Tracey Peake ([00:09](https://www.rev.com/transcript-editor/shared/mzLBdxO7j5Fd9ZA9y4zLVJILlFcquVfmzUpoK28ZPsarY7SP_U4-qf7woo3CEeFe0ZCKmaz2wR7KCHbgR75lysgSuf8?loadFrom=DocumentDeeplink&ts=9.36)):

Hello and welcome to NC State's Audio Abstract. I'm your host Tracey Peake. Summertime is coming and lots of us will be headed to lakes and beaches to enjoy the water. But a poorly timed algal bloom can ruin the experience, not just by making the water unappealing to swim in, but also by disrupting the entire local ecosystem and potentially affecting human health. We're speaking today with Astrid Schnetzer, Associate Professor of Marine, Earth, and Atmospheric Sciences about toxic algal blooms. Welcome, Astrid.

Astrid Schnetzer ([00:44](https://www.rev.com/transcript-editor/shared/oiIk3kIrqrcig0azkHlznJmK53P3HetpvkRZGMtyD-GXr9VJhNq6zalZaBx5feMV4cuZ58OWticnQ3ek1kBLuMAKtYw?loadFrom=DocumentDeeplink&ts=44.88)):

Thank you for having me, Tracey.

Tracey Peake ([00:46](https://www.rev.com/transcript-editor/shared/HHKNz8UlWdhMVvgYaBn7mOYA6d2TsmKt47WzShn-l6fQ6Z5RdPZyzTRHlAgF-WITMzLK0EJZi2cTK-a1xUEvifmqLMA?loadFrom=DocumentDeeplink&ts=46.2)):

I'm very excited about this. We were talking a little before we started recording on my feelings about naturally occurring bodies of water and all the terrible things that could be in them. So this is right up my alley. So first of all, let's define what is an algal bloom?

Astrid Schnetzer ([01:00](https://www.rev.com/transcript-editor/shared/OnXHOEDIjacJtjze0yhlaQNp4zMzyA_JWPv2sHOu4zwx_eX3Vvw4Mnpi12E6x2dGY8ngacNdHDv50GVnxqsjYDdEJIQ?loadFrom=DocumentDeeplink&ts=60.42)):

Sure. So algal blooms are sometimes associated with bad things, but they're actually naturally occurring phenomena. If you think about terrestrial systems, you have your grass, your plants, and at the bottom of the food web, and that's what algae are in the aquatic system. So you have algae that are getting eaten by little crustaceans, krill like organisms. They're being fed upon by fish. And then you have us somewhere in that food chain, and if it wasn't for algae, you wouldn't have any of that life or that productivity within the ocean. So they're generally a really good thing. Where it becomes a little bit less good is when these things bloom excessively.

Tracey Peake ([01:56](https://www.rev.com/transcript-editor/shared/Zs468F0pRcdJzpurliY9T1Rj5lIZj30xMkMVcte_cLtpqqx-JRwdJiqDjpJBSK1y-lyFUl9xRJlA8jUaMbCU0z7gD7c?loadFrom=DocumentDeeplink&ts=116.04)):

This is sort of a normal part of the algal life cycle. Right. So how does this work and what triggers a bloom?

Astrid Schnetzer ([02:09](https://www.rev.com/transcript-editor/shared/Xk89u24RIugiuFc1fRFCEyHYaHtXtDPIGBoeCbJN0R0iBzWqs7ls-KSAqb5IziYtSG3QWyLJaD92qkWHihEYhW8BaaE?loadFrom=DocumentDeeplink&ts=129.03)):

Just like any other plant, they need nutrients, they need light, they need water. Obviously in coastal waters you have the light, you have the water, especially in temperate areas, the light becomes a really important factor during spring and summer and the nutrients, we give them plenty of. So one of the issues with harmful algal blooms is that all the nutrients that make it into coastal waterways just allow them to grow without any limit. So nutrients come from agricultural activities, they come from urban runoff, they come from huge treatment plants, you name it. And that just allows the algae to take off and grow substantially more than they typically do.

Tracey Peake ([02:54](https://www.rev.com/transcript-editor/shared/RyCHFOXCCYXY_uVAw6LT9Y4XBikdJekAyuJBUAAF5ZzDFGEFXRzGfvShCevL_JnSX5-w6z2ysS1scKje-GvUrVx4OmU?loadFrom=DocumentDeeplink&ts=174.36)):

Okay. And so I can kind of picture it, when you talk an algal bloom, so what does it start with? So if you're talking about grass or something here, you have a little seed. Right. And it goes into the soil and it gets nutrients and water and sun, it grows into a grass shoot. What is sort of the algal seed?

Astrid Schnetzer ([03:20](https://www.rev.com/transcript-editor/shared/8FQsSavZ5huck77iIqQtFjqKVZG5FSju8dTjnhU7fTMaGw8IpTvj6OaqhhSi7WI5h0LhiafxLFrxP5RvNIMNXtmRKG0?loadFrom=DocumentDeeplink&ts=200.34)):

What I'm talking about when I talk about harmful algal blooms, those are platonic unicellular organisms. They can sometimes form colonies, but they're typically just very tiny things that you need a microscope for to even see them properly. And their advantage is that they can just recreate by dividing. So some of them, those that are microeukaryotes they can also reproduce sexually. But if the time is right and the environment provides them with a really good growth environment, like there is enough nutrients there, then they can just divide and you get two, four, eight, and so forth, and you can get them from a few per liter all the way up to millions per liter. And that can happen within a very short period of time. You can see nothing in the water and suddenly it's tinged by a color. And that's just because they have taken off within two to three days and created this really, really dense community.

Tracey Peake ([04:31](https://www.rev.com/transcript-editor/shared/GxurtuHsD9VoUMqpF4zZVxw7SgxspOBITkbxnFpsd_pqjXXIi2Xqmp5fkb58e6T5WZItRF7NEKyMKqk561gBJh3UD9c?loadFrom=DocumentDeeplink&ts=271.38)):

Okay. So how long does a bloom, a normal bloom, not one of these crazy ones that gets out of control, but just a normal bloom cycle, how long does that tend to last?

