Haw River Watch Manual

Haw River Watch is a project of the Haw River Assembly
P.O. Box 187, Bynum, North Carolina, 27228
Phone: (919) 542-5790 Website: www.hawriver.org

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THE HAW RIVER WATCH PROGRAM

Haw River Watch is a program sponsored by the Haw River Assembly, a non- profit organization founded in 1982 to restore and protect the health of the Haw River and its tributaries. Haw River Watch, established in 1995, is a citizen's river monitoring effort. The goals of the project are to act as the eyes, ears, and noses on the river and to provide a clearer picture of the health of the Haw.

The heart of River Watch is the four seasonal "snapshots" taken in March, June, September, and December. At different locations on the Haw River and its tributaries, teams of volunteers assess the water quality of the river or creek. They complete an assessment of the river or creek by filling in a survey form and mailing it to the Haw River Assembly or by using the online Stream Monitoring Form found on our website at www.hawriver.org under the heading PROJECTS and STREAM MONITORING. All information is entered into the River

Watch database. The result is a view of the health of the river basin throughout the year via monitoring snapshots gathered by teams. To do this, we use the Izaak Walton League method, which included making observations, performing chemical tests, and counting aquatic macro invertebrates.

Even though the Haw River watershed has a long history of degradation due to pollution it is also a beautiful river that sustains much life. Many creeks are still found to be healthy and home to a wider diversity of aquatic life that one day may be able to return to the river. The advent of the Clean Water Act in 1972 significantly helped the Haw River and stronger environmental regulations and protected buffers have made a difference. Through the Haw River Assembly's River Watch Program, volunteer citizen scientists help keep watch over the watershed. We are working together to protect our streams from further destruction -- protecting the land for all the life that depends on it, and for future generations to enjoy.

About the Haw River

The Haw River travels 110 miles through the Piedmont, arising from springs in eastern Forsyth Co, meandering through upland swamps before it becomes the fast running rocky river well-known to paddlers as it drops southeast to meet the Deep River and become the mighty Cape Fear. Its 1700 sq, mile watershed includes parts of Guilford, Rockingham, Alamance, Chatham, Durham, Orange and Wake counties.

Old hardwood forest and clear fast running waters defined the lands European settlers found who came to live on what had been the home of the Sissipahaw people. Two centuries of farming and timbering dramatically impacted the old growth forests and severely altered the river as sediment from cleared fields flowed into the waters. As the south became increasingly industrial in the late 1800's, textile mills were built along the Haw River to provide hydropower. The waste from the mills and towns impacted the river to such a degree that it made the river unsafe for drinking, fishing, and swimming.

The growth of cities and population in this part of NC in the late 20th century and continuing today has brought new threats to our waters. The building of the 14,000 acre Jordan Lake reservoir at the lower end of the Haw River (officially opened in 1982) brought into public focus the threats from the nutrients and chemical pollution flowing from the cities upstream. The controversy continues today, as drinking water and recreational use is threatened by this pollution.

Threats to the Watershed

New development has brought new water pollution with it. A growing population has meant more stormwater runoff. Sediment is the number one problem in our waters, closely followed by nutrient pollution resulting in excessive algae growth. In this rapidly growing region, development turns vast expanses of forests into housing complexes and strip malls. At times, runoff from these construction projects turns the river orange-brown with mud. New construction and roads also means more impervious surfaces that increase the volume of water running off the land into the creeks and river, also bringing along pollution and trash in its path. Runoff from the land, containing pesticides, fertilizers, metals, manure (including pets), road salt, leaking gas and oil from automobiles, trash and other pollutants are an important threat to the Haw River watershed. Sources of these pollutants, carried by storm water, include farms, lawns,

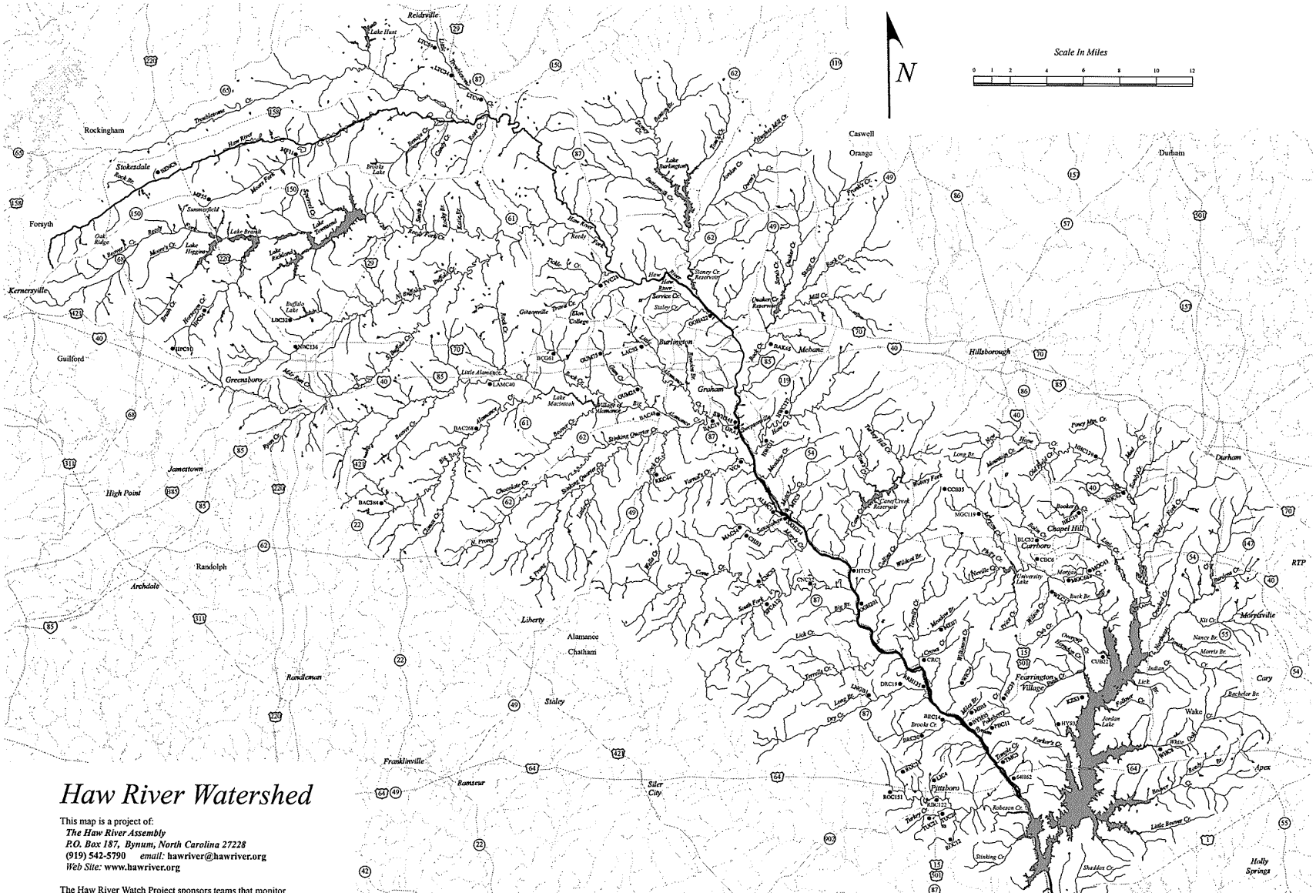
paved urban areas and roads, construction sites, timbering operations, golf courses and home septic systems. Stormwater pollution can quickly kill a stream by introducing organic and inorganic pollutants that can result in decreased oxygen and poison aquatic life forms.

Many cities and towns in the Haw River watershed, including Greensboro, Reidsville, Burlington, Chapel Hill, Durham and Pittsboro empty their treated wastewater into the Haw River or its tributaries. Although modern treatment plants are capable of discharging cleaner water than in the past, problems arise when equipment fails or aging sewer pipes break. Many of the pharmaceuticals and chemicals in personal and home cleaning products are not removed in the treatment process and may be sources of carcinogens or endocrine disrupters in the treated effluent that is returned to the river. Another serious issue is that municipal wastewater treatment plants also treat wastewater from industries. Pre-treatment programs to capture heavy metals and chemicals only do part of the job, and many of the thousands of unregulated newer chemicals used in industry are not monitored or regulated, and end up in the effluent. These pollutants also end up in the sewage sludge (bio-solids) that are land applied to agricultural pastures and fields and can run-off into stream and migration through soil in storm water events.

The total nutrient load in the Haw River and Jordan Lake from wastewater is contributing to the listing of several sections of the Haw– and all of Jordan Lake - on the EPA 303(d) impaired waters list. In 2009 state rules were finally passed into law to begin reducing pollution in all waters that drain to Jordan Lake –the vast majority of the Haw River watershed. These laws are meant to reduce nutrient pollution over time from all sources – wastewater treatment plants, development, agriculture, roads and existing cities and suburbs where storm water controls are inadequate. Unfortunately, the implementation schedule for the rules has been weakened under the current legislature and now the rules are on hold for a costly and futile experiment using in-lake devices (Solarbees) to try to suppress algae growth, instead of reducing the pollution. The first year of data collected by the state showed no improvement where the devices had been deployed.

