Water Advocacy in Massachusetts: A Guide for Curious and Concerned Citizens

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This research was driven by a desire for environmental health and years spent studying the freshwaters in Essex County, Massachusetts. In 2016, my classroom was a canoe bobbing on top of the Ipswich River. Seven years later, I'm hauling my canoe onto the river's shore and thanking it for showing me the way.

And thank you to Paul Crofts for teaching me how to row and stay steady on rough waters.

Abstract

This paper addresses the need for **citizen engagement** and action in the face of the ongoing man-made climate crisis that is rapidly depleting Earth's finite freshwater resources. Focusing on the **Ipswich River** in Essex County, Massachusetts, identified as the 8th most endangered river in America, the research done explores the interconnected challenges of excessive withdrawals, rising temperatures, droughts, floods, pollution, and invasive species paired with the multifaceted challenges surrounding **water politics**, highlighting the complexities of collaborative governance across multiple jurisdictions. The solution proposed is the creation of a climate action **toolkit** specifically tailored to freshwater bodies in Massachusetts, aiming to bridge the information gap between governing bodies, local organizations, and the average citizen to foster grassroots action. Existing water conservation toolkits, guides, and websites often target governing bodies and corporations, or provide low-effort, generic, and vague recommendations that are well-known in the current year. In contrast, this toolkit seeks to empower citizens with knowledge about their role in water management and inspire community and political mobilization through advocacy and lobbying education. Drawing on extensive research from scientific studies, environmental reports, and scholarly insights, this thesis advocates for the pivotal role of citizens in driving effective change. It emphasizes the need for accessible, localized tools that empower individuals to become informed decision-makers and proactive contributors to **environmental conservation** efforts.

KEYWORDS: citizen engagement, Ipswich River, water politics, toolkit, environmental conservation

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Introduction

Freshwater on Earth is a finite resource that faces rapid depletion due to the anthropogenic climate crisis and inequitable water laws across the nation. The Ipswich River in Essex County, which serves fourteen communities in the Commonwealth of Massachusetts, is considered the 8th most endangered river in America due to excessive withdrawals and rising temperatures (Viars, 2021). In the year 2022, the entire state of Massachusetts experienced a range of drought conditions with the worst occurring in the summer and around Essex County (McCarthy, Dee-Ann E., et al., 2023). The threats to freshwater are not far off concerns or predictions; they're current events that are projected to get worse in the next ten, twenty, thirty years as Massachusetts continues to experience unprecedented waves of heat and unusual precipitation patterns extending flood conditions and drought frequencies.

From the years 2016 to 2019, myself and my peers, who volunteered as citizen scientists for the Ipswich River Watershed Association, witnessed the degradation of the Ipswich River as we canoed along the snaking waters with staff gauges, dissolved oxygen kits, turbidity meters, and stream flow meters. Logging the water's depths, the discharge rates, and chemical composition of the water we noticed the poor levels. There were parts of the river that ran so low and dry we walked our canoes to the next push-off point. The surface of the water was coated with duckweed and rather than pushing the water behind us with our oars we were cutting through Eurasian Milfoil, an invasive aquatic plant species in Massachusetts, to the point that we couldn't see the bottom of the river at a three-foot depth. The river, at points, was so choked by invasive plant species the rate of the flow was near zero, when the warm weather grew these spots would be the first to dry

and expose their underlying sediments to the elements to be degraded. While this is one example, poor water quality and availability conditions persisted for years despite concerns and efforts on the part of recreational users, grassroot organizations, and citizen scientists. Concern for freshwater in Massachusetts extends far past the Ipswich River, Essex County, and the North Shore Region. It is a statewide crisis.

