Spring 2011

the Thalweg

Watershed Stewardship Program

Volume 8 ◦ Issue 2

Cobb County Watershed Stewardship Program

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www.cobbstreams.org

Cobb County's *Anuran Monitoring Program* is looking for a few good volunteers

Left to right: Northern cricket frog, pickerel frog, and squirrel treefrog, all species that can be found in Cobb County

Order Anura consists of small, smooth skinned vertebrates that have boggle eyes and webbed feet, and are a the harbingers of Spring. Otherwise known as frogs and toads, anurans are not only one of the main performers in a wetland's evening concert, they are also bioindicators of water quality.

A few years ago, Cobb County citizens began expressing concern that the frogs and toads they once heard calling in abundance were no longer there. Thus, the Anuran Monitoring Program was born. This enables citizens to listen and identify the anuran species calling in their own neighborhood. In addition to providing data that we may create a map of species abundance in Cobb eventually, this program encourages volunteers to get outside and take a walk with their families and pets. It's a great way for families to learn new skills together, and make a difference in their community.

Identifying anuran calls may seem daunting at first, but there are only fifteen species that breed in Cobb County. What's even more surprising is none of them make the ubiquitous *ribbit ribbit* that we think they do. Anuran vocalizations range from high pitched chirps to low, booming calls, and everything inbetween. Come to our workshop and discover what has been living in your swimming pool and which species sounds like a bleating sheep. Learn about the dangers that threaten anurans and what we can do to help them.

Anuran Monitoring Workshop
Thursday, April 14 • 6:00-8:00pm
Cato Environmental Education Center • 5286 Austell Road, Austell, GA 30106
For questions or to RSVP, call 770-528-1482 or email water_RSVP@cobbcounty.org

This article was originally published at Yale Environment 360. http://e360.yale.edu/

Unraveling the Mystery Of The Bizarre Deformed Frogs

By Carl Zimmer

Yale ecologist David Skelly wanted to know why a sizable percentage of frogs in the northeastern United States suffered from deformities. His ongoing research has implicated human activity — but not in the way many researchers had thought.

For the last two decades, strange things have been happening to frogs. Some frog populations have high rates of limb deformities, while others have high incidences of what is known as "intersex" traits associated with both males and females, such as male frogs whose testes contain eggs.

David K. Skelly, professor of ecology at the Yale School of Forestry & Environmental Studies, set out to discover what was causing these deformities. In an interview with Yale Environment 360 contributing writer Carl Zimmer, Skelly described what chemicals may be causing these abnormalities in frog populations, and explained why this phenomena may have troubling implications not only for amphibians, but for other vertebrates, including humans.

Yale Environment 360: You came to the question of pollution not as a medical researcher but as a wildlife biologist you studied frogs. Tell us how that happened.

David Skelly: Well, as an ecologist, I start with the animals. When I started on this project I really didn't know whether I was going to be studying pollution or what. I started off trying to understand where sexual deformities in amphibians came from in the environment. There had been some laboratory work that did in fact use pollutants and figure out whether exposure through pollutants like pesticides might cause these kinds of deformities. But to me, the cart was before the horse because we really didn't understand the natural history of reproductive deformities in many groups.

e360: When did people first notice that there was something weird going on with these frogs?

Skelly: Really the laboratory work in this case came first. About ten years ago people started doing laboratory experiments with amphibians, and some work on atrazine, a pesticide, was important because it was showing that extremely low concentrations of the pesticide might lead to these kinds of deformities.

e360: And what deformities are you talking about?

Skelly: The deformities in particular are traits that are associated with animals that have characteristics of both males and females. And there are lots of different possibilities. The ones that we've been concentrating on and the ones that are most clear are, say, a frog that looks like a male and has testes, but when you look inside the testes there are eggs growing in there. That's an attribute that you can say suggests intersex, a condition in between male and female.

