STATE OF OUR ESTUARIES

FREQUENTLY ASKED QUESTIONS

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PREP
Piscataqua Region
Estuaries Partnership

QUESTIONS

General Questions

HOW ARE THE ESTUARIES DOING?

Our estuaries have declined and are under stress. Of our 18 environmental indicators, 12 of them are either negative or cautionary. Critical habitats such as salt marshes, oysters, clams and eelgrass have declined, and our population continues to grow, which adds more pressure.

On the other hand, we are making real strides (e.g., conservation, wastewater plant upgrades) in much of the work that has to be done, so that's positive. We just have to keep at it.

Read "The Big Picture" at our State of Our Estuaries website for a more extensive answer to this question.

WHAT ARE THE SYMPTOMS?

The vital signs for humans tend to be things like blood pressure, pulse and temperature. For estuaries, the most common vital signs are the health of key habitats such as salt marshes, eelgrass, shellfish beds, and the critters that live in the estuarine sediment (also known as "infauna.")

Our salt marshes have lost over a thousand acres in the last century, due to development pressures and, more recently, sea level rise is having an impact. Shellfish, such as oysters and clams, have declined by 90% primarily due to disease. Eelgrass has declined due to multiple causes. And we need to know more about our infaunal communities.

WHY DO THESE SYMPTOMS MATTER?

As with the human body, everything in our estuaries is connected. When one part of your body is under stress, it is not long before another part declines and then overall health suffers. It is the same with natural ecosystems. Without healthy salt marshes, shellfish, and seagrass habitats, many of the things that we love about living near the water become threatened. These things we love include:

- **aesthetically pleasing water to look at, swim in or boat on**

- **lots of fish for recreational and commercial fisheries**
- **the protection of our homes and communities from storm surge**

HOW MUCH MORE DO WE NEED TO KNOW ABOUT THE CAUSES OF THE SYMPTOMS?

In some ways, we have enough information, but in other ways, we need more. We have enough information because, in general, we understand what is stressing our estuaries: climate change related stressors such as increased frequency of extreme storms; stormwater; nutrient and toxic pollution; conversion of open space into developed areas...each of these are issues we need to address, and we ARE making progress.

We need to know more because these systems are dynamic, and things change. Also, with limited resources we want to be sure we address problems with maximum effectiveness. That is why we need more information: to help us refine our strategies as things change in the future.

HOW MUCH OF THE PROBLEM IS CLIMATE CHANGE?

Climate change is a big issue. It is connected to sea level rise, storm surge, warming waters, ocean acidification, and greater extremes in weather events. But even in the face of climate change, how we live on the land impacts our estuaries. Reducing impervious cover, preserving buffers, and using the best stormwater management practices will improve the overall health of our estuaries.

Also, it is important to remember that we can still mitigate (reduce the impacts of) climate change by burning less fossil fuels!

HOW MUCH OF THE PROBLEM IS HUMAN POLLUTION?

It is an important stressor, but we cannot say if it is the most important. For example, a recent memo written by external experts in seagrass ecology concluded that nutrient pollution remains an important stressor on our system, but they also noted that we do not yet have the data to say how much reduction is necessary.

With regard to toxic contaminants such as: oil, heavy metals, and emerging contaminants like microplastics, etc., we know that these substances impact our ecosystems by negatively impacting the health of fish and invertebrates. There have even been studies showing that toxic contaminants can directly

impact eelgrass. However, we still have very little data on the extent of the problem.

A key concept here is to look beyond what is “the most important stressor” and try to improve ecosystem resilience where we can. As with the human body, there are some things we can change (e.g., exercise regime) and other things we cannot change (genetic ability to withstand disease). So, as in the case of human health, we need to address those issues we can.

WHY IS THIS CONCEPT OF RESILIENCE SO IMPORTANT? SOUNDS LIKE A BUZZWORD...

Einstein famously said that things should be made as simple as possible but no simpler than that. Oversimplifying does not help us protect our estuaries or our communities. The fact is that we cannot know or predict all the different factors impacting our system, so it makes more sense to try to build our ability to withstand stress, rather than focus solely on trying to quantify exactly which stressor is or will impact us and how much of an impact it will have. That is what resilience is: it is the ability to withstand or recover from stress.

