Tracey: [00:00](https://www.rev.com/transcript-editor/Edit?token=EoySo9PATF9lmppkR2xynMnLWoRlx44u9j3snnuWw6h-9OQYjpbxqmTHB8Mce0-pSmNnTn2TYOtPu8wC1KYyX-8t6KM&loadFrom=DocumentDeeplink&ts=0.93) Hello, and welcome to NC State's Audio Abstract. I'm your host, Tracey Peake. 2021 will see the noisy emergence of Brood X cicadas after 17 years underground. So, what's special about Brood X, and why do cicadas do what they do? Clyde Sorenson is an Alumni Association Distinguished Undergraduate Professor of entomology here at NC State, and he's here to shed some light on the life and times of the cicada. Welcome, Clyde, I'm glad you're here. Let's start with just the basic life cycle of the cicada. Why do they have to spend so long underground and what's going on while they're down there, and what happens to them when they emerge and how long do they typically live when they're out here?

Clyde: [00:49](https://www.rev.com/transcript-editor/Edit?token=uh6Bqzxv1XmYIrrrcsGh3Y9MkRQNUjn_ON2Rr83XPh4Jn6PGBlgl9LusDfrQrkgbv9_nmhYswVo5l7HQEOfEmM7mKqo&loadFrom=DocumentDeeplink&ts=49.85) Okay, so cicadas are insects that are actually closely related to aphids and some other insects that you might be familiar with, and they make their living by sucking liquids from plants. And cicadas feed on the roots of trees as nymphs and the tissue that they feed on in the roots of those trees, the liquid's not particularly nutritious, so it takes them several years to acquire enough energy to complete their life cycle.

 So, the basic way a cicadas does is it starts out as an egg, usually laid in a slit, in a twig, on a plant, and then it drops to the ground and it tunnels down into the earth, and then it finds a tree root and it starts feeding. And it may move from time to time, but it goes through several nymphal stages before it eventually gets big enough to come up to the surface of the earth, molt one last time into the adult stage, and then basically the main occupation of the adult cicadas is just to find a mate and put eggs into the twigs for the next generation. When we look at cicadas, they fall into two major groups in Eastern North America, what we call the dog-day cicada, or annual cicadas, some of which come up every year and then the periodical cicadas which, in a particular geographic location, only show up every 13 or 17 years.

Tracey: [02:32](https://www.rev.com/transcript-editor/Edit?token=9gh1l8I27Yreir565trOMBG9KfYTC8TvMAQynpqxeCXQrfi-6DTn4r0HanuN0Hc-mXcHzu5SpeYAwArcpZeu-nHuV9I&loadFrom=DocumentDeeplink&ts=152.68) That brings me to the second question. Not all of these cicadas, like you just said, they're not all in the same cycle. Why do they have different schedules? Is it to do with what they have available to eat?

Clyde: [02:51](https://www.rev.com/transcript-editor/Edit?token=kAxMkxwMEpTklcWSZ90TXbNkVAFHF6wQ14ZVN_egQmsaOEY7gtDmC15MEU1iUNTsOU_g--fodHpq5-i6VeRjw2W22Dk&loadFrom=DocumentDeeplink&ts=171.67) So, if you notice 13 and 17 are special kinds of numbers in that they're prime numbers, and one theory as to why they have these 13 and 17 year life cycles is that as prime numbers, it's difficult for predators to have life cycles that synchronize very effectively with those long period life cycles. That's one theory, also a lot of people don't necessarily buy that theory. They have to have long life cycles because again, it takes them several years to grow up feeding on the tissue that they feed on. The annual cicadas have a strategy, Well, some of us are going to come up every year and, as adults, we're going to be wary and try not to get eaten by predators before we find a mate and lay those eggs.

 The periodic cicadas have, we think, a different strategy, and that is, If we all come out together every 13 years or every 17 years, if we all come out at the same time, there are simply too many of us for the predators to eat all of us. We call that theory the predator satiation theory.

 And that ties in with the 13 and 17 year bit, because it makes it harder for predators to synchronize.

