every citizen is a right fit to actively engage in the role of citizen scientist for every project; effective screening processes need to be developed that are fair and capacity-based, and training resource and time needs to be built into projects.

The positive impacts of active public contribution include:

- •empowering communities to resolve local situations
- •holding government agencies and businesses accountable
- •information sharing and problem resolution
- •promotes greater awareness and community buy-in,
- •cost-effective/reduce costs (in some situations)
- •diversity of approaches to solutions.

The potential challenges include, but not limited to:

- •hidden agendas and ethical biases,
- •privacy violations,
- •misuse of data,
- •additional workloads and resources to manage and train participates
- •open access and data sharing/confidentiality conflicts.

Figure 16: *Considerations - Citizen Science Project Pros & Cons*

Public Health Community Engagement – Research to Policy

Through The Nature Conservancy 2011-12 project, later reinforced by the 2014-16 Coastal Community Resilience Plan process outputs 1 & 2 that engaged people in community conversations, it became apparent that community members, governance, businesses, and other vested parties had both significant and legitimate concerns; that there exists a rather large population of sceptical individuals; and, in some cases, that there are people adamantly opposed to any discussion relating to climate change. As I look back on the earlier study designs and reflect on the later studies, the progressive incremental use of

citizen science was intentional and necessary for these research outputs to move forward. Without that participation, it is doubtful that the initiatives would have transitioned to successful practical public health policy and project achievements. Reflecting on output 1, the 2012 foundational research study, was both a grant-funded project and a partnership between Yale University and the local community. The project investigating why water quality was being impacted, conducted its investigations not via entrenched practice of checking out usual and expected sources – failing septic systems, agricultural run-off, and other known causes – but also through conversations with the community about changing rainfall patterns and intensified weather events. This study also utilised a promising, but unapproved EPA water testing methodology and an experimental, yet innovative, water-quality DNA MTS Tracking tool. This was used to identify contamination between human and non-human sources. Fast-forward to December 2022, output 3, which appeared in the Journal of Environmental Health as the lead feature research "Advancement of the Science" promoting MST as a public health tool for state and local public health officials.

Output 1's research study – the community event, accompanied by education about water quality had the dual purpose of raising awareness among residents and businesses about water quality issues, while also building community connections and cohesion via the first social public clam dig. The event was supported by the community and business in-kind services and staffed with volunteers and was the first citizen science project and landmark citizen science project within Connecticut – a model subsequently taken up elsewhere.

Figure 17: *Branford's First Community Clam Dig - Local Shellfishing Marketing & Promotion. (Front Cover & Event Photos, Seagrant Wrackline Magazine)*

Reflection on outputs 3 & 4 highlights that both of these demonstrate the progression of citizen science and its bold use of experimental innovation methodologies. By now, the "citizen science" tag was being confidently used, along with a shift in project design and implementation. Academic evidence bases wove with close community engagement built in at every stage, from conception to execution. Community engagement included informal conversations with residents on concerns about recreational water quality and excessive rainfall events, that led to beach closures. The process moved on to include grassroots open meetings in the historic Short Beach 1883 neighbourhood church (Figure 18); and

continued into training and empowering a team of highly motivated, driven, and committed citizen scientists who willingly used cars, boats and other in-kind personal finances to sample and deliver water samples to the state public health testing laboratory. This study improved communication within and around Short Beach about improving long-impaired neighbourhood recreational and shell-fishing water quality. The study also aimed to (1) identify possible sewage disposal system sources of beach water *E. coli* contamination; (2) quantify and identify outfall sources of this contamination; and (3) foster engaged relationships and cross-community networks between academia, local government, and neighbourhood residents. Thanks to this study, there is vastly improved understanding of the influence of compromised stormwater systems on local water quality/sewage disposal systems has been mapped to assess sources of contamination; and resident capability and expertise have been mobilised. The cohort of willing and trained volunteers now provides a new resource and workforce base for scientific research projects, supports the democratisation of research, and has built robust cross-community connections.

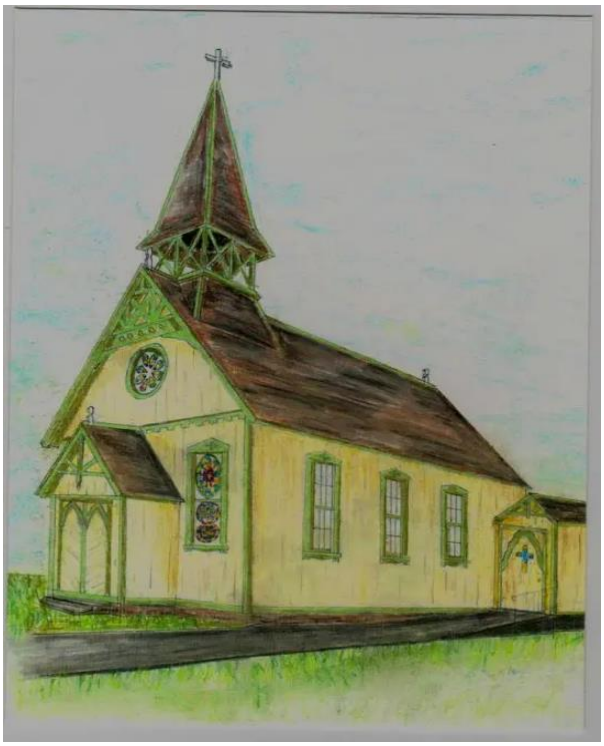


Figure 18: *Founded in 1883, Short Beach Union Church -The First Gathering Site For Connecticut's DNA Water Quality Citizen Science Project. (Source: Branford Connecticut Patch)*

Learning From Our Communities

In many public safety professionals, a measure of success within agencies, especially the public health sector, disciplines is measured in our ability to interface with the community; likewise, law enforcement, fire safety authorities and other governance. Health officials' most effective tool is their ability to modify unhealthy behavior. This can only be accomplished with trustworthy education, which lies within the agency's reputation as a respected governing entity. The lesson was quite apparent in Output 1 and was progressively refined and evolved with the subsequent outputs over the years – community participation was essential to our effectiveness.

One strong example of engagement from community members was quite evident in Output 4, as the scientific integrity of the volunteer samplers significantly increased research capacity. As some outfalls flowed for only 15 minutes following a rain event, many samples would have been unattainable without citizen scientists. Residents were given the opportunity to express concerns and anxiety at Civic Association meetings, such as whether they may be forced into costly public sewer connections if failing septic systems were found at fault; and dismay with lack of public access to past reports and data. The goal of full transparency with citizen science collaborators requires acknowledgment of power differences and potential conflicts of interest. Openly recognising the legitimacy of resident concerns and the value of cooperation to the health department is key to maintaining a balance between collaborators. The project models and acts as a guide on how to open space for better communication, cooperation, and collaboration. The health department is now committed to ongoing discussions, data sharing through its website, and working with sensitivity regarding its regulatory power to force public sewer connections; and the Department works alongside the community to achieve a mutually beneficial and mutually understood outcome. As such, it is innovative in approach and offers a model of best practice for adoption in other local authorities and across other government departments.

Without citizen scientist assistance in output 4, the breadth and frequency of sampling would not have been possible. Furthermore, citizen scientists identified an outfall, RA2, that was not in the original sampling plan. Citizen science can increase data capture in

water sampling, as well as in other public health programmes relying on highly time-sensitive collections (Esenther et al., 2022). A formal Volunteer Appreciation Dinner and Awards Event was held to recognise the MRC members/citizen scientists' commitment to the community and assistance to the health district in protecting public health,. This included official citations of appreciation provided by local and state political leaders, and the health district. This built goodwill, consolidated the volunteer position as something of value to citizens and district administration alike, and offered opportunities to consolidate the work done and hold the base solid, ready for future endeavours.

In an event specifically to engage local youth around climate change – outputs 5 & 6 – the health department held a contest with three middle school districts to name the new solar-electric pump-out vessel. We used this opportunity to promote knowledge about climate change, community engagement, and innovation (10 EPHS Framework). Figure 19 shows how youth were involved in a fun and hands-on manner toward community-based climate change solutions. The winning district school class received a pizza party and a field trip to the marina where the solar-electric vessel was docked – the winning name was "Solar Shark".

Figure 19: *A Tuttle Elementary School Class Aboard the "Solar Shark" (Photo: New Haven Register)*

Limitations

Citizen science has its place in public policy, albeit within governance which was acknowledged and discussed within the literature and in this thesis. I also acknowledge that these projects were conducted within highly well-educated and affluent areas of New England's southern coastal areas of Connecticut, which limits the applicability of findings. The fact that it is a predominantly Democratic region may also play a part in better policy implementation and outcomes. Factors of demography, positionality, and situatedness are acknowledged and explored in this thesis.

Notwithstanding limitations, citizen science has been demonstrated within the literature review and within the practical outputs of this thesis to advance public health initiatives, regardless of demographic and political questions.

Conclusion

Collaborations with local citizen scientists offer opportunities to collect valuable data sets otherwise unavailable to researchers. Involvement of community members in research design and execution can also improve researchers' local knowledge, better inform study aims and approaches, and improve quality, relevance and dissemination of public health research (Cooper et al., 2021). Most public health intervention strategies require a human behaviour change to work. This thesis's qualitative data review and inductive and exploratory approaches highlighted the core themes – stakeholder engagement, trust, and innovation. These core themes underpinned research and projects with authentic local public health citizen science implementation in Southern Connecticut. Linking climate change and water quality proved to be a practical way of mobilising community participation.

Climate change, despite significant research on the subject, is still misunderstood by many in the electorate and government. The issue has become politically polarised – even though, tangible effects on daily life are apparent. Linkages between successful research outputs and public health interventions and policies were engendered via common themes that evolved – with the foundational thread entrenched within citizen science. Community participation strengthens and links the studies, which progressively demonstrate the importance of stakeholder engagement, trust, transparency, innovation, and the human component of sincerity – a key element and foundation of successful public health outcomes. This thesis also reflects upon and demonstrates the significance of relationships and networks among communities, scientists and public health governance to arrive at the conclusion that successful public health policy implementation (or its failure) is grounded in trust and transparency.

Lessons Learned: With local support and policy buy-in, long-term, sustainable health improvements and outcomes offer best returns for governmental policy interventions. However, citizen science has limitations and boundaries that must be better defined.

Respected boundaries are also required between public engagement and the right to participate, and public health governance's long-established legal and moral obligation associated with decision-making to protect population health. This has proven challenging, as observed in discussions where public anxieties about sewerage and costs were evident, while COVID-19 opened significant conversations about the balance between individual rights and community rights. Population health is being tested with different degrees of citizen science, even as it expands to other disciplines.

