The gloworm

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'Twas the First Night of Bug Camp

by Breanna Lyle, Bug and Plant Camp Poet Laureate

'Twas the first night of Bug Camp, and there in the vans
Sat excited Bug Campers with nets in their hands.
The sheets had been hung in the forest with care,
In hopes that large arthropods soon would be there.

The campers were happy with bugs in their jars
Were stalking the lights, eagerly waiting for more.
While some older campers and I, wearing caps,
Were in the woods by the path making pitfall traps.

When from the sheets there rose a great clatter
We jumped to our feet to see what was the matter.
Away to the sheets we made a great flight
Grabbed nets, jars and, of course, our flashlights.

With no moon up above, to offer its glow,
We moved along the path to the sheets we did go.
When there by the lights we saw a great sight
A large Luna Moth in its elegant flight.

It was large and plump, with white and green scales
Its two large wings both ended with tails.
It turned with a jerk, and flew at great speed,
Above all of the campers, professors and me.

Through the tree tops we saw its trail fly,
As it escaped quickly into the sky.
Older campers proclaimed, as it flew out of sight
"Don't worry, y'all, we've got three more nights."

Christmas Arthropod Count

Last spring there was a delightful article in the *American Entomologist*, "Take That, Christmas Bird Counts!" by John Acorn about a topic I think about every Christmas when my friends head out to do their Christmas avian duty. A birder himself, John Acorn admits that winter is a drag for entomologist in Canada and much of North America so he uses the Christmas bird count as an excuse to get outside and explore a variety of environments. However, he and some entomologist friends have added arthropods to their observations and done some rather creative thinking about which arthropods could legally be counted in a Christmas Arthropod Count. For example, in the deep-south, where I live, he would certainly disallow crickets from the bait or pet shops! His goal was to find more arthropods than the birders found birds, and they almost did. He reported 132 species but they really had to work at it! He also expects next year to be even better. I think we could top his efforts. So campers and arthropod aficionados, I have tried to faithfully list the "rules" from John Acorn's article below, but added my southern interpretation! We will share our list with him in January after I receive and compile your records.

Domestic species, or Pet food arthropods, such as crickets and mealworms, will not be counted.
Pets including tarantulas or aquatic crustaceans will not count.
Groceries including crawfish, shrimp, crabs or lobsters - nope!
Uninvited indoor arthropods are allowed, such as ladybugs, ants, fleas, silverfish, etc. My first December insect was a queen red wasp (*Polistes annularis*) who thought she was going to winter-over in our house. And, she will but in my collection! I also collected queen hybrid fire ants that are swarming during early December, so start watching and you may collect some queens for your collection.
Hibernating insects that are aroused by your activity outdoors, such as a mosquito that flies out of wood piles count.
Insects found living under bark count.
Aquatics, yep we are going to count them, unless you have been keeping them in your aquarium!
Insects caught with light traps, pitfall traps and aquatic traps all count.
Soil fauna in potted plants count!
Whiteflies and scale on house plants – you bet!
Go ahead and use the common name, genus preferred also, as well as the date and where you collected them. In fact a collection of December-collected insects would be a fascinating 4-H specialty collection.
Collecting begins on December 1 and ends at midnight on December 31.

The Gloworm is read all over the United States so we will report the state each insect are found in. We do have a couple Canadian readers and if you are steeped in national pride, we will share your numbers with John Acorn and allow him to count yours as well!

List your insects by **order** recording the **common name**, **genus** if you can, location of find (**town**, **state** and/or GPS coordinates if you have them), date found, and conditions – (roach was running across the kitchen floor on Dec 25 and was cleaved by grandmother!).

Send your data to jguyton@ext.mstate.edu and let's see if we can help John Acorn, "firmly reestablish arthropods as the wellspring of biodiversity and remind the birders that even in winter; bugs rule."

Editor's Note: Recently I have listened to bug and plant campers questioning why math is important and parents' concern with their campers low math scores so, I thought I would provide a few examples of why math is important in entomology. Campers, if you have questions about the following article please email me immediately because you need to begin adding some bugs to your studies of math and I will try to help you work through the math. Math is very important and it is easier to learn it now than it will be when you get to college. I will follow this with more examples in future Gloworms.