We know that our estuaries can be more resilient. Our shellfish (clams, oysters) beds are not recovering as they should, nor are our eelgrass habitats. We also know that all these habitats affect each other. Healthy salt marshes buffer human pollution; healthy shellfish beds and healthy seagrass beds also buffer human pollution. Clean water and open space benefit all these habitats and more. By constantly seeking to improve all aspects of our ecosystem, we create estuaries that will be more able to resist disease, storms and other stressors. That is why resilience is so important.

WHAT ARE THE MOST IMPORTANT THINGS WE CAN DO TO HELP OUR ESTUARIES?

Fortunately, there are things you can do as an individual, with your family, and in your community to help! Check out the Citizen Guide and Municipal Guide for examples of ways to improve water quality and protect natural resources.

Here is the gist. Work with your towns to reduce pollution from point and non-point sources. Conserve open space and preserve buffers. We are making progress on these fronts, but we have to stay vigilant and keep making progress.

I HEAR A LOT ABOUT WASTEWATER TREATMENT FACILITIES? ARE THEY THE MAIN PROBLEM?

Treatment facilities are not the problem; they are part of the solution. These facilities are community assets, and the people who run them are dedicated personnel who spend their days cleaning waste for the sake of human and ecosystem health.

While wastewater does represent an additional stressor on ecosystems (click here to read a more general accounting of ecosystem stressors), most treatment facilities in our region have made substantial improvements to their processes, which reduces many kinds of pollution, such as nutrient pollution, bacteria, viruses and toxic pollution, too.

With regard to nutrients (e.g., nitrogen and phosphorus), scientists have agreed that with the reductions that have taken place at many facilities, more attention needs to be focused on non-point sources of nutrients (e.g., stormwater, fertilizer from lawns, septic tanks, etc.).

Wastewater facilities are also very relevant for people who like to harvest shellfish. See the "Shellfish Harvesting Opportunities" section of our report for more information on that relationship.

IT SEEMS WE ARE GETTING MORE STORMS? IS THAT PART OF THE PROBLEM?

Absolutely. We know we are getting more storms and the forecasts predict that extreme weather events will increase. When we have big storms, pollutants are washed into our estuaries. That is why our report highlights the importance of addressing non-point source pollution. It is also why it is so important to reduce impervious cover, conserve open space and preserve buffers around rivers, so that our landscape is more capable of soaking up that extra water. And not just for ecosystem health but also for the sake of mitigating coastal hazards. Our roads and bridges get washed away when we take away the Earth's natural ability to absorb water.

Nutrients & Other Pressures

WHEN IT COMES TO POLLUTION, I HEAR A LOT ABOUT NUTRIENTS, LIKE NITROGEN. WHY IS IT BAD TO HAVE NUTRIENTS?

Nutrients are not bad. They are, in fact, critical for a healthy ecosystem. But just as humans need calories but not too many, ecosystems are stressed when they have too many nutrients. It can result in overgrowth of seaweed and phytoplankton; this, in turn, reduces water clarity and can also lead to dissolved oxygen problems when the algae decompose, and decomposing organisms reduce oxygen levels in the water.

Local and external scientists have concluded that the Great Bay Estuary is still being stressed by our nutrient levels and that further reductions are necessary to improve ecosystem resilience.

DO WE KNOW THAT WE HAVE A NUTRIENT POLLUTION PROBLEM? HOW DO WE KNOW?

It is difficult and often impossible in science to know anything with complete certainty. We do know that we have more nutrients than are generally advisable for estuarine health. We know that seaweeds have increased and that we sometimes have "blooms" of phytoplankton. For these reasons, experts have concluded that nutrients continue to act as a stressor on our system and further reductions would be prudent for ecosystem health and resiliency.

HAVEN'T WE REDUCED NITROGEN A LOT IN RECENT YEARS? WHY ISN'T THE ECOSYSTEM RESPONDING?

A few reasons. First, nutrients are only one of many stressors on our system. Second, ecosystems do not bounce back immediately. In some cases, it takes decades for a system to recover, especially when there are many stressors.

This is why we need to focus on overall resilience, rather just on one stressor.

WHAT MORE DO WE NEED TO KNOW ABOUT NUTRIENTS TO BETTER MANAGE THEM?

Although we have a good handle on where nutrients come from and how much is going into our system, there is a lot we don't know about what happens once the nutrients arrive in our system. How much nitrogen, for example, is fixed by bacteria and released as harmless nitrogen gas? How much comes in as organic matter but is then converted into its inorganic form, which is much more readily used by seaweed and phytoplankton to spur growth.