Tracey: [04:46](https://www.rev.com/transcript-editor/Edit?token=4iqduBr1TVGR-ByJjemAzjam_5cybmqIRC4QDh9zB6T6qEPrGZ_3gUvwGUjnkjhzshkQDmhE9ewq4AkpWsUolNb_CW8&loadFrom=DocumentDeeplink&ts=286.48) Okay. Can we go a little bit more into this idea of predator synchronization?

Clyde: [05:00](https://www.rev.com/transcript-editor/Edit?token=irRS2LXDpDmBLy8xLLQf_MeK918u2yv38Mt1HRr6XxLRuLIrFRUJUrAwad9RvgrBgvNJmu1HIxnsmLtzL8_wPElIMUI&loadFrom=DocumentDeeplink&ts=300.75) Yeah, so basically everybody likes to eat cicadas. When the periodic cicadas come up, everybody eats them, even deer and squirrels are eating them, there's simply too many for everybody to be eaten. And so, when you're coming up, literally, perhaps a race of hundreds of thousands to maybe millions per acre, there's just too many of you for everybody to eat. For that matter, people even.

Tracey: [05:56](https://www.rev.com/transcript-editor/Edit?token=2nCvA3SIp1rrqQqQH4iTe2W321j9-_9Vr9XnX5WQl_hushCEOeuBf-uQeADIhP6TKy4XShZx3qsxL1FH0aJZ8xioofA&loadFrom=DocumentDeeplink&ts=356.49) Let me clarify a little something on the annual broods. They still have that long cycle, but little bits of them are laying eggs every single year and so there's just this continual churn of cicadas?

Clyde: [06:29](https://www.rev.com/transcript-editor/Edit?token=XVABsmdLE57rr0E0WJLdyXKsSSyZtS1VZ4MzvOjk2WcozX3UJUqP-1IITcYFj9eUfoVXFc94c4RIQ7UbxA4aIwQpRoI&loadFrom=DocumentDeeplink&ts=389.6) That's the situation. So, even the annual cicadas are only annual that in that some come up every year, but they still have multi-year life cycles. In fact, they're almost certainly not as long as the periodic cicadas, but they're definitely multi-year cycles. It's just they're annual and that some come up every year, as opposed to the periodic cicadas, where you have a mass emergence once every 13 or every 17 years.

Tracey: [07:12](https://www.rev.com/transcript-editor/Edit?token=fnsOidn9IyeRkyVeDjwmwgGlyV03ZKXW9Jvn6longiBK3MxegHNU0-kYjje63B4tBQfVwzSMzMGniqZ6OZuQmyJiHLc&loadFrom=DocumentDeeplink&ts=432.66) Okay, and we know what they're eating while they're underground. When they emerge, do they eat anything while they're out here or are their lives span so short, it doesn't matter? Or what do they eat? Are they a threat? Locusts are a threat to crops, if you have a big swarm of locusts, they'll eat all your stuff. What do cicadas do?

Clyde: [07:31](https://www.rev.com/transcript-editor/Edit?token=2-dNfnXaw_9xsmN4AFQ3M9rp6UyEk3BvY6qXiO6oUj9KJCo032H4LzED-HUAF7LPAhM0HqdSkUDGuwzM2atzw13nddI&loadFrom=DocumentDeeplink&ts=451.14) So, adult cicadas actually do feed and they feed on plant sap, but they really don't do any damage to the plants. Even when the periodic cicadas come out, they don't do any damage through their feeding activity, to the plants that they exploit, because they're not really feeding that intensely. Their main purpose is, again, to mate.

 Now, when you have a periodic cicada emergence, the oviposition behavior where they're cutting these little slits and twigs and laying their eggs, that does cause the twig beyond where they cut that slit to wilt and die. But that doesn't really appear to have any lasting effect on the trees that they're laying their eggs on. Unless maybe you've got a brand new apple tree you just planted and they lay eggs in the half a dozen twigs that are on that apple tree, then that might damage that apple tree. But it's a really rare event where they do any significant damage to the plants. And the other question that goes to that, well, if you got all your millions of insects feeding on tree roots all those years, what does that do? And it doesn't appear to do a lot to the plants. And then when all those cicadas die, then there's a pulse of fertilizer going back into the ground.