So then after these lab results came out people started going out into the field and, lo and behold, they found these deformities sometimes to be quite common in natural populations. That was interesting because certainly in the past we've known about these deformities for a hundred years. And in fact, a lot of what we know about sexual development in animals, and invertebrates in particular, was worked out in amphibians as a model system. And people have looked for them in natural populations before, but until this recent spate of work starting about ten years ago they hadn't been found to be common in too many places. What we found more recently is that in a variety of studies people are finding them to be quite common. What worried me about the work that had been done so far is that because the laboratory work had been focusing on agricultural pesticides, people went out and basically looked at gradients of agricultural intensity, or just worked in agricultural landscapes.

e360: So they think because atrazine in the lab can cause intersex deformities, let's go look at places where these pesticides are used, like on farms?

Skelly found deformities in almost all ponds sampled in suburban and urban landscapes.

Skelly: Yeah. On one level that makes a lot of sense. But on another level it can be misleading. You can tend to reach a conclusion that isn't warranted because if you say I'm just going to go look in agricultural landscapes and I find these deformities there and I've done the laboratory work to show that exposure to the pesticide can lead to these deformities, you might just wipe your hands and say we're done here. But what we didn't know is what about all these other landscape types? Are deformities showing up in those landscapes as well? And that was really our goal, to ask very broadly, how often is this happening? Where is it happening? What does the landscape of amphibian intersex look like? And what we found was pretty surprising.

e360: Where did you go and what did you do to do the study?

Skelly: The prior work on amphibian intersex had primarily been done in the West and the Midwest. There was a study down in Florida. Nobody had looked at all in the northeastern United States and that's where I'm based. So we worked in Connecticut, specifically in the Connecticut River Valley, and one of the nice things about Connecticut is that it's got a pretty compact size but there is pretty high diversity of land-cover types. So there is an active agricultural landscape in

Connecticut, there are certainly a lot of suburbs. There are urban areas and there are still a lot of forests in Connecticut. Connecticut ranks third or fourth in the nation for population density, and it ranks third or fourth in the nation for the proportion forested. We can take advantage of that. So we worked in a set of land cover types: agricultural; undeveloped, which in Connecticut means forested; suburban, people with lawns and houses and schools and that sort of stuff; and urban, mostly around Hartford.

So essentially we took the entire state and categorized areas around small ponds as fitting into one of those categories and then sub-sampled them randomly. And what we found is that we can find intersex frogs in a variety of landscapes. We find them in agricultural landscapes, but we find them in suburban and urban landscapes at three times the rate. So if they're concentrated anywhere, they're concentrated in these more densely settled places, places where people live and work. We didn't find them in wooded landscapes, these undeveloped landscapes.

"We find intersex frogs in agricultural landscapes, but in suburban and urban landscapes at three times the rate."

e360: So whatever is happening has something to do with human activity, since you're not seeing it in the wooded landscapes.

Skelly: Right. So we feel very confident at this point that whatever is going on seems to be associated with some kind of human activities and we are finding it in agricultural landscapes so it's not that whatever goes on in agricultural landscapes is inconsistent with it happening... [But] I think the fact that we found that in those kinds of landscapes where corn is being grown, the great majority of the ponds we sampled didn't have any deformities at all. It suggests to me that whatever is going on in those landscapes compared with the suburban and urban ones, we're not getting a signal that strongly points towards agricultural pesticides. But one of the striking things is that almost all the ponds in the suburbs and urban landscapes have deformities in them. So this is something that is practically ubiquitous in those places and yet is showing up in a much more spotty manner in agricultural landscapes.

e360: So if atrazine is not the only factor, what are your suspicions about what else might be going on?

Skelly: Well it's pretty well known that amphibians, fish, and frankly vertebrates in general can be influenced by hormones that are just out there in the environment. There are actually whole biological systems that depend on that happening naturally. But it's also clear that we put a lot of hormones into the environment. And in particular we know that estrogen exposure can lead to the kinds of deformities we are seeing. So we would be irresponsible if we didn't at least explore that avenue. It seems like a pretty reasonable set of hypotheses at this point just to imagine that there's a bunch of estrogens out there in the environment and perhaps atrazine is one of them.

"It is widely accepted that the way that toxins work in the environment is often in concert."