Also, we do not know how much nutrients are re-introduced into the water from sediments getting stirred up by wind and waves. Although, preliminary research indicates it could be quite a lot!

What happens to nitrogen once it gets in our estuaries is critical information: not to point us in the direction of a general solution—we know generally what we need to do—but rather to help us better understand how our estuaries respond to our attempts to improve the situation.

I HAVE HEARD THAT THE GREAT BAY ESTUARY IS VERY WELL "FLUSHED" -- THAT IS, THE WATER IN THE ESTUARY GETS EXCHANGED WITH NEW FRESH AND OCEAN WATER -- SO WE DO NOT NEED TO WORRY ABOUT NUTRIENTS. IS THAT TRUE?

No. That is not true, and if you are interested in this subject please see our recently released white paper on flushing time.

It is true that, compared with many estuaries, our system is well flushed; that is, a good deal of the water in the Great Bay Estuary exits to the ocean fairly quickly. However, much of the water also continues to "reside" in the estuary for very long times. Moreover, even those parcels of water that leave most quickly—say, on the order of several days—can still have a significant impact on the ecosystem.

The main reason that flushing is discussed is in relation to phytoplankton, small organisms that cannot fight the current and simply go where the water takes them. However, in other New England estuaries, it has been shown that impacts from water quality are not necessarily manifest by phytoplankton alone, but also by seaweed, which has the ability to attach to rocks or get tangled up in eelgrass beds. And we know that in the Great Bay

Estuary, we have seen an increase in seaweeds. Plant and algae experts at UNH believe this is due to high nutrient levels as well as warmer water temperatures.

I READ STORIES IN THE NEWSPAPERS ABOUT NEW CONTAMINANTS BEING DISCOVERED. DOES THAT HURT OUR ESTUARIES?

It certainly does but we have relatively little data on exactly how much this is happening in our estuaries. We need to put more resources to this important problem. Emerging contaminants impact many levels of the ecosystem and can be directly harmful to humans. At the ecosystem level, these contaminants can harm the health of larger vertebrates (e.g., migratory fish) and smaller invertebrates that swim in the water and live in the sediment. This, in turn, impacts the food chain and the whole ecosystem suffers.

I HEAR THAT OUR WATERS ARE WARMING. IS THAT A PROBLEM FOR OUR ESTUARIES?

Yes, it is. We need more data to understand the extent that this is happening in our estuaries, but we do know that the Gulf of Maine waters are warming at some of the fastest rates on the planet.

Why is this bad? Warmer waters are good for diseases that harm oysters, mussels and clams. Warmer waters are also spur the growth of seaweeds and phytoplankton. And warm waters can be indirectly and directly harmful to eelgrass, which has to work harder to photosynthesize and is left in a weakened state as a result, and more susceptible to disease.

In estuaries to our south, experts have recognized that nutrient management has become more important as a counterbalance to the negative impacts of warming waters on an estuary's health and resilience.

Eelgrass & Oysters

WHY IS THERE SO MUCH TALK ABOUT EELGRASS?

Human body vital signs include pulse, blood pressure, and temperature. The most common vital signs in estuaries are the health of shellfish (e.g., oysters, clams) habitat, seagrass species (such as eelgrass), and the benthic community (small invertebrates in the sediment).

Do you have a lawn? What would it be like if that all disappeared and was replaced by weeds, or bare dirt? Eelgrass is like the grass on your lawn; it has extensive root systems—seaweeds, in contrast, either drift or use their holdfasts to attach to rocks or shells; they do not have roots—that stabilize the sediments, promoting water clarity, and providing lots of habitat for burrowing critters.

The long leaves of eelgrass slow water down so sediment that is being held up by the water will settle down to the bottom, further promoting water clarity. Like many green plants, eelgrass is a primary producer, which means it has the ability to take the Sun's energy and convert it into organic matter. Primary producers like eelgrass, seaweed and phytoplankton form the basis of the food chain.

Finally, eelgrass is universally recognized as being very sensitive to human impacts. Often, though not always, when eelgrass is suffering, it is because of human actions leading to either nutrient pollution or sediment pollution, or both.

HOW IS THE EELGRASS DOING?