Freshwater is endangered by sea-level rise, coastal and inland flooding, pollution, and invasive species that negatively impact the availability and quality of freshwater; becoming a potential breeding ground for waterborne diseases and resilient invasive species with low-quality tolerance. Combined, all these issues threaten watersheds across the state and, in turn, put human and environmental health at risk due to the reduction in the quantity and quality of freshwater for community usage, wildlife habitation, and local agricultural. Shared resources like freshwater rivers and streams that run through multiple municipalities, states, and nations, there are often conflicting and lax regulations surrounding water withdrawal, industrial dumping, and municipal recreation which can allow for the abuse and misuse of water resources. When pollutants and waste flow downstream it degrades streams, potentially creating dead zones where invertebrates, fish, and plants cannot survive nor adapt.

This all begs the question: how can citizens learn about climate change and water resources, find ways to mobilize, and engage their neighbors, town, and state officials in conservation efforts? By creating a climate action toolkit, centered on freshwater bodies in need of advocacy and conservation in Massachusetts, I hope to bridge the gap between local organizations and the average citizen can give their input on individual-level action and even disperse this information to members and communities who are concerned by

droughts, water pollution, flooding, and other consequences climate change has on their local water. Many current climate toolkits are not aimed towards a local and individual level; rather they target governing bodies, zoos, and corporations and the information provided is often vague and commonplace recommending people turn the tap off while brushing their teeth which are not effective methods of water conservation alone. By educating citizens on their power to change how their water is managed there is a chance to inspire community and political mobilization through advocacy and lobbying education. The goal of this research and the associated digital toolkit is to start building up and engaging the skills of citizens as informed participants.

The Nature of Water

Water is, undoubtably, a finite resource at the rate at which the globe is consuming it. Freshwater is the most limited variety of water, much of which is trapped in glacial freeze and inaccessible. Goutam Konapala and others did research across the globe on how climate change will alter the world's water budget and the climate in terms of precipitation, humidity, evaporation, and such (Konapala, 2020). Both Konapala and the Union of Concerned Scientists ascertain that alterations to the globe's hydrological cycle will reduce freshwater access, increase the frequency and severity of floods, and ultimately lead to uninhabitable, deadly conditions for all regions; these mentioned consequences of the ongoing climate crisis, as believed by the World Health Organization, will lead to sanitation issues and the spread of waterborne diseases (UCS, 2018; WHO, 2023). To corroborate the findings of the UCS, the EPA concluded in 2016 that Massachusetts alone had "..warmed by more than two degrees (F) in the last century..", causing noticeable and intense changes to the weather patterns across the state

(EPA, 2016). The rising temperatures have increased the frequency and severity of both floods and droughts in Massachusetts, and with sea-level rise being a looming threat there is further concern for saltwater to flood freshwater.

According to the 2022 Massachusetts Climate Change Assessment reports the most urgent concerns of the Natural Environment Sector are Freshwater Ecosystem Degradation and Marine Ecosystem Degradation due to magnitude and the gap between the current adaption plans and the reality of the threat to water quality and availability. The Executive Office of Energy and Environmental Affairs raised concerns of how the state is experiencing "... Rising temperature and changing precipitation patterns…" there will be a potential environmental justice crisis as water temperatures increase, we see increased runoff due to intense rain patterns, and possible shifts in native vegetation and species who rely on the conditions of water to remain balanced in pH, dissolved oxygen, nutrients, and clarity (Executive Office of Energy and Environmental Affairs, 2022). There are expectations that cold-water ecosystems will shift to cool to warm habitats which will foster the growth of algae blooms, more than half of Massachusetts' marsh areas will transition to other habitats in less than fifty years, and contribute to the eutrophication of rivers, lakes, and ponds.

As climate change progresses and state inaction continues the freshwater within Massachusetts is at risk of diminishing in quality and quantity for municipalities, stressing the current distribution of water for needs like drinking, bathing, washing, and cooking.