There are dozens of chemicals that humans create to actually act as estrogen. Birth control pills are a perfect example. The estrodial people take as birth control or as prostate medicine, it goes through our bodies, it may get complexed with something, and then we excrete it and it can become active again in the environment. I mean that's not hype, that's absolutely been shown to happen as a matter of course. So that's a very potent estrogen. And those molecules are reasonably durable. But there are many other chemicals that were not created to be estrogens and yet can act like estrogens once they're out there. So one that many people may have heard of is Bisphenol A. That's the chemical BPA and there was federal legislation to remove it from baby bottles. It's a plasticizer. So it's an industrial chemical that's supposed to help us create something and then as a totally unintentional byproduct it can have this other kind of biological activity.

And it turns out there's a variety of chemicals with molecules shaped such that they can bind to receptors on our cells, or in cells of frogs that are intended to receive estrogen molecules. And when these receptors bind with these other chemicals they turn that into a signal that says, okay, some estrogen just arrived. And if that happens often enough there are physiological responses in our bodies that in a frog's testes could lead it to start creating eggs.

So the biology of all that is pretty well worked out. It doesn't mean there aren't other possibilities for what might be going on, but we know that these estrogens are out in the environment. We know that a species like frogs can respond to them. What we need to do is see whether the dots connect and whether the exposure happens in these ponds. And then as a follow-up to that, if all that comes together, then another step we need to take is do experiments not in the laboratory, but out in the natural environment, and see whether we can actually create this kind of a cycle where there's exposure going on and we can see inside of a natural pond.

So the way that you would nail this down is by experimentally exposing some animals in the field to this kind of cocktail of chemicals that we can first demonstrate are out there in the field, and then see what kind of biological responses we get. We're talking about a variety of chemicals that are in the environment because they're useful. You know these are people's medications, they are industrial chemicals, they're not out there for no reason. And we're not going to be able to change people's minds about them unless we have very good evidence suggesting that these effects are happening. Then the question is, what do you do about it?

e360: When you hear that frogs are having these sexual deformities, it sounds creepy. But does it have an actual ecological impact? I mean does the fact that we may be changing the nature of these frogs actually mean something to the wildlife itself?

Skelly: I think these results are important in two very different ways. Beyond being creepy, the fact that these kinds of estrogens out in the environment can have this kind of effect on a vertebrate. Many people would say that that alone is a basis for us to be concerned. Because there are many other species that share some of the same biological pathways that frogs have. And that includes people, where we don't want the possibility of this going on. So you can get precautionary about it and just say this isn't about frog population viability. This is about not wanting to have chemicals that have that kind of biological activity out there.

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Develop Your Anuran Knowledge

You may never have seen one up close, but unless you live in a concrete jungle, most likely you've heard a variety of frogs and toads. Anurans love the water and can find their way into small backyard ponds and puddles. In the summer, you may notice tadpoles in your swimming pool and adult treefrogs clinging to window screens. If you live near a stream you may feel as though you are surrounded by singing frogs and toads. These amphibians are important to the ecological health of a habitat, but have also found their way into literature, cultural symbolism, and even as cuisine and pets. But how much do you really know about frogs and toads?

Order Anura gets its name from the Greek *an* (without) and *oura* (tail). They belong to the amphibians, a vertebrate taxon that includes salamanders and caecilians. Although anurans are born with a tail, they quickly lose them through the process of metamorphosis. The first stage of life is spent as a jelly-like egg, usually *en masse* with hundreds or even thousands of siblings. These eggs must be laid in a damp environment - usually, a pond or stream - to keep them from dehydrating. Most tadpoles are herbivorous, subsiding on algae and other plant matter, although some may eat smaller tadpoles. Over time they develop into metamorphs or tadpole/frog hybrids. Eventually, the tail is reabsorbed into the body and the limbs sprout, first the hind legs and then the front. The small, sucker shaped mouth that was once used to scrape algae off rocks, widens into one the width of the head. The eyes migrate from their position on the sides of the head to the top. Internally, the intestines shorten to make way for their new insectivorous diet. Finally, the gills disappear and are replaced by lungs. The process of metamorphosis sets the amphibians apart from most of other vertebrates, the exception being some bony fish who also go through metamorphic changes.