Not well. Like oysters and clams, the steady decline of eelgrass began in the 90s, although eelgrass began declining later than shellfish. In fact, the peak year for eelgrass since 1980 was 1996, when there were 2,900 acres of eelgrass in the Great Bay Estuary. Over the last decade, the total acreage has bounced around 1,500 acres, which is almost a 50% decrease from 1996.

Also, these numbers just talk about the presence or absence of eelgrass, but studies indicate that the eelgrass is getting less dense also.

DO WE KNOW WHY THE EELGRASS HAS DECLINED?

We have ideas, but we are not certain. We do know that, for eelgrass, light is key. Eelgrass evolved and thrives in high light and low nutrient conditions, and most people who spend time on Great Bay Estuary note that the water is more easily stirred up and "turbid"—that is, cloudier, with less light getting through—than it used to be.

That makes sense because, as human communities become more developed, sedimentation tends to increase. Also, when you lose lots of those "vital sign" habitats, such as oysters and eelgrass, there is less structure to keep the sediment in place on the bottom.

Studies also indicate that seaweed, which does better in low light and high nutrients (the opposite of eelgrass), are becoming more abundant.

Finally, although phytoplankton levels are often "fair" or "good," they sometimes bloom and are characterized as indicating "poor" water quality.

To read the external expert report on eelgrass stressors in Great Bay Estuary, click here.

It is important to remember that ecosystems are even more complex than human bodies, and we know that sometimes, even after lots of tests, we cannot say why a person is not doing well. In those cases, you do the things that you know are good for you. In the case of estuaries, that means: manage nutrients, sediments, reduce impervious cover, conserve open space, and preserve buffers.

WE TALK ABOUT ALGAE BLOOMS? WHY NOT TALK ABOUT EELGRASS BLOOMS?

Eelgrass does not bloom (i.e., go through very fast growth spurts) and so it also does not tend to die off quickly, unlike some seaweed and phytoplankton species. It is the very fast growth and subsequent death of seaweeds and phytoplankton that results in significant increases in decaying matter on the estuary floor. This, in turn, can lead to sediment quality problems and a decrease in dissolved oxygen, as microbes feed on decomposing matter and use up oxygen in the process.

I HAVE HEARD THAT "WASTING DISEASE" IS RESPONSIBLE FOR A LOT OF THE EELGRASS LOSS? IS THAT TRUE?

Wasting disease is always present in eelgrass meadows and some years it has more of an impact than others, depending on many factors, such as: salinity, water temperature, and available light. One should be very careful, however, about considering wasting disease an entirely separate cause from other factors, such as low light, because wasting disease tends to do better when eelgrass is struggling from other stressors. Just like humans tend to catch colds easier when they are stressed, eelgrass is less able to fight off wasting disease when it is being stressed by things like low light.

Therefore, it makes very little sense to say "Oh, it is not factor X that is causing eelgrass decline, because we know that wasting disease was a problem that particular year."

Estuarine ecosystems do not work like classic potted plant experiments where all the factors are separate. The factors interact and compound each other. Again, this is why striving for overall resilience is a more prudent approach to keeping our estuaries healthy.

WHY IS THERE SO MUCH TALK ABOUT OYSTERS?

Shellfish such as oysters and clams are also one of the "vital sign" habitats for estuaries. Oysters provide structure in the estuary, which slows water down and improves water clarity. Oysters are natural filters; one adult oyster can filter between 20 and 30 gallons of water per day. Oysters eat phytoplankton and send sediments to the estuary floor. Oyster reefs also provide great habitat for migratory fish and invertebrates. Finally, oysters are an important fishery; they are delicious to eat and support local economies.

HOW ARE THE OYSTERS DOING?

Since the early 1990's, oysters have had a very hard time. We have lost around 90% of the 23 million oysters we had in 1993. Recent work to restore reefs combined with the growth of commercial aquaculture is helping slightly, but we have a long way to go.

DO WE KNOW WHY THE OYSTERS HAVE DECLINED?

Yes, we do. Oysters from the mid-Atlantic up to Canada have declined primarily because of two different diseases, caused by two different

micro-organisms: MSX and Dermo. Both of these diseases do better in warmer temperatures, which is a concern.

Another problem is sediments. As we work to restore oyster reefs, we notice that many of the oysters are being covered up by sediment. Most observers feel much of the sediment is coming from within the estuary, as opposed to from the rivers, but there is not enough data to say conclusively where the sediment is coming from.

