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How to protect estuaries in Durham, NH

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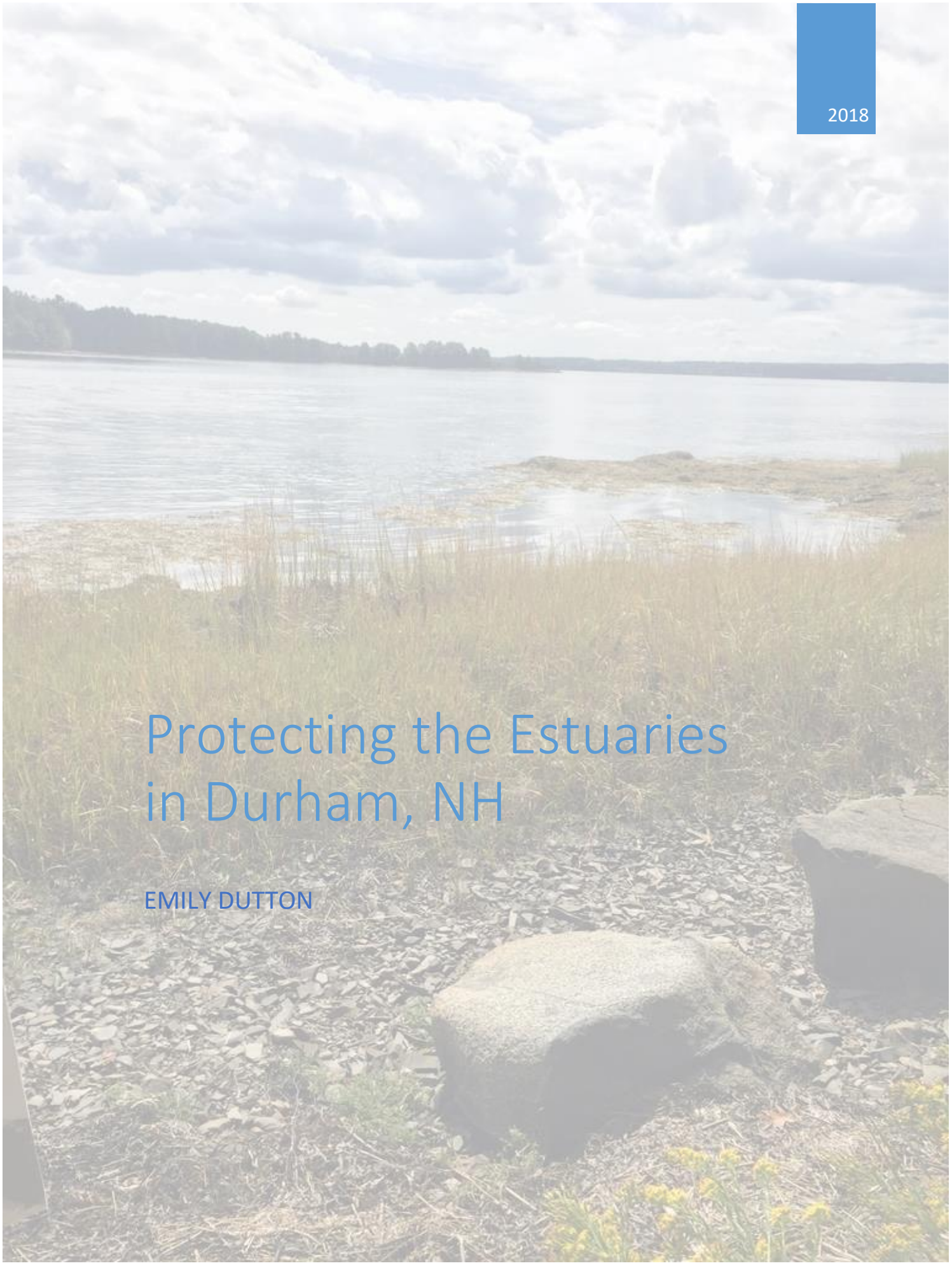
Abstract
Estuaries are some of the most diverse and fragile ecosystems on our planet. All over the nation, along the coastal states, half of the wetlands, about 55 million acres, have been destroyed ("Habitat Loss Nationwide," n.d.). Most of these wetlands get Dutton 3 cleared and drained for development, agriculture, etc. In the estuaries located in the Gulf of Maine, development has doubled in the last forty years in the lower watershed ("Habitat Loss Nationwide," n.d.). This has resulted in an increase in population and impervious surfaces, which correlates with the negative impacts to the watershed, such as runoff and sedimentation (National Research Council, 1987). Other factors have contributed to the degradation of the estuaries in the Piscataqua region such as sealevel rise and an increase in fertilizer use (citations). Some changes have been made to protect these estuaries, however, solving the cumulative impacts need to be included in the protection. Each individual activity is not independent of each other. Their activities work together to decrease the productivity and health of the estuaries. We have policies that have been created, and zoning that has been changed to improve estuaries, however, we need to take that next step forward to fill in the gaps. The goal of this paper is to analyze the current policies and programs, identify the gaps to improve and enhance the programs to be in line with the longstanding ideals of protection and conservation of Durham's estuaries.