Water Conservation is Extremely Important to Insects: the Smaller the Insect the Greater it's Surface Area to Volume Ratio and Problem with Water Retention

Water retention in insects is very important and their tough sclerotin coated chitin cuticle or exoskeleton is well adapted to water conservation. *As animals get smaller their surface area increases in proportion to their volume*. A caterpillar's epicuticle, or epidermis, is very soft and easily damaged. If a caterpillar crawls across sandpaper it's, less than a micron (a thousandth of a millimeter) thick, epicuticle can be damaged and within a few hours it will shrivel and die. The cuticle covering insects' joints, and a few other parts, lacks the scerotin coating, that enables movement, and are thus poorly protected and easily scratched by sand, soil. Sand and soil, works by scratching the soft parts of roaches' exoskeleton thus allowing their water to evaporate, so they dehydrate and die. Diatomaceous earth, which is composed of the sharp silica shells that were phytoplankton in ancient seas, is mined and used as a natural insecticide that scratches insects' cuticles. A common practice during Roman times was to add silica or road dust to stored grain to keep it free from weevils. Greater the surface area, in relation to volume, means more surface area to get scratched.

Now, back to math and why size is so important. Let's use spheres, instead of trying to determine the volume and surface area of convoluted insects' bodies, to make the calculations easy while we examine the *surface area to volume relationship*. Certain coleopterans, and especially the lady bug beetle are almost hemispherical, or dome shaped, so you could divide our final volume and surface area by two for an even closer approximation to a real insect. But that is really not necessary to study the relationship of surface area to volume. Remember as organisms get smaller in volume their surface area gets larger, and that is the point of our math exercise.

The formula for the **volume** of a sphere is $4/3\ \pi r^3$ where r is the radius and π is 3.14. Both, the volume and weight, incidentally, increases and/or decreases with the *cube of the radius* of a sphere.

Surface area, on the other hand, increases or decreases with the *square of the radius*. The formula for the surface area of a sphere is $4\pi r^2$.

Note, the difference is volume increases with the *cube* of the radius while the surface area increases with only the *square* of the radius.

Now let's look at 3 spheres with different radiuses. Let's use spheres with radiuses of 9, 5 and 2 inches. An insect with a 9 inch radius would be huge (18 inches in diameter) but I exaggerated the size to emphasize the surface area to volume ratios.

Volume, Surface Area and Ratio for a sphere with a 9 inch radius (largest insect, or sphere, in our example)

$V = \frac{4}{3}\pi r^3$ $SA = 4\pi r^2$ r = 1017.4 / 3052.0

r (surface area to volume) = *SA/V*

$V = \frac{4}{3}$ 3.14 x 9^3 *SA* = 4 x 3.14 x 9^2 r = 0.333

V = 3052.0 cubic inches *SA* = 1017.4 square inches

Volume, Surface Area and Ratio for a sphere with a 5 inch radius

$V = \frac{4}{3}\pi r^3$ $SA = 4\pi r^2$ R (surface area to volume) = *S/V*

r = 314.16 / 523.6

$V = \frac{4}{3}$ 3.14 x 5^3 *SA* = 4 x 3.14 x 5^2 r = 0.6

V = 523.6 cubic inches SA= 314.16 square inches

Volume, Surface Area and Ratio for a sphere with a 2 inch radius – (smallest insect, or sphere, in our example)

$V = \frac{4}{3}\pi r^3$ $SA = 4\pi r^2$ r (surface area to volume) = *S/V*

r = 50.24 / 33.49

$V = \frac{4}{3}$ 3.14 x 2^3 *SA* = 4 x 3.14 x 2^2 r = 1.5

V = 33.49 cubic inches *SA* = 50.24 square inches

From our calculations you can see that as the size of an insect decreases the surface area to volume ratio increases meaning that for their size the smaller insects have a greater surface area and more surface area that needs to be protected from water loss. As the insect became smaller from a 9 inch radius to a 2 inch radius the surface area to volume ratio went from 0.33 to 1.5. The surface area to volume ratio is higher or larger for smaller spheres or insects and the greater the surface area to volume ratio, the greater surface area for their size they can lose water through. Therefore, the unsclerotin cuticle around their joints and other soft parts are much more critical for smaller insects.

Thanks to Dr. Krish Krishnan, our entomological physiologist, for making suggestions for this article. Dr. Krishnan has joined our Bug and Plant Camp staff and we are discussing some insect physiology activities for camp this summer!