Water Politics

When bodies of water stretch across multiple townships, states, or nations it's difficult and not often incentivized for governments to collaborate on the conservation of these vital resources. It becomes a point of contension and resentment, even, should the matter of a shared river, stream, pond, or lake should become the foundation of a lawsuit. Researcher Örjan Bodin found that with complex and boundary-stretching environmental issues the most effective action was taken through collaborations between governments, but that willingness to negotiate diminished when it did not serve an individual's interest (Bodin, 2017). Due to the ongoing evolution of climate change, the various issues, and the failings of local and state governments to both address and act on the climate crisis there is no definitive way to effectively collaborate on environmental governance. Perramond and Richter, two separate authors, note that nationally and globally there is a disparity in water conservation laws in terms of strictness, protection efforts, and punishment (Perramond, 2019; Richter, 2014). Water withdrawal limits and pollution prevention acts often do not consider the local economy, citizen need, and environmental health; it is further highlighted that these laws often do not work in conjunction across county, state, and country borders. This creates inequitable access to clean water as pollutants flow further down river, even if areas downstream have stringent anti-pollution and clean water laws. These political blockades impede talks of solving issues like pollution, invasive species, flooding, drought, and other threats to water quality and availability for ecosystems and municipalities.

Senator Bruce Tarr has organized the North Shore Water Resilience Task Force (NSWRTF) to bring together over 40 stakeholders, communities, and organizations to

sign an agreement on future collaboration towards efforts of watershed health and resiliency in the face of climate change. This task force includes Salem and Beverly's Water Supply Board, the Salem Sound Coastwatch, the Massachusetts Water Resouce Authority, and twenty-two towns and cities on the North Shore. Signing off the Charter Agreement of the North Shore Water Resilience Task Force (NSWRTF) took six years, it's their biggest achievement so far. Talking with Senator Tarr he discussed the challenges in creating equal but effective measures towards freshwater conservation along the North Shore where the state has little legislature in place to effectively enforce a water ban in times of drought where there would be repercussions for violating withdrawals from watersheds and with many towns having differing views on resource management. Thanks to the $400,000 in state funding to drive their research and information collection in the North Shore's Metropolitan areas the NSWRTF is focusing on the idea of a municipality's 'entitled' water, stormwater treatment, freshwater retention, and aquifer recharging efforts. Unfortunately, where signing an agreement took over five years it seems the prospect of any implementation of widely agreed upon change will take just as long if not longer. This is a step forward in multi-community collaboration concerning shared finite resources and could one day prove to be a model for others across the state to look towards, however it is also a perfect example of the current state of water politics in the face of climate change.

This is one facet of a larger issue and its now budding solutions. Politics and legislature surrounding water, its treatment, withdrawal, and more, are stalled, outdated, and slow to change. Climate change is progressing at unprecedented rates, and to combat

the intensity of these changes there needs to be a collective effort and drive to mitigate, adapt, and reverse the damage done to the state's freshwater.

Pollution

Pollution is a common issue, and while the Ipswich River touts itself as the least polluted river in Massachusetts there are still pollutants in the water which harm water quality and aquatic species. Pollutants can include litter like plastics which clog waterways and contaminate freshwater, as they break down these microplastics infest the stomachs of wildlife which disrupts the balance of the natural ecosystem (Williams and Rangel-Buitra, 2019). These plastics can be sources from improperly discarded water bottles, certain fabrics, or the skin care used before swimming among a countless number of sources. The flood of plastics, and in turn microplastics, in freshwater environments contributes to a decline in biodiversity and potentially toxic waters. Aquatic species who ingest microplastics experience similar adverse effects as studied in humans; decreased fertility, slowed development, and other damaging effects during the developmental phase of life. Plastics made with polyvinyl chloride, commonly known as PVC, contribute to the chlorination of freshwater as they break down in the environment. Exposure to contaminated water can cause birth defects, neurological problems, and an increased chance of developing cancer or heart disease (Issac, Merlin N, and Balasubramanian Kandasubramanian, 2021). These are only recent observations in freshwater, as often the plastic in the oceans is a far more popular and publicized crisis. That is not to undermine the severity of the plastics crisis, but it's to highlight the neglect of freshwater in many ways. The influx of excessive plastics can decrease the rates of

discharge within bodies of water by clogging channels and disrupting the natural flow of a river or stream which can result in flooding.