Astrid Schnetzer ([04:44](https://www.rev.com/transcript-editor/shared/WhKNGB4UH1UQEw8oq46MtJIWYTFj34zcurDpvqZmP5YbL-qi7u3sv48p-cdGPI7msf4Yk1ovTCaCXZ1gEq4me4VNvlk?loadFrom=DocumentDeeplink&ts=284.25)):

So there's no straight answer. This can vary quite a bit from days to something like weeks or even months depending on how well you sustain them and how much of the nutrients they're being provided with. Right. So sometimes you have, for example, in our coastal waters, you have a river discharge event that brings a lot of nutrients in. Once they gobble that up, they might run out and the bloom might dissipate. But if there's another event that brings further nutrients into the system, it might just restart this entire event. So it also depends on the species or the taxa that are growing because some of them have different strategies to keep going.

Tracey Peake ([05:24](https://www.rev.com/transcript-editor/shared/TX97d_47f9DICmK7t-vtPxJ_sJzn180xoiRz3LWSY6Zpg1g6EK9pmgii1XDr3FFcYon37J4DLzwZt01Wd9uOu1Pn5yg?loadFrom=DocumentDeeplink&ts=324.45)):

Okay. Like what?

Astrid Schnetzer ([05:26](https://www.rev.com/transcript-editor/shared/dLhApuJBIJiIVVSFNgqRv6fyVWXIStoSI8r452Z4iaRk9Zw5l8OxBJ_HXYUdjwklmxknO30NjdAFT2hAIbjENO90F1U?loadFrom=DocumentDeeplink&ts=326.55)):

There's actually harmful algal bloom taxa that they can not just rely on light, but they can also eat other things. They're referred to as mixer tropes. So if they run out of the nutrients, they can go and feed on other microorganisms and make up for a shortcoming in nutrients. So there is very fascinating life strategies that you find in these organisms.

Tracey Peake ([06:01](https://www.rev.com/transcript-editor/shared/CJAEhCEN9hiqSXTRfgj6CTfkcuP75P4nMTu5UUk_aUuUBmvo46F9S217OKbGniOGTg36IPqOrQhzqHovUpWQrIsR_IM?loadFrom=DocumentDeeplink&ts=361.62)):

So what makes a particular bloom toxic?

Astrid Schnetzer ([06:07](https://www.rev.com/transcript-editor/shared/beSLLitUQvfy9eIXRTUnVel2kJ_t0giwO98txu3IAPsisSTJrKy8iX22Ehdq6LMZi1A6ICvhcW9fApSbfOp3hk0uQHs?loadFrom=DocumentDeeplink&ts=367.35)):

So toxin production is a common way of defending yourself for not being grazed, for inhibiting your competition to get some of the nutrients and whatnot. So it's been around for a long time. With the algae, there's a couple of dozens of algal species that we know that they can produce toxins, and there's continuous description in regard to what compounds they might be able to produce. Where it becomes an issue for us is when they bloom and it's associated with toxins, the fate of those toxins could be that they are taken up in the food web. For example, through shellfish, we incorporate them or feed on them, and shellfish are really good filter feeders, so they can actually gobble down quite a bit of those cells.

([06:56](https://www.rev.com/transcript-editor/shared/8inMxK2H16kMpagWw2JpaaHAMxawMBK3vZlBMlrjd3VkeJ1yuUvebjUExSWBW9ofJC6c-HPui49LMlSREJuQeOlxFW0?loadFrom=DocumentDeeplink&ts=416.34)):

There's also uptake of these toxins through fish or other organisms. And somewhere in that food web again is us. So we could be affected by that. There's also some concern in regard to those toxins leaking into the surrounding water when those cells die, and that could have implications for drinking water. Some algae are even more tricky because those toxins might be aerosolized. So if you've heard about the red tide in Florida, those are toxins that are actually being released into the air and then us breathing them could also be an issue.

Tracey Peake ([07:34](https://www.rev.com/transcript-editor/shared/FznV4o4zrWrcfWADYzTqR96UO4ZD42U7H2cl8YVs0CIVBCRED5taIMcsP7aF3QSaGlql3cLD3TLjjMF8kPefhsm5NY8?loadFrom=DocumentDeeplink&ts=454.56)):

When we're talking about toxins, are these compounds that we would be familiar with that would be poisonous to us? What kinds of things are we talking about?

Astrid Schnetzer ([07:48](https://www.rev.com/transcript-editor/shared/y8ZnnH4QxrgtocRw-aDDazC-rgRsGCmz2kfg8hHI3IlgrYWH0-7gYC0_PakVuL_7QgwYMB6zP05M-pMu0wgm-g_Rs58?loadFrom=DocumentDeeplink&ts=468.33)):

There's a whole lot of different ones. So depending on what or how they affect us, there has been diseases associated with toxic algal blooms that cause amnesic shellfish poisoning, paralytic shellfish poisoning, diuretic shellfish poisoning, hepatotoxic shellfish poisoning. So it can get at the liver, it can get at your neurological system. It can have all sorts of different effects depending on what the toxins are that are involved.

Tracey Peake ([08:19](https://www.rev.com/transcript-editor/shared/vyguwlCWoh5UwH0u4tLwGQI5yF898OLSP4Vbjp8rL6rr2EVT3lGgUzq1v6NzYhlqnm7GKQ9MluhPEDSyGMnNSiDp0Bo?loadFrom=DocumentDeeplink&ts=499.89)):

Wow. So unless you're special down in Florida breathing the stuff in, generally speaking, it happens when we consume something that's been immersed in this kind of a bloom for a while, like oysters or?

Astrid Schnetzer ([08:33](https://www.rev.com/transcript-editor/shared/S39y2PqNVJvgW3j1rhvaSBDyTEBPGEQy3pgk6psOOuOHwdtjYBxVHSO2uofpm_ZDG0gqYmnYvVlYzmLoj_KMa0cLml0?loadFrom=DocumentDeeplink&ts=513.63)):

Oysters can be a potential vector. And actually some of our new projects that we just got funded, the Ocean and Human Health Center looks into the food accumulation through shellfish and oysters in coastal waterways, in freshwater systems.

Tracey Peake ([08:49](https://www.rev.com/transcript-editor/shared/9O7lK6kZ3pAt9sff5DA_1-SkshoCB97ogpcz1oTjDRBJcmVOzdo0kcu0seONeRGNBc0GCU_Pr8GAZsuAFcBXQiNChQA?loadFrom=DocumentDeeplink&ts=529.26)):

Okay. So what other kind of fish? I'm just like, what are we talking about here?