Tracey: [09:00](https://www.rev.com/transcript-editor/Edit?token=nsZ0RbvwJNVCv1Pwzd9k30H2N754M4DF2mp0BDYQBmoDwjxk8zRI_Nt6wL_WwieaKDCJ4Do7LDcytRGtWqclCctR1zg&loadFrom=DocumentDeeplink&ts=540) If you went outside and started digging around the roots of trees, would you just find millions of millions of little cicada larvae everywhere? How does that work?

Clyde: [09:14](https://www.rev.com/transcript-editor/Edit?token=tt6qgVUJiEikfULF9_SOhCx6Yo8EtsTY3WXm5seFbWHl44odz0MVuBzxElbm-gQdSRiOqg9QJ6y4oDdJ92GMp13ikVk&loadFrom=DocumentDeeplink&ts=554.63) So, the cicada nymphs could be anywhere from six inches to three feet or more down into the soil profile, feeding on tree roots. It really depends on the trees that they're feeding on, where those roots are distributed and also on the soil texture and what bearing that has on the roots systems of the trees that they feed on.

Tracey: [10:16](https://www.rev.com/transcript-editor/Edit?token=khIbTz2PuDPJ2e7hrK9xtP4iv9zW5rtCimKzTEGchOeEWU602J__K9dT3Tf92Zm7djZBu8CtG55R9NjqzdnUAid9CAY&loadFrom=DocumentDeeplink&ts=616.31) Well, let's talk about the main reason that we know cicadas are here, the sound they make. Is that just their mating call? Is that what that is?

Clyde: [10:37](https://www.rev.com/transcript-editor/Edit?token=zmomKf4rHe-Cyw3b2_vJrwKLKUWi1Wtv8sfVdqNH-ozdqLwFHl14SYk_MzEFHq7iyIQJ__XYUXxorDBbh8i8IOL_-Ik&loadFrom=DocumentDeeplink&ts=637.26) So, when you hear cicadas, you're hearing males and that's true for both the annual cicadas and the periodic cicadas, it's only the males that do the singing, and some folks would use the term singing very loosely when they're talking about cicadas, I call it singing. But anyhow, it's the males and what they're doing is they're advertising for mates, and each species has its own song. And you can identify cicadas, periodic cicadas, and annual cicadas, you can identify the species by the songs they sing, just like with birds.

Tracey: [11:14](https://www.rev.com/transcript-editor/Edit?token=g4qIXu2hJpY6AnKbqe78LfiwR_F4IHgzM8FMRaGVkGL-hWNuDkJCXktIHUc8YZu_8T8ebHY7Be6BOQcSzmoaTYt_bRo&loadFrom=DocumentDeeplink&ts=674.09) Wow, that's interesting. How do they make the sound? Is it like crickets do, do they rub their legs together? Are they rubbing their wings together, what are they doing?

Clyde: [11:22](https://www.rev.com/transcript-editor/Edit?token=YKkOz3NOlwS4uXMrPUObMe9zHZHeY_zye-RG-TVOy8FxazQZs7hHyTEp0ax-hE3v8UAip4TLrc2YqIsaCZAaXIjcXyU&loadFrom=DocumentDeeplink&ts=682.46) That's a brilliant question and actually, no, it's not. They have special structures on their abdomens called timbals, And what a timbal is, is it's a plate of ridged cuticle which is the skeleton of an insect, the cuticle, and that plate is attached by a strut to a really huge muscle that can contract at insane rates because of the way it's controlled by the nervous system. And so, if you've ever gone to the state fair and been by the highway patrol booth, and they give out those little red and a white clicker things that they give them to kids and the kids then proceed to drive their parents crazy with them, timbales make their sound in exactly the same fashion. When you de deflect the plate, it snaps and it creates a little tiny sonic boom. And when you release the plate, it snaps again and it makes another sound. And so they make their sounds by deflecting these plates of cuticle at insanely high rates of speed.

Clyde: [12:40](https://www.rev.com/transcript-editor/Edit?token=3VUrfh1mCspT2zHCwfwbn9s7K87Jmo3k_-wJOY6gFfwrux3HD-0rO-h85fsPkQoAnwRGvVO03afOAO9FaumLLpQmfVM&loadFrom=DocumentDeeplink&ts=760.14) Surrounding that are air cells that act as drum head amplifiers.

