



ACID RAIN STUDY

Sampling Instructions



A number of studies have demonstrated the relationship between acid rain, depletion of calcium in the soil, and the steep declines of many European bird species. This led BFL scientists to question the extent to which acid rain was linked to declines of bird species breeding in eastern North America, such as the Wood Thrush, which has suffered steep population declines over the last three decades. We were able to address this question because of the dedicated fieldwork of hundreds of citizen-scientist participants in the BFL project like you, who have returned detailed data on thousands of study sites across the continent and, in particular, the East.

We bolstered some of these data with other citizen-scientist collected data on thrush abundance from the Breeding Bird Survey, as well as with data on soil properties collected by the Natural Resources Conservation Service, and with data on acid deposited in precipitation from the National Atmospheric Deposition Project. After controlling for a number of such influences on Wood Thrush distribution, we were able to show that these thrushes were less likely to attempt to breed at sites that received highly acidic rain. We documented this finding in a paper in the prestigious Proceedings of the National Academy of Sciences that also suggested further study of this problem was needed. The reasoning was simple: while our paper pointed out a pattern of decreased probability of breeding with increasing acid deposition, the physical and biological processes that lead to this pattern remained unclear.

So, BFL scientists began fieldwork in 2002 at forty sites across New York state with two goals in mind. The first was to help increase our understanding of the role that acid rain, soil pools of calcium, and calcium-rich prey species might be having in the decline of the Wood Thrush. (Calcium-rich prey may be very important to breeding thrushes because females experience a tremendous demand for calcium when laying a clutch of eggs and many prey species, such as insects, contain little calcium.) The second goal was to develop and test a protocol that could be used by BFL participants to help us understand the mechanisms behind the effects of acid rain—the

processes that lead to the pattern—across a wide geographic range. What we found was strong links between the number of calcium-rich prey such as snails, slugs, millipedes, and sow bugs and several soil properties such as its pH (acidity) or calcium content. The other result from our work is the simple protocol that you have in your hand, which we think will result in data that will give us a much greater understanding of how acid rain affects birds in North America, information that may be crucial for future conservation efforts.

What's involved?

Taking part in the BFL acid rain study will involve a small amount of extra effort. First, you will cut two squares of cardboard for each site to use as “traps” and get 2 liters of bottled (non-chlorinated) water to dampen the traps. You’ll need to make one brief extra visit to each site to place the traps. Then you will count the calcium-rich invertebrate prey species you find under the trap, estimate their sizes using a scale printed on the field form, complete the simple field form, and send it to the Lab for data input and analysis. (Check next page for full details.) None of the invertebrate prey should be harmed by the process and none will be collected. You may do the acid rain protocol at as many or as few sites as you like; we are hoping that you’ll at least try it at one site and take advantage of this opportunity to help us unravel this scientific mystery by developing another method that can be used by volunteers to monitor the biosphere.

Detailed Protocol

Step 1: Before you go into the field

Before visiting your study sites, you need to prepare **two traps for each site** at which you'll be doing the acid rain protocol. To make each trap, cut a 1 ft. x 1 ft. square of plain (uncoated), corrugated cardboard from a brown cardboard box (such as those used to ship groceries or small appliances.) You can use the corner of another box as a template to make a 90° angle in the corners. (If you are making several traps, you might like to use the first trap as a template for making the others, as we did when making our traps.) At least one side, which will be placed downward, should be free of printing or glue. It is important to use fresh traps each time. Do not reuse the cardboards.

In addition to the traps, you will need to get 1 liter of non-chlorinated water per trap that will be used to moisten the traps as they are placed. You can use almost any bottled water, but check the label carefully to ensure that the water contains no additives such as chlorine. Much of the tap water in the United States is chlorinated and shouldn't be used for our study, as it could potentially repel rather than attract the animals we want to sample.

Step 2: Setting the traps

The traps should be placed in the afternoon or evening before the regular BFL visit, and checked before carrying out the regular BFL Visit 1 protocol the next day. Alternatively, if you do your BFL visit late in the day, the traps may be placed after carrying out the BFL protocol for Visit 1, and checked the next morning. Two traps

should be placed at every site where you are doing the acid rain protocol; **one placed 10 paces to the south, and one 10 paces to the north** of where you stand to do the regular BFL protocol. If you have a compass you can use it to find the directions. Alternatively, you turn so that the sun is



Figure 1. *Slowly pour 1 liter of water across the cardboard to moisten it. Use non-chlorinated water as chlorine may repel animals.*



Figure 2. *Weight the cardboard by placing a few sticks or stones on top of it. Marking the trap with "Conservation Study: Please do not remove" or similar text may discourage other visitors to the site from discarding the trap as rubbish.*

on your left side in the afternoon or on your right side in the morning. The direction you are facing can be used as "north" and the opposite direction as "south." The exact direction isn't what's crucial here; we are specifying the directions to avoid possible bias in the selection of the area within the study site where the traps are placed. The area where the traps are placed should be covered with leaf litter (old decaying leaves and twigs, etc.). If the area is unsuitable because the ground is bare, covered with vegetation (such as grass), or water, the nearest area covered in leaf litter should be used.