2018

Protecting the Estuaries in Durham, NH

EMILY DUTTON

I. Disclaimer:

When I decided to go into my major, my dad was a big supporter. However, he did not blindly take the information I learned as the answer to fix our problems. He would challenge me, pushing me to create solutions that were feasible, realistic, not just good for the environment but good for people to be able to make those changes. People want to do good for themselves and others, their goals is usually not to destroy the environment. A lot of it has to do with the economics and the social implications. If it costs more money to change to a more environmentally sound product, most people cannot make this change. There needs to be some incentive to convert. Because of my father, I am able to see the problem from many different perspectives, the environmental, the economic, and the social. I have become better at articulating my point of view to persuade others of the best way to solve some of the environmental problems we are facing. This paper is a way of looking at the problems we are facing with estuaries to convince the reader, the community, policy-makers, planners, etc. that estuaries are important to protect, because of the economic, social, and environmental benefits we do receive from estuaries. We have known for a long time that estuaries deserve to be protected, we have even come up with policies to protect estuaries, yet we are still faltering. This paper is meant to be a well-crafted argument. It is bringing together all the facts, looking at this from multiple perspectives. Getting in every angle to try to find the chink in my own argument, so that I can answer all the questions tossed my way. When my dad asks me if I have considered x, y, and z, I will be able to say 'yes, and this is what I think we should do'. The ideas in this paper are not revolutionary or even original, but why reinvent the wheel when the answers are already out there. I placed them all in one paper to try to protect estuaries considering all the factors involved.

II. Introduction:

i. Background:

Estuaries are some of the most diverse and fragile ecosystems on our planet. All over the nation, along the coastal states, half of the wetlands, about 55 million acres, have been destroyed ("Habitat Loss Nationwide," n.d.). Most of these wetlands get

cleared and drained for development, agriculture, etc. In the estuaries located in the Gulf of Maine, development has doubled in the last forty years in the lower watershed ("Habitat Loss Nationwide," n.d.). This has resulted in an increase in population and impervious surfaces, which correlates with the negative impacts to the watershed, such as runoff and sedimentation (National Research Council, 1987). Other factors have contributed to the degradation of the estuaries in the Piscataqua region such as sea-level rise and an increase in fertilizer use (citations). Some changes have been made to protect these estuaries, however, solving the cumulative impacts need to be included in the protection. Each individual activity is not independent of each other. Their activities work together to decrease the productivity and health of the estuaries. We have policies that have been created, and zoning that has been changed to improve estuaries, however, we need to take that next step forward to fill in the gaps. The goal of this paper is to analyze the current policies and programs, identify the gaps to improve and enhance the programs to be in line with the longstanding ideals of protection and conservation of Durham's estuaries.

ii. Current Policies:

Currently there are policies in place to protect our estuaries around the country, including the Coast Zone Management Act (CZMA) and the Estuary Restoration Act. The CZMA has three parts that deal with management, research, and conservation. The management program utilizes state and federal resources and advising to protect, restore, and develop coastal areas. The research reserve system was established to get a better understanding on our coastal areas and the human impact imposed on coastal areas. The conservation program was created for state or federal government to purchase critical land for conservation land. Restoration programs can also be created if funding is acquired.

The Estuary Restoration Act was created to restore the many wetlands that have been destroyed due to human activity. It connects many different agencies to provide funding, expertise, and resources for these projects. They have even revised the program guidelines to include monitoring of the projects to document their success.

iii. Policy Problems:

The Coastal Zone Management Act has a few holes in the policy that make it difficult to completely protect our coasts and estuaries. In the management program, there is a vague definition of what is considered a coastal zone. Without an adequate definition, development can be difficult to control. The land that should be protected for conservation land needs to be “ecologically important”, which can lead to discrepancies in if the land should be protected or not. The policy does offer some examples of what this would mean. If the area has a scenic view, historical feature, or recreational opportunity then it is ecologically important. However, these values are variable from person to person and are focused on the aesthetic values we receive from estuaries rather than ecological values. Instead areas that support rich biodiversity, areas most vulnerable to storm damage, or that have been significantly degraded should be examples of what is ecologically important. Once the area has been chosen it has to go through a competitive merit review to determine if the program will get federal funding. The funding is given to projects that have been determined most critically important. If the project does not get the federal funding, it does not facilitate other ways to acquire funding. Lastly, if the land has been chosen, funding is provided, and a conservation plan has been created. There is no minimum size requirement for conservation land. Smaller conservation areas are less effective at protecting the species present. The buffer around the protected land needs to be large enough so they allow the species living inside to replenish to a stable population.