Final Words

My professional contributions to these outputs supported quality research and dissemination, plus impactful public health resolutions to problems. As senior author and group leader, including the corresponding author, I was involved in every research phase, from design and execution, to write-up for professional and scholarly outputs. I note that these research outputs do not discuss the "outcomes of impact plans". This is because every study has already been implemented via real-world solutions positively impacting environmental and human health.

Upon completing my Ph.D. by (Retrospective) Publication, I will further publish my findings to add to the corpus of knowledge. Lessons for policymaking will be shared for the benefit of public health colleagues and for social policy communities of research and of practice. In addition to contributing to the literature on climate change, water quality, and citizen science, I plan to contribute to in-person conference proceedings of national professional associations with a core focus on these areas of interest. It should also be noted, that the solar-electric vessel investigational research is ongoing – I currently investigating the next generation of solar-electric technology with an open-sourced shared design. It includes comparative noise pollution levels of traditional fossil fuel combustible engines and electric engines, as well as data on the relative impacts on marine life. The studies are ongoing and are expected to continue over several years, and provide a demonstrated triple development: research methodologies and scientific knowledge;

effective strategies for stakeholder engagement; and follow-up development. Dissemination and public impact work.

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Appendix 1.

Glossary

Common universal definitions

- **Citizen Science (CS):** Also known as community science, crowd science, crowd-sourced science, civic science, or volunteer monitoring project, it is scientific research conducted, in whole or in part, by amateur (or non-professional) scientists.
- **Climate Change (CC)**: Climate change refers to long-term shifts in temperatures, precipitation, and weather patterns. These shifts may be natural, such as through variations in the solar cycle. Since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels such as coal, oil, and gas.
- **Community Engagement:** Community engagement (also sometimes referred to as civic engagement) is the collaboration between institutions of higher education and their larger communities (local, regional/state, national, global) for the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity.
- **Epidemiology**: Epidemiology is the foundation of public health and is defined as the study of the "distribution and determinants" of diseases or disorders within groups of people, and the development of knowledge on how to prevent and control them.
- **Innovation:** Innovation can refer to something new, such as an invention, or the practice of developing and introducing new things. Innovation is often the development of a new product, but it can also be a new way of doing something or even a new way of thinking.
- **Public Health:** Public Health is defined as "the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society" (Acheson, 1988; WHO).

- **Transparency:** Transparency promotes accountability and provides information for citizens about what their government is doing and how it is doing it.
- **Trust:** Firm belief in the character, strength, or truth of someone or something.
- **Water Quality:** Measurements of the characteristics of water, which can include chemical, biological, physical, and radiological characteristics. This is usually measured relative to human needs, though it can also be looked at in terms of how the quality of water affects animal and plant ecosystems.

Appendix 2.

Acronyms

CDC	Centers for Disease Control & Prevention
CO2	Carbon Dioxide
CT DEEP	Connecticut, Department of Energy & Environmental Protection
DITO	Doing -It-Together Science
DNA	Deoxyribonucleic acid
EPA	Environmental Protection Agency
EPHS	Essential Public Health Services
FEMA	Federal Emergency Management Agency
IPCC	Intergovernmental Panel on Climate Change
MHHW	Mean Higher-High Water
MRC	Medical Reserve Corps
MSL	Mean Sea Level
MST	Microbial Source Tracking
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
NEHA	National Environmental Health Association
PPM	Parts Per Million
U.K.	United Kingdom
U.S.	United States
U.S. FWL	United States Fish and Wildlife Service

Appendix 3.

List of Publications

- Output 1: Pollution Source Survey and Assessment of the Farm River Watershed in East Haven and Branford, Connecticut. 2012. Published 2012 in the State Archives: State of Connecticut Department of Agriculture – Farm Viability Database

- Output 2: Bacterial Contamination in Long Island Sound Using Preemptive Beach Closure to Protect Public Health, New Haven, Connecticut. 2016. Published 2023 (Accepted/To Be in Print April 2023) in the National Environmental Health Association's Journal of Environmental Health

- Output 3: Microbial Source Tracking (MST) - Analyses in the Sasco Brook, Lower Farm River, and Goodwives River Watersheds in Long Island Sound, New Haven, Connecticut. 2017. Published 2022 in the National Environmental Health Association's Journal of Environmental Health – Feature Research, Front Cover, Achievement of Science

- Output 4: Improving Water Quality in the Short Beach Neighborhood of Branford – A Citizen Science Project, New Haven, Connecticut. 2019. Published 2022 in the American Public Health Association's American Journal of Public Health

- Output 5 (A, B & C): Solar-Electric Pumpout Vessel, United States Provisional Patent NO. 63/030012 United States Patent NO ESDH100001000 – October 10, 2020

- Output 6: Climate, Health, and Cost Impacts of Solar-Electric Pump-out Boats, New Haven, Connecticut. 2017. Published 2020 in the Journal of Water Practice and Technology

These are represented graphically on the following page.

Retrospective Ph.D. By Publication – Cohesive Body of Research

Appendix 4.

Publication contribution summary to the critical appraisal and my contributions

Provisional Title: Climate impacts, water quality and citizen science in coastal southern Connecticut: A review of factors supporting practical public health engagement

Introduction:

In the course of my ~30-year career as a public health official - from a college undergraduate and newly minted field health inspector to my current role as an appointed CEO/Director of Public Health at a regional coastal governmental agency, as well as recent roles as academic researcher and educator at two USA universities - I have increasingly come to realise the role of stakeholder engagement in determining the level of success of any public health community project, policy, or initiative. Over the last 10 years, I have documented issues in relation to climate impacts, water quality, and citizen science which demonstrate my research competences at a doctoral level. Through the process of producing five peered-reviewed publications and registration of a U.S. Patent (summarised below), I have trained and become professionalized in doctoral-level work. This includes selection of a suitable journal, the submission and resubmission processes - including dealing with rejection - the costs of open access publication/patent application and joining a community of scholars as a peer. The foundation for my probationary proposal for a PhD by (Retrospective) Publication is a critical appraisal of my own research questions, goals, and aims. This critical analysis reflects my progressive involvement in citizen science, and an academically informed understanding of and commitment to significant open and honest stakeholder participation. The foundational core of my published outputs was partnerships, reflecting both formal and informal networking. Failures and setbacks, as much as success, furnished learning opportunities. While my early research outputs only addressed stakeholder engagement at the margins, over time, a common thread of citizen science and deep-rooted, community partnership and collaboration emerged.

About My Publications/Contribution to the Research & Profession:

My citizen science engagement has revolved around water quality/climate change issues, where my contribution has been significant in all phases of research and publication. As the last and corresponding author for several articles, I formulated the research questions and designed the research methodology in ways that served practical public health outcome objectives. Many of these publications have resulted in - or document - positive measurable community-based impacts on quality of life, while advancing the knowledge-base significantly. Deep stakeholder engagement created an investigative roadmap of data to explore 'root cause' health analyses and create a unified approach towards practical strategic solutions. Each output involved an assessment informed by academic literature and robust methodology.

Capital investments in community and stakeholder engagement, while beneficial, do pose risks and potentially negative impacts to public health policy implementation. The cost-benefit balance of these scientific outputs requires further examination. For example, in the Short Beach research (output 4), significant water quality field investigation and sampling was necessary. However, limited local public health resources hampered field investigations and water sampling, especially during random wet weather events. Engaging local, long-time residents within the neighborhood of concern was fruitful, generating field environmental field sampling and in-kind local resources that would not have otherwise been available. Likewise, town records on outfalls were minimal or non-existent. Local neighborhood knowledge directed the team to sample outfalls that were unknown to town records, where high levels of bacteria were subsequently identified. While this community engagement was significant and beneficial, volunteer involvement also created a set of project management challenges, including employee-like relationships, (involving neighbor disputes and complaints) as well as increased political scrutiny.

Another successful project was the solar-electric pump-out vessel research and patent (outputs 5 & 6). A current pump-out vessel needed to be replaced - costing around $100,000.00. I undertook the research, development and construction of a zero-carbon emission replacement vessel, complementing the electric/hybrid automobile fleet. While the cost was twice as much as a traditional gasoline powered vessel, with grant funding covering only 75% of total cost, the funding gap was bridged via research and community engagement. While the local community was supportive, local stakeholders were less so, with the project investment becoming the target of political scrutiny. When the local community rallied behind our agency, private funding and donations moved the project forward.

These studies also offer significant post-research impacts and public engagement outcomes. Each of the original studies has led directly to the design and practice-based policy execution addressing public health problems and issues. This includes: cutting-edge implementation of experimental DNA water quality identification and source tracking of human and animal fecal contamination (outputs 1 & 4); advanced follow-on research that drilled down on the DNA analysis limitations to conduct animal species identification from E. coli contamination isolates. Each of the studies served as building blocks to secure further funding investigation into limitations identified via previous outputs, demonstrating academic progression and maturity. Later research identified limitations in bathing water methodology with the state and federal guidelines, and through government-stakeholder partnership, local preemptive beach closure policies (output 2) were implemented to backfill state and federal gaps in established recreational water quality policy. Regarding the patent of the world's first solar-electric pump-out vessel (output 5), research outputs 1-4 and 6 represent scholarly and professional work currently used within climate change and water quality applications. The vessel investigational research is ongoing, currently investigating the comparative noise pollution levels of traditional fossil fuel combustible engines and electric engines, and the impacts on marine life. The outputs I am submitting on the noise research are recent and have not yet had the chance to gather citation but can be expected to do so over the next 5 years.

Summarizing, my professional contributions to these outputs led to quality publications and impactful public health resolutions. As senior author and group leader, I was involved in every phase

of the research, to include the research design, execution, and the write-up of results for professional and scholarly outputs. I note that these research outputs do not discuss the "outcomes of impact plans" because every study has already been implemented through real world solutions with positive impacts upon environmental and human health.

Note: The research outputs comprising my dissertation are outlined and further detailed in my CV.