To set each trap (when at the correct location), hold the cardboard at an angle of about 45° with one side touching the ground (see Figure 1). Slowly pour 1 liter of water across the top surface of the cardboard (the plain side) so that the water wets the entire top surface and runs onto the ground at the bottom edge. Then place the cardboard (wet side down) in the wet area in the leaf litter where the excess water ran off. Weight the cardboard by placing a few sticks or stones on top of it (Figure 2). You might like to mark the top side of the trap with something like "Conservation Study: Please do not remove" to prevent the trap being removed as rubbish by other visitors to the site. Before leaving, record the date and time on your data form. You may also want to mark (or

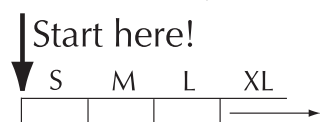
flag) the location of each trap so that they can be found easily.

Step 3: Checking the traps

Traps should be left in place overnight and checked in the morning of the next day. **If at all possible, traps should be checked before 10:00 A.M.**, as the number of invertebrate prey items under the traps drops very sharply around this time, based on our testing in New York. Try to check the traps in the same order in which they were placed to equalize the amount of time that the traps are out. If you are doing the regular BFL protocol on the same day at that point, check the traps first *before* doing BFL.

To check each trap, first note and count any individuals of any prey species on its top surface. Then carefully lift the side of the cardboard farthest away from you and flip the cardboard over towards you so that it is bottom up. (In areas where small snakes are common, you may want to turn over the cardboard with a stick.) Then quickly get a count of the faster prey species (centipedes, millipedes, and isopods; see mini-field guide) before they can run away; slugs and snails aren't so good at escaping. You should count all the animals on the cardboard (both top and bottom) as well as any animals on the *surface* of the leaf litter that was under the trap. (Don't actually search through the litter itself.) Sometimes animals hide along the edge of the cardboard, so check there, too.

Then use the "size class ruler" on the field form to assign each of the animals found to the proper size class; hold the line under the "Start here" arrow next to one end of the animal, and note the box in which the opposite end of the animal is located. This is the size class to which it should be assigned (see diagram below). Note this size class, and measure the next animal



Use the size class ruler on the field form to assign each of the animals found to the proper size class.

until all have been measured. For snails, measure the width of the shell at its widest point. For slugs, first touch the animal to be measured with a twig,

to cause it to contract (wait a second or two), then measure the slug in its contracted state. Some participants found it easier to make "size-class rulers" out of popsicle sticks, etc.

You may brush the animals from the surface of the cardboard with a twig after you are done. (Note: Because snails and slugs may serve as intermediate hosts for a number of parasites that can cause disease in humans, we recommend that you do not handle them with your bare hands, and that you wash your hands after any contact.) Remember to check all traps before 10:00 A.M., if possible. Note the time and the temperature (if you have a thermometer use it; otherwise estimate the temperature, or use the NOAA website <<http://lwf.ncdc.noaa.gov/oa/ncdc.html>> for your region.) After you are done, you may retrieve the cardboard for proper disposal away from the study site.

Step 4: Filling out the Field Form

See page 4 for a sample Field Form and some tips.

Step 5: Submitting Data

Photocopy your field forms for your records (and in case they are misdirected in the mail) and send the originals to the BFL staff at:

**Birds in Forested Landscapes
Cornell Lab of Ornithology
159 Sapsucker Woods Rd.
Ithaca, NY 14850**

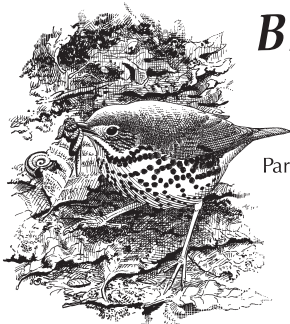
Acid rain field forms can be returned with regular BFL forms at the end of the season.

