HAB first version

Thu, 9/23 10:36AM • 35:35

SUMMARY KEYWORDS

harmful algal blooms, algae, blooms, florida, nutrients, red tide, water, plants, ecosystems, algae blooms, fish, conditions, lake, people, species, area, fertilizer, beach, harmful, impacts

SPEAKERS

Michaela Kandzer, Ricky Telg, Phillip Stokes

Ricky Telg 00:04
This is Science by the Slice, a podcast from the University of Florida's Institute of Food and Agricultural Sciences Center for Public Issues Education. In this podcast, experts discuss the science of issues affecting our daily lives reveal the motivations behind the decisions people make, and ultimately provide insight to solutions for our lives.

Phillip Stokes 00:38
Hello, and welcome to Science by the Slice, Phillip Stokes here. Just a quick note, this month we're releasing one episode instead of two. And we actually have three different experts contributing to this episode. And they're all discussing the topic of harmful algal blooms. Here in Florida harmful algae blooms received a lot of media attention. If you live in Florida, there's a good chance you've heard about red tide which in Florida is caused by naturally occurring marine dinoflagellate, as well as blue green algae or cyanobacteria which is common in fresh and brackish water in Florida. But of course, this is a global issue impacting communities all over the world. And the topic of harmful algal blooms is complex, in that there are many different types of algae. The word algae itself is an informal term that represents a diverse group of organisms. And the harm that can be brought on by aquatic algae can vary based on the organism that is blooming and the intensity. And on top of that, while scientists know many of the factors that contribute to algae growth, there are still things to learn about how all of these factors come together to create blooms. Okay, so to start, let's just figure out what algae is. I asked one of our guests to explain just that. Here's Dr. Ed Phlips, a professor of algal physiology and ecology at the University of Florida.

Ed Phlips 01:57
Well, it's that's an interesting question, in the sense that literal photosynthetic organisms are actually bacteria, that evolved the capability of taking up co2, splitting water and producing carbohydrates to allow them to grow. That's called primary production. And it's actually photosynthesis. There's also chemosynthesis. But photosynthesis is the most important component. So originally, there were actually bacteria that had the capability of photosynthesizing. And then over time, eukaryotic algae evolved, which are more complex. They also carry out photosynthesis, but they have a slightly different cellular structure. But they're really all were referred to as algae for historically, cyanobacteria used to

be called blue green algae. And now they're predominately called cyanobacteria. So they're all really fall primarily under the algae category. And the other groups, of course, that actually carry out photosynthesis, land plants, and land plants evolved from algae. And so the original precursors of land plants, were actually macro algae that evolved into land plants.

Phillip Stokes 03:16
So of course, today, we're talking about harmful algal blooms. And in Florida, that's a very relevant topic. Right now, we're kind of getting into that time of the year where we see some of the, you know, more significant blooms, especially in the Gulf. But before we get into the harmful aspect of that, or even the blooms, I did want to ask, what are some of the characteristics of a healthy aquatic ecosystem, and kind of where do planktonic algae fit into that system when kind of the status quo is at center and is at rest, and everything is, quote, unquote, healthy? So can you just kind of describe that a little bit?

Ed Phlips 03:57
Yeah, sure. Well, let's start with what are planktonic algae. And basically, they're, in most cases, microscopic algae that are living primarily in the water column. And they may actually have cysts that are in the sediments, but basically, they live mostly in the water column. Some of them can actually physically move around through flagella or buoyancy regulation, most some of them are just basically staying in the water column from the turbulence and so forth in the water column. So the question is why are they important? Well, first of all, they form the base of the food web in many ecosystems, actually, most ecosystems and the aquatic environment. So as someone in Maine might say, no base, no fish, no lobster. They basically, they are the source of carbon for the best of the food web. And so the other if you look at it from a broader perspective, they actually are responsible planktonic algae are responsible for about 50% of global primary production. And that means they are actually responsible for 50% of oxygen production on earth. And that's a very significant contribution to the overall health of the ecosystem. And certainly, from an evolutionary perspective, they are actually also the original origin of oxygen in the atmosphere. And that happened a long time ago, 3.5 billion years ago when they first evolved. And then it took about a billion years for oxygen to be produced in large enough quantities to be abundant in the atmosphere. And that led to the evolution of more complex organisms. So when you think about algae in the water column, give them a thank you for the air that we breathe.