The Estuary Restoration Act has a clear mission on what to protect and restore and how it will do it. However, the purpose of the act is to create projects that are feasible and realistic. These terms can vary from person to person in what seems to be feasible and realistic. This could also lead to project goals that are below what is capable. It is possible to underestimate feasibility. In which case, the goals of the project may not fully solve the problems that we have created. What is realistic and feasible will change throughout time and space, which is why these words were likely chosen for this act; however, we also need to push our boundaries on what we think is attainable to face the degradation of our estuaries.

Many of the solutions for managing coastal resources do not help the cumulative impacts. The cumulative impacts are the result of multiple actions creating a greater effect on the ecosystem than the sum of the individual parts (Halpern et al., 2008). For example, the development of a neighborhood on a plot of land. The area has to be cleared to build the houses, which reduces and fragments the habitat for the wildlife that live in this plot of land. It creates an opening for invasive species in the disturbed landscape. The constructions of the houses will use materials which had to be cultivated somewhere. Roads and driveways will be put in the neighborhood which will increase the impervious surfaces for runoff. The runoff will likely get contaminated and drain into our waterways. These actions can no longer be considered independent from one another, however, management practices will only try to solve the results of one of the actions. The root of the problem will not be fixed and will result in a perpetual problem. The only way to solve these multifaceted problems is to attack the problem on all sides, which will mean a drastic change to what is currently happening.

iv. Policy Change Recommendations:

These are the holes in the policies that should be changed or definitions agreed upon in Durham, NH to protect the Oyster River estuary.

Coastal Zone:

To sufficiently protect the estuaries in Durham, New Hampshire, a collaborative definition of the coastal zone needs to be created. We need to comprehensively understand what is considers safe to develop in the coastal area. Should we have a set buffer zone around our coastal zone? Using the technical assistance and resources from other towns to help with creating a healthy management program.

Ecologically Important:

When defining what is ecologically important for Durham, NH, this decision should be made as a community. What is ecologically important for some may not be as important as others. Creating a comprehensive definition of what is ecologically important with the conservation commission and the planning board is crucial in protecting Durham's landscapes. Durham should conserve areas that would protect areas that provide ecosystem services, which provide benefits for humans and the environment.

Cumulative Impact:

Understanding and incorporating cumulative impacts into Durham's management system will improve the protection and conservation of our estuaries. The cumulative impact is something that is often disregarded in most management tactics, but is usually the root of most human induced environmental problems. The impact on the environment of the human activities are greater that sum of the individual activities. One solution will not solve the problem; a team of people will have to work together to help solve the many problems. To protect our estuaries Durham needs to assess the cumulative impacts.

Funding:

Protection and restoration projects require funding. Funding should be acquired through federal, public, and private sectors. Within the Estuary Restoration Act and the Coastal Zoning Management Act there are opportunities to get federal funding. This funding, while helpful, is limited. Only a portion of the projects can get federal funding. There needs to be more funding opportunities for these projects. These agencies should help facilitate groups to finding other sources of funding, either supplied by the state, local, or private agencies. Since coastlines and wetlands have been prioritized for protection, availability of funding needs to be prioritized.

Conservation Land Size:

To create the most effective conservation area, there should be a minimum size. This will allow the species enough room to replenish their population. If the area is too small, the edge effect will limit the species protected within. The edges of the conservation land are impacted by the adjacent unprotect environment. This will not give an accurate representation of what that ecosystem can be. Buffers need to be used to protect the surrounding landscape. Large buffers can help to increase the protected area, and also decrease sedimentation and erosion two very big challenges facing estuaries and wetlands.

Constructive Goals:

While it is beneficial to keep projects realistic and feasible, however, we cannot keep that from solving the problem at hand. This could lead to project goals only covering up the problem with a bandage rather than fixing the deeply rooted problems.

The primary problem needs to be identified and the goals should be to stop the source of this problem.