Astrid Schnetzer ([08:54](https://www.rev.com/transcript-editor/shared/Czt8Iv-v_0zeNLBpAZPgyhRGz--oQi7A2XBKmNuSl2ZedpR1BqwLEWdsJFwOThhbkVI-Nsx_lvRxc8Z-u_SRRntdk_M?loadFrom=DocumentDeeplink&ts=534.45)):

So depending on whether you talk about marine toxic algae or freshwater toxic algae, obviously you will have different animals involved. The good news to some degree is that typically it takes a lot to accumulate. Some of the things that we're working into in the estrogen systems and where we've done some analysis and preliminary studies, we find that it typically is mostly accumulating in common fish like blue catfish, perch, gizzard shad, but typically found in the guts, in the viscera. Things that you,-

Tracey Peake ([09:35](https://www.rev.com/transcript-editor/shared/vuFvK9t-21-CBh-igoMUSQjrkydhDNV2NmRvS1FCWgTH35vplAZHxrT8vzzPF1lpBe6GGoKOLO2kXebu_1UMhpbtbJs?loadFrom=DocumentDeeplink&ts=575.04)):

Don't eat.

Astrid Schnetzer ([09:35](https://www.rev.com/transcript-editor/shared/DoYAD_01WS6r6wR71GisL08vL87ZPCWRxDXzuqiIOGC2QFSaU1RI8vTPNFXCQoOiv13xNF1ZM_2gA8mK4k5urqeFLao?loadFrom=DocumentDeeplink&ts=575.34)):

Don't eat.

Tracey Peake ([09:35](https://www.rev.com/transcript-editor/shared/rEyZxGFuKOGuVTn7fAOQMEZJn742sCQIs5GCxNgLoFe6_A-eko86EBj6zrhgkAuK0pCTYBh74OGLxBXu8PIspQuzVTs?loadFrom=DocumentDeeplink&ts=575.97)):

Okay.

Astrid Schnetzer ([09:36](https://www.rev.com/transcript-editor/shared/WwTlQCSIbwDRj0MV7WjdNt-2DTckYplguQKJLmL-V6S1v5bVRtHSuXI2eIzKlP1eBsCpJ2Hu76bq_QntPsqWV-uVWec?loadFrom=DocumentDeeplink&ts=576.3)):

And if it makes it into the muscles or the filet, it's typically in very low concentrations,-

Tracey Peake ([09:43](https://www.rev.com/transcript-editor/shared/E9FrAXz1PlClksMUfLTMonIcSnDuRVwjHgA1sNlAlpITis5DrF-wF3o7oB36pkJi3XsTQoAlwE3Pwdw44yEP40usYHo?loadFrom=DocumentDeeplink&ts=583.62)):

Okay.

Astrid Schnetzer ([09:43](https://www.rev.com/transcript-editor/shared/eosmY9XmOUMC3hF68TkLnt5vOhmpvAo78cmUpMbp1saJ0Dm7VXqvHaszmj7eQKS8rCZ9No4veIdlGmdtR5TQ3n0PR10?loadFrom=DocumentDeeplink&ts=583.65)):

That are not necessarily considered an issue. But it depends on if you sample those animals at the right time in the right area. Right. Like we said, those algal blooms come and go and testing should typically be associated with when you know the bloom is going on. And this is actually some of the research that we're trying to do.

Tracey Peake ([10:03](https://www.rev.com/transcript-editor/shared/KRSdi0Y66onE13RLrKTKEODmHgThfs7ByDdvVboIlKo6zyNOFN9GFtD-GuunJmUgdPJaPZsrWpn0tw2sh_ASGs3l-xA?loadFrom=DocumentDeeplink&ts=603.96)):

Okay. So these animals can survive it, but we're not sure if once they've been exposed to one, they just retain a little bit and then they're exposed to another one and maybe they retain a little bit more.

Astrid Schnetzer ([10:16](https://www.rev.com/transcript-editor/shared/YLZ8Kh8OqovN9uIUorJ3__agqE1q76b5cO_zquke56gVb4owOB68gs3ZzLblEtpapp5vI126TlRqB_y3zqCxeIBm4p4?loadFrom=DocumentDeeplink&ts=616.44)):

Yeah. So,-

Tracey Peake ([10:17](https://www.rev.com/transcript-editor/shared/PqUrWgG8_zaJ6JSlEpJfGdTwqYhYfq1eLikgrT9X0dRt13QMAZsDGhvw2qkDsB8RxOOsRBdRkrbfw853t9UikapSyaU?loadFrom=DocumentDeeplink&ts=617.43)):

And then it becomes a problem.

Astrid Schnetzer ([10:18](https://www.rev.com/transcript-editor/shared/NXPAQmTlPzCbACHguq3iC3of8A_q7k3RCKn-yYEC3F-7hHyhxzqndpmhakvGqtMLzblwc7t36RziMAqRU8tUTBUklgs?loadFrom=DocumentDeeplink&ts=618.72)):

Yeah. So what we know from marine blooms is a little bit more, and for example, paralytic shellfish poisoning is called by saxitoxins, and you find those occurring in the Gulf of Maine and also in the Arctic. And the problem there is that that toxin doesn't seem to do anything to the shellfish and that it stays around in the shellfish long when the bloom has dissipated. So you might not be safe to eat the shellfish quite some time after the bloom has occurred.

Tracey Peake ([10:50](https://www.rev.com/transcript-editor/shared/QebprEDMDfXsPV_r_7W8ZDg7VR0ixZOGZQZ9YMEzzKvNcmoA8z-sRnibUMBGl1ZFJfgJzI7kt9nE5LoAK97mE0GaeLQ?loadFrom=DocumentDeeplink&ts=650.37)):

Okay.

Astrid Schnetzer ([10:50](https://www.rev.com/transcript-editor/shared/1q4X3inlv7gcJ9zVATLbD8hrJoZ-7iPnegPJ8FW0g3ualExvSl-outWZK7_WB7zkvTN3icJcV7JY-HuMXWeHOMeag6E?loadFrom=DocumentDeeplink&ts=650.58)):

And then the other issue can be that you can cook that shellfish, but it might not necessarily get rid of the toxin. So again, it's really important to keep in mind what toxin we're talking about and what the vector species are that might be an issue for exposure.