Phillip Stokes 05:45
So I just want to interject really quickly. So, you know, we talked about oceans and bodies of water as being a carbon sink, right, taking out a lot of the co2 out of the atmosphere. Is it this planktonic algae that's doing that or is it something else?

Ed Phlips 06:02
Well, I in terms of the total budget, obviously, if you have 50%, of primary production was, you know, associated with planktonic algae. That means that 50% of the co2 uptake for photosynthesis is being carried out by planktonic algae. And then the other 50%, roughly 50% is aquatic plants, terrestrial plants, and aquatic algae, you know, benthic algae, macro algae, seaweeds. And so it's this combination of those elements that form the carbon uptake. And so that's a really important part of

global warming and global cooling, which is a cycle that that happens throughout time. And as a consequence, they play a major role.

Phillip Stokes 06:47
As that flips just stated, planktonic algae plays a major role in life here on Earth, our existence wouldn't be possible without them. But I suppose as with just about everything, there can be too much of a good thing. Michaela Kandzer, one of the hosts of Science by the Slice, spoke with another expert on Harmful Algal Blooms to help us understand when planktonic algae become harmful. This is Betty Staugler, the harmful algal bloom liaison with the National Oceanic and Atmospheric Administration and Florida Sea Grant.

Betty Staugler 07:20
And HAB is a fancy acronym for harmful algal bloom. And basically what that means is, it's a rapid increase in algal biomass, or just a rapid explosion in algal cells that create these bloom conditions that result in some form of harm. And that harm can be in the form of toxins that the cells might produce, which might be harmful to people or wildlife. Sometimes there's a huge turnover where the cells rapidly they grow, they die, they decompose, and as they decompose and are broke down by bacteria, it creates these oxygens deplete conditions, and we call that hypoxia or when there's no oxygen and anoxia. And that can be harmful to the wildlife that that need oxygen to survive. And then other times, they just form these massive layers overtop of the submerged vegetation and preventing the plants that are on the bottom from reaching sunlight. And that can also cause harm. And when these things occur, it impacts humans and the activities that we tend to enjoy out on the water. and that in turn impacts the economies.

Michaela Kandzer 08:41
Well, that was a really great natural transition, because today we're going to be talking all about harmful algal blooms, or you may hear us say HABs a lot. So thank you for explaining that and telling us a little bit more about harmful algal blooms. So I know that HABs are very broad, right? There are a lot of different kinds of HABs. So what does that kind of look like? And what kind of research have you done or work have you done related to these HABs?

Betty Staugler 09:05
Yeah, so there are a ton of different harmful algal blooms. And I, you know, I do want to preface this by saying we can have, and we do have algae in the water all the time, and we can have algae blooms that are not harmful. And in fact, most blooms are not harmful. It's just kind of a small subset that we have concerns about and that's because they do cause that that harm through either, you know, the toxins or hypoxia or other things. In Florida we have a handful that that, you know, are very newsworthy, I guess I would say and that is red tide along the Gulf Coast. We have some out there right now in Pinellas County, and that causes concerns on the beach, where a lot of our tourist activity occurs. We have blue green algae that occurs in a lot of our freshwater systems and you'll hear about that frequently. Where it's in Lake Okeechobee and some of the water management issues related to getting the water levels in the lake down and having to release that water east or west or south. And then, you know, some of the maybe lesser known harmful algal blooms are things like brown tides that occur in the Indian River Lagoon system, which is caused by a different type of algae called Pico

plankton that becomes so dense that sunlight can't penetrate through it. And so there's just a there's a whole suite of different algaes, there's 1000s of algeas, a fraction of those can be harmful.

Michaela Kandzer 10:45
Yeah, it seems like it's really all encompassing. So not only is it affecting the earth, or is it not only affecting our ecosystem here in Florida and our waterways, it's also affecting the people here in Florida and our economy, and the mental health, probably of these people that are relying on the water and on, because that's, you know, that's their workbench. That's how they make their living. And so that's just really fascinating. And so talking about that, can you tell us a little bit more about where Harmful Algal Blooms come from and where they populate and how they populate?