Publication ***(Note: Research order based on original study – current to past)***	**Contribution**	**Word Length**
Output 6a: *Hemez C, Ryan E, Chiu J, Sun J, Dubrow R, Pascucilla MA. Climate, Health, and Cost Impacts of Solar-Electric Pumpout Boats, New Haven, Connecticut. July 2020.* **Output 6b** - Journal of Water Practice and Technology. July 2020. (Last Author) Open Access Funding Secured - $1,900.00 / In-Kind Contribution: Health District, Yale University, U.S. Fish & Wildlife Agency & State of Connecticut Department of Energy and Environmental Protection https://iwaponline.com/wpt/article/doi/10.2166/wpt.2020.063/75388/Environmental-and-health-impacts-of-electric?searchresult=1	Last Author	34,892 (Long Version) 6,849 (Manuscript Version)
Output 5a: Patent/Creative Works: *Solar-Electric Pump-out Vessel / Four-year Grant Funded, Research and Development Project. Research & Design/Development/Operational Cost - $302,000.00~* **Project Grant Award** – U.S Fish & Wildlife/Connecticut State Environmental Protection Grant Recipient- $150,000.00 for Research & Design Solar-Electric Pump-out Vessel. **Project Matching Funds** – Leveraged Partnerships, fundraising and community grants to bridge the balance of $50,000.00. **Operation Grant Award** - $102,000.00 for the vessel's operational cost. ***Output 5b: Patent: United States Provisional Patent Completed Application NO. 63/030012 – May 25, 2020United States Patent NO. ESDH100001000 / Confirmation # 9722– October 10, 2020, Patent Fee $1,820.00 -*** ***https://patentcenter.uspto.gov/applications/17077151/ifw/docs*** ***Output 5c & 5d*****: Magazine Publications:** **Output 5c**: University of Connecticut, Sea Grant Wrack Lines Spring/Summer 2020 - https://seagrant.uconn.edu/wp-content/uploads/sites/1985/2020/05/Wrack-Lines-S2020-final-web.pdf	Sole Inventor (Consulted with Patent Attorney)	41 Plus Page Application with Numerous documents, grant/legal applications, drawings, and other writing submissions required for this project. Film/Video Coordinator & Project Grant / Patent Lead. 1,946 1,278

(2020 Association for Communication Excellence, Bronze Award) **Output 5d:** Southern Connecticut State University, Alumni Magazine Summer 2020 - https://issuu.com/scsu/docs/smag48ppsum20-f-proof-r6 **Note**: Multi-Grant applications, budget, project management, fundraising, legal review, support letters, patent application, presentations, conference presentations/creative film/video, numerous media articles – local, state, national and worldwide, interviews, last author, etc... This project was nominated* for the following water quality/climate change recognition: 2021 States Organization of Boating Access – Leading Project Award* 2020 The Oceans Award* 2020 Association for Communication Excellence, Bronze Award – Sea Grant Wrack Lines Spring/Summer Magazine (Received) 2019 Dan David Award, Climate Change Category* 2019 States Organization of Boating Access – Scholarship/Presidents Award* 2019 American Climate Leadership Eco-Award, Invited/Attendee Scholarship* 2019 American Public Health Association's Excellence in Climate Leadership Award, Finalist*		
Output 4a: *Dubrow R, Esenther S, Jossart C, Schlick K, Wang N, Pascucilla MA* *Improving Water Quality in the Short Beach Neighborhood of Branford – A Citizen Science Project, New Haven, Connecticut. March 2021.* ***Output 4b:*** ***Publication*** – American Journal of Public Health. September 2022 (Last & Corresponding Author) Open Access - https://ajph.aphapublications.org/doi/10.2105/AJPH.2022.306943 **Grant/In-kind match: $11,600.00 total** Part I: $4,000.00 Yale University Grant Part II: $6,600.00 Local Public Health In-Kind	Last & Corresponding Author	7,312 (Long Version) 5,310 (Manuscript Version)

Output 3a: *Brooks L, Cooper M, Caccone A, Knauf D, Pascucilla MA. Microbial Source Tracking (MST) - Analyses in the Sasco Brook, Lower Farm River, and Goodwives River Watersheds in Long Island Sound, New Haven, Connecticut. March 2021.* Grant Funded – State Department of Energy & Environmental Protection Project Clean Water Act Section 319 Grant - $105.351.00 (Including Match) in Public Domain. **<u>Grant Actual</u>: $49,906.00 total** **<u>In-kind match</u>: $55,465.00 total** Part I: $20,465.00 Yale In-Kind Water Quality Laboratory Part II: $35,000.00 Local Public Health In-Kind ***<u>Output 3b</u>: Publication*** **-** Journal of Environmental Health. December 2022, (Last & Corresponding Author). Open Access. Achievement in Science, Featured Cover Research Article - https://2022.neha.org/sites/default/files/flipping_book/dec-2022-jeh/index.html	Last & Corresponding Author	8,074 (Long Version) 4,072 (Manuscript Version)
Output 2a: *Lehane A, Marks B, Ramsden D, Chen R, Dubrow R, Pascucilla MA. Bacterial Contamination in Long Island Sound: Improving Beach Closure Policy and Assessing the Impact of Climate Change, New Haven, Connecticut. March 2021.* ***<u>Output 2b;</u> Publication*** **-** Journal of Environmental Health. April 2023. Last & Corresponding Author). Open Access - https://2022.neha.org/sites/default/files/flipping_book/april-2023-jeh/26/index.html **Total Research Funding: $**9,000.00 – Combination Local Health Departments/Yale University	Last & Corresponding Author	11,223 (Long Version) 1,688 (Manuscript Version)
Output 1: *Brooks L, Romrick L, Pascucilla MA. Pollution Source Survey and Assessment of the Farm River Watershed in East Haven and Branford, Connecticut. 2012.* ***Manuscript Completed/Published in State Archives***: **CT Department of Agriculture - Farm Viability Grant Database -**https://portal.ct.gov/-/media/DEEP/water/tmdl/CTFinalTMDL/farmriver5112 Grant Funded - State/Federal Project Total $97,039.00* in Public Domain.	Last & Corresponding Author	7,025

***Grant Actual**: **$41,711.00 total** Part I: $36,235.78 Water quality studies Part II: $5,475.22 Promotional projects **In-kind match**: **$55,328.00 total** Part I: $36,529.00 Water quality studies Part II: $18,799.00 Promotional projects		

Non-Published/Current Related Research & Practical Professional PhD Supplemental Considerations:

Grace, S, Pascucilla MA. The Sound of Silence; Environmental Benefits of Solar-Powered Pump-out Boats in Branford Harbors. Branford, Connecticut. June 2020.
Grant funded: Total $11,000.00 - Private industry - Torqeedo Seed Funding ($5,000.00), Southern Connecticut State University in-kind match ($3,000.00) and East Shore District Health Department ($3,000.00)

Soroka H., Naclerio. B, Pascucilla MA. A Citizens Science Project – Climate Change in Connecticut: A Research & Photojournalism Road Map to Awareness.
Grant Funding: Total $20,000.00 - National Environmental Health Association ($8,000.00), Yale University's Center for Climate Change & Health ($6,000.00) and East Shore District Health Department ($6,000.00)

Research & Professional Articles:

- Yale Center on Climate Change and Health - ***Climate Change and Health in Connecticut: 2020 Report.*** https://publichealth.yale.edu/climate/YCCCH_CCHC2020Report_395366_5_v1.pdf - Acknowledged / Contributor

- Report to the Connecticut Governor's Council on Climate Change - Public Health and Safety - Contributing Work Group Member/Reviewing Author. September 2020 - https://portal.ct.gov/DEEP/Climate-Change/GC3/Governors-Council-on-Climate-Change

- University of Connecticut, Do Good Feel Good Alumni Magazine - https://magazine.uconn.edu/2021/02/17/class-notes-spring-2021/

- Community Person of the Week, Branford, Connecticut - https://www.zip06.com/profile/20160907/mike-pascucilla-finding-balance-as-health-director-and-ceo-of-east-shore-district-health-department

- Yale University, Yale Environmental Sustainability Summit https://yess.yale.edu/2017-agenda

- Southern Connecticut State University Newsletter - https://issuu.com/scsu/docs/smag48ppsum20-f-proof-r6

- Community Person of the Week, East Haven, Connecticut - https://www.zip06.com/profile/20200122/michael-pascucilla-ppsafeguarding-public-health

Research Description: Reflecting trends across the United States and globally, Connecticut's coastal communities are facing climate change impacts. There is an agreed necessity of preparing for further, more substantial effects of climate change, including water quality impacts in Long Island Sound. Coastal concerns related to climate change and water quality have been extensively explored in the research documented above and comprising this dissertation. Climate change, despite significant research on the subject, is still misunderstood by many in the electorate and government. The issue has become politically polarized - even though solid, tangible effects on daily lives are apparent and impactful. As differential COVID-19 vaccine rates have demonstrated, publics can have diverse and highly misunderstood understandings of science. The proposed thesis will explore best strategies for community understanding and participation, investigate the association linkages between stakeholder participation and education, and examine the relationship between community engagement and successful public health academic work. Specifically, while at the surface these research outputs may appeal broad, within my 10,000-word thesis, my critical analysis will drill down on the research questions and link the different outputs and patent commonalities into a cohesive body of public works. This research will also investigate strategies for creating public interest and building community resilience in transparent and trustworthy manners, in a context of addressing climate change impacts and improving water quality.

Critical aims/goal appraisal:

To develop a systematic executive framework that pulls together the citizen science literature from each study/patent output. To provide a comprehensive review clearly identifying the research limitations, gaps, and complications and the opportunities for successful, practical-based public health policy implementation.

To address the following research objectives:

- How can governmental agencies and policymakers improve health decision confidence and trust in the local communities they serve and the public health research that is presented?
- How best can agencies safeguard the health of populations within governmental agencies' charge by mobilizing the democratization of science - benefits and deficits arise from stakeholder engagement?

- How can agencies harness and mobilize the energy of scientific "boots on the ground" localism to improve specific environments, while supporting and promoting public health initiatives and policies?
- Can the human component of sincere communication form part of essential strategies in successful public health policies?

Upon graduation from QMU, the final critical analysis will be published in a peer reviewed high impact journal.

Proposed Research Methodology:

The core of my qualitative data review and underlying research explores the human side of successful and practical public health policy implementation. Public health is misunderstood and complex (Den Broeder et al. 2018). There does, however, appear to be a strong association between successful policy execution and community involvement/support, leading to better health outcomes (Vohland et al. 2021). These issues will be explored via a further examination into my individual outputs. My fundamental research philosophy is grounded in a multi-faceted, balanced, relationship between trust and transparency, rooted in an articulation and fostering of clear communication and intended impacts. This analysis will include a focused and layered critical appraisal of each study that will encompass a linkage to the collective cohesive body of research as a whole. Citizen science (or "crowd-source" science) links these studies, which progressively demonstrates the importance of stakeholder engagement, informal preparation/groundwork, and networking, especially at the local community level.

The qualitative approach that I will be taking will be a holistic review of the body of research. This critical appraisal will focus on the human relationships between local communities and successful public health policy. My research strategy will utilize an inductive approach to explore the research outputs on community perceptions as to how to effectively use citizen science and examine not only "what" people think but understand "why" they think this way. Specifically, in every study, the team faced a local risk factor within a neighborhood or town, with a desired outcome to resolve the problem in a systematic way, through stakeholder transparency and open and honest, sincere, conversational interactions. I will examine the outputs' various research methods, which include observational, interviews, focus groups, and surveys. The intent is to draw from this knowledge-based within an interpretive approach, to explore each output's lessons learned and understand the underlying theme of their success. While there may not be a specific research gap in citizen science research (Cohn 2008), many public health organizations do not fully participate and embrace this level of stakeholder engagement. If citizen science approaches are adopted, they are not always taken up with full commitment and transparency (Madison 2017). In some cases, the literature suggests some agencies may treat community engagement as a check-off box. Many governmental grant-funded projects require such engagement. Therefore, true candidly research crowdsourcing science used within public health governmental agencies, may, in many cases be superficial at best (Haklay et al. 2020, Gobel et al. 2019).