Tracey Peake ([11:05](https://www.rev.com/transcript-editor/shared/OQzMQMVuRhwCFsKH51wSu4DfVyBIsh5542CsZ97sfE_NqRaULHz5ode67wijIHIYz2TmbtZau63JLvXp75Df3GgQcEc?loadFrom=DocumentDeeplink&ts=665.7)):

So I assume this would also affect any wildlife that eats the stuff, right?

Astrid Schnetzer ([11:13](https://www.rev.com/transcript-editor/shared/ugN-Lo0A5s0BHamx06KZpCNOzi6DDFeKAIe31oi-4BdTE1Jc0mFl2bpyM9Z0tJr9_szOHRT3JRndWLpm8ohdN0p8LVc?loadFrom=DocumentDeeplink&ts=673.44)):

Yeah. There is studies in regard to marine mammals, especially birds, sea birds, where these phenomena have been studied. But I would say that there's a lot more research to be done in regard to that. Some of these toxins can be lethal to humans. What we know about how those toxins work, again, depends on which toxin we're talking about.

Tracey Peake ([11:38](https://www.rev.com/transcript-editor/shared/n3hY9oPbr9QfyowEcjHkRgf5_Wg4tpYAbt-1QUP0bnspacZ4mq5vS_it9UEr4hV5rKNTz0X93AwWN46fj5r7B1Kwhtg?loadFrom=DocumentDeeplink&ts=698.91)):

Right.

Astrid Schnetzer ([11:40](https://www.rev.com/transcript-editor/shared/_rPDnm5Lzq_EDQs4iRvkCuLCmDQgFzUuDCm_tmodChx97dMa6w9q4nDHV_JiedD5K0w7LEHsu8Mc5t_vtzoB22JDxug?loadFrom=DocumentDeeplink&ts=700.2)):

For some of the research we're doing here in the Pamlico, Albemarle area and cyanotoxins, which are these freshwater toxins of concern, there is only a limited amount of research done in regard to how we are harmed by them. They've been associated with liver toxicity and liver cancer, but most of that information is based on animal studies and animal models.

Tracey Peake ([12:04](https://www.rev.com/transcript-editor/shared/qmob70-GpzowRLQqEH_D5Bcn2G1b_gVn-8zByJk4HxMdWdBpS0BM4kEKsRtOp9EkJan1xgan8Ui0jvrhzO4oOrUAxBQ?loadFrom=DocumentDeeplink&ts=724.53)):

Okay.

Astrid Schnetzer ([12:04](https://www.rev.com/transcript-editor/shared/Mdr-59X3BJIripUp-hoGAuRZDXEEmB4oKsz2FyctCPeohlE39ixIfpxe7N9z7tHtUh4mTJ0ri7akhF1h-eQT0ZFdYlo?loadFrom=DocumentDeeplink&ts=724.95)):

So lots to be explored on that side.

Tracey Peake ([12:08](https://www.rev.com/transcript-editor/shared/l9AlG2u_-SUTxI0UdEKOPAbZglgWoq6QDL5y1m29MOUdMBnzJpu5w8_eWsEAFCGilIP6CpJALWVcX7QPjR_KlT4S1n0?loadFrom=DocumentDeeplink&ts=728.28)):

But I'm interested, when you mentioned Maine and the Arctic, these are colder water areas and I don't tend to think about this happening in colder areas when the stuff says it's temperature dependent. So I assume this is a particular strain of algae.

Astrid Schnetzer ([12:42](https://www.rev.com/transcript-editor/shared/iJBqHOqq6QcdaBw03DLk001iNvyCSsUW84Qa5RaI_Gi0Mwt02Ozdkdsm8hSQdrYHa47F8XKg1zl_M2JKJFZDrxB5EaI?loadFrom=DocumentDeeplink&ts=762.96)):

So if you had a map and you would look at a map of the US and you would color code the coasts and associate them with different algal toxin phenomena, you would see that they're all restricted to different geographical regions. Each of those little algae species likes their own set of temperature range, their own set of nutrient concentrations. So you will see that there are typically found in one region or another.

Tracey Peake ([13:30](https://www.rev.com/transcript-editor/shared/9pMTMlEsM7Kq0vxrb8GHJZ4KiO8PSfk1KjHgi-vCHxLKnBmqY0JP11AZVpalZVH0bQmwACwnfJRB282Mlg3GlP34NDI?loadFrom=DocumentDeeplink&ts=810.39)):

Okay. So potentially as the climate changes or different bodies of water got warmer, the ones that are infecting shellfish in Maine, which that just seems like a bad set of circumstances to me, might move on somewhere colder if everything gets warmer, but then something else would just move in that was equally bad maybe.

Astrid Schnetzer ([13:52](https://www.rev.com/transcript-editor/shared/V_3_04pZ71tQBfN0rLZ_4zTBXNKlTdHLOACGD8ejQZ6bsnCYjnsTom2baN__l-6rHkvg1pHo-okDZ9O7TRh2XfnT8DM?loadFrom=DocumentDeeplink&ts=832.71)):

Maybe. It seems really complex and I wish I could give you a straight answer there.

Tracey Peake ([13:59](https://www.rev.com/transcript-editor/shared/CGrxacrZA8OprWN9OZDRaup7XH2oleBu17DrPjQGCb2Mn15d8m1Dz8k86lWTUtr788ZzqKSeG-NTBrfbHkZbgm5isbk?loadFrom=DocumentDeeplink&ts=839.88)):

Yeah.

Astrid Schnetzer ([13:59](https://www.rev.com/transcript-editor/shared/NPl5nFM3meEDIiQPkUdzU32ZnMdUo83pY4RNFB_QSyE0YhWxPCUYiRdBCqrYKdRMc0DcuUIL2AHI-CDmyRgfodaoe3A?loadFrom=DocumentDeeplink&ts=839.94)):

But there's also different, like you mentioned, strains within the species that might just switch over. Right. Or there's different toxicity associated with different strains. So it becomes a little complex. What the good thing is, or the good news is that we now have the tools, whether it be molecular tools, where we can get into those details and really try to figure that out a little bit better. But yeah, there's a whole lot of discussion going on in regard to climate change and harmful algal blooms. And there is several regions where these phenomena have been studied where there seems to be a clear indication that the frequency in the toxicities actually increasing with climate change. And that always has a little bit to do with eutrophication, which is nutrient access to those systems. So systems that are prone to have too much nutrients in the water and then also experience things like temperature increases seem to be most prone for this really becoming a huge issue.