Betty Staugler 11:13
Sure. So the, you know, each species has its own specific recipe, I'm gonna say, but one thing that all algal blooms have in common is that they need sunlight because they photosynthesize, and they need nutrients and nutrients is what allows them to grow and to multiply. Some other factors are things like time, so particularly in our freshwater blooms, we'll find that we get these blooms in areas where there's a lot of stagnant water. So where the residence time is, is very, very high. And water's just kind of sitting there and pooling and that provides these conditions for these blooms to occur. Temperature and salinity or other factors. So each one has their own specific, favorable conditions of temperature and salinity. And as long as those conditions are met, we can have algal blooms. Some of these blooms are naturally occurring, like karenia brevis, that red tide that I talked about in the Gulf of Mexico. So we know it's been there, you know, it just naturally occurs, the Gulf of Mexico provides favorable conditions for that to happen. But then once it comes on shore, it can take advantage of nutrients that we put in the water as well. Other blooms like the blue green algae and the brown tides, those are directly tied back to human activities. So those nutrients that we are providing, and its nutrients is really the one thing out of all of those things that I mentioned, that we have the ability to control.

Phillip Stokes 12:54
And that is a major point of discussion with harmful algal blooms, the premise of how human activity impacts growth of planktonic algae and marine and freshwater systems. To help understand the current status of algae blooms in Florida. I asked Dr. Phlips to provide some historical perspective.

Ed Phlips 13:13
Well, I mean, it's been a concern, probably ever since the mid 1900s. The reality is that development in Florida accelerated in an exponential fashion around or just after World War Two. And part of that has to do with air conditioning, and so forth, making life more pleasant here in Florida. And so there's been a huge influx of people. Population growth has been, you know, large throughout Florida, and is continuing to expand. And with development, and with increased population, you have increased nutrient fluxes into these aquatic ecosystems, not just lakes, of course, into the estuaries and coastlines as well. And so concerns date way back, but the actual consequences of the development have really only been monitored carefully since the 1970s. And before that, it was kind of like happening in obscurity. And so as a consequence, the data that we have for how things are changing a really is more recent than the beginnings of the changes to the ecosystems that actually started in the early 1900s. And so with the progression of development, you have progression of more nutrient fluxes into these

systems and also hydrologic alterations. And so it's not just nutrients, it's also hydrology. And to give you an example, Lake Okeechobee is the classic example. Of course, in the at before 1920s. Lake Okeechobee was a natural lake that it's you know, expanded in size and compacted in size depending on the wet season. And then they built a dike is on it because of the risk of flooding. There was severe flooding in South Florida because of high rainfall periods caused severe flooding people died because of it. And they developed, you know, basically a dike around the lake. And that made the lake into a reservoir. And as a consequence, now, nutrient inputs to the lake have been accumulating, causing more and more accumulation of nutrients that are driving blooms in Lake Okeechobee. So Lake Okeechobee has become a hyper eutrophic lake, not only because of nutrient inputs from development, but also because of a hydrological alteration of the lake. no longer an open system, it's a reservoir.

Phillip Stokes 15:43
Now, I do want to get back to something you said previously, you said, you know Harmful Algal Blooms have been a problem or an issue since maybe you said about the 1950s. And he said, that's about the time we started understanding the consequences of them. So I want to get to that word consequences. What are some of the consequences of of blooms and harmful algae blooms as well.