If you need assistance

Please contact:

**Jim Lowe
Cornell Lab of Ornithology
159 Sapsucker Woods Rd.
Ithaca, NY 14850
607-254-2413
forest_birds@cornell.edu**

Same name and ID number as BFL point are important so we can match with bird data.



BIRDS IN FORESTED LANDSCAPES ACID RAIN STUDY—FIELD FORM

Participant(s) Name: Jim Lowe ID #: 5551212

SURVEY POINT ID
(use same name as BFL point)
WAG

Protocol Quick Start

- Place cardboard traps late in the day before BFL Visit 1:
- 1) wet traps and ground with 1 liter of bottled water for each trap
 - 2) place traps (wet side down) on wet spots
 - 3) weight traps down with sticks or stones

Check traps before 10:00 A.M. (**before** doing the BFL protocol)

- 1) record time and temperature
- 2) **carefully** turn over traps
- 3) count and classify organisms using the size class ruler below
- 4) record data on Field Form

Field Checklist

- cardboard traps
- 1 liter of bottled water per trap
- compass (or use direction of sun)
- data forms and pen or pencil
- metric ruler (or use guide on form)

Prey Size Classes

- S** < 10 mm
- M** 10-20 mm
- L** 20-30 mm
- XL** > 30 mm

VISIT 1 INFORMATION

TRAP 1 (10 paces to North)

Date placed 3/19/2003 Time placed 17:00
 Date checked 3/20/2003 Time checked 08:30
 Temperature when checked 65°F

Number days since last rain 0 1 2 3 4 5+

	Total Count	S	M	L	XL
Snail	3	2	1		
Slug	1			1	
Myriapod	3	2			1
Isopod	2	2			
Earthworm	0				

Comments _____

TRAP 2 (10 paces to South)

Date placed 3/19/2003 Time placed 17:05
 Date checked 3/20/2003 Time checked 08:35
 Temperature when checked 65°F

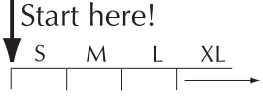
Number days since last rain 0 1 2 3 4 5+

	Total Count	S	M	L	XL
Snail	0				
Slug	3	2		1	
Myriapod	1		1		
Isopod	5	4	1		
Earthworm	1		1		

Comments _____

Day it rained:
 0 = Today (day checked)
 1 = Yesterday (day placed)
 2 = Day before yesterday ... etc.

Be sure to use unit (C or F) with temperature.



Prey Size Class Ruler:

Fill in all boxes under "Total Count." Use zeros if not found

BFL: ACID RAIN STUDY

Prey Field Guide

Snails

Description: Snails are gastropods with hard, external shells. The shells of the land snails that we are interested in can be as small as 1–2 mm or they can be relatively large (>30 mm).

Where found: In forested areas, snails usually live in low vegetation, leaf litter, or woody debris (Hotopp 2002).

Diet: Land snails generally eat living or dead plant material. Some snails are carnivorous and eat earthworms, leeches, or other snails (Baker 1939).

Reproduction: Land snails are hermaphroditic (both sexes represented in each individual), but it takes two individuals to mate. Most land snails lay eggs in the spring or early summer in moist sheltered places. It can take 3–4 weeks for the eggs to hatch, and up to two years for the snails to reach maturity.

Importance: Snails and slugs may represent up to 8% of the animal biomass of boreal forests (Hawkins, et al. 1997). Snails are eaten by many animals, including: shrews, moles, mice, squirrels, and birds.

Notes: Snails can serve as intermediate hosts for a number of parasites. We recommend that you do not handle them with your bare hands.



Snail

Slugs

Description: Slugs are gastropods that lack external shells, although some species do have small internal shells. They can be relatively small (<10 mm) or very large (>100 mm).



Slug

Where found: Often found under loose bark, stones, sticks, leaves, or any other forest debris.

Diet: Slugs generally eat living or dead plant material.

Reproduction: Slugs are hermaphroditic (both sexes represented in each individual), but it takes two individuals to mate. Eggs may hatch in a few weeks or they may overwinter.

Importance: Snails and slugs may represent up to 8% of the animal biomass of boreal forests (Hawkins, et al. 1997). Salamanders and newts eat small forest slugs (Baker 1939).

Notes: Slugs can serve as intermediate hosts for a number of parasites. We recommend that you do not handle them with your bare hands.

Myriapods

Description: Centipedes and millipedes are myriapods. Centipedes usually have a slightly flattened body and one pair of legs per body segment. Millipedes usually have a more cylindrical body and two pairs of legs per body segment. Millipedes often curl up into a tight spiral for protection (don't confuse this with a snail shell).