Citizen science has its place in public policy, although its limitations within governance must be acknowledged and will be discussed within each output. I also acknowledge that my projects were conducted within New England's southern coastal areas of Connecticut, one of the most well-educated and affluent areas in the world, which will limit the generalizability of my findings to other places. Given that citizen science can also be political by design, the fact that this is a predominantly Democrat region may also play a part in better policy implementation and outcomes. Factors of demography, positionality and situatedness will be explored within an intersectional framework.

Conclusion

Collaborations with local citizen scientists can offer opportunities to collect valuable data sets otherwise unavailable to outside researchers. Involvement of community members in research design and execution can also improve researchers' local knowledge, better informing study aims and approaches and improving the quality and relevance of public health research (Cooper et al. 2021). Most public health intervention strategies require human behavior change to work. With local support and policy buy-in, long-term, sustainable health improvements and outcomes are most likely to get the best return on investments for governmental policy interventions.

Upon completion of my PhD by (Retrospective) Publication, I will publish my findings in order to add to research knowledge about successful use of citizen science. Lessons for policy will be shared for the benefit of public health colleagues and social policy communities of research and of practice.

References:

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Appendix 5.

The Outputs: Five Publications and U.S. Patent Filing/ Application

Holland & Knight

10 St. James Avenue | Boston, MA 02116 | T 617.523.2700 | F 617.523.6850
Holland & Knight LLP | www.hklaw.com

Michael T. Abramson, Esq.
Michael.Abramson@HKLaw.com

22 June 2021

Re:
U.S. Patent Application No. 17/077,151
Filed: 22 October 2020
Applicant: East Shore District Health Department
Title: SYSTEM AND METHOD FOR SOLAR-ELECTRIC PUMP-OUT-BOAT
Our Reference: 094000.10472

Dear Mr. Pascucilla:

I can confirm that you are the only inventor listed on this patent application. Please let me know if you have any other questions.

Sincerely yours,

HOLLAND & KNIGHT LLP

Michael T. Abramson, Esq.

Holland & Knight

10 St. James Avenue | Boston, MA 02116 | T 617.523.2700 | F 617.523.6850
Holland & Knight LLP | www.hklaw.com

Michael T. Abramson, Esq.
Michael.Abramson@HKLaw.com

22 June 2021

Re:

U.S. Patent Application No. 17/077,151
Filed: 22 October 2020
Applicant: East Shore District Health Department
Title: SYSTEM AND METHOD FOR SOLAR-ELECTRIC PUMP-OUT-BOAT
Our Reference: 094000.10472

Dear Mr. Pascucilla:

I can confirm that you are the only inventor listed on this patent application. Please let me know if you have any other questions.

Sincerely yours,

HOLLAND & KNIGHT LLP

Michael T. Abramson, Esq.

Appendix 6.

Co-Author Contribution Statements

STATEMENT OF AUTHORSHIP OF PUBLICATION On behalf of Michael Pascucilla

By Lauren Brooks

I am registering for a PhD by Existing Published or Creative works. A condition of the registration is that I have a statement from collaborating authors confirming the contribution made by myself to jointly authored work. In our case the work is:

Brooks L, Pascucilla MA, Romrick L. Pollution Source Survey and Assessment of the Farm River Watershed in East Haven and Branford, Connecticut. 2012.

Michael Pascucilla actively pursued and successfully received grant funding for this project and led all aspects of the field and research coordination. This research project was locally recognized and was featured and presented State- wide by Connecticut's Department Agriculture, Bureau of Aquaculture, and the University of Connecticut's Sea Grant Program.

I would be grateful if you would supply the percentage of work in that article that is attributable to me by completing and signing the following statement.

I confirm that (Name of Candidate) contributed ____**80**_____ % to the above publication(s).

Signature _____

10/28/2018

Date _____

Statement of Authorship of Publication

June 21, 2021

Queen Margaret University
Queen Margaret University Way
Musselburgh EH21 6UU, United Kingdom

Re: Statement of Authorship of Publication
Michael A. Pascucilla

ATTN. Ph.D. by Publication Graduate School Review Committee:

My name is Mark A.R. Cooper and I support Michael Pascucilla's PhD by Publication for Queen Margaret University. As co-author, I attest that Michael A. Pascucilla made a significant contribution and is the last author to the below co-authored publication:

Brooks L, Cooper M, Caccone A, Knauf D, Pascucilla MA. Microbial Source Tracking (MST) - Analyses in the Sasco Brook, Lower Farm River, and Goodwives River Watersheds in Connecticut, New Haven, Connecticut. March 2017.

Mr. Pascucilla's contribution to the above reference study was instrumental as he pioneered the way for our MST research in Connecticut. Working in collaboration with Yale University and the State of Connecticut (CT), Department of Agricultural (DOA), he conducted the first water quality source tracking research study on the Connecticut coast in 2011-2012. At the time the research study, the methodology was considered cutting edge, experimental research and not approved by the US Environmental Protection Agency.

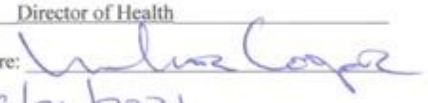
From his original research, we were able to secure funding from the State of Connecticut Department of Energy and Environmental Protection (CT-DEEP) through a U.S. Clean Water Act (CWA) Section 319 grant, in-kind resources from Yale University and collaborate with new partners to advance our research effort to improve the water quality of Long Island Sound.

Mr. Pascucilla, was essential securing the funding for this grant funding, and was the led project manager for Lower Farm River watershed areas. He also drafted the final presentations and research posters, and presented at several local, state and national conference venues.

Our research work continues today, and Mr. Pascucilla is one of the leads on this progressive water quality research, with the end goal of making this research tracking tool available to all local health departments in Connecticut.

Name: Mark A.R. Cooper

Title: Director of Health

Signature: 

Date: 6/21/2021

Output 1

Statement of Authorship of Publication

June 21, 2021

Queen Margaret University
Queen Margaret University Way
Musselburgh EH21 6UU, United Kingdom

Re: Statement of Authorship of Publication
Michael A. Pascucilla

ATTN. Ph.D. by Publication Graduate School Review Committee:

My name is Lauren Brooks and I support Michael Pascucilla's PhD by Publication for Queen Margaret University. As co-author, I attest that Michael A. Pascucilla made a significant contribution and is the last author to the below co-authored publication:

Brooks L., Pascucilla MA, Romrick L. Pollution Source Survey and Assessment of the Farm River Watershed in East Haven and Branford, Connecticut. 2012.

Michael Pascucilla actively pursued and successfully received grant funding for this project and led all aspects of the field and research coordination. This research project was locally recognized and was featured and presented State-wide by Connecticut's Department Agriculture, Bureau of Aquaculture, and the University of Connecticut's Sea Grant Program. This state/federally funded research also sits in the public domain for all to review.

Name: Lauren Brooks

Title: Dr.

Signature: [redacted]

Date: 06/29/2021

Appendix 7.

Academic CV

MICHAEL A. PASCUCILLA, M.P.H., REHS, DAAS

H: (203) 689-5599 • 55 Ocean View Road • Guilford, CT 06437 • W: (203) 481-4233 Cell: (203) 619-1286
Email: Office-East Shore District Health Department: mpascucilla@esdhd.org Home: mapascucilla@gmail.com
Southern CT State University: pascucillam1@southernct.edu Yale University: michael.pascucilla@yale.edu

QUALIFICATIONS SUMMARY

Public Health Executive, Educator and Researcher with extensive, progressive experience of 30 yrs. leading strategic public health / environmental programs and initiatives, public health emergency management, workforce leadership / union management. Expertise in public health education, grant / research, disease control / prevention, and compliance with federal, state, local and academic health regulations. Exceptional communicator; fosters strong relationships with health officials, chief executive officials and community leaders. Published Researcher / Patent Experience. Depth of experience includes:

- Executive Management / Leadership / Public & Private Higher Education
- Government / Academic Health Regulation / Accreditation
- Public Sector Program Development / Budget / Funding
- Community Outreach / Health Education
- Strategic Planning & Emergency Preparedness / Public Health Response
- Public Health / Climate Change / Environmental Health Risk Research / Patent / Grants
- Recreational / Health / Food / Water Quality / Housing / OSHA Employee Safety
- Communicable Disease / Injury Surveillance & Prevention / PH Nursing & Clinical Services

PROFESSIONAL / ACADEMIC EXPERIENCE

EAST SHORE DISTRICT HEALTH DEPARTMENT, Branford, CT
2010 - Present
Chief Executive Officer/Director of Public Health

- Serves as the Chief Executive Officer (CEO) for a three Town Health District and advises an eight-member Board of Directors on the fiscal state of our 2.3 million-dollar budget and overall operations of the Health District Agency. Seeks grant funding and partners to foster strong relationships with community leaders, constituents, and health agency regulators.
- Serves as the Director of Public Health for the Towns of Branford, East Haven and North Branford that comprises of a population of approximately 72,000~ people. Ensures the East Shore District Health Department (ESDHD) provides the essential public health services to our communities and meets the Connecticut State Commissioner of Public Health expectations as required by the Connecticut General Statutes.
- Provides leadership and direction to the Districts administration and program staff, contractors, interns and volunteers. Managers a Regional Federal/State Grant Funded Pump-out Boat Program for five New Haven County Towns/Cities.
- Serves as the leader of Connecticut's Region 21 Mass Dispensing Area (MDA - Population 112,162), New Haven County - Region 2 Medical Reserve Corp (MRC - Population 859,470) and Incident Commander for the Health District. Directs staff and resources in emergency response / bioterrorism incidences and responds to after-hours / weekend emergencies.
- Maintains public / environmental health compliance with federal regulations, state general statutes / public health code, and municipality environmental health ordinances.
- Identifies problematic behavior in community through research and community need assessment and develops practical prevention / educational programs, including food safety and nutrition training, quality of life outreach, maternal child health, public health nursing / clinical services, mobile public health clinic / substance / opioid use prevention, emergency preparedness and lead poisoning health screenings.
- Serves as an academic preceptor/host organization to public health workforce development. Internship and practicum experiences include high school, undergraduate, postgraduate/PhD students from Connecticut and out of state colleges/universities.