Ed Phlips 16:08
I mean, I think one of the problems with having harmful algae blooms is that can lead to loss of habitat. And loss of habitat is means instability of biological communities. In invisible lagoons, a great example, we had a system which had regular blooms, and then in 2010-11, we lost a lot of the seagrass communities. And because the loss of seagrass, communities, the nutrients that were being balanced within the system all went into phytoplankton. And since 2011, we'd have one year after another massive algae blooms, which are disruptive in several different ways. And one of the ways is the light limitation, so does not allow the seagrasses to come back. And so we lost that habitat. And hopefully, we will be working on different ways of mitigating this. And to see if we can get a situation where we can form conditions which will allow for the resurgence of the seagrass communities. Another thing is the loss of resources. When you destabilize and you change ecosystem, you can lose a fish, fish communities, shellfish communities. And so you can have a significant loss of valuable resources for human for human activities such as lobster, fisheries of major fish species, shellfish species. So the loss of resources are definitely a potential consequence, loss of recreational use, and loss of property value. And I mean, it's it may seem trivial, but it's not trivial to people who's living on the coastlines or in lakes where that happens.

Phillip Stokes 17:49
So this instability in ecosystems caused by HABs can lead to a loss of resources for communities that depend on them. And this is especially important in coastal communities throughout Florida where tourism and fisheries are vital to the economy and livelihoods of those living there. Dr. Michael Allen is a professor of Fisheries and Aquatic Sciences at the University of Florida, and is located at the nature coast Biological Station in Cedar Key Florida. I spoke with him about the impacts of HABs and coastal communities, especially those that can occur where he is located around the Big Bend area of Florida.

Michael Allen 18:26
Well, they can be devastating in a month in a number of ways when we get a really big bloom. At one, it's just direct fish mortality. And for example, a lot of the in our in kind of the northwestern I mean Northeastern Gulf like the Big Bend area of Florida. We saw a really bad red tie bloom in 2014 and 2015, which really set our grouper and snapper populations back and they're recovering now from that event. But red grouper for example, which is a primary group of species was really hit hard in our region by that red tide event. We also see it can the effects can vary by species. Like for example, things like the common snook and animals that can use fresh water a lot of times could avoid a red tie bloom because if conditions get bad in the estuary, they'll go up in the rivers and the red tides not in the freshwater environment. So some species can either move fast enough to get away from it or can select a different habitat that where it doesn't grow and actually withstand a red tide bloom. Well, but other species aren't able to get away from it and may not have options and that's where we have mortality. So there can be direct fishery implications in itself. But these kills have gone on for a long time and red tide associated fish kills are natural. They're not it's not all a manmade thing but it can cause big problems they typically form slightly offshore and the fully saltwater full salinity seawater. red tide does not like freshwater that algae does not grow well in freshwater Estrin condition, so they tend to form offshore, but they can form really big blooms. And they can be large enough that fish can't escape fish and other wildlife can't escape the toxin and so you can have massive fish kills and these skills we know now can have devastating impacts on fisheries because they can be large enough to wipe out large swaths of reef fish communities and things that people really care about, like groupers, and snappers, and that kind of thing as well as potential toxicity to things like sea turtles and marine mammals. You know, I think another one of our biggest issues as far as damage from red tide, and then Harmful Algal Blooms is in tourism and fisheries, tourism because these things get a lot of press in the media. Now, there's a lot of pictures of dead fish, and people don't want to come to areas where you have dying fish, and they the environment is not seen as healthy. So that can hurt tourism is just people don't want to come here during those events. And of course, if you go to the beach, and there's dead fish on it, it spoils experience, so to speak. So I think it can have economic implications not just directly through fish mortality, but also through the tourism, both of which are really tough for coastal communities.

Phillip Stokes 21:34
We know that harmful algal blooms are extremely disruptive to ecosystems and human activities. And because of that there are a lot of agencies and organizations involved in studying and monitoring them. Here's Betty Staugler discussing how they are monitored.

Betty Staugler 21:51
Usually, we find out about Harmful Algal Blooms through remote sensing. So that's kind of the first eyes if you will, satellites can see ocean color. And so they can detect chlorophyll, because all of these algae have chlorophyll pigments, that's what they use to photosynthesize. And so that's kind of the first line of defense. And then once a bloom is identified, then there are a whole host of other types of monitoring that help paint the picture. We also have a variety of offshore buoys in both, let's say the Gulf of Mexico, but also some of our larger water bodies like Lake Okeechobee, gliders that carry equipment in the water, and then all of those things combined, allow scientists to develop models. And those models can give us a picture of how big a bloom is, whether it has the potential to grow and expand in size and