Unrestricted, unmonitored, and unequal pollution dumping can also adversely affect the wildlife and water quality of freshwater bodies, an example local to Massachusetts is the Boston Harbor's toxic, polluted waters. Old sewage pipelines that ran through Boston Harbor leaked sewage, industrial chemicals, and other toxic compounds which flooded the harbor and lead to tumors developing in the local fish population; the water became unsafe and native fish species were threatened due to this (Burton, 2019). While accidental, the situation poses profound questions and concerns: if someone downstream or if these chemicals leeched into groundwater aquifers what can be done? What if municipalities and nations nearby have strict anti-pollution laws, new infrastructure, and rigid water conservation efforts? That no longer matters. While not at fault, water follows its path and takes everything with it: good and bad. It serves as an example, not just of the detrimental impacts of pollution, but to the lack of collaborative efforts to create widespread and equal legislature around shared waters.

All of this is to say: freshwater bodies are vulnerable to pollution and are documented in Massachusetts to be suffering from its consequences. No matter how little or how much a river, pond, or lake has been exposed to PVCs, sewage, pesticides, chlorine, and the likes there is still adverse effects influencing the health of aquatic species and water quality. In the introduction, it was stated the Ipswich River is the 8th most endangered river in America and the Ipswich River Watershed Association proclaims it as the least polluted. Less pollution in this case does not diminish the title of 8th most endangered river, it is still a contributing factor. Less so than excessive

withdrawals and rising temperatures, but a factor that is not aiding in the water quality and availability for the dozens of municipalities who rely on the Ipswich River for freshwater.

Invasive Species

An invasive species is often introduced accidentally to an environment, on the bottom of a shoe or stuck to the body of a canoe. It can be a disease to which native populations have no natural defense towards or a plant or animal which disrupts the local food chain and ecosystem's composition. It is important to note, however, that not every invasive species is a pest, nuisance, or unwanted. Populations of non-native species can be introduced to help bring balance to a damaged ecosystem or rid an environment of a different, more destructive exotic species which took over.

To continue to use the Ipswich River as an example, one can look at how invasive vegetation has impacted the river's water level and flow. The Ipswich River Watershed Association serves as a local, non-profit organization which aims to protect the Ipswich River and has identified many of the non-native species which have taken over: variable milfoil, Eurasian milfoil, fanwort, water chestnut, purple loosestrife, and many more. Invasive plants are able to spread rapidly due to the lack of native predators to keep the population from growing out of control as well as their often-deep roots. Vegetative invasives, especially, have a tendency to grow exceptionally fast due to aggressive root systems which can choke native plants with no defense against such an attack. The deep root systems also serve to make eradicating the entire population problematic as if even one plant or root is left behind it will aggressively regeneration and once again begin its takeover. This invasion has many consequences without the intervention and immediate,

thorough clearing out of invasives. First, and foremost, the abundance of vegetation on top of rivers and submerged, "…where the flow could be blocked effectively by dense vegetation…", can lead to flooding and downstream droughts; excessive emergent plants can prevent sunlight from reaching the river bottom and causing a domino effect that leads to the eutrophication, or death, of the river (Kíss, Tímea, et al., 2019). Citizens may find concerns arise when invasives and dense vegetation impede the recreational and aesthetic values of rivers, ponds, streams, and such. Clumps of milfoil can prevent boating, kayaking, or canoeing due to their weight when packed together and their tangling; and species like fanwort and water chestnut can disrupt fishing by blocking the surface of the water and catching on hooks. Floating plant invasives also pose issues to sunlight getting into the river, if blocked en masse then it can be difficult for submerged plants to survive and produce enough oxygen to keep the water healthy and aquatic species alive. Kíss and their fellow researchers who have observed the effects of invasive species on rivers recommend the swift removal and reporting of invasive species, as does the Ipswich River Watershed Association, to reduce flooding, drought, and damage to the fragile health of aquatic ecosystems (Kíss, Tímea, et al., 2019). Drought and floods, though, are their own separate issues and have more causes than invasive species.