Taking a Closer Look at Your Watershed

What is a watershed? A watershed is all the land area that drains to a given body of water such as a creek, a river, a lake, and ultimately the ocean.



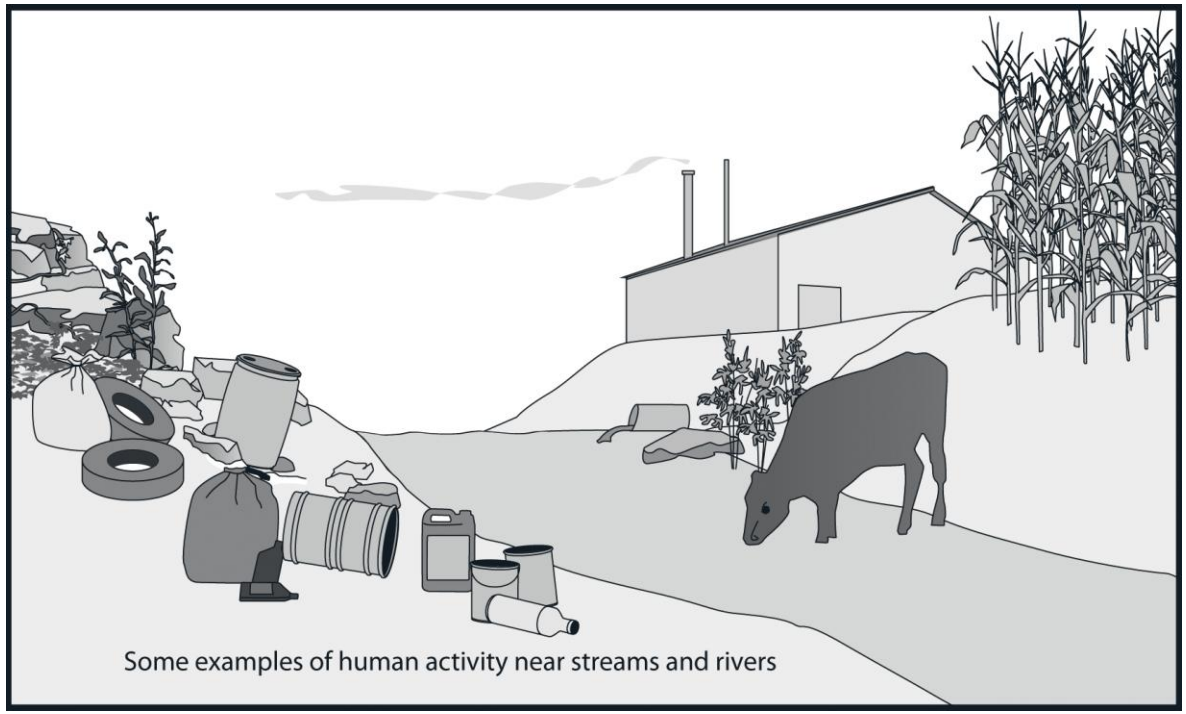
River Monitoring

The goal of our river monitoring snapshot is for you to determine the health of a section of stream or river. To do this, we use the Izaak Walton League method, which includes making observations, performing chemical tests, and counting aquatic macro-invertebrates.

Select a stream: The first step is to select a stream or section of river you would like to monitor. It is best to choose a location that can be monitored in the spring, summer, fall, and winter.

Explore: Walk along the stream or riverbank if possible. Investigate what is immediately up and downstream from your monitoring location. Things to look for: recently cleared land, erosion, effluent pipes, trash, evidence of farm animals near or in the stream/section of river, and large amounts of algae and/or foam.

Take note of the sounds and smells: Take notice of any strange or offensive sounds and smells. These could include the sound of heavy equipment, traffic, or the smell of animal waste or chemicals.



Best place for a monitored location: Look for an area that is easily accessible and has small riffles where the water flows over rocks.

Standard Procedures for Haw River Watch Monitoring

Safety First:

River Watch teams sample throughout the Haw River watershed at times and places where medical facilities or cell phone service may not be readily available. It is imperative that all volunteers follow safety precautions when using equipment and hazardous materials, hiking down trails or through wooded areas where there might be poison ivy, ground nesting bees, snakes, sharp metal/litter, and other

unforeseen dangers. Sampling conditions are the primary safety factor to be considered for stream monitoring. If any field conditions, such as high flows or thunderstorms, raise the question of whether a sample can be safely collected, then decisions should always be made with the safety of the volunteer as the prime concern. This same concern for safety of volunteers must be of primary importance when scheduling the amount of time to be spent in the field. Long hours combined with strenuous effort increase the probability of accidents occurring. Sample days should not last longer than 4 hours. With the increasing prevalence of Lyme disease and West Nile virus, it is the responsibility of all volunteers to maximize protection against these insect borne diseases. We strongly advise all teams to make sure you do not monitor on your own. Always take a friend or coordinate with your team members.

Sample Collection/ Biological Assessment: Sampling Requirements

Most of the sampling methodologies described in this manual require that freshwater streams or rivers be wade-able for efficient data collection. High water conditions severely impair sampling efficiency by making some critical habitats inaccessible. An under estimate of taxa richness due to high flows may lead to an incorrect assessment of water quality. If high water makes sampling conditions marginal, it is better to return to the site during a more appropriate flow regime. Drought conditions can also play a major role in altering the composition of the benthic fauna. Every effort should be made by volunteers, in parts of our watershed that are susceptible to flow interruption during droughts, to be sure that flow has been continuous prior to sampling. In addition, flowing water in a stream immediately following a period of rain may mask antecedent conditions. Prior flow conditions can be difficult to determine, especially in smaller streams. Sampling should be delayed, if possible, when prior flow conditions have been extreme-either high or low. Streams less than 1 meter wide should not be sampled. The rule of thumb is that if you can jump across it, you shouldn't sample it.

Standard Procedures for River Monitoring/ Measuring Water Quality/ Monitoring Survey
Section A

Haw River Watch Survey

Data enterer: _____
Date entered: _____
Office use only

Return to: Haw River Watch Project, P.O. Box 25, Saxapahaw, NC 27340
(919) 967-2500 E-mail: riverwatch@hawriver.org

The purpose of this form is to aid you in gathering and recording important data about the health of your stream, to document changes in water quality. Refer to the Stream Insects and Crustaceans ID chart to identify stream macroinvertebrates.

SECTION A. *Fill in this section each time you do a sampling of your stream.*

Team Name _____ Site ID _____ # of participants: _____

Stream _____ Location _____

County _____ Survey Leader _____ Phone # _____

Date: _____ Start time _____ End time _____ Survey Scribe _____

Air temperature _____ Water temperature _____ Flow rate: ❑High ❑Normal ❑Low ❑Negligible

Weather conditions (last 3 days) _____

Chemical testing: pH _____ Nitrate _____ Phosphate _____ Transparency (in inches): _____

Macroinvertebrate Count

Search several likely habitats: look under stones in riffle areas; use net to sample bottom in several places; and sample underbank, leaf mat, and woody debris. Use letter codes to record number of organisms of each type found: A = 1-9; B = 10-99; C = 100 or more. Add up the number of letters in each column and multiply by the indicated index value.

Pollution Sensitive	Somewhat Pollution Sensitive	Pollution Tolerant
_____ Stonefly	_____ Crayfish	_____ Aquatic Worm
_____ Caddisfly	_____ Sowbug	_____ Midge Fly Larva
_____ Water Penny	_____ Scud	_____ Blackfly Larva
_____ Riffle Beetle	_____ Alderfly Larva	_____ Leech
_____ Mayfly	_____ Fishfly Larva	_____ Pouch (and other) Snails
_____ Gilled Snail	_____ Damselfly	
_____ Dobsonfly (Hellgrammite)	_____ Watersnipe Fly Larva	
	_____ Crane Fly	
	_____ Beetle Larva	
	_____ Dragonfly	
	_____ Clam	
_____ # letters times 3 =	_____ # letters times 2 =	_____ # letters times 1 =
_____ Index Value	_____ Index Value	_____ Index Value

Now add together the three Index Values from the columns for your total index value: Total Index Value = _____

Compare the Total Index Value to the following ranges of numbers to determine the water quality of your stream. Good water quality is indicated by a variety of different kinds of organisms, with no one kind making up the majority of the sample. Although the A, B, and C ratings do not contribute to the water quality rating, record them to see how your macroinvertebrate populations change over time.

Water Quality Rating

_____ Excellent (>22) _____ Good (17 - 22) _____ Fair (11 - 16) _____ Poor (<11)

What kind of Algae? Is water discolored (green, bright blue, red)? [Phytoplankton type algae] ❑Yes ❑No If No:
Is algae big thick "hairlike" mat (green, blue-green, black, yellowish)? [Filamentous type algae] ❑Yes ❑No If No:
Are rocks and logs covered with beardlike growth (green, blue-green, golden brown)? [Periphyton type algae] ❑Yes ❑No If No:
Is there brown slimy algae on rocks? [Diatomaceous type algae] ❑Yes ❑No
Algae is located: ❑ everywhere ❑ in spots _____% of stream covered (for one stream-width by one stream-width area)
Are you seeing an unusual amount of algae? ❑Yes ❑No

1. Select a "scribe" to enter the data you collect onto the form.

2. Fill out the "Team" and "Site" information.

- **Team Name:** Fill in the name that you and other volunteers have chosen to represent your "Team Name".