SOUTHERN CONNECTICUT STATE UNIVERSITY, SCHOOL OF HEALTH & HUMAN SERVICES, DEPARTMENT OF PUBLIC HEALTH, New Haven, CT
2012 - Present

Adjunct Professor of Public Health

- Serves as a Part-time Adjunct Faculty member of the Southern Connecticut State University, School of Health & Human Services Department of Public Health. Teaches Several Public/Environmental Health Courses per year (12-15 credits).
- Highly competent and dependable teaching professional with an established reputation in curriculum enhancement and integration of technology into daily lessons. Excellent communicator with strong speaking, writing, research and analytical skills. Proficient in prioritizing and completing tasks in a timely manner. Highly competent in assessing and evaluating the

student's performances and implementing need-based lesson plans to address student challenges in academic areas, with a focus on health, wellness and research literacy/writing.

- Serves as a mentor to students, regularly host student internships and guest lecturer in Public Health/Environmental Health.

YALE UNIVERSITY, SCHOOL OF PUBLIC HEALTH, DEPARTMENT OF ENVIRONMENTAL SCIENCES, New Haven, CT **Lecturer of Epidemiology**

2018 – Present

- Serves as a Part-time Faculty member of Yale University, School of Public Health, Department of Environmental Health Sciences.
- Community partner within the field of Public Health/Environmental Health with several research and grant-funded projects. Lead Preceptor for several undergraduate and graduate-level research classes with practical public health applications and local/state and national policy change goals. Mentor students on research publications, to include abstract presentations and research posters submissions to local, state, national and international professional conference venues.
- Highly competent and dependable teaching professional with an established reputation in curriculum enhancement and integration of technology into daily lessons. Excellent communicator with strong speaking, writing, research and analytical skills. Proficient in prioritizing and completing tasks in a timely manner. Highly competent in assessing and evaluating the student's performances and implementing need-based lesson plans to address the challenging academic areas.
- Serves as a mentor to students, regularly host student practicums and guest lecturer in Public/Environmental Health.
- Appointment (two-year) to the Advisory Board for the Yale Center on Climate Change and Health (YCCCH), to provide guidance and feedback on the YCCCH draft strategic plan.

NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION (NEHA), Denver, CO2016

United States / United Kingdom Sabbatical Exchange Recipient

- 2016 NEHA Professional Sabbatical Recipient - Conducted a funded research / academic professional sabbatical on food allergen education and policies in the United Kingdom.
- Served as the Sabbatical Exchange United States Ambassador to the United Kingdom.
- Conducted in-depth interviews and research with governmental local and country regulatory agencies, private industry and non-profit stakeholders to better understand their world leadership position, and progressive policies and strategies in food allergen safety. The established goal started conversations in the US in partnership with NEHA leadership to improve the Federal Food and Drug Administration's food allergen education and implement common-sense legislation, while finding balance for consumers, businesses and economics.

CONNECTICUT'S CAPITAL - CITY OF HARTFORD, DEPARTMENT OF HEALTH AND HUMAN SERVICES, Hartford, CT **Assistant Director of Public Health** 2005 – 2010

- Supervised and led a team within the Departments administration division with direct oversight on department's strategic plan, epidemiology program, building operations and employee safety, personnel management, residential insurance discount program, Metro homeless shelter lead, parks & recreation, public health nursing clinics, fleet management, budget of over 23~ million dollars (contracts / grants / procurement oversight) and social service / emergency relocation program.
- Coordinated education, prevention, and enforcement activities for the Department's health related divisions and programs. Served as the lead on environmental matters for Connecticut's Capital City.
- Served as Incident Commander / Evacuation Coordinator; directs staff and resources as needed in emergency response and bioterrorism incidences, City Readiness Initiative; responds to after-hours / weekend emergencies.
- Pursued funding opportunities through private, state and federal grants; ensures public / environmental health compliance with federal regulations, state general statutes / public health code, and municipality environmental health ordinances.
- Mentored staff to foster strong relationships with community leaders, constituents, and health agency regulators.
- Acted as Director of Health in absence of regular director as authorized by CT State Commissioner of Public Health.

YALE UNIVERSITY, DEPARTMENT OF EPIDEMIOLOGY AND PUBLIC HEALTH, New Haven, CT 2001 - 2011

Research Assistant, Connecticut Emerging Infections Program (Part-time Position)

- Assisted in development and planning of Centers for Disease Control and Prevention (CDC) funded project for the Foodborne Disease Active Surveillance Network (FoodNet); maintained project database.
- Prepared reports and research data for FoodNet study. Conducted collection and laboratory set-up analyses of meat and poultry samples to determine prevalence and antimicrobial susceptibility of Campylobacter and Salmonella within state food supply.
- Served as co-author of CDC FoodNet / National Antimicrobial Resistance Monitoring System (NARMS) Retail Food Study for Enhanced Surveillance of Antimicrobial Resistance Among Enteric Bacteria.

UNIVERSITY OF CONNECTICUT, DEPARTMENT OF ENVIRONMENTAL HEALTH & SAFETY, Storrs, CT 1999 - 2005

Environmental Health and Safety Specialist

- Planned, promoted, maintained public / environmental health programming and staff supervision for food / water protection, pest control, housing and lead-based paint removal, recreational safety, communicable disease prevention and employee safety training. Served as the main liaison between University health clinic, all regional campuses & state health department.

- Coordinated safe rental housing initiative with facilities management and residential life, focusing on best lead abatement practices, routine water testing, underground oil tank removal, air quality, and septic tank maintenance.
- Assisted in laboratory safety / environmental state reporting for the Public Sewer Treatment Plant & Water Supply.
- Served on the Leadership in Energy and Environmental Design (LEED) committee; participated in Earth Day events and other environmentally friendly campus initiatives.
- Collaborated with government federal, state and local health regulators / Presidents Office; managed budget, permit / license fees, and emergency response coverage. Lead for the Universities public drinking water system - monitoring and planning.
- Conducted food safety / foodborne illness prevention training for all University food service establishments.
- Maintained database of all licenses and employee Qualified Food Operators (QFO) as required by state regulations.

WEST HARTFORD-BLOOMFIELD HEALTH DISTRICT (WHBHD), West Hartford, CT 1998 - 2005

Environmental Sanitarian III (Part-time Position)

- Conducted after-hour / weekend food service inspections; investigated public / environmental health nuisances.
- Performed inspections / surveys within WHBHD communities, focusing on housing code violations, property preservation, and lead-based paint awareness; provided residents with informational / financial resources.
- Served as a Special Constable / member of the emergency response team; enforced West Hartford Housing and Property Maintenance Code.

CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC), Atlanta, GA 2002

Graduate Public Health Intern, Foodborne & Diarrheal Diseases Branch (FDDB)

- Conducted a working onsite employment / academic masters-level practicum at the CDC's NARMS and FoodNet programs.
- Participated in CDC's foodborne illness outbreak surveillance state calls, conducted research on antimicrobial resistance for Foodborne Disease Active Surveillance Network (FoodNet) Project. Co-Author of Published CDC NARMS Report.
- Developed several multi-state surveys, global educational pamphlets, and other projects designed to decrease inappropriate use of antimicrobial agents in animals and prevent increasing resistance in human pathogens.

NORTH CENTRAL DISTRICT HEALTH DEPARTMENT, Enfield, CT 1993 – 1999

Registered Sanitarian

- Functioned as Certified Food, Lead, and Subsurface Sewage Disposal System (SSDS) Inspector; education and enforced all health ordinances of the District Health Department and state general statutes / public health code.

- Served as Lead Health Coordinator for the Lead Poisoning Prevention and Day Care Facility Safety Programs for all District Health Department offices; inspected food service providers, daycare centers, and schools.
- Reviewed lead abatement / management plans; investigated foodborne illness and housing code complaints and conducted SSDS / well water plan review and site inspections as required by state and local regulations.
- Provided food / water safety and community lead-based paint awareness training; served as expert witness for public and environmental health cases, local emergency responder and prepared notice of violation letters / orders in accordance with state law and district ordinance.
-

VOLUNTEER EXPERIENCE

YALE UNIVERSITY SCHOOL OF PUBLIC HEALTH, YALE CENTER ON CLIMATE CHANGE & HEALTH, NEW HAVEN, CT **Advisory Board Council Member Appointment** 2020-2022

- Serves as an Advisory Board Member for the Yale Center on Climate Change and Health (YCCCH) for a two-year term.
- Assists in the YCCCH's strategic plan and review the Center's annual progress report - to provide advice/input on the Centers progress, offer needs improvement, and how to address challenges and make needed adjustments; and to be available for consultations on critical issues that arise between advisory meetings.

NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION (NEHA) CLIMATE CHANGE COMMITTEE, DENVER, CO **Committee Member**2021 – 2023

- Serves as a voting advisory member of the NEHA Climate Change Program Committee for a two-year term. The Committee works collaboratively to: ensure NEHA members have access to current climate science research, develop, share, review and disseminate resources on climate change polices, program and best practices, identify and recommend the needs of the environmental health profession, training gaps, challenges and emerging issues.
- Advise the Executive Director and President on climate change in the planning and implementing the annual meeting of the NEHA Conference.

CONFERENCE FOR FOOD PROTECTION, MARTINVILLE, IN 2021 – 2023

Executive Board of Director

- Serves as a voting member and directs the Chair, Executive Director, and Program Chair in the planning and implementing the biennial meeting of the Conference.
- Manages the affairs of the conference, approves the annual budget, and appoints ad hoc, standing committees and the membership of council.

Food Allergen Advisory Committee Co-Chair 2018 - 2021

- Appointed to the Advisory Committee by the Conference of Food Protection (CFP) 2018-2020 to review the current U.S. Food & Drug Administration's (FDA) Food Code for Food Allergens, convene all stakeholders on the Food Allergen Committee and

make recommendations/present findings for Food Allergen Regulatory Code enhances at the 2021 CFP Meeting in Denver, CO.

CONNECTICUT GOVERNOR'S COUNCIL ON CLIMATE CHANGE, COMMITTEE ON ADAPTATION PLANNING AND IMPLEMENTATION STATE OF CONNECTICUT, CAPITAL CITY OF HARTFORD, CT 2020 - 2023

Advisory Council Member - Appointment

- Serves as an Advisory Council Member for the Governor's Council on Climate Change as directed by Executive Order 3.
- Develop adaptation strategies to assess and prepare for the impacts of climate change in areas such as infrastructure, agriculture, natural resources, and public health by revising and updating the 2011 Connecticut Climate Change Plan.

STATE OF CONNECTICUT, ADVISORY COUNCIL OF THE CONNECTICUT HEALTH IMPROVEMENT PLAN, DEPT. OF PUBLIC HEALTH, HARTFORD, CT 2019 - 2021

Advisory Board Council Member - Appointment

- Serves as an Advisory Board Member for the Connecticut Department of Public Health in accordance with Connecticut General statutes 4-8 and 19a-2a with 30 other Connecticut leaders providing strategic guidance on coordination and implementation of Healthy Connecticut 2020, the Connecticut State Health Improvement Plan.