range and where it's headed. And then at the basic level, we have a lot of water samples. So a lot of people who are collecting water, they take it back to the lab, and they will actually count it using a process called microscopy, where they're actually looking for the individual cells and determining how many of those are present. And then at the most basic level, we have sentinels. And those are volunteers and volunteers that are usually they have some kind of set protocol. And so they're maybe standing on a beach and they're determining, you know, Do I smell anything? Do I see dead fish? Am I coughing, and they will report that type of information as well. But I think the best thing that people can do is arm themselves with information and go to those trusted sources. So for instance, you know, let's say you wanted to go to the beach and the news said that there was a red tide bloom you know, in the area that you wanted to go to the beach. I would then go to the state resources the Florida Department or excuse me, the Florida Fish and Wildlife Conservation Commission, I would look to see what those cell counts looks like. There's also some real time information from what Marine Laboratory from their beach conditions reporting system, that's an app you can actually download from your app store, just put in BCRS snd it'll take you to that app. And that's where the Sentinels will stand out on the beach and give you these real time conditions. There's some experimental programs such as HAP scope, and that is on the the GCOOS. website so GCOOS.org and that is actually a respiratory forecast. So volunteers collect a water sample they put it under a microscope, take a video and machine learning actually counts the cells. And then it's combined with wind speed and direction. And that produces a forecast that's updated every three hours for many of the beaches in Florida. So you can get a feel for, you know which beach is more favorable to go to and when, because when we're talking about red tide, red tide is not it doesn't it comes on shore in patches. And so conditions can be very different even a mile apart along the shoreline.

Phillip Stokes 25:34
Many of you listening may be wondering what can and should be done to reduce or mitigate HABs. And there are a number of strategies in place to help improve water quality. Some of those strategies may be large scale restoration projects. And some include promoting public awareness around the topic and helping empower citizens to play their own role. Here's Mike Allen giving advice on what people can do in their daily lives to make a difference.

Michael Allen 26:00
You know, one of the biggest things that I would say for the for the the average individual is to think about water use in general, conserve water, if you can conserve water, with regard to your household uses in general, also fertilization. You know, the the manicured very green lawn is it's a beautiful thing. But there's other landscaping options that could reduce water and fertilizer use. And so it's kind of exploring like Zurich landscaping. We use that here at our biological station where we have no, no irrigation and no fertilizer produced on the property at all. Where, but it's still a beautiful landscaping. So it's a different mindset in landscaping. But there is, I think, options there to reduce the fertilizer application and water use would be one area for folks to explore. You know, but I do think we're making progress in a number of areas of agriculture processes have changed a lot. And you know, there's a there's been a lot of headway in, in reducing fertilizer and water use in agriculture. And then there's more to go. But I think that, you know, the goal is to develop best management practices, they're going to, you know, mitigate some of those impacts long term. That's what we hope. And you know, wetland restoration restoration techniques have a lot of potential to reduce nutrients that are coming into into

rivers and lakes and into estuaries. And, and protecting submerse plants. I mean, submerse plants actually compete with planktonic algae including algae that produce harmful algal blooms, so things like eelgrass and, and, and submerse plants that grow even some of our non-native plants like hydrilla actually provide quality fish habitat if managed at moderate levels, and can prevent algae blooms because they compete and they actually take nutrients out of the water that algae would otherwise use. So, so submersed plant management can actually be another option for this to try to mitigate the effects of harmful algal blooms as well seagrass as well will be another one that is important in the in the estuary for not only directly for fish habitat, but as a potential to mitigate algae blooms as well.

Phillip Stokes 28:58
Because those grasses and that submerged vegetation, those are also filtering out some of those nutrients.

Michael Allen 29:06
Yeah, they're taking up nutrients that without the seagrass, those nutrients would just be available for planktonic algae. So, if you have a seagrass Meadow there, it's taking nutrients that otherwise could contribute to planktonic algae, which potentially could cause a harmful algal bloom. So.