Remembering the King of the Forest by Clarissa Balbalian

Diagnostician/Laboratory Manager Plant Pathology Lab

In the 1500's as Hernando de Soto's expedition made its way through the old growth forests and fields of the Appalachian mountains, one member of the expedition wrote "Where there be mountains, there be chestnuts". Revered by people throughout history, American chestnut (*Castanea dentata*) has been immortalized in poetry, song and lore. The tree is also at the center of one of the greatest ecological disasters of our time. With The Christmas Song (chestnuts roasting on an open fire) accompanying our on-line search for the latest bargain, let us pause to reflect upon the lessons learned from the fall of this mighty giant.

Through the turn of the 20th century, American chestnut grew in the Appalachian Mountains from Maine to Georgia and west to Mississippi, sometimes in pure stands. The tree thrived in the southern Appalachians and the livelihood of many subsistence farmers in this region was intimately connected to the tree. Approximately one third of the Appalachian hardwood forest was American chestnut. It's fast growing, straight form dominated the forest canopy, sustaining wildlife that grazed beneath its branches, and carrying man from cradle to grave. The sweet tasting chestnuts, wrapped in a prickly burr, are low in fat and high in carbohydrate. The nuts fed not only wild game, but also people and their livestock, and provided a cash crop. The rot resistant wood was used to build furniture, homes, railroads, fences, and the caskets that would shelter one's bones at life's end. Every part of this tree was put to use, including the tannic acid it produced in abundance and which accounted for 50% of the vegetable tannins used in the U.S. leather tanning industry. After a tree was cut down it would quickly resprout from its roots, and this timber harvesting practice, called coppicing, renewed chestnut's presence in the forest with ease. American chestnut was a truly renewable resource that was an integral component of Appalachian ecology, economy and society.

In 1904, American chestnuts in the Bronx zoological park in New York City began dying from a fungus that invaded wounds on the bark of the tree and created lethal cankers that quickly girdled the trunk and branches. Chemical treatment did not stop the fungus once infection had occurred. The fungus spread rapidly and the total lack of resistance of the tree to infection lead scientists to speculate that the fungus was an exotic pathogen, not native to the United States. The source of the fungus was traced back to a Long Island nursery that was unknowingly selling infected Japanese chestnut trees, which are resistant to the fungus. Modern genetic analysis confirms an Asian origin of the fungus and it is likely that there were multiple introductions of the fungus on nursery stock entering the U.S. from China and Japan.

Within 50 years of its introduction, chestnut blight decimated the entire range of American chestnut (about 4 billion trees), and is considered one of the most devastating plant disease epidemics in history. Chestnut blight was one of the reasons the U.S. established the Plant Quarantine Act of 1912 which regulates the importation of plant material in an effort to prevent the introduction of foreign pests and pathogens. Today USDA inspects shipments

at our ports in an effort to prevent the introduction of exotic organisms that could threaten U.S. agriculture.

While chestnut blight has not rendered American chestnut extinct, it did lead to extinction in the southern Appalachians of at least 7 species of moth that depended on American chestnut, and was one of the final nails in the coffin of Appalachian subsistence agriculture. The fungus does not affect the root system of the tree and root sprouts of American chestnut can still be found in relative abundance throughout its native range. Now relegated to life as an understory shrub, rather than a dominant canopy species, chestnut rarely reaches reproductive maturity before it succumbs to blight, so nut production is very low. Numerous tree species such as oak, hickory, pine, beech and hemlock have filled the void in the canopy left by the demise of chestnut. However, no single tree species has replaced what was one of the most important natural resources in the Appalachian region.

One can still walk through the Appalachian forests and see the silver stumps of chestnuts killed more than a century ago. These ghosts are a testament to the rot resistance of this tree and a reminder that in this age of global commerce we need to be ever vigilant about unwittingly moving pests and pathogens to new places. Each year new pests and pathogens come to our shores along with the uncertainty: Is this the next chestnut blight?

Because American chestnut was such a beloved and iconic species, efforts to restore the tree to its native range have been pursued since the onset of blight. Breeding a resistant hybrid that has the tall, straight form of American chestnut and the resistance of Chinese chestnut has been one goal. After 25 years of intense breeding and selection efforts, resistant hybrid chestnuts are now being planted throughout the native range to further evaluate the strength of resistance as well as to test the hardiness of the hybrids in the varying climates throughout the native range of the tree.