- **Site ID:** Fill this in if you know it; otherwise, leave this item blank and the River Watch Coordinator will fill it in when you return the form via online or by mail.

- **Number of Participants:** This lets us know how many folks looked for macro- invertebrates which may affect your results based on possible limited data collected.

- **Stream Name:** Enter the name of the waterway you are monitoring such as "Haw River" or "Pokeberry Creek".

- **Stream Location:** Give specifics on your location such as "HWY 64 Bridge Paddle Access".

- **County:** Enter the name of the county where your site is located.

- **Survey Leader:** Fill in the name and phone number of your team leader.

- **Date:** This is important information, as the date combined with your Site ID could help us in determining or linking data with environmental causes for concern.

- **Start and End Time:** This informs us how long you spent on gathering data, which may affect your survey results. Keep in mind, the more time you spend gathering data, the more we will know about your selected location.

- **Survey Scribe:** Enter the name of your scribe for this monitoring session.

3. Take 5 minutes just to look at the site. Use as many senses as possible-- sight, smell, sound.

- Has the vegetation changed? Is erosion occurring?

- Are there signs of wildlife?

- Does the air/stream smell different?

- Have the sounds changed? (Do you no longer hear birds? Can you hear machinery? Is the stream no longer gurgling?)

4. Take air temperature. When you first get to your monitoring site, hang the thermometer in a shady spot. Leave it there for at least 5 minutes. Enter the Fahrenheit reading on the survey form.

5. Take water temperature. Submerge the thermometer in shaded, flowing water.

- Make sure to fasten your thermometer to a rock so that it doesn't float downstream.

- Check the temperature at the end of the macro-invertebrate study and enter the Fahrenheit reading on the survey form.

6. Note the current weather conditions. Include the three days prior to monitoring session.

7. Record Flow Rate. Is the water level high, normal, low, or negligible (usually seen during times of drought)?

8. pH Testing

- **Lets first take a closer look at pH.** pH measures the activity of hydrogen ions in the sample, which indicates how acidic or basic (also called "alkaline") the water is. For example, lemon juice is acidic; dissolved baking soda is basic. On the pH scale of 1 to 14, 7.0 is neutral, below 7.0 is acidic, and above 7.0 is basic. The scale is logarithmic; for example, a change from 7 to 8 represents an increase in con-centration that is ten times: in other words, a tenfold increase in concentration. A pH range of 6.5 to 8.2 is optimal for most aquatic organisms. Extremes of pH (below 4.5 or above 9.5) are stressful to organisms. Low or high pH can affect egg hatching, kill sources of food for fish and insects, or make water uninhabitable for any aquatic life.
- **What factors influence the pH?** Bogs, decomposing forest vegetation, tannic acid from leaves, and acid rain can LOWER the pH reading. Rapidly growing algae or submerged aquatic vegetation can RAISE the pH.
- Runoff from farms, logging, commercial areas and residential developments can alter the pH of waterways.
- Effluent from wastewater treatment plants and septic tanks can raise the pH, due to the presence of detergents, which are basic.
- pH generally increases as you go downstream or down river, as runoff from many of these sources tend to be more basic than acidic.
- **Test water for pH level.**
- From the flowing area of the stream,fill the test tube with stream/river water to the back line.
- Add required amount of drops (8 or 10 depending on what LaMotte pH testing kit you have) of the Bromthymol Blue Solution, being careful not to touch the dropper tip to the side of the tube, as this may result in a half-drop.
- Cap and shake up the solution and place test tube in the color comparator to find the closest matching hue (i.e. the degree of matching yellow, green, or blue rather than the darkness of the color).
- Enter the pH reading on the survey form.
- **If applicable to your section of stream or river, test water for the presence of Nitrate.** Nitrogen and phosphorus enter water from human and animal waste, decomposing organic matter, and fertilizer runoff. Phosphates also are found in some industrial effluents, detergent wastewater from homes, sediment, and natural deposits. Follow the directions that come with your kits, and record your results on the survey form.

9. Test water for turbidity. This test will give you an idea of the relative clarity of your selected stream or section of river. Note: Keep out of water until you have completed this test to avoid disturbing the stream or river bottom. - Recent rainfall will likely bring sediment, which will decrease the water clarity.

- You may detect dramatically excessive sediment from sources from construction or agricultural practices.

- Excess phytoplankton algae can also effect water clarity.

- Let everyone look down the transparency tube to become familiar with the Secchi pattern found inside and at the bottom of the tube.
- Without stepping in the water or disturbing the stream or river bottom in any way, gather water from a flowing part of the stream. Pour this water into the transparency tube.
- With the transparency tube in the shade, check the Secchi pattern to see if you are still able to see it. Repeat this step until you are just beyond the point where you are able to see the pattern.
- Note the height of the water level on the scale (marked in inches) on the tube.
- Record the results on your survey form in INCHES.

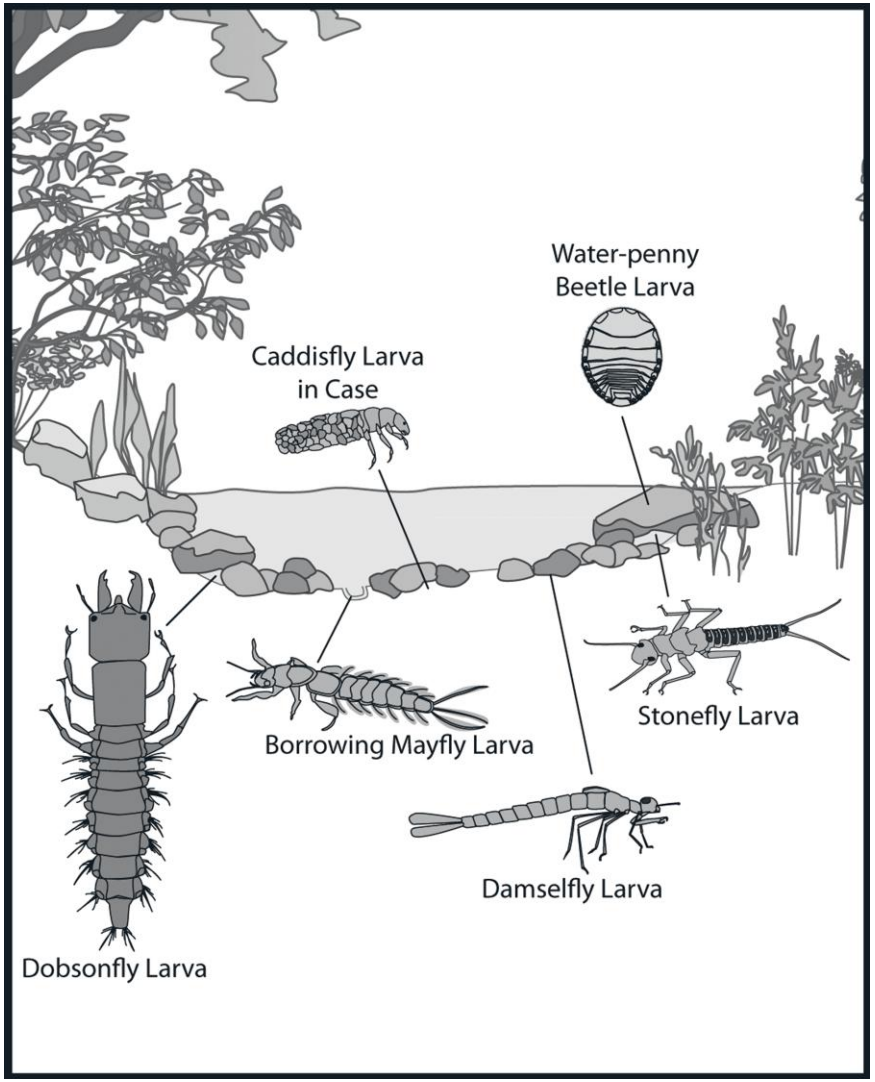
Standard Procedures for River Monitoring/ Measuring Water Quality/ Monitoring Survey Section A Continued…

What Are Macro Invertebrates?