Tracey Peake ([14:58](https://www.rev.com/transcript-editor/shared/HVHjlLez-nhrmhmmNz19Xd8hFjfPrOhdbuVmbsk7KYrXBjurBAaAIrQNGXC53gB5s1OyHaCBK3l2CoE_4kpwH4mBK80?loadFrom=DocumentDeeplink&ts=898.71)):

Okay. So one other question. If there's a harmful algal bloom or an algal bloom going on in a body of water and you weighed into it with your skin, which is a natural barrier, do these irritate the skin? If you have a cut, can they get absorbed into your body? Is it terrible? If you see a bad algal bloom,-

Astrid Schnetzer ([15:22](https://www.rev.com/transcript-editor/shared/cQRAvTKuYqsfCRSN5ebdB8TLG8DV85PD8vIWIT2-7rtjH0cPkqmAd8739k9bk4Knf_iCOtaCiPOaf0S5MffTBy493s0?loadFrom=DocumentDeeplink&ts=922.08)):

Stay out.

Tracey Peake ([15:22](https://www.rev.com/transcript-editor/shared/-v944o0RLxUtvGVSSxvzggkbkemAmG-ObXiue4QDkwoQVYY-v_3DcEu4pB0PJ7VEDRhmvL_T-VXpnSBkO_oLMLQopzk?loadFrom=DocumentDeeplink&ts=922.86)):

To just stay out. Okay.

Astrid Schnetzer ([15:23](https://www.rev.com/transcript-editor/shared/luxkx0P6gu_Udkjo2jjJKGYV_2UhEGYrxtU_qZbkD7LZ3cGjCJYJqJxGQQ55rqadqEFP7NW1hFonVdWUI7cFeGHqBwg?loadFrom=DocumentDeeplink&ts=923.1)):

Yes. So if you are not certain, you can distinguish, for example, in a freshwater system like in North Carolina, if you see greenish slimmish water and you're not sure if this is something natural like duckweed or something that is not harmful, I would just stay clear of it. There is some research that you can also take up these toxins through your skin. So there is effects like that. And then depending on the person themselves, they might be more or less prone to show a reaction to certain substances. Right. People are more or less sensitive to any kind of pollutant when they're exposed to it.

([16:04](https://www.rev.com/transcript-editor/shared/Ac19yHYY4PLmmpe0IPsRmlYuJXeRhkLZPosrZzMmV-jypgW-aTqAhcX71Ip3ea2etEiD5O2Vz5vvTmfz3enaT5GAJTY?loadFrom=DocumentDeeplink&ts=964.44)):

But I would definitely say stay out and most importantly, don't let your pets go in there either. So dog mortalities have been reported in regard to the cyanobacterial blooms and it doesn't take all that much. So some of the research we've done in North Carolina, coming back to the freshwater blooms in 2019, shows that these blooms can be highly toxic in our area. And when I say highly toxic, I'm talking levels that have been associated with Lake Okeechobee or the Great Lakes where these blooms have been causing concerns for quite some time.

They can get flushed out pretty quickly, especially in river environments. But again, if you're not sure, just stay away. Yeah.

Tracey Peake ([17:18](https://www.rev.com/transcript-editor/shared/-RuV8vQbRVB51oEcSN0Tj5km6Xw2pH193tK9tEpv8uY4cXscY0NIUb86UEpwAp0s2itY7naRmzZoevDeBkspV7IVIBY?loadFrom=DocumentDeeplink&ts=1038.87)):

Okay.

Astrid Schnetzer ([17:19](https://www.rev.com/transcript-editor/shared/GTY5MzAjc2lAlljJy3QCC2jApopuTK9I-nhaGTKtzYwRIVIINbC12xACKChw05SJ9rxEd5y3J-K_ne4hMwRz3Q0hUf8?loadFrom=DocumentDeeplink&ts=1039.62)):

And also keep in mind that not all of these blooms form scums, and if the color of those little microorganisms don't end up to show you a really clear colored water body, it might also be happening underneath the surface. So knowing where those things occur and when to look out for them is exactly what we're trying to figure out to mitigate this. They're not going to go anywhere. Harmful algal blooms are not going to go anywhere, but we can get way better predicting them and warning about them and saying, well, at this point, shellfish in that area at that time is fine.

Tracey Peake ([17:55](https://www.rev.com/transcript-editor/shared/0zggG09WLEKAR8eQEnH5MYXu5-DlbJr4-XOJ_GlPtf9hq_KmH8LlOTGYjtvPWwfugJHnrJwBEGhxuGWVGJSIedzbH10?loadFrom=DocumentDeeplink&ts=1075.14)):

Right. Okay. And how do we do that? How are we doing that?

Astrid Schnetzer ([18:18](https://www.rev.com/transcript-editor/shared/qGYpnddbftauVjtYbHsUYB0sH2-6uHYvFKkA7jGKHoK3f_Dn_mEELjcXrit2jE3ox2o_DsFMPz4H2im_7d8Uz1hCg6g?loadFrom=DocumentDeeplink&ts=1098.42)):

So the freshwater blooms are mostly active in some fall. So we work a lot with the Department of Environmental Quality. They have an algal and fish keel dashboard that you can access, and if you see something in the water, you can actually submit that information and they will come out and test on a case by case basis and look through the microscope, say, well, these could be potentially be toxin producers, but then they have to do the testing to really confirm that. And we've worked with them on their regular monitoring events where you go out on a regular basis, let's say monthly and test for all those things. But what we've come to learn is that you need to be there when it's happening and it's not happening when you go out. The algae don't play games like that.

Tracey Peake ([19:06](https://www.rev.com/transcript-editor/shared/yZU2TIVIxRzkawhPdk7oN9V-oSpkMkOPGeR-9AMqhJjoOUBOV_H6kfvatq1jRvMVg9_OYrxlmnyOGtfF1aCiJfTvuQQ?loadFrom=DocumentDeeplink&ts=1146.57)):

Oh, they're coming. Quick, let's bloom.