CONNECTICUT DIRECTOR OF HEALTH ASSOCIATION (CADH), CT 2012 - Present

Past President / President / President-Elect / Board of Director (Elected Officer of Organization)

- Currently serves as a Past President of the organization and has held past positions as a President Elect / President/Board of Director / Committee Chair and advises the leadership on public health matters as applicable to CADH policies / strategic plan for the membership of our CEO/local public health directors and public health legislation at the state and federal levels. Represents State Public Health Association Chapter at various local, state and national professional venues
- Appointed to the CADH Climate Change Committee - Serves as the committee chair to develop practical local public health climate change initiatives and responsible to engage all state, business and academic stakeholders.

SOUTHERN CONNECTICUT STATE UNIVERSITY (SCSU), SCHOOL OF HEALTH & HUMAN SERVICES, DEPT. OF PUBLIC HEALTH, NEW HAVEN, CT 2016 – Present

Advisory Board Council Member - Appointment

Serves as an Advisory Board Member for the SCSU Department of Public Health's undergraduate and graduate programs and assists in an advisory role for the Departments accreditation application.

CONNECTICUT PUBLIC HEALTH ASSOCIATION (CPHA), CT 2016 - 2021

Board of Director

- Currently serves as a board member for the association and assists and provides leadership and advice to operations, budget, program activates and serves as a liaison for public health workforce development.
- Coordinates and assists in planning activities and supports Committee Chairs.
- Co-Chair – Annual Meeting Planning Committee 2008-2011, Coordinated and assisted in planning activities and supports Committee Chairs with the CPHA Annual Meeting.
- Current / long-standing active member and guest speaker of the organization for over 19 years.

PUBLIC HEALTH ACCREDITATION BOARD (PHAB), ALEXANDRIA, VA 2013 – 2020
Site Visitor
- Served as a traveling Site Visitor for PHAB and completed all require certification trainings. Participated in site team visits to assess local health departments eligibility and reviewed their accreditation application status in detail.
- Reviewed PHAB Domains, Strategic Plan, Community Health Assessment, Community Health Improvement Plan and interviewed governing entity, local boards of health and health departments leadership / staff / community leaders.

MADISON BASEBALL LITTLE LEAGUE, CT. 2010 – 2011
Assistant Coach
- Assisted in the development and training of children enrolled in the Towns Little League program.
- Coached little league baseball games and held training / mentoring sessions with local youth.

CONNECTICUT MULTICULTURAL HEALTH PARTNERSHIP, CT 2008 – 2011
Co-Chair – Language Proficiency Committee
- Assisted in the development and implementation of a state plan to identify and address health disparities and multicultural health issues through the effective and systematic collaboration of a diverse, multidisciplinary group (the Partnership).

CONNECTICUT ENVIRONMENTAL HEALTH ASSOCIATION (CEHA), CT 1999 – 2007
President / Vice-Past President / Past President / Educational Chair (Elected Officer of Organization)
- Served as an officer on Executive Board of Directors with four-year commitment functioning as President Elect, Vice President, President, Past President and Educational Chair; represented CEHA at state / national conferences.
- Served as liaison with other public health organizations and organized, promoted and directed Educational Committee.
- Current / long-standing active member and guest speaker of the organization for over 29 years.

UNIVERSITY OF CONNECTICUT, PROFESSIONAL EMPLOYEES ASSOCIATION (UCPEA), Mansfield, CT 2001-2005

Professional Development Committee Member

- Reviewed and approved travel / professional development requests for UCPEA members within fiscal year budget.

FOOD AND DRUG ADMINISTRATION (FDA), STATE TRAINING TEAM, Rockville, MD. 2000 – 2002

Instructor

- Assisted in the development and teaching of the National Temporary Food Safety Service Event Training Course throughout the US. Taught Public Health officials how to reduce / eliminate foodborne disease.

ARTHRITIS FOUNDATION, NORTHEAST REGIONAL AJAO CONFERENCE, Braintree, MA 2001

Volunteer

- Assisted teachers with children's learning activities, including art, reading, and recreational sports.

EDUCATION / CERTIFICATION

QUEEN MARGARET UNIVERSITY – EDINBURGH, SCOTLAND 2023 July (Anticipated Graduation)

Doctor of Philosophy Candidate - Institute for Global Health & Development

UNIVERSITY OF CONNECTICUT - HEALTH CENTER, Farmington, CT 2002

Master of Public Health, Community School of Medicine and Health Care

ANTIOCH UNIVERSITY – NEW ENGLAND, Keene, NH 1995 – 1996

Master of Environmental Studies, Environmental Studies & Sustainability – Completed Credited Courses Transferred

SOUTHERN CONNECTICUT STATE UNIVERSITY, New Haven, CT 1992

Bachelor of Science, Public Health, Nutrition, and Business

Certificate, Environmental Health Training Program, School of Graduate Studies

UNITED STATES NAVAL POSTGRADUATE SCHOOL, Monterey, CA 2021 – 2022

Executive Leaders Program, Department of Homeland Security's Center for Homeland Defense and Security - One year, graduate-level program with a residential, hands-on educational forum for senior-level homeland security/public safety leaders. A selective, multi-discipline diverse application-based small (32 person~) cohort designed leadership training course to enhance decision-making and foster collaboration to strengthen the national security of the United States.

LEADERSHIP GREATER HARTFORD, Hartford, CT 2007
2007 Quest Class Graduate – One year leadership training program for executive-level management. Instructional included hands-on training and academic sessions in leadership with a final team project and public presentation.

- **American Academy of Sanitarians – Registered Environmental Health Diplomate # 603**
- **National Register Environmental Health Specialist # 17040**
- **Registered Sanitarian CT # 569**
- **Connecticut State Certified Food Service Sanitation Officer CT # 591**
- **Connecticut State Certified Subsurface Sewage Disposal Inspector: Phase I**
- **Connecticut Occupational Safety & Health – General Industry Safety & Health 10-hour Training Certification**
- **Connecticut State Certified Subsurface Sewage Disposal Inspector: Phase II**
- **Connecticut State Certified Lead Inspector #00162**

PROFESSIONAL DEVELOPMENT & RESEARCH PRESENTATIONS

- **US National Environmental Monitoring Conference, Citizen Science Co-Chair/Presenter,** Arlington, VA, 2022
- **States Organization for Boating Access – Award Recipient/Presenter,** Cleveland, OH, 2022
- **Connecticut Public Health Association Annual Meeting & Conference**, **Presenter,** Plantsville, CT. November 2022
- **American Public Health Annual Conference, Presenter,** Boston, MA, 2022
- **National Environmental Health Association Annual Conferences - Presenter**, Spokane, WA, 2022
- **US National Environmental Monitoring Conference, Citizen Science Co-Chair/Presenter,** Bellevue, WA, 2021
- **National Environmental Health Association Annual Conferences - Presenter**, Virtual Annual Meeting, 2021
- **American Public Health Annual Conference, Presenter,** Denver, CO, 2021
- **US Conference for Food Protection (CFP), Food Allergen Committee Co-Chair & CFP Council Committee Appointment & Presenter,** Denver, CO 2021
- **Yankee Conference – New England States, Presenter,** Uncasville, CT, 2021
- **National Recreational Water Quality Workshop, Invited Presenter & Scholarship Recipient** Chicago, IL, 2021
- **American Public Health Annual Conference, Presenter, Abstract Reviewer & Film Festival Screening,** San Francisco, CA, 2020
- **World Aquaculture Society Conference, Presenter and Abstract Reviewer**, Honolulu, Hawaii, 2020
- **Connecticut Public Health Association Annual Meeting & Conference**, Plantsville, CT. November 2020

- **US National Environmental Monitoring Conference, Citizen Science Co-Chair/Presenter,** Minneapolis, MN 2020
- **Global Studies Association of North America, Presenter**, St. John's University of Queens, New York, NY 2020
- **State of Connecticut, Gathering of the Shellfish Commissions, Invited Presenter**, New London, CT. 2020
- **American Public Health Association Annual Meeting & Expo**, **Roundtable Presenter**, Philadelphia, PA, 2019
- **States Organization for Boating Access – Scholar Award Recipient/Presenter,** Portsmouth, VA, 2019
- **Eleventh International Conference on Climate Change: Impacts & Responses**, **Emerging Scholar Award Recipient & Presenter** Washington, DC. 2019
- **US National Environmental Monitoring Conference**, **Citizen Science Co-Chair & Presenter,** Jacksonville, FL, 2019
- **National Environmental Monitoring Conference - Presenter,** Nashville, TN, 2019
- **Long Island Sound Research Conference** – **Presenter,** Port Jefferson, New York, 2019
- **World Aquaculture Society Conference - Presenter,** New Orleans, LA, 2019
- **State of Connecticut, Gathering of the Shellfish Commissions - Presenter,** New Haven, CT, 2019
- **Northeast Aquaculture Conference & Exposition - Presenter,** Boston, MA, 2018
- **States Organization for Boating Access - Co-Presenter,** Duluth, MN, 2018
- **National Environmental Monitoring Conference - Presenter,** New Orleans, LA 2018
- **States Organization for Boating Access - Presenter,** Anchorage, AK, 2017
- **Yale Environmental Sustainability Summit (YESS) - Presenter,** New Haven, CT 2017
- **International Conference on Food Studies - Emerging Scholar Award Recipient & Presenter,** Rome, Italy, 2017
- **States Organization for Boating Access - Presenter,** Anchorage, AK, 2017
- **Food Allergy Research & Education,** San Antonio, TX, 2017
- **U.S. Food & Drug Administration, New England Regional Meeting - Presenter,** North Hampton, MA, 2016
- **American Public Health Annual Conference, Research Writing Workshop,** Denver, CO, 2016
- **Allergy Eats Conference,** Boston, 2013 & New York, 2014
- **Oregon Cities Readiness Initiative (CRI) - Exercise Evaluator**, Portland, Oregon, 2011
- **U.S. Dept. of Homeland Security, Center for Domestic Preparedness EHTEP**, Anniston, AL 2011
- **CDC Asthma Triggers and IAQ Training Course - Scholar Recipient,** Washington DC, 2009

- **EPA Tools for Schools Indoor Air Quality Symposium - Scholar Recipient,** Washington DC, 2007
- **National Incident Management System Training**, Hartford, CT, 2006
- **Biology and Control of Insects and Rodents IPM Training Program**, San Antonio, TX, 2006
- **Managing Staff Effectively Workshop**, Meriden, CT, 2005
- **National Environmental Health Association Annual Conferences - Presenter**, Multi-Locations
- **American Public Health Annual Conference**, Multi-Locations
- **CDC Epi-Ready Foodborne Illness Response Strategies Workshop**, Anchorage, AK, 2004
- **Risk and Crisis Communication Workshop**, Cromwell, CT, 2003
- **51st Annual Epidemic Intelligence Conference**, Atlanta, GA, 2002
- **Biosafety Cabinet Certificate**, Safety Cabinet Technology, Eagleson Institute, Sanford, ME, 1999
- **Brownfield Risk Management and Assessment Training Program**, Hartford, CT, 1997