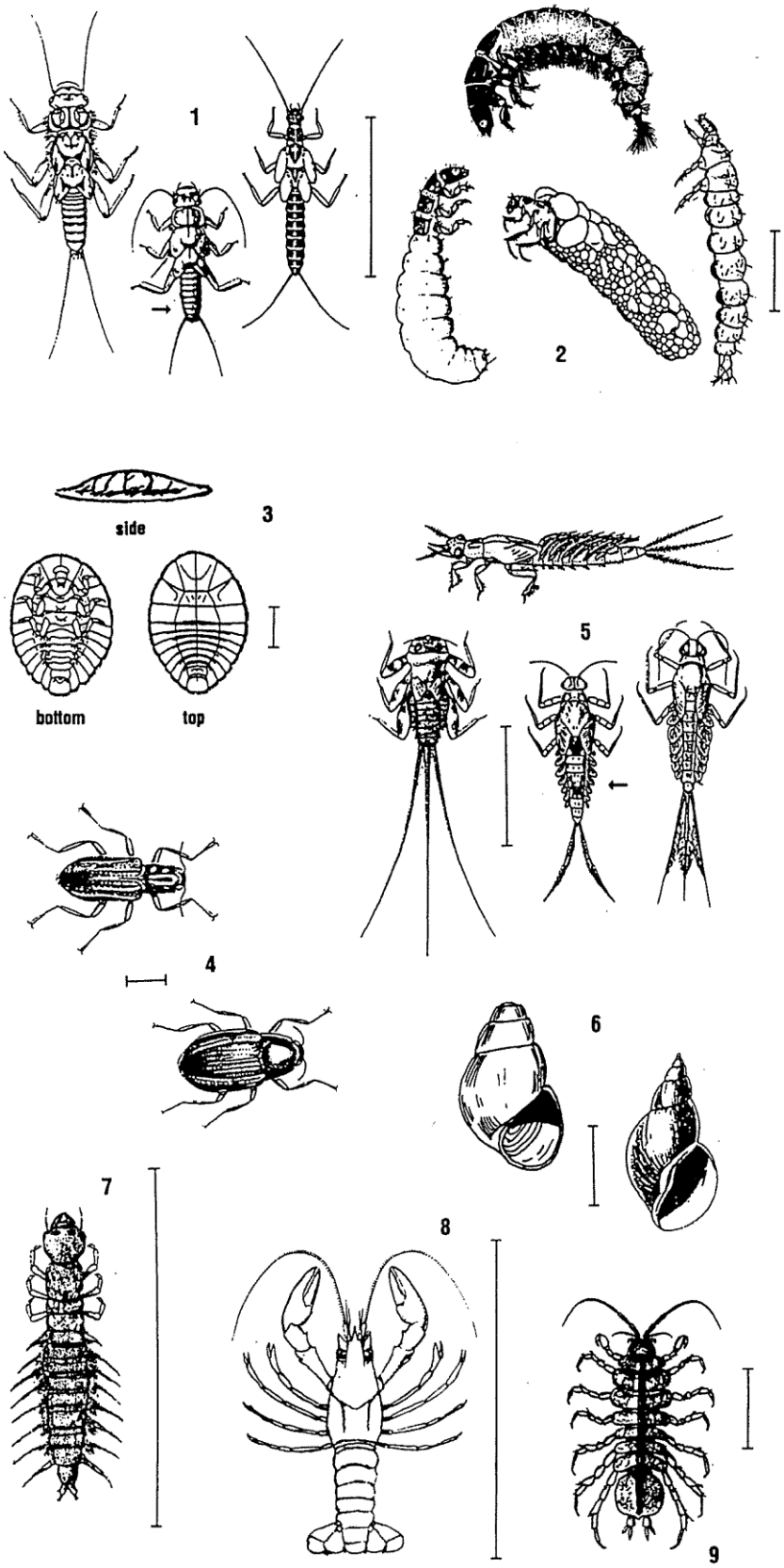
Why collect and count macro invertebrates? We use macro invertebrate identification and counts to help determine water quality. The technique is based on the fact that different stream macro invertebrates have different tolerances to pollution, thus they can be used as water quality indicators.

What are macro invertebrates? These are organisms large enough to be seen without a microscope and which do not have backbones. Biologists and citizens alike identify and count these including the larval and adult stages of aquatic insects, crustaceans, and mollusks in order to determine stream water quality. Many of the organisms that we look at in our stream and river monitoring program are the aquatic larvae of common terrestrial insects found in North Carolina; others are adult aquatic insects and crustaceans.

Where do they live? Macro invertebrates are found throughout aquatic environments. They can be found swimming in the water, on the underside of rocks, borrowed deep within the streambed, and also attached to the streambed bottom. They occupy a variety of niches in the aquatic community. Knowing where they tend to live can make it easier to locate them. In addition, these niches change over time due to water quality. It is important to make notes as to where they are located, as well as where you find them over the following months and years.



Stream Insects & Crustaceans



Bar lines indicate relative size

GROUP ONE TAXA

Pollution sensititve organisms found in good quality water.

1 ***Stonefly: Order Plecoptera.*** 1/2" - 1 1/2", 6 legs with hooked tips, antennae, 2 hair-like tails. Smooth (no gills) on lower half of body. (See arrow.)

2 ***Caddisfly: Order Trichoptera.*** Up to 1", 6 hooked legs on upper third of body, 2 hooks at back end. May be in a stick, rock or leaf case with its head sticking out. May have fluffy gill tufts on underside.

3 ***Water Penny: Order Coleoptera.*** 1/4", flat saucer-shaped body with a raised bump on one side and 6 tiny legs and fluffy gills on the other side. Immature beetle.

4 ***Riffle Beetle: Order Coleoptera.*** 1/4", oval body covered with tiny hairs, 6 legs, antennae. Walks slowly underwater. Does not swim on surface.

5 ***Mayfly: Order Ephemeroptera.*** 1/4" - 1". brown, moving, plate-like or feathery gills on sides of lower body (see arrow), 6 large hooked legs, antennae, 2 or 3 long, hair-like tails. Tails may be webbed together.

6 ***Gilled Snail: Class Gastropoda.*** Shell opening covered by thin plate called operculum. When opening is facing you, shell usually opens on right.

7 ***Dobsonfly (Hellgrammite): Family Corydalidae.*** 3/4" - 4", dark-colored, 6 legs, large pinching jaws, eight pairs feelers on lower half of body with paired cotton-like gill tufts along underside, short antennae, 2 tails and 2 pairs of hooks at back end.

GROUP TWO TAXA

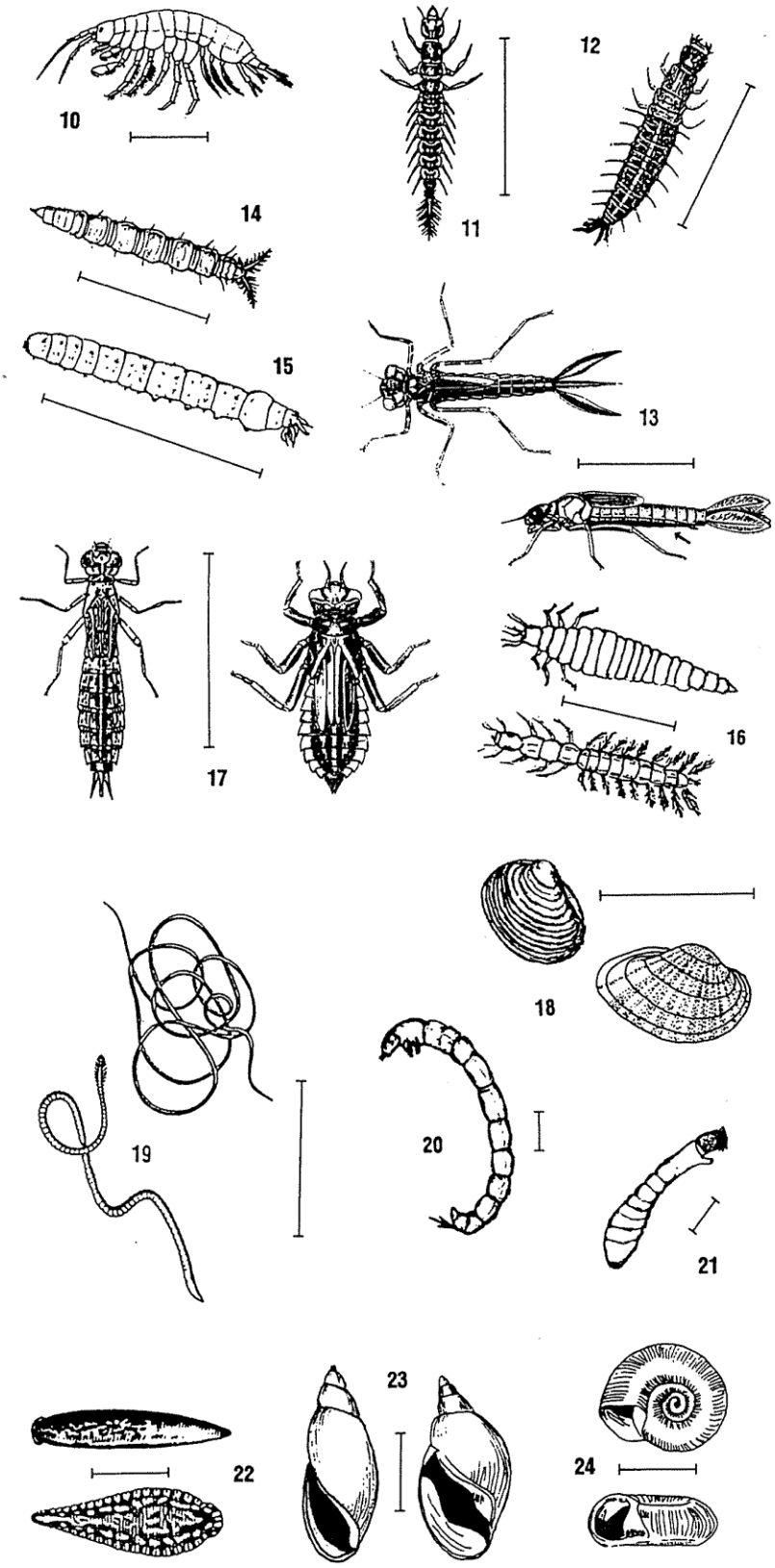
Somewhat pollution tolerant organisms can be in good or fair quality water.