As adults, anurans no longer spend all of their time in the water, but must live close by to continuously rehydrate their permeable skin. Some species that live in desert environments have adapted to their dry conditions by being able to burrow as far as three feet underground, and secreting a membrane that thickens their skin to protect them while they are buried. Even temperate species in Georgia bury themselves in the mud at the bottom of a pond to ride out the cold winter months, a process called *estivation*. They are able to aborb oxygen through their skin while the rest of their bodily processes slow down to the point that they don't need to eat. Some species estivate on land, burying themselves below the frost line. Perhaps the most well known cold weather frog is the wood frog, a species that lives as far north as Alaska. The high levels of glucose in it's blood allow its organs to freeze safely. The heart stops beating and the frog ceases to breathe, but once spring comes the frogs thaw and return to normal.

Contrary to popular belief, there is no taxonomic difference between frogs and toads. Outwardly, toads have warty skin and prominant paratoid glands that can secrete an alkaloid toxin. Generally, toads have more robust bodies and shorter hind legs than frogs. These characteristics are

a result of convergent evolution in dry habitats. Skeletally, frogs and toads are exactly the same. Their difference in appearance results from specific adaptations to their habitats. Although family *Bufonidae* are considered the "true toads", individuals in other families use the "toad" moniker as well. Other anuran families that can be found in Cobb County include *Ranidae* (true frogs), *Hylidae* (treefrogs and their allies), and *Mycrohylidae* (narrowmouth toads).

The Fowler's Toad (*Bufo fowleri*) demonstrates the stout body and warty bumps typical of family Bufonidae

Amphibians in general have been facing a worldwide decline that has been documented since the 1980's. There have been numerous hypotheses put forth as the reason for their decline. The true culprit is likely a combination of several factors, such as habitat loss and degradation, climate change, overuse of pesticides and herbicides, disease, and the introduction of non-native species into their habitat. Scientists estimate that 30% of the 7000 species of amphibians worldwide were extinct by 2004. Although amphibians are small and non-descript, this loss rings alarm bells because they represent a greater biomass that all other vertebrates combined. They play the role of the "middle man" in a food web, transferring energy from the lower trophic levels to the upper, and across the aquatic/terrestrial divide. Without amphibians, many ecosystems would cease to function as they should.

So the question remains: How can we help the amphibian crisis? Much of the research looks grim, since even drastic measurements in habitat conservation and limits in human consumption would not prevent the spread of disease. Unfortunately, short lived amphibians are quickly losing the race against time. Captive breeding programs have been established to save these declining species, but even this has been acknowledged as a last resort. Ordinary citizens may feel hopeless in this onslaught of depressing news. The reality is that for most people, the most we can do is educate ourselves about these amazing creatures so that we understand how our day to day actions might impact them. Armed with education, we are better equipped to make wise choices that not only benefit amphibians, but the environment in general. The key is to keep in mind that everything is related and all of our collective actions can make a positive difference, even if we don't understand all the details of those relationships.

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e360: So back when Rachel Carson was writing *Silent Spring*, she was focusing on DDT and there was a certain clarity there where she could focus on one pollutant. And here we have a situation today where you have to think about atrazine and all these other chemicals that each individually might have an impact on these frogs and on people, or maybe together cumulatively have an impact. It makes the problem more complicated. How do you deal with that?

Skelly: It is complicated. The EPA [Environmental Protection Agency] and ecotoxicologists in general have been trying to figure out how to deal with mixtures for some time. So it is widely accepted that the way that toxins work in the environment is often in concert. But the paradigm that you described where beginning with Rachel Carson we were thinking about one chemical at a time. It's clean and if you do this in the lab you get beautiful results. This standard of pure clear repeatable results has kind of gotten in the way of thinking about how bad things happen out in nature.

One thing that I can see on the horizon is that people are thinking about looking at biological pathways. So we've been talking about pathways where estrogens get turned into physiological responses. And instead of thinking about one chemical at a time, what are the chemicals out there that could cause that, and shouldn't we be managing those as a group? Because we're talking about medications, we're talking about industrial chemicals, we're talking about pesticides.