AWARDS

- **President's Award – Innovative & Groundbreaking Project**, States Organization for Boating Access, Cleveland, OH, 2022
- **Scholar Award Recipient**, Climate Change: Impacts & Responses Conference, Washington DC, Common Grounds Research Networks, 2019
- **Lacy E. Nichols Scholarship Award Recipient,** States Organization for Boating Access, Portsmouth, VA, 2019
- **Recognition of Volunteer Service Award,** Public Health Accreditation Board, 2018
- **Emerging Scholar Award Recipient**, Food Studies International Conference Rome, Italy, 2017
- **Adjunct Faculty Teaching Award Recipient,** Southern Connecticut State University, 2016
- **Sabbatical Recipient,** Food Allergy: UK/USA-United Kingdom, National Environmental Health Association, 2015-2016
- **Certificate of Appreciation Award,** Southern Connecticut State University, Student Government Association, 2015
- **Hero Award,** Food Allergy Education Network, 2013
- **City of Hartford, CT - Mayoral Citation**, Volunteer Recognition for Celebration of Lights, 2009
- **Certificate of Merit**, National Environmental Health Association, 2005
- **Sanitarian of the Year, Raymond Brunelle, Jr. Award**, Connecticut Environmental Health Association, 2002

PROFESSIONAL AFFILIATIONS

- American Academy of Sanitarians

- American Association of University Professors
- American Public Health Association
- Conference for Food Protection
- Connecticut Directors of Health Association
- Connecticut Environmental Health Association
- Connecticut Public Health Association
- Food Allergy Research & Education
- National Association of County & City Health Officers
- National Environmental Health Association
- States Organization for Boating Access
- World Aquaculture Society

PUBLICATIONS/RESEARCH PRESENTATIONS

Hemez C, Ryan E, Chiu J, Sun J, Dubrow R, Pascucilla MA. Climate, Health, and Cost Impacts of Solar-Electric Pumpout Boats, New Haven, Connecticut. July 2020. *

Project Start 2016: One major goal of the research project was to commission the first nationwide survey of pump-out vessel programs. This was of significant interest to our federal/state funders, to better understand the barriers and strengths to implement this new, cutting-edge technology nationally to reduce both the operation costs and the carbon footprint of pump-out boat programs throughout America. This creative research project has significant future applications/impacts within the boating community to help soften the effects of climate change, as we pioneered the way not just for pumpout vessels, but also for the future planning of recreational boating and working-commercial vessels worldwide. This research was collaborative effort

***Publication** - Journal of Water Practice and Technology. July 2020. (Last Author) Open Access Funding Secured - $1,900.00
https://iwaponline.com/wpt/article/doi/10.2166/wpt.2020.063/75388/Environmental-and-health-impacts-of-electric?searchresult=1

Research Conference Abstract Accepted & Presented:

- Southern Connecticut State University 8th Annual Tapas Event – A Taste of Scholarship and Creative Activity Across the Disciplines, New Haven, Connecticut. November 2021
- National Environmental Monitoring Conference, Bellevue, Washington, August 2021 – Citizen Science Track Co-Chair and Presenter
- American Public Health Association Annual Meeting & Expo - Virtual, San Francisco, CA, PA, November 2020 – Presenter / Abstract Reviewer / Film Festival Acceptance
- Global Studies Association of North America, St. John's University of Queens, New York, NY, June 2020 - Postponed due to COVID-19 / TBD

- American Public Health Association Annual Meeting & Expo, Philadelphia, PA, November 2019 – Selected Roundtable Presentation
- States Organization for Boating Access, Annual Education & Training Symposium, Portsmouth, Virginia. September 2019 – SOBA Scholarship Project Awardee Recipient – Presidents Award Nominee
- World Academy of Science, Engineering and Technology, Stockholm, Sweden. July 2019. http://waset.org/pdf/books/?id=93883&pageNumber=4
- Long Island Sound Research Conference, Port Jefferson, New York, March 2019
- World Aquaculture Society Conference, New Orleans, LA. March 2019.
- State of Connecticut, Gathering of the Shellfish Commissions, New Haven. CT. January 2019
- Connecticut Public Health Association Meeting & Conference. Rocky Hill, CT. October 2018. https://cpha.site-ym.com/page/AnnualConBreakout
- Greater New Haven Green Fund Awardee Presentations, New Haven, CT. October 2018.
- States Organization for Boating Access, Duluth, MN. September 2018. http://www.sobaus.org/conference/2018_SOBA_Agenda_v13.pdf
- US National Environmental Health Association Conference, Anaheim, CA. July 2018. (Phase II) https://www.neha.org/node/59898
- US National Environmental Health Association Conference, Grand Rapids, MI. July 2017. (Phase I) https://www.neha.org/news-events/aec-annual-educational-conference-0/2017-recorded-sessions
- US National Environmental Monitoring Conference, New Orleans, LA 2018. http://www.nemc.us/meeting/2018/techprog.php#tpm1_3
- States Organization for Boating Access, Anchorage, AK. 2017. www.sobaus.org/conference/conference13.html
- Various Local/State/Community Meeting Venues

Patent/Creative Works: *Solar-Electric Pump-out Vessel / Four-year Grant Funded, Research and Development Project. Research & Design/Development/Operational Cost - $302,000.00~*

Project Start 2016: Through community collaboration, this project has been the highlight of my career to date. I pursued private/public-grant funders and held stakeholder fundraisers to conduct the research/development, designed and built the world's first full-size solar-electric pump-out vessel. This project is the first of its kind in the world and addresses our local climate change initiative. The vessel construction was commissioned/tested in October 2018, and it went into regional operation in May 2019.

Project Grant Award – U.S Fish & Wildlife/Connecticut State Environmental Protection Grant Recipient- $150,000.00 for Research & Design Solar-Electric Pump-out Vessel.

Project Matching Funds – Leveraged Partnerships, fundraising and community grants to bridge the balance of $50,000.00.

Operation Grant Award - $102,000.00 for the vessel's operational cost.

This project was nominated* for the following water quality/climate change recognition:

- 2022 States Organization of Boating Access –Presidents Award (Received)
- 2020 The Oceans Award*
- 2020 Association for Communication Excellence, Bronze Award – Sea Grant Wrack Lines Spring/Summer Magazine (Received)
- 2019 Dan David Award, Climate Change Category*
- 2019 States Organization of Boating Access – Scholarship/Presidents Award*
- 2019 American Climate Leadership Eco-Award, Invited/Attendee Scholarship*
- 2019 American Public Health Association's Excellence in Climate Leadership Award, Finalist*

Patent:

United States Provisional Patent Completed Application NO. 63/030012 – May 25, 2020

United States Patent Pending NO. ESDH100001000 – October 10, 2020, Patent Fee $1,820.00

Magazines:

- University of Connecticut, Sea Grant Wrack Lines Spring/Summer 2020 - https://seagrant.uconn.edu/wp-content/uploads/sites/1985/2020/05/Wrack-Lines-S2020-final-web.pdf
  (2020 Association for Communication Excellence, Bronze Award)

- Southern Connecticut State University, Alumni Magazine Summer 2020 - https://issuu.com/scsu/docs/smag48ppsum20-f-proof-r6

***Note**: Multi-Grant applications, budget, project management, fundraising, legal review, support letters, patent application, presentations, conference presentations/creative film/video, numerous media articles – local, state, national and worldwide, interviews, last author, etc...

Dubrow R, Esenther S, Jossart C, Schlick K, Wang N, Pascucilla MA
*Improving Water Quality in the Short Beach Neighborhood of Branford – A Citizen Science Project, New Haven, Connecticut. September 2022. **

Project Start 2018: The coastal Short Beach neighborhood of Branford, Connecticut and its popular local beach have experienced high frequencies of elevated enterococcus bacteria levels compared to other areas in the region. To address this public health issue, we engaged the community to assist with contamination assessment and source investigation.

Publication: American Journal of Public Health. September 2022 (Last & Corresponding Author) Open Access - https://ajph.aphapublications.org/doi/10.2105/AJPH.2022.306943

Grant/In-kind match: $ 11,600.00 total
Part I: $ 4,000.00 Yale University Grant
Part II: $ 6,600.00 Local Public Health In-Kind

Research Conference Abstract Accepted & Presented:

- American Public Health Association Annual Meeting & Expo - Virtual, San Francisco, CA, PA, November 2020 – Presenter, Film screening & Abstract Reviewer
- US National Environmental Monitoring Conference, Minneapolis, MN – Citizen Science Educational Track Co-Chair & Presenter. August 2020 (Virtual)
- State of Connecticut, Marine Beach Conference/Workshop, New London, CT. May 2020. Postponed due to COVID-19 / TBD Summer 2020
- Southern Connecticut State University Tapas Event – A Taste of Scholarship and Creative Activity Across the Disciplines, New Haven, Connecticut. November 2019
- Connecticut Annual Bathing Water Meeting & Gathering, New London, CT. May 2018.
- US National Environmental Monitoring Conference, Jacksonville, FL – Citizen Science Educational Track Co-Chair & Presenter. August 2019
- Various Local/Community Meeting Venues

*Brooks L, Cooper M, Caccone A, Knauf D, Pascucilla MA. Microbial Source Tracking (MST) - Analyses in the Sasco Brook, Lower Farm River, and Goodwives River Watersheds in Long Island Sound, New Haven, Connecticut. December 2022. **

Project Start 2015: Shortcomings in traditional methods for understanding sources of bacteriological contamination limit the ability of public health officials to adequately protect public health and mitigate pollution sources. This study used Polymerase Chain Reaction as a tool for MST to attempt to identify host species contributing bacteria to three watersheds flowing into LIS. Samples were analyzed for both *E. coli*, a traditional fecal indicator, and genetic markers for members of the phylum Bacteroidetes. They include host specific markers which may be used to identify sources of contamination such as humans, domestic animals and wildlife.

- Grant Funded – State Department of Energy & Environmental Protection Project Clean Water Act Section 319 in Public Domain / Grant Total funding: - $105,351.00 (Including Match) in Public Domain.