8 ***Crayfish: Order Decapoda.*** Up to 6", 2 large claws, 8 legs, resembles small lobster.

9 ***Sowbug: Order Isopoda.*** 1/4" - 3/4", gray oblong body wider than it is high, more than 6 legs, long antennae.

Save Our Streams

Izaak Walton League of America
707 Conservation Lane
Gaithersburg, MD 20878-2983
1(800)BUG-IWLA



Bar lines indicate relative size

GROUP TWO TAXA CONTINUED

10 ***Scud: Order Amphipoda.*** 1/4", white to grey, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp.

11 ***Alderfly Larva: Family Sialidae.*** 1" long. Looks like small hellgrammite but has 1 long, thin, branched tail at back end (no hooks). No gill tufts underneath.

12 ***Fishfly Larva: Family Corydalidae.*** Up to 1 1/2" long. Looks like small hellgrammite but often a lighter reddish-tan color, or with yellowish streaks. No gill tufts underneath.

13 ***Damselfly: Suborder Zygoptera.*** 1/2" - 1", large eyes, 6 thin hooked legs, 3 broad oar-shaped tails, positioned like a tripod. Smooth (no gills) on sides of lower half of body. (See arrow.)

14 ***Watersnipe Fly Larva: Family Athericidae (Atherix).*** 1/4" - 1", pale to green, tapered body, many caterpillar-like legs, conical head, feathery "horns" at back end.

15 ***Crane Fly: Suborder Nematocera.*** 1/3" - 2", milky, green, or light brown, plump caterpillar-like segmented body, 4 finger-like lobes at back end.

16 ***Beetle Larva: Order Coleoptera.*** 1/4" - 1", light-colored, 6 legs on upper half of body, feelers, antennae.

17 ***Dragon Fly: Suborder Anisoptera.*** 1/2" - 2", large eyes, 6 hooked legs. Wide oval to round abdomen.

18 ***Clam: Class Bivalvia.***

GROUP THREE TAXA

Pollution tolerant organisms can be in any quality of water.

19 ***Aquatic Worm: Class Oligochaeta.*** 1/4" - 2", can be very tiny; thin worm-like body.

20 ***Midge Fly Larva: Suborder Nematocera.*** Up to 1/4", dark head, worm-like segmented body, 2 tiny legs on each side.

21 ***Blackfly Larva: Family Simulidae.*** Up 1/4", one end of body wider. Black head, suction pad on other end.

22 ***Leech: Order Hirudinea.*** 1/4" - 2", brown, slimy body, ends with suction pads.

23 ***Pouch Snail and Pond Snails: Class Gastropoda.*** No operculum. Breathe air. When opening is facing you, shell usually opens on left.

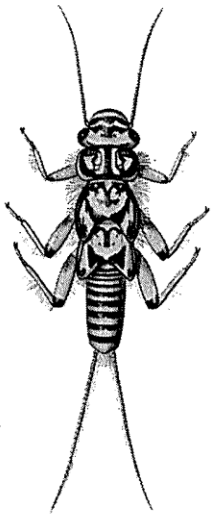
24 ***Other Snails: Class Gastropoda.*** No operculum. Breathe air. Snail shell coils in one plane.

Group One Taxa

Pollution sensitive organisms can be found in good quality water.

1. Stonefly (Order Plecoptera)

Stonefly larvae live in highly oxygenated water and are an important component of the food chain. Stonefly larvae are one of the most pollution sensitive groups of macroinvertebrates. Typically they are found in cool, clean streams with high levels of dissolved oxygen. Generally, these critters are adapted more for crawling among stones rather than for active swimming. Usually they are found in rapidly moving water. Larval development time ranges from 3 months to 3 years.



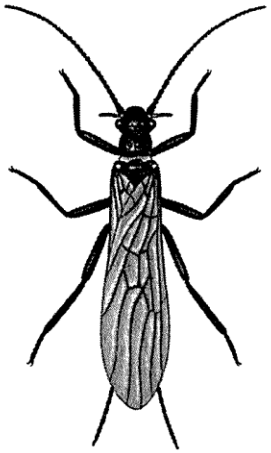
What do they look like? Generally, stonefly larvae are elongated, with a somewhat flattened form, usually ¾" to 1½" long. Their heads have widely separated eyes and long slender antennae. Each leg ends in two claws, which allows these larvae to maneuver in fast currents. The smooth edged abdomen ends in two thread-like tails. Coloration ranges from white, tan, yellow, and brown to glossy black.

Distinguishing features: Slow moving, two tails, long antennae, and generally don't have abdominal gills.

Where do they live? They are slow moving and are generally found in protected areas of debris and under stones. As the larvae grow many species migrate from gravel to leaf debris to stones.

Where Do River Watchers usually find them? Look for stonefly larvae on the underside of rocks, clinging to the net, and crawling on the bottom of the sample tray.

Do they look different as adults? Yes, the adult form looks like the larval form with wings which, when the stonefly is at rest, are folded over its back. Frequently, they can be seen clinging to leaves on streamside trees. All but one of the close to 500 species of stoneflies found in North America are terrestrial as adults.



2. Caddisfly (Order Trichoptera)

The Caddisfly larvae are a significant component of the food chain, and have adapted to a variety of aquatic environments. Most species indicate high water quality. Caddisfly larvae are best known for the protective cases of sand, stone, sticks, or leaves that most species build. These cases can be beautiful intricate structures; some even include complex nets for trapping food. Typically caddisflies have one generation (hatch) per year, but many have several overlapping generations annually.

What do they look like? Larvae resemble caterpillars and can reach 1" in length. Colors can vary from green to orange to brown. Caddisfly larvae are elongated with a distinctive head and small and simple eyes. Antennae are often inconspicuous. Well-developed legs, often with a single hook on the end, can be seen in the anterior sections. In the posterior areas legs, wing pads and tails are absent, with the exception of two small fleshy appendages ending with a hook-shaped claw. Sometimes filamentous gills are present on the underside of the caddisfly larva.

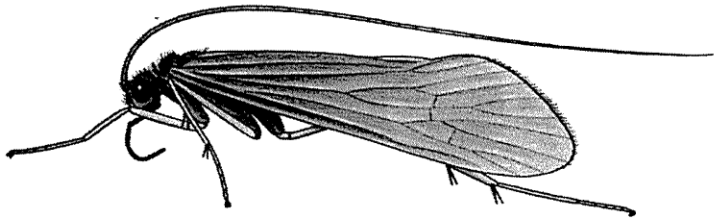
Distinguishing features: The caddisfly larva has a characteristic motion, "the caddisfly dance" of wiggling back and forth, then up and down in the water. The species most often seen in the Haw (because this species is the most tolerant) is a pale iridescent green, and curls in a crescent shape.

Caddisfly larvae can be confused with dobsonfly, fishfly, alderfly, and beetle larvae. Look for the curve-shaped single hook at the end of each leg and at both tips of a slightly forked abdomen.

Where do they live? Caddisfly larvae live in both slow and fast moving waterways. Generally, ones that build stone cases are found in swift currents and those who construct leaf and twig cases are found in slow calm waters. Caddisfly larvae that are burrowers form well-defined burrows or tubes and can be found in the stream bottom.

Where Do River Watchers usually find them? Caddisfly larvae are often found in their cases attached to rocks, sticks, or leaves. Look for these caddisfly cases on rocks. In the Haw, when you find little clumps of tiny pebbles or leaf debris on the undersides of rocks, they are most likely caddisfly cases. On large rocks in the Haw, you might notice large numbers of tiny caddisfly nets (outlined with sediment) on the downstream side of the rock.

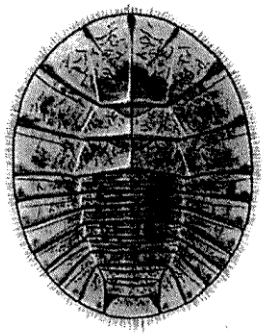
Do they look different as adults? Yes. Caddisflies are terrestrial during their relatively short-lived adulthood. The adults, also known as shadflies, sandflies or periwinkles, are delicate and moth-like, usually dull colored, with long thread-like antennae. The wings are covered with tiny hairs and are typically folded over their backs. They can appear in very large groups or swarms.