III. Methods:

v. Ecosystem Services

To define ecosystem services, the broadest, more universally understood definition should be used. For instance, the Millennium Development Assessment defines an ecosystem service as something that benefits human well-being (Barbier et al., 2011). In these broad terms there are specific categories in which an ecosystem can benefit a human: goods, services, and cultural benefits (Barbier et al., 2011). Goods refers to nature providing materials, such as water, food, or raw materials for making other goods. Services are the ability for that ecosystem to filter and purify water, sequester carbon, detoxify, pollinate crops, and control pests and diseases. Cultural benefits are the least tangible of the services. It is providing intellectual and spiritual experience through nature, recreation, and scientific discovery. It includes the historical values of the land as well. While some services may seem more important, all of these provide benefits to human's well-being.

With looking at this definition of the services an ecosystem can provide, I will create an evaluation of estuaries using the ecosystem services as my framework. By looking at the services this landscape provides, we can determine how valuable it is and how it can be protected from direct or indirect human impact to keep those ecosystem services intact.

vi. Assessment

The evaluation should be used to create a list of high priority estuaries that are most critical. These are the areas that will be most susceptible to erosion, storm damage, flooding, sedimentation, etc. Using the current policies, a plan to protect and conserve should be drafted. There are gaps in these policies that I, and my interviewees, will make recommendations to enhance their ability to protect and conserve. To get a greater perspective for recommendations, I will be doing key informants interviews, one person from the policy perspective, one person from the science prospective, and one person from the community development perspective.

The town planner should be involved in this process to understand how development can still continue in Durham, but ensuring sensitive areas are well protected from any development. If the land has been damaged, a restoration plan with government or private funds will be created. The plan will create clear, comprehensive goals to mediate the current damages and prevent any future damage while still providing public access. A monitoring system or group will be implemented to monitor the progress of the projects to make sure the goals will be achieved. A partnership between UNH and the town of Durham should be created. A group of students can go out to do the yearly monitoring of each project to be put into an annual report of the project. These reports will watch for any signs of degradation and they will also provide feedback for future projects on the successes and failures of each project. This will make each project thereafter more and more efficient and effective. If there are any lapses in the restoration, some of the funds of the project should be set aside for maintenance.

vii. Strengthening Our Community

A strong community starts with a good foundation. The base of that foundation is a healthy, resilient ecosystem. In the face of rising sea levels and more intense storms, strengthening our community is critical. Communities that are able to bounce back after these events are going to be necessary, otherwise they will continue to be devastated. Strong, healthy estuaries will be able to curb many of the damaging affects after a severe storm. Healthy estuaries will store flood waters, provide filtration, and reduce wave action. While severe storms will still disrupt a community, the damages will not leave them devastated, unable to get themselves up again. By protecting our estuaries, we are buying in to protect and strengthen our community.

IV. Analysis

viii. Regional Scope

Durham is a good model for protecting estuaries in New Hampshire, however within the Piscataqua watershed problems still need to be addressed. During my interviews with Melissa Paly, the Piscataqua waterkeeper at the Conservation Law Commission, and Dr. Kalle Matso, the coastal science program manager at the Piscataqua Regional Estuary Partnership (PREP), both mentions that non-point source

pollution is the biggest challenge. The policies we have in place work very well at protecting estuaries and waterways from point source pollution, but storm water and septic systems are large contributors to the non-point source pollution. Both are regulated at the municipal level, not at the state or federal level. The distributed sources make it very hard for municipals to regulate and the lack of an over-arching septic regulation can create gaps in protecting our waterways, including estuaries.

Septic systems create a truly troublesome problem. Each town sets up their own building codes to regulate septic systems. A majority of the nitrogen loading that ends up in our waterways is from septic as Dr. Kalle Masto discussed in our interview. He stated that we do not know what is a safe level of nitrogen input, but we do know that excess nutrients can be very harmful to aquatic ecosystems and our loading levels are likely too high.

Melissa Paly mentioned that half of the population in the Piscataqua watershed are on septic and a fifth of the nitrogen loading that is put into waterways is from septic systems. This problem needs to be addressed. Even the most diligent of homeowners can forget to get their system pumped, cleaned, and maintained properly. The septic companies are the ones that call homeowners to schedule cleanings, however there is no enforcement if the homeowner does not get their septic pumped.

Because we know that excess nutrients in our waterways disturb the ecosystem and can degrade the clean water, there should be some authority given to environmental agencies to enforce septic cleanings. Environmental companies and agencies should call homeowners to ensure their septic system is scheduled for cleanings. Incentives should be available to those that keep their septic systems up to date and follow the building codes. Federal, state, or local environmental agencies should work with septic companies to provide homeowners a subsidized price for keeping their septic system maintained. More people will be willing to keep their septic system clean if it is the cheaper option. These programs are only feasible with governmental funding or partnerships with private sectors for funding.