Centipede

Where found: Often found under bark, stones, sticks, leaves, or other forest debris. Also found in soil and rotting wood.



Millipede

Reproduction: Eggs are laid in or on the soil. The young go through several molts, increasing the number of body segments and pairs of legs with each molt. It can take many years to complete development. (Sanders 1999)

Notes: Some centipedes can inflict a painful bite. Millipedes don't bite, but many can produce a noxious fluid from stink glands located along the sides of the body.

Diet: Centipedes are predaceous on insects, etc. Most millipedes eat plants or decaying plant material.

Isopods

Description: Isopods (or sowbugs or pillbugs as they are commonly called) are generally gray or black, relatively flat, and rather small (<20 mm). Pillbugs can roll themselves into tight balls when disturbed.



Isopods (sowbugs or pillbugs)

Where found: Often found under bark, stones, logs, or other forest debris or in rotting wood.

Diet: Isopods are scavengers, eating both plant and animal matter.

Reproduction: The eggs are carried by the female in a brood pouch for three to four weeks. The young look like miniature versions of the adults.

Earthworms

Description: Usually reddish or pinkish colored with distinct segments. Can be very small or very large.

Where found: Often found underground, but they come to the surface to feed (especially at night). Earthworms require fairly moist conditions.



Earthworm

BRIAN ROBINSON
WWW.EARTHWORMS.CA

Diet: Feed on decaying organic matter.

Reproduction: Some species of earthworms are hermaphroditic (both sexes represented in each individual), but it takes two individuals to mate. Some species reproduce uniparentally, with no sexual fertilization by another individual (Tomlin 1980).

Notes: Earthworms are an important food source for many animals (birds, moles, toads, etc.). They are also valuable for their role in circulating and aerating the soil.

References

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- Borror, D.J., and R.E. White. 1970. A Field Guide to the Insects of America North of Mexico. Houghton Mifflin Co., Boston, MA.
- Hawkins, J.W., M.W. Lankester, R.A. Lautenschlager, and F.W. Bell. 1997. Length-Biomass and energy relationships of terrestrial gastropods in northern forest ecosystems. Canadian Journal of Zoology 75:501–505.
- Hotopp, K.P. 2002. Land snails and soil calcium in central Appalachian Mountain forest. Southeastern Naturalist 1:27–44.
- Palmer, E.L. 1949. Fieldbook of Natural History. McGraw-Hill, New York.
- Sanders, D.P. 1999. Sowbugs, Pillbugs, Millipedes and Centipedes. Agricultural Publication G7362, University of Missouri.
- Tomlin, A.D. 1980. Earthworm Biology. Agriculture and Agri-food Canada, London, Ontario.

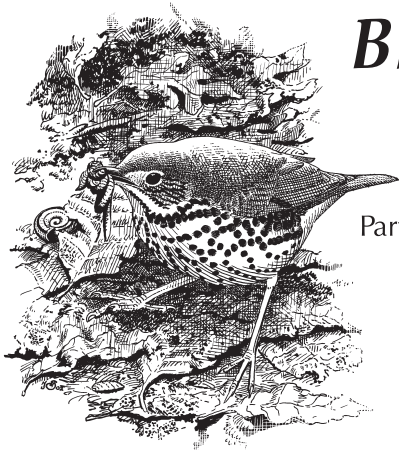
*This work is funded through a cooperative agreement
with the U.S. Environmental Protection Agency*



**BIRDS
IN
FORESTED
LANDSCAPES**



**CORNELL LAB of
ORNITHOLOGY**



BIRDS IN FORESTED LANDSCAPES

ACID RAIN STUDY—FIELD FORM

Participant(s) Name: _____ ID #: _____

SURVEY POINT ID
(use same name as BFL point)

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VISIT 1 INFORMATION

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Date placed _____ Time placed _____

Date checked _____ Time checked _____

Temperature when checked _____

Number days since last rain 0 1 2 3 4 5+

	Total Count	S	M	L	XL
Snail					
Slug					
Myriapod					
Isopod					
Earthworm					

Comments _____

TRAP 2 (10 paces to South)

Date placed _____ Time placed _____

Date checked _____ Time checked _____

Temperature when checked _____

Number days since last rain 0 1 2 3 4 5+

	Total Count	S	M	L	XL
Snail					
Slug					
Myriapod					
Isopod					
Earthworm					

Comments _____