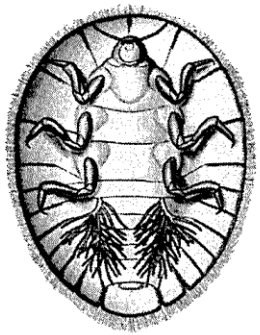


3. Water Penny (Order Coleoptera)

Water pennies are the aquatic larvae of the psephinidae.

What do they look like? Water pennies are flat and oval shaped, almost as wide as long. A segmented plate-like covering conceals the head, legs, and gills. If pried loose from the rock or tray, the head, legs, and threadlike gills can be seen on the underside.





Distinguishing features: They are very flat and usually are clinging tenaciously to rocks or the tub bottom.

Where do they live? Water pennies are beetle larvae that cling to the undersides and tops of stones in shallow riffles.

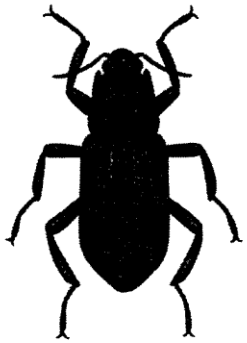
Where do River Watchers usually find them? They are often found attached to rocks and on the bottom of the white tray after pouring the sample water out.

Do they look different as adults? Yes, the adults are small beetles, rarely seen, in flight or crawling on streamside rocks.

4. Riffle Beetle (Order Coleoptera, Family Elmidae)

What do they look like? Riffle beetles look like elongated small hard-bodied beetles. Antennae are usually slender but are sometimes clubbed. The feet have long claws.

Distinguishing features: Riffle beetles have a small oblong oval-shaped beetle body usually measuring only ¼". They have one pair of tiny antennae. Riffle beetles don't swim on the surface; rather, they walk very slowly underwater.



Where do they live? Riffle beetles are usually found in the rocky stream bottoms of riffles and rapids. They also can be found in the sandy bottoms of slower stretches of streams, in crevices, under bark and in wood debris.

Where do River Watchers usually find them? Riffle beetles may be seen walking slowly underwater or in the tub after taking a sample from the stream bottom.

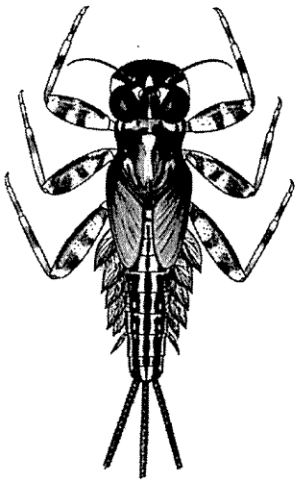
Do they look different as adult? No, this is their adult form. (The larval form is shown below.)

5. Mayfly (Order Ephemeroptera)

Mayflies are very primitive, and show traits common to the earliest winged insects. They occupy a fundamental link in the food chain. Mayfly larvae can be found in a variety of aquatic habitats, including rock surfaces in rapids or buried in soft streambeds. Mayflies can have two to three generations per year. Larval development time varies from 2 weeks to 2 years. Mayfly larvae can be found in healthy streams year-round.

Mayfly larvae can dart, crawl, cling and tend to move quickly. Some are burrowers and can be found in the bottom sediments of streams.

What do they look like? At first glance, mayfly larvae appear similar in shape to stonefly larvae. Fortunately, there are several differences. To distinguish the two, compare the number of tails and the sides of the abdomens. Mayfly larvae usually have three tails (can have two), prominent gills along the sides of their abdomen, and a single claw on each foot. These abdominal gills can be plate-like or feathery in appearance. Mayfly larvae also have two antennae, which are fairly short compared to the stonefly larvae antennae. Mayflies can be brightly striped in color. Mayfly larvae can vary in length from 1/4" to 1 inch.



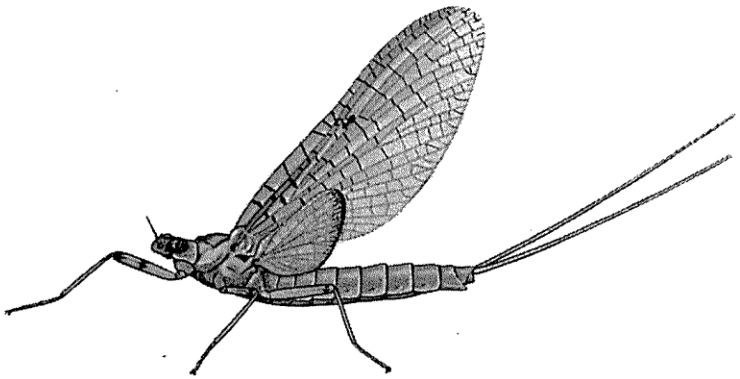
Distinguishing features: Look for three tails and gills along the abdomen.

Where do they live? Mayflies live on the underside of rocks. Some burrow into the mud, using their gills to produce a flow of water through the burrow to provide food and oxygenated water.

Where Do River Watchers usually find them? Mayfly larvae are usually found when you turn over rocks in a riffle (remember that they are likely to be moving quickly). They can be caught in the net after scraping the stream bottom and can be seen in the sample tray darting and moving quickly.

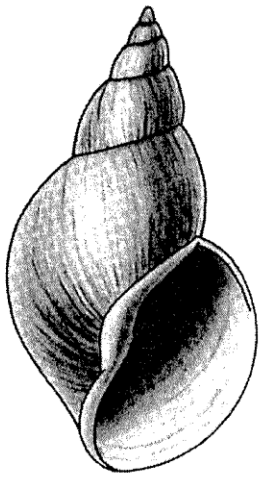
Do they look different as adults? Yes. Adult mayflies, also known as imagoes or spinners, generally live less than a month. They do not eat and their activities revolve around reproduction. You can often see them in the spring, flying above streams.

All of the approximately 700 species of mayflies have aquatic larvae and relatively short-lived terrestrial adult life.



6. Gilled Snails (Class Gastropoda)

Gilled snails (prosobranchs) have gills and rely on oxygen in the water for respiration. This makes gilled snails more sensitive to physical and chemical changes in streamwater quality. A plate-like door protects the shell opening and can be closed quickly to avoid predators.



What do they look like? These aquatic snails look like small conch snails. A muscular foot protrudes from a coil or cone shaped shell. The spiral shell opens to the right. To determine right or left opening, hold the snail with the tip pointing up and the shell's opening toward you

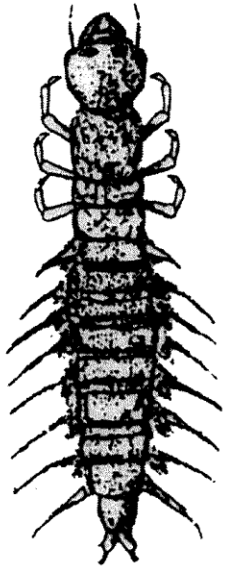
Distinguishing features: Gilled snails open on the right, with a plate-like door protecting the opening.

Where do they live? Generally, these snails are found burrowed in soft substrate and detritus, or attached to rocks and debris on the streambed.

Where do River Watchers usually find them? These snails can be small (1/8") and frequently are on the undersides of rocks.

Do they look different as adults? No, this is their adult form.

7. Dobsonfly (Order Megaloptera, Family Corydalidae)



Watch out! These critters will bite!

What do they look like? Dobsonfly larvae (also called hellgrammites) are large, 2" to 3" when full-grown. Dobsonfly larvae are fierce-looking. They have elongated, stout bodies with strong mouthparts. There are seven or eight pairs of long fingerlike gills, one on each abdominal segment. Paired filamentous gill tufts can be seen under the abdominal appendages. Dobsonfly larvae are usually brown or black in color.

Small dobsonfly larvae can easily be confused with alderfly and fishfly larvae; see page 14.

Distinguishing features: They are usually large and fierce-looking. They have pincer-like mouth parts. Their back end is forked with two short fleshy tails, with two hooks per tail.

Where do they live? Dobsonfly larvae are frequently found on rocks, or hiding beneath stones and debris on the stream bottom.

Where do River Watchers usually find them? Hellgrammites often end up in the net after a bottom scraping and are then dumped in the tub. Look in the sample tray containing the stream bottom sample.

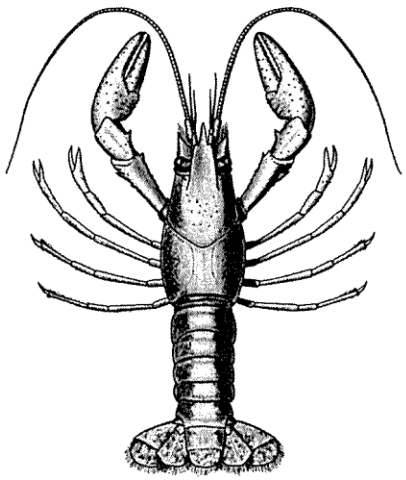
Do they look different as adults? Yes. Adult dobsonflies are terrestrial, with mottled wings, usually over 1 ½" long.

Group Two Taxa

Somewhat pollution tolerant organisms can be found in good or fair quality water.

8. Crayfish (Order Decapoda)

Crayfish are common inhabitants in aquatic systems. There are more than 200 species of crayfish in North America. Most live 2 years; some live 6 or 7 years.