Planning and protection of resources comes down to the town’s decisions. The people in the town play a major role in what is done in the town. The community members make up the town council and the conservation commission. Both groups are

volunteer positions that provide the structure for the town. Abigail Lyon, the community technical assistance program manager at PREP, spoke about how community members do not realized the influence they have in decision making process. They often do not realize what they are able to change, protect, and stop with enough support. Education and outreach are some of the most important aspects of getting people to change. When people learn about something, especially something personal to them like their local estuary, they care about it and they want to protect it. Programs like PREP need to become more widespread, with workshops, videos, articles, etc. about what is happening with their regional resources, like estuaries, and how they can get involved, empowering communities, to stand up together and make change. Because some people that want to changes the current policies may not fully understand the process, the commitment, and the resources it would take to complete; within those workshops people should be taught what to expect. Getting a policy to change or to stop a development from happening takes a lot of time: to get support, go to town meetings, write up counter arguments, and do research. Funding is also necessary to implement these changes. Without knowing this ahead of time, this task will seem daunting and impossible to complete. If towns had programs to walk people through the process step by step, helping them in the research, drafting of reports, applying for grants, etc. maybe more people would feel more apt to getting involved in the local government. Towns should have monthly workshops on how to write a report or apply for a grant to help townspeople feel comfortable with these skills to make change. The best ways to incentivize people to get involved would be ensuring there would be funding and technical assistance along the way, which will be provided by other the community members in the town council and conservation commission.

Currently we do not have a good model of ecosystem services to use as a framework for decision making. We do not have a way to put a monetary value on the ecosystem services that allow people to wrap their head around it. This is a great tool to use for researchers, planners, and students to understand and conceptualize, however, as a framework it seems to lack the decisions making ability. It creates a barrier for community members and the local government. Not everyone will have an understanding of what ecosystem services are. Additionally, when the value and

importance of the ecosystem is understood, people understand the measures that should be taken, however, it is often expensive to make those changes to protect our ecosystem. To update a waste water treatment plant, for instance, it could cost anywhere between $10-20 million, which is paid with tax dollars. People do want to help protect their resources, however, if there is no more money available, no changes can be made. In addition to town planners, town council, and the conservation commission understanding and considering ecosystem services, the framework that may be most beneficial for the community and the local government would be create a protection plan based on the town's specific values. If a majority of the townspeople do not agree with the direction of the protection plan for estuaries, they will not want to invest tax money into those programs because it does not align with their values. Understanding what is most important for the town, historical preservation, aesthetic values, recreation opportunities, etc. will likely get more of the community on board with the investments required to make these protection programs and ecosystem services can be used to guide those protection plans.

What was not included in the interviewees responses was the functions and benefits of buffers. This is an aspect that was not overlooked by the Wetland Protection chapter from the Shoreland Protection Act. Buffers provide many benefits toward protecting wetlands and estuaries, including reduction of erosion, sedimentation, noise, etc. (Department of Environmental Services, n.d.). Buffers can even provide a habitat refuge if it is big enough, however if storm water problems are not properly handled, the benefits of the buffers may not be fully fulfilled. During peak storm runoff, the sedimentation that was caught in the buffer zone can be swept off into the waterway (Department of Environmental Services, n.d.). This is another cumulative problem that should be managed simultaneously to get the full protections of the buffers.

One of the other aspects consulted in the document is the mitigation of nonconforming uses, the actions that were permitted but are now prohibited (Department of Environmental Services, n.d.). If a property action is approved, mitigation can be a way to help with the impact that may be imposed on the wetland. This can be a helpful way to offset some of the damages that can be created by the activity. It is putting some ownership into the damages caused by development and

including it in the action plans, which will increase the cost for the development. However, this is assuming it is an equal tradeoff, that damaging the wetland in one area can be made up for by protecting and conserving another area in the wetland from development. While this tool may be helpful in getting land protected, it should not be relied upon because of its reactive approach to protections.