Astrid Schnetzer ([19:08](https://www.rev.com/transcript-editor/shared/0N1VUTzCj6c01XqEYyQNFvNkaE0i2dL6Ix6yzOrcm68eZqd5cHPdqbrPxbbyqtmjISm6Tq0boq09YjOfj2zXHrHqk8M?loadFrom=DocumentDeeplink&ts=1148.58)):

Let's show up.

Tracey Peake ([19:09](https://www.rev.com/transcript-editor/shared/83_sE9xJE4js4HHm7FyYb4dwHBZYCY-H1Umg_oj-o3plbH9BcYeQFEToS01CQ8lEIBz2ZNZ28-1NnBMsMg_JaNCe0gk?loadFrom=DocumentDeeplink&ts=1149.33)):

Yeah.

Astrid Schnetzer ([19:10](https://www.rev.com/transcript-editor/shared/RsFPJ2ZC3pAxqA3BIcxCZXDxECjwzAyjSNWHn_xMtQgmGo0vGfSXPL9dxltOA8wUKZBMYVexhG1b-HXzjALuT1emGv4?loadFrom=DocumentDeeplink&ts=1150.23)):

So we've been super lucky in regard to working with communities all around the Chowan, the Albemarle Sound and they literally send us an email or contact us when they see a bloom in a certain area, and then we go out and sample that.

Tracey Peake ([19:24](https://www.rev.com/transcript-editor/shared/2T8I0A3nXbTn30qAAgO-brZeo-uP6Ud-WEBPFFr6YAfVvAepPTrctK7xC8j78HpJOOXghtytsWpS_EWNd7ixbECzZKA?loadFrom=DocumentDeeplink&ts=1164.39)):

Okay.

Astrid Schnetzer ([19:25](https://www.rev.com/transcript-editor/shared/vLWJW5G587ZID_HSilkx9DpOAoxgLlL5SpiTOcRUEX_ZR0zgIKPEhWZiUBHeUfKTTTnsGt9NH09p3Z-BVfWEP7zaInY?loadFrom=DocumentDeeplink&ts=1165.89)):

But some of our future work will include is we're actually going to have sensors that we put out in the water that can alert us to algal biomass increasing. And what's really exciting is with this new grant, we're going to have a submersible microscope that we put in the water,-

Tracey Peake ([19:42](https://www.rev.com/transcript-editor/shared/W946MpKqZyNHQM2T9qK-YSlD4ygS7HPrcn_by6sbci-93x3RKdkoKnUKcAwHB2ih6GcJ1bDn3J8bbi7w7xU1hFESaKE?loadFrom=DocumentDeeplink&ts=1182.66)):

Oh, fun.

Astrid Schnetzer ([19:43](https://www.rev.com/transcript-editor/shared/-wORWr7zKR_3tto668psHIO7006PkG9iNhYrCUhsI-9BvccMSTSUqPUaIggjvPuhSuydoSLmHnOCxoqYYxIP344SSrA?loadFrom=DocumentDeeplink&ts=1183.74)):

Upstream. And it's actually going to show us the type of cells that are in the water, and that can then trigger us to go out and sample when these blooms are actually happening, to not miss that window when it becomes important to look for toxins.

Tracey Peake ([19:57](https://www.rev.com/transcript-editor/shared/dTCXrJksaju-flMyr6Ek40Wz6xQOVcQ4XFAgLilw-VwfhLFs9vau7Qhbbd5vN-s1TLI32SQqTaWhL9ugK_-Dhxnvyq8?loadFrom=DocumentDeeplink&ts=1197.18)):

Right. Because an algal bloom can just bloom, but the toxins wouldn't be generated during the entirety of the bloom.

Astrid Schnetzer ([20:03](https://www.rev.com/transcript-editor/shared/a_tlUN4aBK8RkQJfNvh13UXKjsJZEFs6ATLv7N8hFHHxugfzS0rjEWnm6XTACSfUa2d-fPTAPCx9ZIIVkTKptq5Qvno?loadFrom=DocumentDeeplink&ts=1203.48)):

It wouldn't.

Tracey Peake ([20:04](https://www.rev.com/transcript-editor/shared/m8xBoZQuwpu70mits-nm6BwhIKTPHQPfnQsfXZOpl9vLSZdECX7z3nGNFRkMkFVsmtzxSjI3b504R1ECzhF6czODVIY?loadFrom=DocumentDeeplink&ts=1204.35)):

Right.

Astrid Schnetzer ([20:05](https://www.rev.com/transcript-editor/shared/vvtxMCcbRjkWvY7HXg-YIE7xYhQqMsLY79hB5IhDWzxyuIHRlXv-oNOMxL6SKg7WzCIcWXUv60gCimgl4fsJMhh8ps4?loadFrom=DocumentDeeplink&ts=1205.37)):

Just having a lot of biomass doesn't mean it's the toxic kinds. And even having the toxic critters doesn't mean they produce the substance the entire time, so.

Tracey Peake ([20:14](https://www.rev.com/transcript-editor/shared/OemNWAgzPk9p2-tnzWjtGE6uGfVgAypua-NxBF3xtK5dXXatl0NkVFPfbLBIa9ENf6ES7x8lBAcOR_-n0RQb1QT27ww?loadFrom=DocumentDeeplink&ts=1214.49)):

Okay.

Astrid Schnetzer ([20:15](https://www.rev.com/transcript-editor/shared/ucf5HpcvZW8wymSDcjhfUbgnzkNNAoGYL8C5EXFJ1mYRsRHOSym2a6KYz4iw4NQ00pYqHZ8Mx7gTBNRYTV_FGjIbk5U?loadFrom=DocumentDeeplink&ts=1215.06)):

To get your hands on what those criteria are when and how they might actually link to environmental conditions, whether it be temperature or a weather event, a rain event that flushes things downstream, that really requires to look in detail.

Tracey Peake ([20:36](https://www.rev.com/transcript-editor/shared/adVFSnBcrNNhjCmx1vo2chOD2Nu1cjVHkJK92chKzprG6S09bkn2U8DA5dTKQKcvXnUfIrMMI6N0LjNKWTgFP-ly12A?loadFrom=DocumentDeeplink&ts=1236.36)):

So that was, and I don't know if I've asked you this in a different way, so we're not real sure what that trigger is for toxic,-

Astrid Schnetzer ([20:47](https://www.rev.com/transcript-editor/shared/FR4eDy-aEhVOfTf_B89anP6l2GcBl0SGwHn-5JpZo7SRMlR0gaUWRdlNt_uZyJMNHP-VbwTZkJVGqFCXnNZzb1oIz38?loadFrom=DocumentDeeplink&ts=1247.55)):

It's a combination. There's no silver bullet.