  Grant Actual: $ 49,906.00 total

  In-kind match: $ 55,465.00 total
  Part I: $ 20,465.00 Yale In-Kind Water Quality Laboratory
  Part II: $35,000.00 Local Public Health In-Kind

***Publication*:** Journal of Environmental Health. December 2022, (Last & Corresponding Author). Open Access. Achievement in Science, Featured Cover Research Article - https://2022.neha.org/sites/default/files/flipping_book/dec-2022-jeh/index.html

Research Conference Abstract Accepted & Presented:

- National Recreational Water Quality Workshop, Chicago, IL. Invited Speaker and Scholarship Recipient, Chicago, IL. April 2020 - Postponed due to COVID-19 / April 2021
- US National Environmental Health Association 83rd Annual Educational Conference & Exhibition, Nashville, TN. July 2019
- Northeast Aquaculture Conference & Exposition, Boston, MA. January 2019.
- Microbial Source Tracking - Sasco Brook Pollution Abatement Conference, Westbrook, CT. November 2018
- Connecticut Public Health Association Annual Meeting & Conference, Rocky Hill, CT. October 2018.
  https://cpha.site-ym.com/page/AnnualConBreakout
- US National Environmental Health Association Conference,
  Anaheim, CA. July 2018.
- US National Environmental Monitoring Conference, New Orleans. LA. August 2018.
  http://www.nemc.us/meeting/2018/load_abstract.php?id=28
- State of Connecticut, Gathering of the Shellfish Commissions, New Haven. January 2017.
- Various Local/Community Meeting Venues

Ramsden D., Esenther S., Marks B, Lehane A., Chen R, Dubrow R, Pascucilla MA. Bacterial Contamination in Long Island Sound: Using Preemptive Beach Closure to Improve Public, New Haven, Connecticut. April 2023. *

- *Project Start 2017:* Currently, a beach is closed if enterococci levels are found to be above 104 colony-forming units (CFU)/100 mL of marine bathing water during weekly sampling. One major issue with the current protocol involves the time it takes for the water sample to reach the lab, for

the assay to be set up, and the 24 hours it takes to run the test. This results in a greater than 24-hour lag time; thus, the beach remains open to bathers to continue to swim in unsafe water. Policy changes included community outreach and involvement with all stakeholders and political leaders.

Publication: Journal of Environmental Health. December 2022. Last & Corresponding Author) – Open Access. April 2023
https://2022.neha.org/sites/default/files/flipping_book/april-2023-jeh/26/index.html

- **Total Research Funding (including the High Tide Foundation): $**9,000.00 – Combination Local Health Departments/Yale University

Research Conference Abstract Accepted & Presented:

- State of Connecticut, Marine Beach Conference/Workshop, New London, CT. May 2020 – Update Research & Presentation - Postponed due to COVID-19 / Summer 2020
- Eleventh International Conference on Climate Change: Impacts & Responses, Washington, DC. April 2019
- Connecticut Department of Public Health, Commissioners Semi-Annual Meeting, Berlin, CT November 2018
- Connecticut Annual Bathing Water Meeting & Gathering, West Haven, CT. May 2017
- Various State & Local/Community Meeting Venues

*Brooks L, Romrick L, Pascucilla MA. Pollution Source Survey and Assessment of the Farm River Watershed in East Haven and Branford, Connecticut. September 2012. **

Project Start 2010: This grant-funded project was the foundational research for my Ph.D. by Publication and led the way for my water quality and climate change studies, including community/citizen science participation. Engaged the community's awareness role in improved water quality and held several neighborhood clam digs to promote the localism of fresh shellfish markets.

Manuscript Published in State Archives: **CT Department of Agriculture.** September 2012, (Last & Corresponding Author) – Open Access Farm Viability Grant Database - https://portal.ct.gov/-/media/DEEP/water/tmdl/CTFinalTMDL/farmriver5112

Grant Funded - State/Federal Project Total $97,039.00 in Public Domain.

Grant Request: $41,711.00 total
Part I: $36,235.78 Water quality studies
Part II: $5,475.22 Promotional projects

In-kind match: $55,328.00 total

Part I: $ 36,529.00 Water quality studies
Part II: $18,799.00 Promotional projects

Research Conference Abstract Accepted & Presented:

- Various State & Local/Community Meeting Venues
- Grant Funded - State/Federal Project Total $90,510.00 in Public Domain. https://patch.com/connecticut/branford/old-fashioned-fun-clamming-in-branford

Ongoing and Presented Climate Change / Science Research (unpublished):

Grace, S, MA Pascucilla. The Sound of Silence; Environmental Benefits of Solar-Powered Pump-out Boats in Branford Harbors. Branford, Connecticut. June 2020.

Grant funded: Total $11,000.00 - Private industry - Torqeedo Seed Funding ($5,000.00), Southern Connecticut State University in-kind match ($3,000.00) and East Shore District Health Department ($3,000.00)
Project Start 2019: A grant-funded project to investigate sound pollution from boat motors is known to affect whales, crabs, and eels behavior and the physiology of fish embryos. Alleviating sound pollution is one management strategy that can affect marine environments positively. Recently, a solar-powered boat was developed that produces less sound and has a lower carbon footprint. This study will compare motors by examining the differences in motor noise using a hydrophone and examine the effects of these motors' noise on fish behavior and physiological (heart rate) responses in local blue and ribbed mussels.

Research Conference Abstract Accepted & Presented:

- World Aquaculture Society Conference, Presenter and Abstract Reviewer, Honolulu, Hawaii, 2020
- Southern Connecticut State University Tapas Event – A Taste of Scholarship and Creative Activity Across the Disciplines, New Haven, Connecticut. November 2019
- Various State & Local/Community Meeting Venues

Diaz-Hernandez M., Soroka H., Naclerio. B, Pascucilla MA. A Citizens Science Project – Climate Change in Connecticut: A Research & Photojournalism Road Map to Awareness

Grant Funding: Total $20,000.00 - National Environmental Health Association ($8,000.00), Yale University's Center for Climate Change & Health ($6,000.00) and East Shore District Health Department ($6,000.00)

Project Start 2021: This climate change project with grant support for staffing from the National Environmental Health Association and Yale University's Center for Climate Change & Health. Through its photojournalism will also compare and research the human impacts both from coastal and non-coastal, inland communities, as well as urban and rural living environments. Our intent is to tell the visual "human story" of climate change, supported by state and local research with the end goal to promote awareness and positive, sustainable behavioral population change to soften mankind influences on our local ecology.

Research Conference Abstract Accepted & Presented:

- American Public Health Annual Conference, Presenter, Boston, MA, 2022
- Connecticut Public Health Association Annual Meeting & Conference, Presenter, Plantsville, CT. November 2022
- US National Environmental Health Association, Annual Educational Conference & Exhibition, Spokane, WA. June 2022
- Southern Connecticut State University 8th Annual Tapas Event – A Taste of Scholarship and Creative Activity Across the Disciplines, New Haven, Connecticut. November 2021
- National Environmental Monitoring Conference, Bellevue, Washington, August 2021 – Citizen Science Track Co-Chair and Presenter
- Various State & Local/Community Meeting Venues

Published Food Allergen & Other Research:

Allen D, Mitchell G, Pascucilla MA. "How can you be allergic to peas?"- A Qualitative Study to Explore Food Handler's Knowledge, Attitudes and Understanding of Food Allergens. December 2019

Publication: International Journal of Sanitary Engineering Research, December 2019. https://journal.institut-isi.si/how-can-you-be-allergic-to-peas-a-qualitative-study-to-explore-food-handlers-knowledge-attitudes-and-understanding-of-food-allergens/

Research Conference Abstract Accepted & Presented:

- US National Environmental Health Association, Annual Educational Conference & Exhibition, Presenter, Spokane, WA. June 2022
- Various State & Local/Community Meeting Venues

Fox S, Mitchell G, Pascucilla MA. A Matter of Trust: A Quantitative Study to Explore Allergen Awareness and Compliance in Takeaway Food Businesses in the Borough of Knowsley, International Journal of Sanitary Engineering Research. Liverpool, United Kingdom. December 2018.

Publication: International Journal of Sanitary Engineering Research, December 2018. https://journal.institut-isi.si/category/volume-12-number-1-december-2018/

Research Conference Abstract Accepted & Presented:

- Various State & Local/Community Meeting Venues
- US National Environmental Health Association Conference, AEC Virtual, April 2021

Pasc*ucilla MA. Food Allergies: Sabbatical - A Comparison between the U.S. vs. U.K. Final Research Report, May 2016.*

Pascucilla MA. Food Safety Journal - Cover Story. Allergen Management: Challenges and Trends | December 2014/January 2015. Glendale, CA 2015. https://www.foodsafetymagazine.com/magazine-archive1/december-2014january-2015/allergen-management-challenges-and-trends/

Stevenson JE, White DG, Torpey DJ III, Craig AS, Smith KE, Park MM, Pascucilla MA, Anderson AD, and the FoodNet/NARMS Working Group. Enhanced surveillance for antimicrobial resistance among enteric bacteria: FoodNet/NARMS Retail Food Study. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002. https://www.cdc.gov/narms/annual/2002/2002ANNUALREPORTFINAL.pdf

Pascucilla, MA. Hepatitis A - Should Food Service Workers be Vaccinated? Unpublished Master's Thesis, University of Connecticut, School of Community Medicine and Health Care, Farmington, Connecticut. May 2002.

Below are a few additional supporting research and practical professional experiences:

- Yale Center on Climate Change and Health - ***Climate Change and Health in Connecticut: 2020 Report.*** https://publichealth.yale.edu/climate/YCCCH_CCHC2020Report_395366_5_v1.pdf - Acknowledged / Reviewer / Contributor

- Report to the Connecticut Governor's Council on Climate Change – Public Health and Safety – Contributing Work Group Member/Reviewing Author. September 2020 - https://portal.ct.gov/DEEP/Climate-Change/GC3/Governors-Council-on-Climate-Change
- University of Connecticut, Do Good Feel Good Alumni Magazine - https://magazine.uconn.edu/2021/02/17/class-notes-spring-2021/

- Perceivant's 21st Century Wellness + Guided Learning – Peer Reviewer of Public Health Interactive Learning Platforms - http://www.perceivant.com/21st-century-wellness

- Community Person of the Week, Branford, Connecticut - https://www.zip06.com/profile/20160907/mike-pascucilla-finding-balance-as-health-director-and-ceo-of-east-shore-district-health-department

- Liverpool John Moores University Newsletter - https://phi.ljmu.ac.uk/wp-content/uploads/2018/10/PHIAnnual-Report_2018_Final_Digital.pdf

- Connecticut Public Health Association Student Mentoring - https://cdn.ymaws.com/www.cpha.info/resource/resmgr/annual_conference_2017/Final_CPHA_Booklet.pdf

- Yale University, Yale Environmental Sustainability Summit Panelist- https://yess.yale.edu/agenda

- Southern Connecticut State University Newsletter - https://www.southernct.edu/academics/schools/health/academic-programs/publichealth/PHconnectionsFA17.pdf

- Community Person of the Week, East Haven, Connecticut - https://www.zip06.com/profile/20200122/michael-pascucilla-ppsafeguarding-public-health

- UK Allergy – News Flash Newsletter Food, Allergen Guest Article

*Posters were also created and presented.