There are restricted actions that cannot take place on or near wetlands, however, there are conditions that are permitted. These conditions are still able to be carried on. In some cases, like with the agriculture and timber activities, they need to follow the most up-to-date regulations of best sustainable practices (Department of Environmental Services, n.d.). Dams can be constructed if they are to be used for fire control, habitat creation, and/or recreation (Department of Environmental Services, n.d.). Likely, this impoundment is to flood the wildlife that is already existing. It will be taking away from one habitat to create room for another in an area that it did not exist before. Impervious surfaces are restricted near and on wetlands, except if they are for the creation and repair of roads, driveways, foot paths, bridges, powerlines, and pipelines (Department of Environmental Services, n.d.). It seems counterintuitive restrict impervious surfaces, yet have all these conditions that are still permitted. Impervious surfaces are correlated with increased runoff, which is one of the problems facing wetlands. Taking from one example in the Durham, Newmarket road, Route 108, is under construction throughout the year because it was constructed through a wetland. The road is constantly sinking into the wetland and has to be fixed to keep it safe for travel. This not only holds up traffic on 108 every day, but it is using tax money to patchwork this road, which can never be fixed. Heavy machinery that is always present and the laying of new asphalt will have an impact of the surrounding wetland not matter how careful the construction is. If roads are constructed on or near wetland, starting with a foundation that is not stable the road will need constant repair, which will use up tax payer dollars instead of using that money for a better solution. While Route 108 might be the most direct and technically convenient way to get from Durham to Newmarket when the road was built, with flaggers stopping people as they drive and the bumpy, patchwork paving of this road, it is a nuisance to drive on. If we are truly committed to protecting our wetlands, we need to stop these provisions that allow for poor planning. The result is expensive

and damaging. We need to do more forward thinking, which means taking that step to stop building where we know we should not. We understand how to protect our estuaries and wetlands, we have the proper policies in place to make it happen, we need to become stricter on the permits to build.

ix. Durham Case Study:

The best way to create a framework for protecting estuaries is to start with creating a value system that aligns with the town's views. This process with include many different perspectives to come together to collectively decide on how Durham's resources should be managed and protected. Once the town has agreed it can start to work on the smaller gaps that need to be addressed. However, trying to fill the gaps without having a baseline will lead to inconsistent regulation and protection. This step may seem obvious and simple, but it ensures everyone is on the same page.

Within Durham's 2015 Master Plan in the natural resource section, it is very focused on wetlands and estuaries and even the risk of climate change due to sea level rise ("Town of Durham Master Plan," 2015). These specific references to wetlands shows that Durham does realize the importance of this resource. It dives into the importance of encouraging private landowners to manage their land thinking about wildlife and the environment, creating adequate buffers, discouraging of development in floodplains ("Town of Durham Master Plan," 2015). To be able to ensure protection of the estuary, however, stricter zoning changes would need to be implemented. This would be a change in how much of the land adjacent to the estuary is available for development. The minimum buffer size is 50 feet, which is required by the Shoreland Water Quality Protection Act, created by New Hampshire Department of Environmental Services (New Hampshire Department of Environmental Services, 2011). Each town can have a larger setback, however they all have to follow the minimum buffer size. In some zones in Durham the buffer is only 50 feet. However, along the shore land, much of the zoning is described for Resident C, which has a 200 feet minimum distance from the shoreline and a 20% impervious surface ratio ("Chapter 175 Zoning," 2015). However, homes along the coastline are often built very close to the shore and their lawn goes all the way to the coast line. While development cannot happen within those 200 feet, there are no specification that require a vegetative planting to go within this

buffer. Fertilizer for the lawn can easily be washed into the estuary. Private land is difficult to regulate, however, specification for the buffers should be defined to encourage or require the planting of native vegetation. Durham should also prevent or discourage the use of fertilizers for lawns. This will help prevent erosion and runoff from entering the waterways. Annual monitoring of the shoreline should be conducted to see if these requirements are being fulfilled. This could be conducted by a UNH student for either service hours or credit hours to reduce the cost of monitoring project. Drones could also be used to fly over the coast to make a monitoring assessment of the buffer zone. Monitoring programs are what is lacking on the enforcement of these regulations.

Within the Wagon Hill Farm reports written in 2009, the stewardship makes suggestions for shoreline protection. The protection suggestions include a change in beach access, fixing and managing for trail erosion, creating and restoring an oyster reef, working to remove invasive species, and creating a living shoreline (Snyder & Ingraham, 2009). The living shoreline is a management tactic that would help to curb many other problems that are created by human disturbance, such as erosion, runoff of non-point source pollution, and increasing ability to store and filter flood water (Snyder & Ingraham, 2009). Since 2009, not many changes have been documented on Wagon Hill Farm. An inventory form was submitted before January 19th, 2018 to be accepted for the 2018 grant application (New Hampshire Division of Historical Resources, 2018). This grant is for the eligibility of becoming a historical monument. This would be to preserve the houses on the property and some of the grounds on which they reside (New Hampshire Division of Historical Resources, 2018). For updates on the environmental restoration of Wagon Hill Farm, I found a mention in the Friday Updates. It is a newsletter Todd Selig sends out weekly on what is happening in Durham, NH. On August 31st, 2018, the living shoreline project that was proposed in the stewardship plan is mentioned (Selig, 2018). The design for the living shoreline is almost finalized. The Strafford Regional Planning Commission is the funding source for this project and once the design is picked, the implementation will begin (Selig, 2018). This project has been in the report for nine years before a design was even created. This is only one of the recommendations that the stewardship plan suggested. The other aspects, which were equally important in protecting the estuary, have published no updates. Projects like