Droughts

In Massachusetts a consequence of climate change has been the increasing frequency and severity of droughts. As they become common there are various effects on the ecosystem and the severity can make long-lasting droughts a problem for municipalities which have no plans in place to prevent losing their freshwater resources or ways to source potable water for citizens. Droughts have direct impacts on soil quality

due to how the heat will decrease the activity of organisms in the soil and directly reduce the fertility of it and contribute to the desertification of soil. Air quality can decrease due to droughts as the dry, displaced soil loses vegetation which locks it in place and can now be picked up by the wind, a common example of this is the 1930's Dust Bowl. Habitat loss due to the death of vegetation and increased possibility of wildfires, a decreased amount of quality of freshwater, and other consequences all make droughts a high-level threat to freshwater in Massachusetts and has been a major contributing factor to the Ipswich River's ranking of the eighth most endangered river in America (Vincente-Serrano,et al., 2019). The cycling of organic matter in soil is dependent on soil respiration; when there is a drought there is a lack of soil moisture which reduces respiration. The pause in the cycle lowers soil quality, temporarily, unless this soil is subject to human interference or erosion. A loss of vegetation cover as droughts persists and kill of plants that act as soil anchors can exacerbate soil degradation and further compromise the land.

When soil dries it is easily displaced and can be picked up by wind; this dust can compromise air quality. Furthermore, during droughts there is an increase in surface ozone and a hazardous chemical called tropospheric ozone which can inflame the respiratory system (Vincente-Serrano, etal., 2019). These effects, too, are not limited to the area of the drought and can travel across townships and state-lines. As the soil and air grow dry it's more likely for forest fires to spark which directly destroy natural landscapes and urban environments; this endangers wildlife and the human population that lives near the site of a fire. Forest fires further exacerbate drought conditions and the effects they have on the human respiratory system. This also leads to the destruction of

wildlife habitats and the degradation of land, decreasing its ability to recover. When droughts occur in urban or suburban environments habitat loss is especially dangerous as there is less undeveloped land for wildlife to reestablish a home. Animal populations are further stressed, in these scenarios, by a lack of freshwater and food due to fires and human development.

As droughts continue the low water quantity disrupts flow and discharge, often growing warm in stagnation; this can lead to algae blooms and aquatic-species death. In extremes, drought can cause freshwater body eutrophication which kills all life in a body of water. Droughts in fresh water can also increase salinity and reduce the ability for substances in the water to breakdown which impedes and complicates the water treatment process for municipalities (Vincente-Serrano, et al., 2019).

The effects of droughts are complex and intertwined deeply, it's a domino effect that breaks down environmental quality and the health of organisms. As water quantity and quality declines due to climate change and droughts its apparent there is a pervasive issue at hand that shows no sign of slowing soon.

Floods

Climate change and human development act as exacerbators of the valleys and peaks of environmental processes like the hydrological cycle. As precipitation seasonally increases and decreases, it's likely that these patterns will grow far more intense and prolonged leading to droughts, as mentioned prior, and flooding. Inland and coastal floods are both hazards posed by and to rivers and the surrounding environment. Saltwater infiltration can negatively impact water quality and the health of the vegetation and wildlife who depend on the freshwater environment to thrive, it also serves as a

potential breeding ground for disease and contamination as water quality drops. Inland flooding serves as a danger to fragile habitats and human safety by damaging infrastructure damaging vulnerable, native species.

As a humid region of the globe, Massachusetts is expected to see a 5% increase in extreme precipitation events due to global warming (Tabari, 2020). This will increase the intensity and likelihood of flood events across the state, even areas of Massachusetts that have not flooded could potentially see flood events in the future. These events will further pollute water, infiltrate urban infrastructure, and potentially become a source of waterborne illnesses making them more prolific in their spread.