A deformed leopard frog metamorph found near Lake Champlain in Vermont.

I think first what we need to do is come up with clear field-based cases where you can show very clearly that it is mixtures causing this and that managing chemicals one at a time isn't going to work... It's ironic you mentioned Rachel Carson because she started with a natural history phenomenon and then followed her nose to figure out what was going on, and traced it to a single chemical. It could have easily been traced to a group of chemicals and perhaps the history of environmental regulation would have rolled out differently.

e360: And so we would conceivably be regulating these chemicals in groups? I mean, wouldn't somebody who makes the birth control pill say, well, we only contribute a tiny amount to this problem so why are you picking on us?

Skelly: I think that if we do get into thinking about and regulating mixtures of chemicals based on their action, as opposed to their intended use and their origin, it's going to be an incredibly hairy regulatory problem. We can deal with a lot of chemicals regardless of their origin and regardless of their intent by changing how we manage waste. The other way that we can deal with this is to build it into research and development of these chemicals so that we're trying to think about could you create a plasticizer that works like BPA, but doesn't act like a steroid?

welcome
new watershed stewards

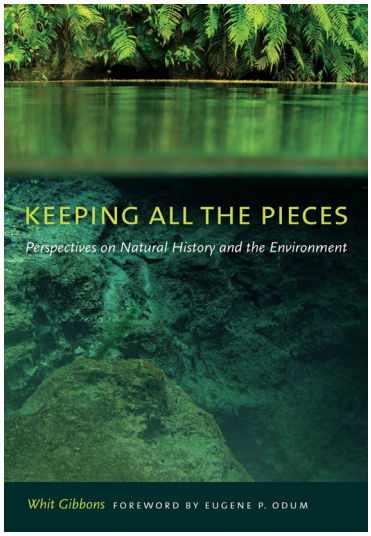
Whitefield Academy
students will be monitoring two sites on Nickajack Creek

Mike Seeley
will be monitoring Noonday Creek

Campbell Middle School
will be marking storm drains near the school

Girl Scout Troop 28289
will be marking storm drains in their neighborhoods

RECOMMENDED RESOURCE



Keeping All the Pieces by Whit Gibbons

With scholarly expertise and infectious enthusiasm, Whit Gibbons explores the many pieces that support our natural environment. Whether describing caterpillar disguises, fish that produce antifreeze, the mutual reliance of rhinoceroses and Trewia trees, or the origins of tumbleweed, he affirms the delicate and intricate biological relationships between species and encourages a deeper knowledge of our natural world. In these essays Gibbons celebrates the beauty of biodiversity and laments the tragedy of "ecovoids," a term he coined to describe missing components of our environment that we wish were still present but can never be replaced.

From www.ugapress.org

Congratulations to our 2010 Watershed Award Winners!

During our Watershed Stewardship Fair on March 2, we honored several of our volunteer groups have gone above and beyond the call of duty in 2010. All of Cobb's volunteer do great work and we had a very difficult time choosing who to specially recognize. But in the end, these volunteers' dedication and persistance won us over. Congratulations to all of you, and thank you so much for dedicating your time and energy to Cobb County!

2010 Volunteer of the Year
Pam Subalusky

Pam has been participating in Adopt-A-Stream monitoring since 2001, and is one of our longest running volunteers. She has been submitting consistent and reliable data for her site near her home in Roswell. She has also worked with Cobb's Stormwater Division, providing citizen input on county projects. Pam is a dedicated and reliable volunteer that we know we can always count on!

2010 School of the Year
Tritt Elementary School

Led by teachers Tamera Neal and Christy Goss, Tritt's 3rd grade Target students (otherwise known as the River Kids) have been monitoring a stream near their school since 2009. These students are engaged in a year long study on water, and act on their knowledge through chemical and bacteria monitoring. They have also marked the storm drains near the creek and participated in Rivers Alive cleanups. We have no doubt that they will continue to be responsible stewards of their environment as they move to 4th grade and beyond.