Tracey Peake ([20:47](https://www.rev.com/transcript-editor/shared/8X2WH6xjAod4yPPi9F4U7ynQOaQ5A504Pf56YM31GGAbWEo6rYpmQQ0stGalAP-lRZhb1rn5Hn-SS46icxmYrH63iHc?loadFrom=DocumentDeeplink&ts=1247.55)):

Okay. Okay.

Astrid Schnetzer ([20:47](https://www.rev.com/transcript-editor/shared/4mf__c1xqpErunlLCFPb0nJqKgAN9EdMs3qb53xqiv7bm3H76O8XHKN4ZLcvIGOB3n0KqP_9PQy_rwmo2Vh4fzQA1ik?loadFrom=DocumentDeeplink&ts=1247.64)):

So it would be really easy.

Tracey Peake ([20:49](https://www.rev.com/transcript-editor/shared/V26GoumcxCxcEAZe7En0q1RRZODzSDIJaq94O2ewNEDIse9x-WwY_9MD2jvzJ3FCvRQOj7xGKniU5eNWaNoDTaVol6M?loadFrom=DocumentDeeplink&ts=1249.77)):

It would be cool if we just solve that whole problem right now.

Astrid Schnetzer ([20:51](https://www.rev.com/transcript-editor/shared/H4vZ39UhwW9HE5KpzjoKR4ecmj-TRG51HEl8r1wLeBh8D0bITGx5kaY8Hqd5qcjR2PFFCZj85iJ51b8HLro4r5ZSdVc?loadFrom=DocumentDeeplink&ts=1251.78)):

It would, but there's certain criteria where you can be pretty confident that it will happen. So high nutrient concentrations, a special or a specific combination of nutrients, especially information about the types of nitrogen that you might find in a system together with the light conditions in the water and the temperature conditions, can give you pretty good indication. And when we collect all this data, we actually work with molars that put that together and then can give you some predictions, which is the ultimate thing that you want to translate and communicate to people is like, if these conditions show up, look out in that area.

Tracey Peake ([21:37](https://www.rev.com/transcript-editor/shared/mpP6tMhunt4G7nDLBStMKLPwjxiDJ_Knha7Bfkt8m58xNfl0M0TsBh7drNIr7tvsWyGZPMolUD1W1Hen9aqAW0bCvOI?loadFrom=DocumentDeeplink&ts=1297.53)):

Okay. All right. So we do have an early warning system in place. I would like to also request when you get your underwater microscope that you attach it to a webcam because I think it would be fun to watch microscopic things fly by.

Astrid Schnetzer ([21:48](https://www.rev.com/transcript-editor/shared/QFAktdxxeb8KpUk0EphM2UvyyxBLH_nrEs0al6jpU7s6HBq1R67F43VuEixP6YJQ10qVU91gl0SRdMtJKfz9pCXqN24?loadFrom=DocumentDeeplink&ts=1308.75)):

Absolutely. So there's actually a way to have a platform where you can look at that data in real time.

Tracey Peake ([21:54](https://www.rev.com/transcript-editor/shared/DWnAI_3FFYs_XhtbTz9jXYsk0rDe9FRk4Wojm4QV_JpqdQCj_HJvL_MRzezc6JrvreZJTm8ekv6rFrntRmOpGBxfW5E?loadFrom=DocumentDeeplink&ts=1314.9)):

Okay.

Astrid Schnetzer ([21:55](https://www.rev.com/transcript-editor/shared/BPAd4A39XvyEq0GCH5eeJzVQRYhECssl3s4a8mZs2mNsPR9L99SYsEM4oVc3ODG_brwEhKIw1fJKIsD22mfEQ74NVRg?loadFrom=DocumentDeeplink&ts=1315.95)):

And there's been successful networks of these that have been installed in the Gulf of Maine along the West Coast. So this will be our first one in North Carolina waters. So we're really excited about that.

Tracey Peake ([22:07](https://www.rev.com/transcript-editor/shared/TDvUqsCE7kkAtsQMz2eVmJslL_EZvEg3T9td9EDHKPmB1n4bBmHQc8mU7QH8xV2kC-JDnjeCzp2vwVKPHcxiyQyMBl0?loadFrom=DocumentDeeplink&ts=1327.53)):

Well, that's really cool. So that leads me, what if anything can be done to sort of reduce? I mean, we're an agricultural state.

Astrid Schnetzer ([22:18](https://www.rev.com/transcript-editor/shared/BEIc9wEp7zJuIe20AI_8RTJnHunsQ0h7JuUDDn1KAy2eFmh2uEt4q3hq69ILYgfUDdenI8Qq_CedwOKRLU20oCUNgks?loadFrom=DocumentDeeplink&ts=1338.06)):

Yes.

Tracey Peake ([22:18](https://www.rev.com/transcript-editor/shared/K0ZK9uYKDI-KZyKhr9rIsqAufvl6PNHCMwoRxGkcCtgSKCA6kLA_ZdrwTLavo4Z0wF6W10lIK7Iwl5h5rab5tzxfmuE?loadFrom=DocumentDeeplink&ts=1338.21)):

You're going to get agricultural runoff.

Astrid Schnetzer ([22:20](https://www.rev.com/transcript-editor/shared/YE0ZDW2K9Mdi8W1ZzCLdXaZyJBRDSKLPxgDYdXXKWV_w0TVU_OsuDxC8XXcEc-GDFkYWTHWUeV7jmxXLEdR5gpdCla0?loadFrom=DocumentDeeplink&ts=1340.88)):

Yes.

Tracey Peake ([22:22](https://www.rev.com/transcript-editor/shared/N7nd8HsBtYaZarQtLH10f95_hKdMX1jNl_Y6SfTNZQ456PF6xKZNwZ89faZqTgsmyMQ0LCy4mEKVzog6ydjVpCDdarA?loadFrom=DocumentDeeplink&ts=1342.38)):

So is there anything we can do?