Flooded waters will collect dirt and pollutants as they recede to their sources and muddy waters to a dangerous tipping point which could cause river, pond, or stream eutrophication. As stated, before when discussing the impacts of drought, an increase in sediment and a decrease in dissolved oxygen in water lowers water quality for aquatic species and submerged plants. The mass death kills the fragile aquatic ecosystems and the further polluted it grows the harder freshwater is to treat for municipal usage which limits the availability of water for towns and cities. A lower quality of water that is too expensive or energy-consuming to treat is further exacerbated by urban stormwater runoff and effluent discharge, these factors increase the risk of floods and intensify freshwater pollution as the urban runoff mixes with the freshwater (Miller, Hutchins, 2017).

Climate change and urban development and densification will intensify precipitation patterns across the state and create more frequent and more intense flood events which will not only endanger the environment but societal safety as well.

The Toolkit

A toolkit is a collection of information and resources with the express purpose of acting as an aid towards the collective goals of education, advocacy, awareness, and promoting volunteerism in communities throughout the state. Governments, grassroot organizations, hospitals, and schools, among others, can all utilize physical and digital toolkits for their communities. Often these can be found online as PDFs or booklets given out by organizations and companies as educational and preventative resources for those untrained and unfamiliar with certain fields. Knowing this, it was apparent the best way to get information to citizens about the impacts of climate change on Massachusetts' freshwater was to create a digital toolkit based on the research within this paper.

The toolkit, published on December 19th, 2023, is available to the public: Massachusetts Water Advocacy and Conservation.

A Digital Product

The creation of this digital toolkit took months of trial-and-error; trying applications foreign to me to try and produce a paper pamphlet for either tabling or handout at community events. A physical guide to water conservation proved to be too small of a media for all the information from my research and left little room after for guidance and advocacy. What would likely have happened had I kept pursuing a toolkit on paper I would likely have made two versions: one for education and the other for advocacy. Dividing my work up was not ideal and defeated the purpose as you can't have advocacy without knowledge of what or why you're advocating.

A digital format proved to be fruitful. Utilizing free software, I was able to create a website with Wix.com that focuses on statewide water conservation education with sections for outreach. The benefit of a website is that it gave me the option to have multiple tabs and give viewers the chance to reach me with questions, concerns, and feedback. Should I be lacking in areas of information or outreach, people can comment and in real-time I can supplement those aspects of the website through publishing blog posts. Furthermore, owning a device that can connect to and display the internet is commonplace making this format far more accessible to people and far easier to distribute.

A website is also handy, as many internet browsers have built-in translators. While my website may only be in English due to a lack of proficiency in any other language browsers like Safari and Google have the ability to transcribe my webpage in different languages which a paper pamphlet handed to non-native English speakers could not achieve. In order to help the spread of my toolkit I can utilize tools like QR codes which can be printed or distribute links to representatives and organizations to display in their resources or highlights.

Production Process

Wix.com gave me a preset template based on the topics of education and a starter business; from there I altered the sections included, developed a blue aesthetic to match the theme of water, and began to plug-in all my past research to provide an educational foundation for viewers. To accomplish my goal of bridging the education gap between citizens, organizations, and representatives and giving power to citizens to advocate for their resources I’m utilizing five main tabs: Home, Outreach, Blog, About, and Contact.

The Home tab is my way of drawing in a first-time viewer; I state quick facts about Massachusetts' current environment, my mission as an educator and environmental activist, and a quick preview on how people will be able to utilize the information provided. Next, the Outreach tab is arming citizens with knowledge on how to contact their representatives; from finding the information to writing what they want to say. This tab also offers information on volunteering and local organizations who are working every day to protect the finite resource that is water. After that is the Blog tab; this is where I'm periodically publishing different sections of my research for the viewers to read at their leisure. By breaking up the bulk of my research into digestible posts I believe readers can find the topics they care about more easily and can share those smaller posts as opposed to an entire student thesis. Second to last is the About tab which gives information on myself, my mission, and what the website is in terms of my thesis. Finally, the Contact page gives viewers a chance to reach out to me with any questions or comments. As stated prior I intend to use this page as a way to improve the information I'm disseminating and keep the toolkit relevant as it continues to be spread.