What do they look like? Crayfish are crustaceans that resemble tiny lobsters 1" to 3" in length (they can be up to 6"). They have 5 pairs of walking legs, including 2 large pincher claws. Their eyes stand out from their body. Their color can range from brown, orange, black and even blue. Sometimes females can be seen with eggs or young clinging to the underside of the abdomen.

Where do they live? They are usually found in slow areas of rivers and streams, especially in the vegetation along stream banks. These critters frequently remain hidden in burrows. They often retreat backwards rapidly when disturbed.

Where do River Watchers usually find them? Scrape the net along the stream bank to find them. Or, if observant, one can spot them on top of rocks or crawling in the stream or on the bank. Often they are found hiding under rocks or foraging on the stream bottom at night.

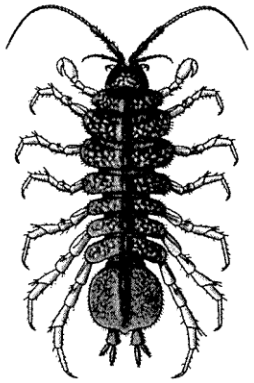
Do they look different as adults? No.

9. Sowbug (Order Isopoda)

Sowbugs are also known as pill bugs. There are roughly 130 species of freshwater sowbugs in North America. Large numbers indicate high nutrient levels in the water.

What do they look like? Sowbugs are flat forms, less than ¾" in length, with seven pairs of well-developed legs extending on either side. The head is joined to the first thoracic segment; the abdomen section is relatively short. They are flattened dorsally (top to bottom), are much wider than tall, and their color ranges from dark brown to gray. They have 2 pairs of antennae, one pair usually longer than the other.

Distinguishing features:
Sowbugs are flat. They move slowly, crawling over surfaces. Sowbugs are sometimes confused with scuds, but sowbugs are wider than they are high, and walk slowly.



Where do they live? Sowbugs tend to live on the stream bottom in shallow water, often among rocks and leaf detritus. They usually remain hidden and often are found under rocks, vegetation, and debris. Typically, they are found in very small streams.

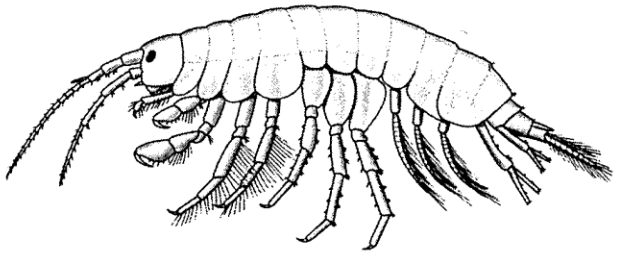
Where do River Watchers usually find them? Sowbugs can be seen in stream bottom and stream bank samples.

Do they look different as adults? No.

10. Scud (Order Amphipoda)

Scuds are associated with aquatic vegetation.

What do they look like? Their bodies resemble laterally compressed shrimp with a crescent moon shape. They have a white to clear body with many segments. The head and first section of the thorax are joined; seven pairs of tiny legs are used for movement. They have two pairs of antennae. You can recognize scuds by their unusual jet propulsion type movements. They look like very tiny shrimp, but without the hard shell.



Distinguishing features: Resemblance to shrimp. Jet propulsion movements; scoot rapidly on sides. Body flattened laterally (side to side), higher than it is wide.

Where do they live? They are often found in shallow waters within the vegetation, in debris, or burrowed in the stream bottom.

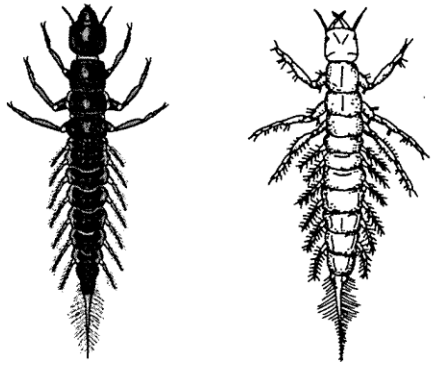
Where do River Watchers usually find them? Scuds usually are scooped up in the bottom scraping and can be seen in the tub, scooting around on their sides.

Do they look different as adults? No.

11. Alderfly Larvae (Order Megaloptera, Family Sialidae)

Alderfly larvae are similar and closely related to dobsonfly and fishfly larvae; see page 14 for a comparison.

What do they look like? These larvae are brownish bottom dwellers reaching a length of about 1". They have long tails and a row of bristly fingerlike gills along each side. To distinguish alderfly larvae from dobsonfly and fishfly larvae, compare their size and tail structure. Alderfly larvae are smaller than dobsonfly larvae and have a single tail (terminal filament). Alderfly larvae have a smooth underside--no gill tufts along the underside of their abdomen.



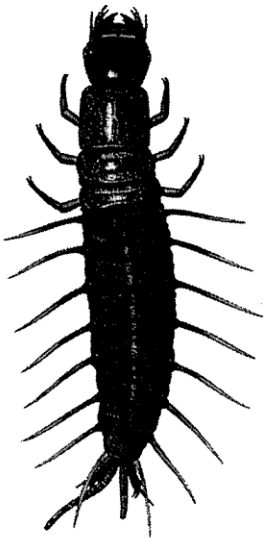
Distinguishing features: Small size relative to the dobsonfly larvae, and a single branched tail extending straight back. May be light-colored.

Where do they live? They are frequently found in debris and vegetation and on the underside of rocks. They usually prefer quiet waters.

Where do River Watchers usually find them? They are scooped up in the stream bottom sample, or found on the underside of rocks.

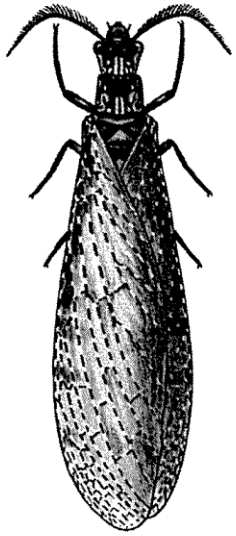
Do they look different as adults? Yes. Adults are less than ¾" in length and have wings that often are black or dark brown.

12. Fishfly Larvae (Order Megaloptera, Family Corydalidae)



Fishfly larvae are closely related to the dobsonfy and alderfly larvae. These can bite, too.

What do they look like? Fishfly larvae look like dobsonfly larvae but are smaller, 1" in length, and are a lighter reddish-tan in color. The tail has two terminal appendages, distinguishing them from alderfly larvae which have only one. Fishfly larvae have a smooth underside--no gill tufts along the underside of abdomen. Their back end is forked, with two short fleshy tails, two hooks per tail. They may be light-colored. Breathing tubes may extend from their top abdominal surface.



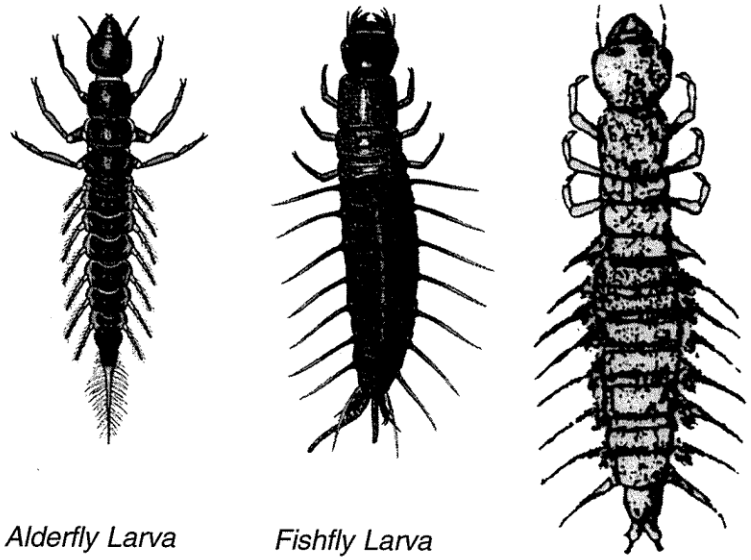
Distinguishing features: Smaller size relative to the dobsonfly larva, pale tan coloring and dark reddish head.

Where do they live? They are found in quiet waters, along banks, and on large rocks and stones.

Where do River Watchers usually find them? They are scooped up in the stream bottom sample, or seen on the undersides of rocks.

Do they look different as adults? Yes. They look similar to the adult stage of the alderfly.

Comparison of Alderfly, Fishfly, Dobsonfly Larvae



Alderfly Larva *Fishfly Larva* *Dobsonfly Larva*

Dobsonfly, alderfly, and fishfly larvae all look very similar, and can be hard to distinguish one from another. All three have three pairs of segmented legs (6 total) on the mid-section of the body, with tiny pinchers at the end of each. All have many fleshy, filamentous appendages extending from each side of the abdominal segments. And all have large pincher-like mouth parts. The larval stage of the species usually is less than a year long but can last up to three years.

If you are not sure of the ID, count the critter as Fishfly on the survey.