Tracey: [12:48](https://www.rev.com/transcript-editor/Edit?token=ymflk4zvua40DLonbw9R1F0bSygFxCsehL3XzT0P94nGVu0NjeyxnmpiSVKchfkjZF1RBGkbX9WT-NjSIrdizAlYIao&loadFrom=DocumentDeeplink&ts=768.69) Oh wow, they have their own subwoofers.

Clyde: [12:53](https://www.rev.com/transcript-editor/Edit?token=iANiTO472mVtxiW4-bYUHTmhyfqySe-HgsKQzbfBGjaDDVGu-ednf4sOBRcEv0t_s9gcw11qgRHuisdAgYQFfeBWKa4&loadFrom=DocumentDeeplink&ts=773.95) They actually amplify the sound, and in fact, cicadas are the loudest insects in the world and amongst some of the loudest animals in the world, at least in some species. Some species have calls that exceed a hundred decibels, so it's like standing beside a jet engine, basically.

Tracey: [13:12](https://www.rev.com/transcript-editor/Edit?token=xz5p8_HG1t9UXpS7vR0FKcq7pAigo5iYn8_u13ci4VYZLy8e2iN5OuzNHP66fmKDltdrCj9moKuLValsPPnSBUjZmI4&loadFrom=DocumentDeeplink&ts=792.13) Wow. Why does is it almost seem like they start and stop in a round, or groups of them all do it at the same time? ~~W~~hat's going on there, did they synchronize that way?

Clyde: [13:40](https://www.rev.com/transcript-editor/Edit?token=Jg4ho5E7Sp8sdplYOUreNov0jCWFpvHHCF1dDKokbXWIxNc-pWHXz0Kkxrg0pxz9XyjbaEIc-CyCM-V6dlUT3apxfpo&loadFrom=DocumentDeeplink&ts=820.16) So, I don't know if they're synchronizing or if they're competing.

Tracey: [13:43](https://www.rev.com/transcript-editor/Edit?token=j_ypRxFPtGpK8OP63hKzjz-Hj24Bd1xULhy3txry00wSQ5PoGwvIMkZfFgCaVtKyZIOsYN_QcRAxEI1d2YYEuTrVTZU&loadFrom=DocumentDeeplink&ts=823.35) Okay, that would make sense.

Clyde: [13:46](https://www.rev.com/transcript-editor/Edit?token=r4mmpXxwqxpHW3lYRQEGmhRmACe0KTdrsVGsWm2sFwg7CNq_U5sBstOsWzAz9yhn8cEWkb5-SoVsc4yvy4sgEPfM9D4&loadFrom=DocumentDeeplink&ts=826.22) Yeah. And again, it differs with the annual cicadas and the periodic cicadas, because the periodic cicadas come up in such huge numbers, if you got a million per acre, you got a half a million of them singing at the same time. So, from dawn until dusk, they're all going to be singing unless they actually convince a female to come over by them and they do something else then.

Tracey: [14:12](https://www.rev.com/transcript-editor/Edit?token=5SRTU9Yq4iknb68bDBH40Xa_FBtnIXvk5P42zbnEYsaXEc1h26oT3KQAcdEzhXrI6DzXkLPaTVD1ndFpP3dvmlQqA0Q&loadFrom=DocumentDeeplink&ts=852.92) Yeah. So, they are active, is it just at daytime?

Clyde: [14:23](https://www.rev.com/transcript-editor/Edit?token=iFyG5l4Lt8_DG0bLMLOQvp69k5NaBFFloUnNfh-hzNc-jRWSRa4CXhgeJoii08rclCK3sJCEXxFv9eZBUPWjfMgEwUE&loadFrom=DocumentDeeplink&ts=863.21) The periodic cicadas are, are diurnal, they only call during the day time, and most of the annual species only call during the day time. Most of the annual species though, have a part of day where they're more likely to call. So, some of them call primarily at dawn, some of them call primarily at dusk, and some of them primarily call in the middle of the day in the heat of the day. But with periodic cicadas, it's when they're out, and out in numbers, are pretty much calling all day.