2010 Community Event Coordinator
Amy Boggs

Amy contacted us with the desire to get her neighborhood in Acworth involved in protecting their stream. Not only did she become certified in Adopt-A-Stream chemical monitoring, but she coordinated a neighborhood cleanup and storm drain marking project. She continues to follow up by educating her neighbors about non-point source pollution.

STUDENT SUBMISSIONS

Untitled
Hannah White, 2010
Walker School

K-12 students can submit art or poetry to water_rsvp@cobbcounty.org

Ruby-throated hummingbirds have just arrived in Georgia after flying non-stop from Central America over the Gulf of Mexico ~ quite a feat for a tiny bird that only weighs as much as a few pennies! This species is the only hummingbird that breeds in eastern North America. Males sport a brilliant red throat while the female has a dull grayish-white throat. The top of the head and back on both sexes is a metallic bronze-green color. You can attract these fast-flying jewels to your backyard by planting flowers and by putting up a feeder with one part sugar dissolved in four parts water.

Linda May, Environmental Outreach Coordinator
Georgia DNR, Wildlife Resources Division

ECOPEDIA

Carrying Capacity is how many organisms an ecosystem can support at maximum. It is a limit set by nature and cannot be evaded. Ecosystems are immensely complex with hundreds or even thousands of species influencing each others' populations. Humans are tempted to believe that we can use technology to escape carrying capacity, but the huge human population on earth is almost certainly temporary. Unless we respect Earth's limited carrying capacity, we face increasingly bitter struggles over dwindling resources. *From Ecology: A Pocket Guide*

CONSERVATION TIP

Take advantage of getting your money back electronically from the IRS instead of waiting for a check to arrive in the mail. About $135 billion in tax refunds still makes its way through the mail to individuals, which means the IRS has to stuff, print, and mail some fifty-four million envelopes. *From The Green Book*

REMINDERS

- Adopt-A-Stream and Anuran Monitoring Volunteers: Please submit your data in the same month in which it was collected. This ensures that we are correctly counting your volunteer hours as we submit our monthly reports.
- Keep up with our latest events and photos on our Facebook page! Search for "Cobb County Watershed Stewardship".

Cobb County
Watershed Stewardship Program
662 South Cobb Drive
Marietta, Georgia 30060

Cobb County...Expect the Best!

This is an official publication of the Cobb County Water System, an agency of the Cobb County Board of Commissioners.

Calendar of Events

April

5 Rain Barrel Make & Take Workshop ◦ 2pm - 3pm ◦ Cobb County Water Quality Laboratory
7 Household Hazardous Waste ◦ 6pm - 8pm ◦ Cobb County Water Quality Laboratory
14 Anuran Monitoring Workshop ◦ 7pm - 9pm ◦ Cato Park
30 Georgia Native Plant Society Plant Sale ◦ 10am - 2pm ◦ McFarlane Nature Park

May

7 Cobb Master Gardener Tour & Plant Sale ◦ 10am - 5pm ◦ Plant Sale at Cobb County Water Quality Laboratory
14 River Rendezvous ◦ 8am - 1pm ◦ Cobb County Water Quality Laboratory
19 Septic Tank Maintenance Lunch & Learn ◦ 12pm - 1pm ◦ Cobb County Water Quality Laboratory

June

8-10 Cool Waters Workshop for Teachers ◦ 8am - 4pm ◦ Georgia Association of Water Professionals
13 Summer Reading Program for Kids ◦ 2pm - 3pm ◦ Kennesaw Library
16 Summer Reading Program for Kids ◦ 3:30pm - 4:30pm ◦ East Cobb Library
23 Summer Reading Program for Kids ◦ 2pm - 3pm ◦ Vinings Library
28 Summer Reading Program for Kids ◦ 11am - 12pm ◦ Powder Springs Library
28 Summer Reading Program for Kids ◦ 3:30pm - 4:30pm ◦ Mountain View Library

Events in red are Cobb County Watershed Stewardship events.
More information can be found on our Calendar at www.cobbstreams.org.