All these sections maintain a uniform aesthetic and use credited illustrations and cited information within. It took four months to create a finished website for publication alongside the written portion of research.

Why Citizens?

The role of citizens in advocacy has always been and always will be the most vital effort to true change. The most imposing barrier to prevent this unionizing is a lack of knowledge on conservation science and climate change. Often the term "citizen science"

is brought up in discussion of advocacy in environmental areas, and it's defined by, "…the practice of engaging the public in a scientific project- a project that produces reliable data and information usable by scientists, decisionmakers, or the public…" (McKinley, Duncan, et al., 2016). Citizen scientists, therefore, is any member of the public who engages in valid scientific processes through volunteer or crowdsourcing efforts; even professional efforts similar to that of a paid, academic scientist. The organization and application of citizen science is able to collect large swathes of data on a scale that is not feasible or usually practical; and citizens benefit from the gained knowledge to be informed and engaged decisionmakers in conservation efforts in their community. Through active participation in community science citizens can become educators in their community and leaders in local discussions of environmental and natural resource management. Education is the best tool to become an informed advocate for change and often local organizations like the Ipswich River Watershed Association are looking for volunteers to become citizen scientists with free training provided.

The encouragement and engagement of citizens in conservation efforts and environmental science creates educators in their communities. The more tools available to teach and engage citizens in decisions concerning their natural resources and environment the more citizen scientists there are to lead others. Easily understood and accessible tools are necessary to citizen science when being a scientist is not an accessible option; this is where toolkits come in as an aide. Researchers found the most successful and useful toolkits are based on a local level and used to fill in informational gaps to meet the needs of readers (Thoele, Kelli, et al., 2020). This toolkit fits those criteria to be the most effective as a tool for citizens and communities and will inform the

audience on the issues they're facing and how to address them as decisionmakers in their homes.

Solutions

The delay of legislature from government officials to conserve vital, finite resources can be remedied by constructing a foundation of education and confidence from the bottom of society. A person who understands or is beginning to learn about the many different aspects of their local aquatic ecosystems and its fragilities, as well as the levels of government surrounding the freshwater, can become informed decisionmakers and advocates in their community who can eloquently and effectively voice opinions on how such resources should be safeguarded. When discussing with neighbors, local organizations, and elected officials it is not enough to say, "Something needs to change". When citizens can come together to put pressure on officials with a specific proposal or solution, then there is an attainable, mutual goal to rally around. Citizens have to not just understand the detriments of pollution, invasive species, droughts, and all the other issues at hand, they must also be leaders to remedy those issues which is the hardest part of advocacy.

There are many ways citizens can engage their community in local politics and advocacy, each with varying levels of effort and socialization. For many, this can be daunting task to undertake, which is why the need to understand how to go about effective advocation is equally as important as knowing what the issue is. The benefit, too, of knowing the different levels of advocacy help community leaders and organizations tailor the process of mobilizing members of the public as volunteers and

advocates. A common form, and one that allows for three different degrees of personal involvement, is contacting local representatives via written letters, emails, or phone calls. The ability to choose how to converse with representatives can give control to the citizen and work with their comfort level in socialization.

While this is an easy one, it's important for citizens to know who the best officials are to contact about water conservation as a municipality has dozens of boards who may have some influence over aspects of aquatic ecosystems such as planning and zoning boards, conservation committees, park and recreation commissions, water supply boards, and sustainability committees among many others. It's also important to acknowledge the existence of these boards, commissions, and committees may vary and not every town and city have sustainability councils or conservation commissions. When deciding who to contact, mayors and city councils are always a safe bet, from there looking at boards and committees whose names involve water, sustainability, recreation, beautification, zoning, or related words likely have sway in the development, conservation, and preservation of local bodies of freshwater.