these need to move faster. The problem is not understanding the problem, because most people have a decent understanding of the degradation to our estuaries. Part of the problem is funding; town's lack the resources needed to fund all of these projects. However, another big problem is keeping this at the forefront of people's minds. The conversation gets dropped and the momentum is lost. A lot of time does need to be dedicated to complete these projects, but if more people get involved the time can be split. Getting more community members interested and invested will not only help with getting the project moving, but it will also help to gain support. With more support, change can happen easier. To build up support, the information on the project needs to be accessible. This can be through the Friday Updates for Durham, creating a website with the progress, guided tours or site visits of Wagon Hill Farm that can inform visitors on the history of the land as well as what is currently being done, and how people can help. People will begin to value this land, and some will want to help protect this land. These strategies need to be included keep the projects moving forward.

UNH is a huge aspect and advantage of Durham's community. It provides many opportunities for research projects to be conducted within the town. The Jackson Estuarine Laboratory at Adam's Point, is a lab dedicated to doing estuary research. They have projects throughout the Piscataqua Region. The research projects they are working on cover a wide range of topics including, aquaculture, monitoring macroalgae, common tern behavior, oyster reef restoration, etc. Durham should continue and enhance their use of UNH as a resource. The town should partner with the Jackson Lab to help foster research projects that are also desired by the town. These two forces should work together to get the information they both want. For many of these programs, one of the biggest limiting factors is the time that needs to be dedicated to the implementation. The town of Durham should take interns from UNH that are interested in these programs. The interns would go to all the meetings, do site visits, help in the designing of the project, the grant writing process, and the final implementation. These projects do take time, which means that the interns would not likely be involved every step in the process, however, they will still be able to learn and achieve a lot from this experience. Because of this, UNH should count this internship as

credit towards the student's major as a capstone, work experience, or an independent study.

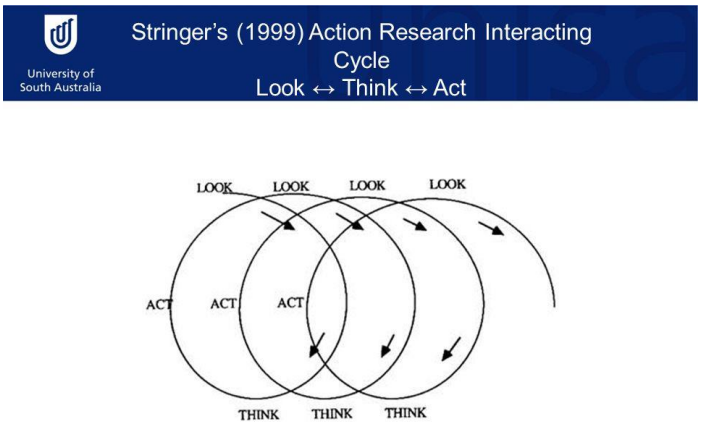


Figure 1: Stringer's Look, Think, Act model *("Innovation and Learning from Research," n.d.)*

The last suggestion that would create a great framework for protecting estuaries in Durham, NH would be the adoption of the "look, think, act" planning model (Stringer, 2014). This model is a not just a linear model of planning for the future, it a cycle that requires review (Figure 1) (Stringer, 2014). The "look, think, act" model is simple and palatable for everyone to understand. With this model, Stringer is telling us to look at and define the problem, think about how we can solve this problem by evaluation, and take action to change the problem (Stringer, 2014). This model is intended for action or applied research to inform the public about a problem to move to a solution (Stringer, 2014). The steps need to be easy and comprehensive for people to remember and follow through. This model can even be applied to the individual scale. A homeowner lives along the shoreline and notices an increase in algae growing on the water surface. The owner has to be aware of the surroundings to notice the problem. This not only an eye-sore, it is also a sign of a poor water quality. Once the problem is noticed, the owner may look up or ask people what the cause of this is; neighbors in the area may also be experiencing the same problems. The cause of the problem needs to be identified to know how to conceptualize a solution. The possible source could be from the nitrogen and phosphorus in the fertilizer running off lawns. The homeowner that now have this information can stop putting fertilizer on their lawn and may even talk to other neighbors in the area to ask them to stop their fertilizer use. The people in the area may

even come together to go to the local government to create a change to the law on fertilizing lawns near the waterways. If enough people come together, the town will go through the “look, think, act” process to evaluate and rectify this problem. This will be a constant conversation that needs to be addressed continuously.