HAVEN'T WE SPENT A LOT OF MONEY ON OYSTER RESTORATION? WHY AREN'T THEY COMING BACK?

The twin stressors of disease and sedimentation take a toll on our restoration efforts. On the other hand, some of our restoration efforts have been successful. We are learning from our efforts and adapting our techniques for more success. Plus, we are seeing some natural expansion of oyster reefs, too.

I HEAR THE WORD "TURBID" FROM RESEARCHERS, DESCRIBING THE WATERS OF THE GREAT BAY ESTUARY. IS THAT DUE TO LOTS OF TOTAL SUSPENDED SOLIDS (TSS)?

As noted in the discussion on eelgrass, the waters of the Great Bay Estuary are often not very clear. The scientific word for "unclear" water is "turbid." One of the indicators we track is Total Suspended Solids or TSS, which is related to turbidity but slightly different. Turbidity describes the clarity (or lack thereof) of the water; TSS involves filtering a sample of water and weighing the material that remains on the filter. So, the two concepts are related but not the same.

Experts agree that our waters have relatively high TSS levels and are very turbid, and have become more so over time. This makes things difficult for eelgrass, which requires more light than seaweed does.

The best way to control TSS is by getting oysters and eelgrass habitats back to the levels they were in the past; this will reduce internal resuspension of sediments. Regarding new sediments from the shoreline and the rivers, we address that with the usual "best practices" for ecosystem health: conserve open space, reduce impervious cover, better manage stormwater and preserve buffers.

Seaweeds, Phytoplankton & Fish

I HEAR A LOT ABOUT SEAWEED. IS SEAWEED GOOD OR BAD?

Seaweed is an important primary producer in estuaries. Primary producers harness the Sun's energy and convert it into organic matter. The seaweeds we see attached to rocks in the intertidal zone (i.e., kelp or rockweed) also provide valuable habitat for many creatures.

On the other hand, under high nutrient conditions and with warming waters, seaweed growth can get out of hand. As with any good thing, too much becomes bad. Seaweeds can grow and die very quickly, impacting water quality. Studies in the Great Bay Estuary indicate that seaweeds have increased over the last three decades, and new species are becoming dominant including some species that did not even exist here before the year 2002. New work is happening right now, trying to better understand how much seaweed is out there in the subtidal areas (those areas never exposed by tides) and whether this is impacting sediment quality and/or eelgrass.

I HEAR A LOT ABOUT PHYTOPLANKTON OR MICROALGAE. ARE THEY GOOD OR BAD?

Phytoplankton (or "microalgae) are tiny organisms that produce biomass by photosynthesis. They are incredibly important as one of the critical foundations of the ecosystem. They are the food of choice for oysters, zooplankton, certain species of migratory fish, and even some whales!

But too much of a good thing becomes a bad thing. "Blooms" of phytoplankton can indicate poor water quality and can lead to loss of eelgrass and low dissolved oxygen events. In our system, phytoplankton levels are usually "good" or "fair" but are sometimes "poor." Because our system is fairly well flushed by ocean water—due to the 3-meter tide range in our area—a lot of phytoplankton get washed out of the estuary. However, depending on exactly where in the estuary you are talking about, these infrequent blooms can hang around for days or longer and impact water quality.

Some people believe that if you do not have huge phytoplankton blooms all over the estuary, then you are not seeing impacts from too many nutrients. That is not the case. Other New England estuaries that are well flushed have shown that too many nutrients can result in too much seaweed, rather than too much phytoplankton. Seaweed, unlike phytoplankton, can resist the tides by attaching to rocks or shells, or by getting tangled up in eelgrass.

HOW IMPORTANT IS IT THAT WE DO NOT HAVE AS MANY BIG FISH AND OTHER BIG PREDATORS AROUND AS WE USED TO?

Very important. This is an acknowledged stressor on our system. When you lose the big migratory fish predators that used to roam these waters—such as the Atlantic salmon—less desirable invasive species can become more abundant. For example, the invasive green crab that we see in our waters can have a significant impact on our ecosystem. In fact, in Monterey, CA, they found that bringing back sea otters brought back the disappearing eelgrass. How? Because the otters decreased the crab populations; this, in turn, allowed the smaller invertebrates to recover and, once again, venture out onto eelgrass blades, feeding on the algae that was growing on the blades and impeding the eelgrass' ability to harvest the Sun's light for energy.