Astrid Schnetzer ([22:28](https://www.rev.com/transcript-editor/shared/paDCjEHyPqcHp5UFg2yOtYSqQyKQZcXQXReBawtMQZdQqfo4u11QWqKJXNVLtKM5lx9pLCDIWTO7S-dfpZqapMstF3Q?loadFrom=DocumentDeeplink&ts=1348.41)):

There's a lot that can be done. So general nutrient reduction strategies are a huge factor in trying to make this better. Right. Riparian buffers around waterways where you have things that get taken up. We have a wonderful natural system with marsh, right, where those nutrients might get filtered out before they make it into coastal waters.

([23:12](https://www.rev.com/transcript-editor/shared/uLe9nnlqaJe3_XFfvv3B-kYFQOtDwB-wENIw_bjuAHPdzGc-2fSl6hF_9Mk5ObTHU5VTVRp089PBeqKrDGwE1SPDB4A?loadFrom=DocumentDeeplink&ts=1392.42)):

So there's a lot in regard to land use. There's a lot in regard to sewage treatment that can be done to dampen that. But there's also a lot of things that when you wash your car in the driveway, those things that foam, those phosphates, they're going to go and end up in our waterways eventually. So there's a lot of things that can be done in regard to how you use some of these substances at home, whether it be with detergent you use, whether you put your clippings in the trash can versus letting them out and again, get into the system. I think there is a fair amount that can be done and learned to then help mitigate when they do occur to not be harmful to the ecosystem, to wildlife, or to humans.

Tracey Peake ([24:10](https://www.rev.com/transcript-editor/shared/wBTydOSXtOezq3D2caL8CMtl7K3OSPUTFu-zz-YJYRRVo4QwnGO-qdqJ6viJQbcgYZ2180N3O2B1LzZkMNsesv3RhF8?loadFrom=DocumentDeeplink&ts=1450.14)):

Okay. So what would the perfect algae monitoring early warning system look like to you? If you had all the money and all the stuff, what would that look like?

Astrid Schnetzer ([25:08](https://www.rev.com/transcript-editor/shared/H8bW0xT2D-KqWDVPtXe9iuoCzwvJ4twX7L7BdMYyBwGOxcqc28lGBX0cGsVoJXdfzDznq_mYNyyBCfF3x73sR71M2ho?loadFrom=DocumentDeeplink&ts=1508.34)):

Let me think about that before you ask that because I would rattle down my wishlist. All right. So a perfect network would be a combination of multiple tools that would include satellite imagery, sensors, real-time sensors that you can submerge and get data from as things happen in the water column. And then also the inclusion of people who live in those places, and a way to communicate with them if they see these things happening. So a lot of the research that we're doing is meant to be useful to inform people who use or live at those waterways. Right. And then it depends on what the uses for these waterways are.

([26:01](https://www.rev.com/transcript-editor/shared/86IRmLmBKAEruHbYt03jSTIH0g5awOIrUv-vX21i7drFmgYfzttdefvyoYgvL3LwYzxJ7VRsx14MpxrYUlzW4QYc03k?loadFrom=DocumentDeeplink&ts=1561.38)):

So if it's source water for drinking, if it's recreational for swimming, if people want to fish in there and eat what they take out of the water. So depending on those uses, it would be really important to know what the best information is that you can bring through your research. And between those different techniques and an increased ability to look for those toxins and use molecular targets to see which corporates are the most important in a certain system, you can already do a lot with what we have at hand.

Tracey Peake ([26:51](https://www.rev.com/transcript-editor/shared/60qAWMk65gTaqTauDTjpBRpg_Ocn1M78Bd7Vp6IU7ardOHnjh7RbCDd08an8sd_1OIruQgZzUqTx2bFGo5JKSgQ0MOQ?loadFrom=DocumentDeeplink&ts=1611)):

Okay. Okay. Well, we will be able to monitor when we should and should not be eating shellfish, because as someone who really enjoys shrimp, this is important to me personally.

Astrid Schnetzer ([27:03](https://www.rev.com/transcript-editor/shared/fvnFJpNRlRIj9NKb9lAyD0yQbO3UCyRMBnS0n8T2VRLKGUeBw9Fudx-_C25eGmp0EPhQDgsqt0yHWYk-k3Dnb3Re0G0?loadFrom=DocumentDeeplink&ts=1623.12)):

I love seafood. Yes.

Tracey Peake ([27:04](https://www.rev.com/transcript-editor/shared/8LWpK2VUx5VlDZdKkd-sBMdB7_ZL51KGxwhwBFVSWMcfxQDkMCmU-hUIsEeh23_ctFBtaj84vPneAPNeYmQFubTKQkA?loadFrom=DocumentDeeplink&ts=1624.29)):

Yeah.

Astrid Schnetzer ([27:04](https://www.rev.com/transcript-editor/shared/NoY1YHDGLTkx1Walj0Lv8NSUZHffqNJE7jIo9OA84SD6tuPO0unVZF3CxeHzCY-2jrHTyrBdlvks2EV_-i_uOhHBprQ?loadFrom=DocumentDeeplink&ts=1624.29)):

I'm with you.

Tracey Peake ([27:05](https://www.rev.com/transcript-editor/shared/8-ooVwTSyQp2PCwQOcydQues24alz08SuoFgFFAznkg_zF-trEHeCpR7-V1fgtd7rdsn1O6f2JbXDv5KAYz7i0S9QWA?loadFrom=DocumentDeeplink&ts=1625.28)):

So well, thank you so much for being here today, Astrid. This has been very interesting.

Astrid Schnetzer ([27:09](https://www.rev.com/transcript-editor/shared/WCUPUtyI0LPffwKk0G-8ESr4wVW-yn-mzwC7WT2D-3CuCJIl1skH0BMRgCST5IeYf9ngE6m_cvhJ8L1hP-LvpWPENxk?loadFrom=DocumentDeeplink&ts=1629.75)):

Thank you so much. Could talk about algae all day long.

Tracey Peake ([27:13](https://www.rev.com/transcript-editor/shared/r2s2xohbPuQgQE6x7MhWpCsw0WBqHCJaEhzhFabqQR3cj2kxVi418Wh9PxmOaLIiFQgRnI_lj4VPvFyc_PBRSqUmohg?loadFrom=DocumentDeeplink&ts=1633.41)):

Good. This has been NC State's Audio Abstract. We've been speaking today with Astrid Schnetzer, Associate Professor of Marine, Earth, and Atmospheric Sciences. I'm your host, Tracey Peake. Thank you so much for listening.