V. Conclusion

The protection of estuaries requires a good framework. An ecosystem service framework will fall flat in the decision making process as was found with multiple key informant interviews in the estuarine field. It creates a barrier between policy makers or researchers and the public. While this is something that should be understood and studied by those in planning, it should be considered while making decisions but should not be the only framework used. It does lack the economic abilities that are required with making decisions since everything is based on monetary values. Instead a town-based value system should be implemented in Durham to evaluate and protect the estuaries, in addition to the consideration of the ecosystem services the resource provides. These can be based on aesthetics, historical preservation, recreation, etc. to get the town to support the protection of their resource. This will make taxpayers more willing to put their money towards a projects that they value. This will also be a stepping stone to lead to creating goals for the town. Once the values that are important are decided upon, defining what is ecologically important will fall into place. Using this framework will help create priority in conservation and protection. Goals for projects or any ordinance revisions will be based on the priorities of the town and what Durham finds valuable, making the project’s purpose transparent to the public.

Money is one of the major limiting resource that delays these protection projects. Alternate funding sources need to be utilized in order for these programs to keep their momentum. Creating a network to find funding sources is crucial for these projects to accomplish their goals, making use of government, public, and private sectors to find funding. If the federal, state, or local government cannot provide funding for the project, they should point them in a direction of where they can obtain funding.

Another limited resource for conservation projects is the time required for completion. This will require tapping into volunteer resources of community members or UNH students. Outreach programs will need to be intensified to get people involved.

This will require the town or the leaders of these projects to market themselves. They will need to keep the community updated through a website, weekly updates, tabling at community events, etc. It is important to get others involved, not just to make the work load lighter, but it will also get support for these projects. When making changes to Durham the more support from the community it can get, the easier the changes can be. If these projects are split up into more manageable parts, they could be accomplished quicker. Partnering with UNH students and allowing the hours they serve to count for credit hours toward their major will be able to reach a different community. Younger generation are usually not involved in town planning projects, so this would be a way to let a younger demographic sit at the table and let them see how to get things done on the local level.

Stricter and clearer regulations are another way of being able to protect Durham's estuaries. Around the entire estuary there are buffers. While these buffers restrict built structures or impervious surfaces in those areas, nothing is said about what needs to grow in this area. Within that buffer could be a fertilized lawn that goes down to the shoreline. This will likely lead to a problem for the water quality due to runoff. Regulations need to be enforces and defined so that misinterpretation is curbed. Buffer zones should include native plantings and a restriction or limitation of fertilizer use. Conditional actions need to be limited to promote smart planning. While impervious surfaces are to be limited in certain zones, there are conditions that allow for impervious surfaces to be built close to the shoreline. If previsions are always being made to allow for development where development should not happen, it will require constant maintenance. This will be very costly and create for poor planning. Having lenient regulations can lead to a problem of cumulative impact. Actions that are taken can have a greater impact on the environment than was anticipated. These impacts cannot be solved with just one change, it will take a collective change to the regulations to get to the root of the problem. Stricter and clearer regulations will protect Durham from costly constant reconstruction and a damaged ecosystem.

"Look, think, act" is a model that should be adopted by Durham. This model is not only comprehensive, but also reflective. It requires looking back at the changes we have made to understand if they still work or if they need to be updated. It allows people in

their daily lives to adopt this process as well: noticing the things around you, telling others about what you have found, gaining knowledge on the topic, and bringing what you have found to your local government to change it. The cyclical motion of this process is necessary for this model to be sustainable. In sustainability we have to continuously maintain, update, and change our developments and policies to ensure our resources are not being degraded. We cannot just change something and call it done, this process forces reflection on what was changed. We have to measure the differences before and after. Monitor for the positive and negative impacts that can be brought about by this change. If there are negative impacts, assess the situation, and change it. Then repeat. With planning there is never an end, it is only working to improve on what has already been done. We need to have an upward motion in our progress but reflection is impertinent so we can learn how to protect in the future.

VI. Citations

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