American chestnut also is playing a significant role in conservation throughout the coal mining areas of Appalachia. Forests are removed during mining operations and reclaimed mine sites have compacted soils and have usually been planted to aggressive, non-native grasses, which inhibit reforestation of these sites. Resistant American chestnut trees have been planted and thrive on reclaimed mine sites, providing hope that perhaps two man-made ecological injuries can be reduced by reforesting mine sites with a valuable native tree species that is tenaciously clinging to life in the mountain forests in once dominated.

If you are interested in learning about efforts to restore American chestnut to the eastern hardwood forests, The American Chestnut Foundation website www.acf.org is very informative.

Editor's Note: Campers will remember Ms. Balbalian and their analysis of pepper plants to determine if they had been infected by a virus. I look forward to Ms. Balbalian's next plant article. I knew of her work before we met and had been enjoying her annual report on the plant diseases diagnosed in her lab. So, I am excited to have her on our Bug and Plant Camp and Gloworm staff!

The Christmas Spider by Breanna Lyle

It was Christmas Eve. The small house had been thoroughly cleaned, and the tree had been decorated. The children were nestled into bed, and were dreaming of the exciting morning that was to come. Even the little spider that lived in the house had moved to the attic so that everything would be just right when Santa Clause arrived to bring the children their presents.

The light from the fire place was casting a beautiful light on the room, and the spiders were sitting quietly in the attic. Before long, he heard the sounds of the adults turning in for the night. He peered through the attic floor, but couldn't see the tree very well. Spiders have very poor eyesight, despite their many eyes. Oh, but the spider wanted to see the beautiful Christmas tree. He had never seen one before, and it seemed so beautiful.

He decided, after much thought, that he would go down and take a quick look. It wouldn't take long, and he'd be really careful. No one would ever even know he was there. Without making a sound, the small spider scuttled through a crack in the floor, and dropped down on his web next to the tree. Sure enough, the tree was as beautiful as he had imagined that it would be. Delicate ornaments hung from every branch, reflecting the light of the fireplace.

He wandered all over, looking at everything. He turned, ready to go back to the attic, when he noticed that the tree was covered with webs. He hadn't realized it, but as he was walking around he had been laying down a drag line. A drag line is a piece of web that spiders use to ensure that they won't fall down and get hurt.

The little spider was devastated. He sat there trying to figure out a way to fix the tree when a noise came from the chimney. The spider turned around and saw the form of Santa Clause standing next to the tree. The spider started crying. The tree had been so beautiful, and now Santa was seeing it covered with webs. The little spider thought that now the whole night was ruined.

To his surprise, though, Santa didn't look upset at all seeing the webs left by the little spider. He smiled and asked the spider "What's wrong, little one? Why do you seem so sad?" to which the spider replied, "I wanted to see the beautiful Christmas tree, but I ruined it with my webs. I'm sad because I ruined it." Santa laughed. With a wink, and a little magic, he touched the web left by the little spider. A light grew from the web, and it turned a lovely silver color. Instead of ruining the tree, or hiding its beauty, the webs now made it even more beautiful!

From that night on, the little spider found a new passion, using his webs to make the Christmas trees even more beautiful. To this day, we still find the little spiders influence, in the form of tinsel, which we still wrap around our Christmas trees. Some people even leave small spider sculptures in their trees, in honor of the little spider.

Buggin' ain't bad!

Grasshoppers, katydids, cicadas, mantids, and walking sticks too,
Some of my favorites in the bug world, just to name a few!
It's fun to chase after that big one there on the ground,
However, just stop and listen to their songs and all that sound.
Chirps and squawks they can rasp out a cacophony of tunes,
Most have a story to tell and learning it would be a boon!
In the fall the cicada male sings mightily for a mate,
After waiting for four years, it would not do to be late!
Tree crickets chirp out the temperature right at nine,
Just takes a while to collect the data and still be on time.
Katydids nightly sing long and loud and we don't know why,
But when you use a light to look for them they become very shy.
The background of night sounds are always enhanced
When we stop and listen to the insects in their chorus and dance.

M. Williams

Ogden Nash wrote:

The Ant

The ant has made himself illustrious
Through constant industry industrious.
So what?
Would you be calm and placid
If you were full of formic acid?

Edward Lear wrote this limmerick:

There was an Old Man in a tree,
Who was horribly bored by a bee;
When they said, "Does it buzz?"
He replied, "Yes it does!
It's a regular brute of a bee!"

I hope you have a joyful and restful Christmas vacation.
John

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