Tracey: [14:56](https://www.rev.com/transcript-editor/Edit?token=c7dq3zypzEz1jCwnUm0Ywn18kyimfUYp22Qb5znjqFhSe4-U69NPn6U27aZpWkc7QyqsGjtcW7CmhQjIKdsyl1JQps0&loadFrom=DocumentDeeplink&ts=896.23) Well, this is all really interesting stuff, I'm looking forward to it. We're not really going to get the lion's share of them here though, geographically, are we?

Clyde: [15:09](https://www.rev.com/transcript-editor/Edit?token=MjpMlZoKYcj2lEgztiar9LSdCxZyZ2qd8ALVzgZCxfGF9ssSgqon2fx2REHrR760wpkByBo77FeWhpc5A9kQyB0zVMU&loadFrom=DocumentDeeplink&ts=909.37) This year's emergence is called Brood X, and it's one of the largest broods in geographic extent. Brood X is a brood of 17-year cicadas and there are three species of 17-year cicadas that are going to be emerging in Brood X. Brood X extends from the north-east, all the way through parts of Virginia, the far western extent of North Carolina, Tennessee, down into Northern Alabama, and then up into Illinois and Indiana. But in North Carolina, if you want to see Brood X, you're going to have to go to the far western parts of the state, to the north-western part of the state and the south-western part of the state. Our big brood in this part of North Carolina into Piedmont is Brood XIX of the 13 year cicadas. And that's going to happen in three years, in 2024 around here, at least in some locations, it's going to be deafening. North Carolina has pieces of six different broods, but because two of those broods that we have pieces of our 13 year cicadas, over a 17 year period, we have cicadas seven or eight years.

Tracey: [16:38](https://www.rev.com/transcript-editor/Edit?token=mNLoBDBHEYUxgGWQ7VWyZ5j0bNq6EH1s7zhDAtoFr4jaeO_q1PF58Aip0r3lJn7rkYX79UZw1Hr308TcEIzYoB2q7DA&loadFrom=DocumentDeeplink&ts=998.17) Are they starting to emerge right now? The beginning of May, is this prime cicada time coming up?

Clyde: [16:48](https://www.rev.com/transcript-editor/Edit?token=tHZNP6iRgBKDvleIFAn04EJLnu_b6t2NVy8xhgFe21gsJhmXG4cDq2WRy6sI-zJZl6oQOxj-_RXljhYISwfqe-JNh_8&loadFrom=DocumentDeeplink&ts=1008.22) It depends on latitude, because what really drives when they come up is soil temperature. And so, they start coming up in numbers when the soil temperature three or four inches into the ground or five inches into the ground reaches about 64 degrees. So yeah, in most of the areas where Brood X is going to be coming out this year, people are getting braced, because they're not coming out already, they're going to coming out within the next week or two.

Tracey: [17:37](https://www.rev.com/transcript-editor/Edit?token=zm5yE06eCEbYtND36MVwc1Z7THIqVyld5aLDXuoibJ3n-0hCaHeIB85M84sPkpMSeeBErzLvb_oGeqWmavwHv964zqs&loadFrom=DocumentDeeplink&ts=1057.92) Okay. Well, we will keep an ear out for that. And finally, what is the coolest or most interesting thing that you know about a cicada, or cicadas generally?

Clyde: [17:54](https://www.rev.com/transcript-editor/Edit?token=oQLAAaQ9OmHVsDA_7sS9ndGjxhYcZPu2Tcc72NbzNMumdy6l71S53_fY61FjCx3QXqgDC8beV9D1aF3bzo2BhGRH_kM&loadFrom=DocumentDeeplink&ts=1074.38) Well, other cicadas in general are just fascinating animals, because again, they have this interesting sound production system. I'm a birder and so I like them because you can identify them like you can birds, by their songs, and if you get a chance to look at them, they're actually pretty visually arresting animals as well. So, the coolest thing about cicadas is their communication systems, and the fact that we can actually start interpreting them, even at a very superficial level, because we can recognize different cicadas by their songs.