Phillip Stokes 29:23
I know so I'm in the, of course the Gainesville area, you know, some things that they've been installing or some of those wetland parks right so instead of having like a physical plant to filter out wastewater, you know, they're just using some of those species up, you know, if I go out and visit one here locally, the Sweetwater one if you see that that hydrilla even though like you said, it's not a native species, but it's, it's doing some good and as well as all those other plant species out there.

Michael Allen 29:54
It is. I mean it Phil, it's a great example in the Sweetwater restoration side. That that wetland is is an excellent example of letting submersed plants serve as a natural filter and a natural nutrient uptake. And so the water coming out of that there's a recent study just came out that that the water coming out of that restoration site at Sweetwater is actually having a big impact on nutrients on the back end. So. So those kind of things, I think large scale restoration efforts that are going to naturally clean water with some submersed plants, as a submerse. plants have a really strong habitat value deficient wildlife in their own right, so they're really good habitat. And then if they also reduce the potential harmful algal blooms, it's like a double win. So that's it. That's great.

Phillip Stokes 30:43
Here's Betty Stuagler continuing that thought on the types of efforts that can reduce harmful algal blooms.

Betty Staugler 30:49
But then there are also efforts like supporting efforts to expand advanced wastewater treatment in areas where there's currently septic systems or aging sewer lines. Reducing your dependence on fertilizer is another one. There's a lot of fertilizers or ordinances in Florida, particularly along the Gulf, the coastal counties, and in many of those June started a blackout period where you're not allowed to

apply phosphorus based fertilizer and in some cases, fertilizer at all. And so just making sure that you know what those rules are. Planting plants that don't require a lot of fertilizer, you know, seek out your your county Master Gardener program, your Florida friendly landscaping programs. And you know, how we landscape in our yards has a major impact on what our waterways ultimately look like in terms of the nutrients that are available. I guess if I haven't said it enough, you know, I think education is power. And the more we know about these harmful algal blooms, and recognizing, again, that when we talk about a harmful algal bloom, we're talking about a variety of organisms. So, you know, we really need to, to educate ourselves and know that they're not the same. And the impacts are not the same, the causes are not the same. And the more we can arm ourselves with knowledge, the more we are better able to protect ourselves, our families, our pets, and ultimately, our coasts and the state of Florida.

Phillip Stokes 33:00
I want to thank all three of our experts for being on Science by the Slice. Ed Phlips, Betty Staugler, and Michael Allen. There are many resources on the topic of harmful algal blooms, including a red tide toolkit that was created in conjunction with the PIE Center and Betty Staugler with the Sea Grant. We'll be sure to include links to the toolkit along with other resources in the show notes. I mentioned at the beginning of the episode that HABs are complex, and the conversations you heard today really just scratched the surface on this topic. There's no way to cover everything in a podcast. But if you would like to learn more details on some of the concepts you heard today, you can listen to a bonus episode with mostly raw and uncut pieces from the conversations that didn't make it into this episode. There you can hear more details about the algae that cause blooms, as well as the toxins they can produce. I also want to briefly tell you about another podcast, our extension colleagues and Natural Resources agents Lera Milligan and Shannon Cannavale with Pinellas and Polk counties, respectively, have recently launched a nature podcast, and they actually have an episode titled, where does rain go after it falls? It's a great episode. And what they discuss in that episode is another piece of the puzzle that makes up water quality, which of course, is a big component of harmful algal blooms. So if you want to check out that episode, and learn more about Florida's natural areas and the wild things that live here, be sure to check out Naturally Florida on your favorite podcast platform. As always, I want to thank everyone involved in Science by the Slice, Michaela Kandzer, Rachel Raybon, Valentina Castano, Sydney Honeycutt, Ricky Telg, Ashley McLeod Morin and Alena Poulin. And for one last piece of advice, here's Dr. Ed Phlips with your final thought on harmful algal blooms.

Ed Phlips 34:48
They said, Well, if there's a really bad blooming in the lake, should I swim? And I said, Well, if you have a really bad bloom, it's ugly. It's awful, and it's First of all, why would you even want to swim in it? But the my guidance would be, don't jump into blooms. It's not pleasant. It's not recreational really, and so avoid it.

Phillip Stokes 35:18
I'm Phillip Stokes. Thanks for listening to Science by the Slice.