Another way for citizens to engage and advocate is to work with local organizations or commissions to spread awareness, strengthen the bonds and mission of their community, and further fill their toolkit by building skills such as citizen science. Organizations like the Ipswich River Watershed Association (IRWA) train citizens to perform basic water quality tests like dissolved oxygen, turbidity, and salinity in collaboration with the environmental science programs as Essex North Shore Agricultural and Technical School. This is at no cost to volunteers, and they are given the tools necessary with safety training. Local towns and cities have Stream Teams, one prominent

example is the Middleton Stream Team, which organize river cleanups, wildlife crossing signage, and Earth Day festivities for education and engagement. Stream Teams offer both volunteer opportunities and low-level educational engagement to fit the busy schedules of everyday people. A more involved organization is the North Shore Water Resilience Task Force (NSWRTF) organized by Senator Bruce Tarr which has brought together representatives from 18 cities and towns in the North Shore area of Massachusetts to collaborate and pass legislature on water availability and environmental conservation. The meetings held by the task force are open to the public via Zoom and in-person attendance, but unlike attending a town or city meeting there is no forum for citizens to take the floor and discuss their concerns. If the goal of a community is to speak directly to their representatives it would be better to focus on local meeting attendance. One may consider organizations like the NSWRTF as an important venue to engage in behind-the-scenes discussions on water conservation legislature and collaborative efforts to further understand water politics.

In the end, the first steps for change are to educate oneself, engage with neighbors, the larger community, and then representatives. Starting with education and good faith discussions based on the concerns of environmental health and freshwater availability builds a strong and confident foundation for mobilization and advocacy to create true change in how freshwater is managed in Massachusetts.

Conclusion

The paired research and toolkit underscore the urgent need for citizen engagement and education in the efforts of protecting vital freshwater resources and the need for

effective change in the face of the ongoing climate crisis. Having delved into the conflicts of excessive water withdrawals with no uniform conservation efforts across a shared resource and the influx of climate change's consequences, with the Ipswich River in Massachusetts as the prime example, one can see the need in safeguarding a finite and precious resource. As temperatures intensify and patterns of precipitation skew towards extremes to exacerbate flooding and droughts, native plant and wildlife loss are fueled, and water quality is compromised there is an obvious need for advocated change.

The solution proposed is a digital toolkit to bridge the educational gap between citizens, grassroots, and their local governments. This climate action toolkit is tailored to freshwater bodies in Massachusetts and the threats they face every year as current water conservation guides focus on at-home tap water. Unlike the conventional toolkit about turning off the faucet while washing dishes, this digital tool with work to empower citizens to become informed decisionmakers in the conservation of their vital resources and environment. The production of the digital toolkit aims to offer an accessible and straightforward user interface to help people become engaged in the environmentalist movement. By accessing information on the condition of freshwater in the state and the many ways to become part of the solution, citizens can become leaders within their own communities and involve themselves in local organizations and politics.

Created on the foundation of environmental reports and scholarly insight, the information provided highlights the vital nature of citizen involvement in conservation efforts in Massachusetts. By looking at the nature of water, the climate crisis, and local water politics viewers can gain a picture of the threats posed to their world and rather than leaving a sense of doom and gloom, the power of education and spurring

involvement in unintimidating ways can begin a wave of positive change. As the state faces the climate crisis as it intensifies and compounds to make more frequent and more dangerous droughts and floods, among other consequences, one can see citizen engagement is going to become the core to combating the ramifications of climate change and freshwater loss. As citizens become informed and grow into leaders there can be an organized movement to get citizens, grassroots, and policymakers on the same level to conserve and preserve freshwater for today and for the generations to come.

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