Tracey: [18:36](https://www.rev.com/transcript-editor/Edit?token=g5gMMu4jjUSIs5zW74aqak5wrYjfGcbXUfN17AgoekwiyPswgvssl_50zs8SfBOYdGFS_PEaQiLQTXVdogyJWBMflN8&loadFrom=DocumentDeeplink&ts=1116.93) And this is a followup question. It may seem silly, but do the different broods have different physical characteristics, like coloring or patterning or anything?

Clyde: [18:50](https://www.rev.com/transcript-editor/Edit?token=JV4zb-cHs7MyFQGn_iao915lnR-taXuneU0_5NYbUfqg9owDwtBrEg3Glnwan7xRHGGnNr9Q4bfWPN3PTZ-FCKUsEkc&loadFrom=DocumentDeeplink&ts=1130.3) So, within a brood of periodic cicadas, you may have only one or two of the three species of 17 year cicadas, you may have all three of them. They all look pretty much the same. They're black insects with orange wings and brilliant red eyes, but there are some subtle differences in their coloration between the species. The interesting thing about the relationship between the 17 year and 13 year cicadas is, is that they are sibling species. So, in the 13 year cicadas, there's a species called tredecim, and there's a sibling species in the 17 year cicadas called septendecim, and they have the same basic song, their song sounds very similar. So, they originated from a common ancestor and became different species because they had got to these different life cycles and the same thing with cassinii and Cassini tredecassini and septendecula and tredecula.

 And with the 13 year cicadas, we have an extra species, neotredecim, which has a different song. But as far as within a brood, you can visually identify, if you know what you're looking at, the three different species of 17 year cicadas, if they all come up in your area. And you can visually identify at least three of the species of 13 year cicadas, if they come up in your area. But from brood to brood, there's three species of 17 year cicadas, even though there's nine different breeds of 17 year cicada And there's four species of 13 year cicadas, even though there's three different breeds of 13 year cicadas. The broods are distinguished because they're geographically distinct. In any given geographic area you typically only have one brood of cicadas that will happen in your area.

Clyde: [21:47](https://www.rev.com/transcript-editor/Edit?token=znbtAQ1G8S3JhkvjnCLA1WgsQdOHsCPfFB4HoKchzEc9vn2Lr_TvtgcTUs_CUB1DtIGv65meZ1zoUdgKlua1YWYY76w&loadFrom=DocumentDeeplink&ts=1307.51) In North Carolina, we probably have maybe 10 or 12 species, it's hard to know. I know we have at least 10 or 12 species of annual cicadas, and some of them are more prevalent in the west, some are more prevalent in the coastal plain, some of them are found statewide.

Tracey: [22:19](https://www.rev.com/transcript-editor/Edit?token=Aoabt3awizg0XV6g3aGzdFf342mVQ40mX-UIOsB3rEPVg457cn5lXVLswEZDOn_DR3kOsKVQJGVY_ARHrFP_xR2N4LM&loadFrom=DocumentDeeplink&ts=1339.08) That's really interesting. Is there an online resource or anything where you can listen to different cicada songs?

Clyde: [22:42](https://www.rev.com/transcript-editor/Edit?token=x2Y4cMsKc_zuf5oSRM2r9vm63KLXz9dZFreTcWSV8q7LKviJWa8E6QyF85_iyMYe_OII60xgGDO4-wPrbO3lnH8qziw&loadFrom=DocumentDeeplink&ts=1362.59) There actually is a really cool resource and I think it's called Songs of Insects, there are a couple different ones, but the one that I like, it's called Songs of Insects and they have a cicada page.

Clyde: [24:52](https://www.rev.com/transcript-editor/Edit?token=ud67I5KSVenj4pB_9g7Kqa-4ITr6Vyp-uTsvdE6z09gDFurWc36_I4BobqGHsdawKVoi1dRJPgwyVOP-MWQB5veeDQ8&loadFrom=DocumentDeeplink&ts=1492.98) So, any way, this is a really good resource for learning some of the cicadas around. It's not completely comprehensive, but it does give you an introduction to some of the cicadas that we have around.

Tracey: We've been speaking today with Clyde Sorenson, an Alumni Association Distinguished Undergraduate Professor of entomology here at NC State. This has been Audio Abstract, I'm your host, Tracey Peake. Thank you so much for listening.