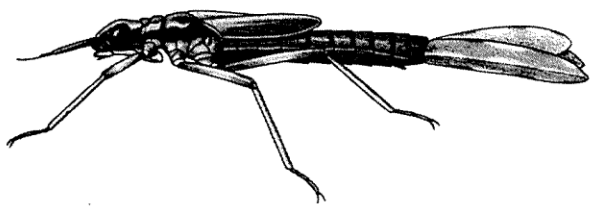
All three can also bite, so handle carefully.

13. Damselfly (Order Odonata, Suborder Zygoptera)

The damselfly is closely related to the dragonfly (see below).

What do they look like? Damselfly larvae have a slender and narrow body with three tail-like gills. These gills look like three oar-shaped tails extending in a tripod formation. Damselfly larvae have three pairs of long spindly legs near the front of the body. The hinged lower jaw folds back on itself under the chin but can be extended forward to grab prey. Sometimes the damselfly larva is mistaken for the mayfly larva because both usually have three tails. However, the damselfly larva's tails are broad and fan-shaped, and it has no abdominal gills.

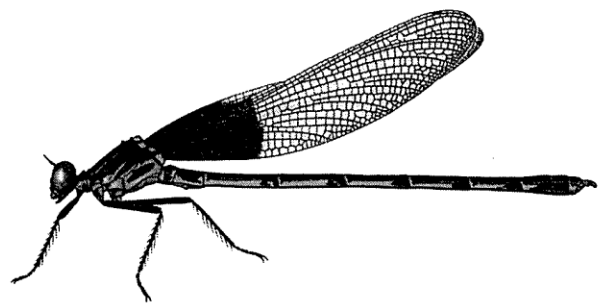
Distinguishing features: Smooth sides and three broad tails.



Where do they live? Damselfly larvae are usually found in submerged vegetation or along the stream banks. Sometimes you can see their trails on or along streams in shallow areas. Many live within the stream bottom, and some can burrow as deep as a few inches into the stream bottom. They can vary from gray, brown, black, orange or green in color.

Where do River Watchers usually find them? They are usually scooped up when doing the bank scraping, as they tend to live in streamside vegetation and mud.

Do they look different as adults? Yes. They resemble adult dragonflies, and are frequently iridescent blue.

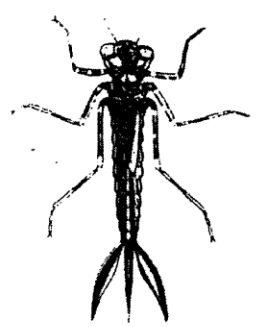


Damselfly And Dragonfly Larvae

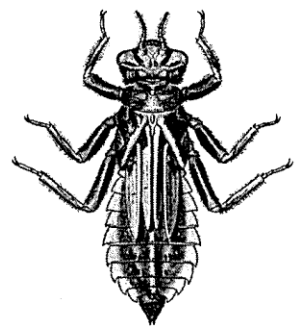
Both are common residents of aquatic environments, with life cycles of usually a year, but some have life spans of four years.

Common features are: large eyes; three pairs of segmented (jointed) legs on the upper mid-section (thorax) of the body; large scoop-like mouthparts; no gills on sides or abdomen.

Differences: Damselfly larvae are more elongated and delicate, with 3 oar-like gills or tails extending from the posterior end. Dragonfly larvae tend to be much broader through the abdomen and lack the tail-like projections.

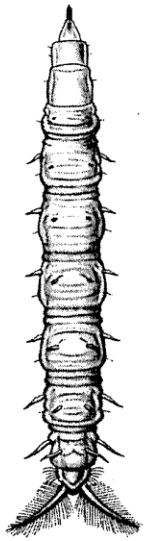


Damselfly Larva



Dragonfly Larva

14. Watersnipe Fly Larva (Order Diptera, Family Athericidae)



Watersnipe fly larvae are predacious and found in streams with good oxygen levels. Larvae can bite!

What do they look like? The watersnipe fly larva is caterpillar-like with many pairs of legs on underside. The abdomen has distinct segments, with tiny soft pairs of fleshy filaments extending from the top and sides of body segments. The posterior end of the abdomen has two prominent diverging tails with feathery projections. The conical body is tapered at the head end. It can be up to two inches long.

Distinguishing features: Fleshy caterpillar-like body, no distinguishable head, two feathery tails, and many pairs of legs.

Where do they live? The watersnipe fly larvae tend to be detritus dwellers.

Where do River Watchers usually find them? They are usually found in detritus, leaf debris, and on the stream bottom.

Do they look different as adults? Yes. Adults are medium sized flies with moderately long legs.

pH And Its Implications For The Haw River

pH measures the concentration of hydrogen ions or the balance of hydrogen (H+) and hydroxide (OH-) ions in a solution. This measurement tells us whether a solution is acidic or basic (alkaline). pH values usually lie between 1 and 14. A solution with a pH of 7 is considered neutral. pH values of less than 7 indicate an abundance of H+; the solution is acidic. A pH reading of greater than 7 indicates that more OH- ions are present and the solution is basic.

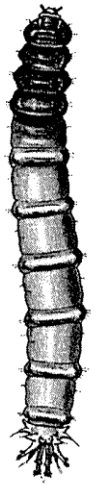
The pH scale is logarithmic, so a change of one pH unit means a tenfold change in acid or alkaline concentration. A change from 7 to 6 represents 10 times the concentration, from 7 to 5 represents 100 times, and so on. A pH of 4.5 is considered the lethal threshold. Below that most organisms are impaired or die. The upper end for life is 9.5. Immature stages of aquatic insects and young fish are extremely sensitive to low and high pH values.

In North America most streams have a natural pH of between 6.5 and 8.5. Run-off from farms, logging, mining sites, commercial areas and residential developments can alter the pH of waterways. Factors such as soil and stream bank composition can also influence pH. pH generally increases as you go downstream, as inputs from many sources tend to be more basic than acidic. Effluent from wastewater treatment plants and septic tanks can raise the pH due to the presence of detergents, which are basic. Bogs and decomposing forest vegetation can lower pH in nearby waterways. The pH may decrease in the fall and winter due to decomposing vegetation and the tannic acid in oak leaves and pine needles. Our data shows a slight increase in pH in the fall but no significant seasonal change.

Some stretches of the Haw River register above 8 on the pH scale. Most likely this is due to wastewater treatment plant and septic tank effluent, which can raise pH levels. Bogs, decomposing forest vegetation, and acid rain can lower the pH in nearby waterways.

15. Crane Fly (Order Diptera, Family Tipulidae)

Crane fly larvae are important food for trout and other game fish, and are used for bait. There are one to two generations per year. The aquatic stage can range from six weeks to five years. There are close to 300 aquatic and semi-aquatic crane fly species in North America.



What do they look like? Crane fly larvae are peg-like, soft-bodied critters that usually range in length from1/3" to 2", and can reach 4". They have a fleshy, plump, round-segmented caterpillar-like body. Their color is often milky, light brown, or greenish.

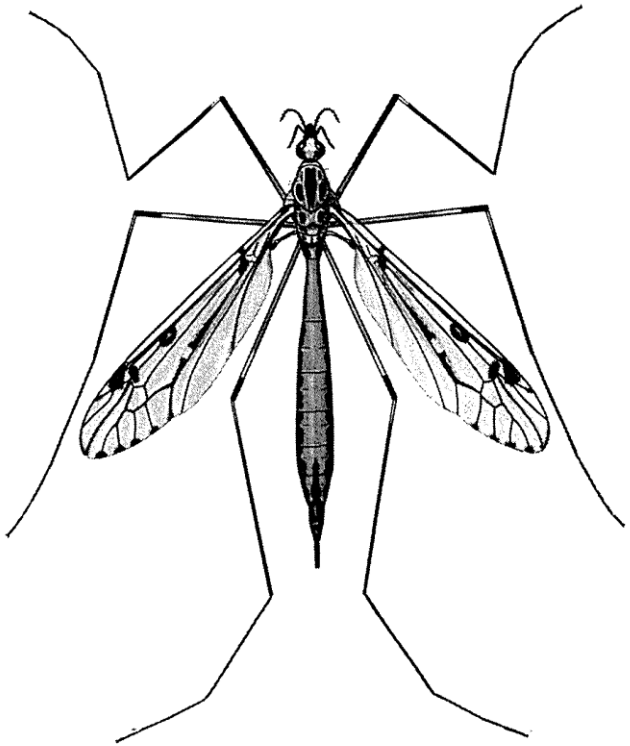
The head is usually fully or partially retracted into the thorax, giving the front end a rounded appearance. The abdomen has small leaf-like appendages; for some species, the abdomen is slightly flattened or flattens as it swims. The back end usually has several extensions or finger-like lobes. Frequently the digestive tract can be seen as a dark line moving back and forth as the larva crawls.

Distinguishing features: Resembles a large, slow-moving, light-colored caterpillar.

Where do they live? Crane fly larvae are usually bottom dwellers and often can be found in woody debris or vegetation. They usually live in the stream bed.

Where do River Watchers usually find them? Crane fly larvae can end up in the tub after dumping the contents of the stream bottom sample.

Do they look different as adults? Yes. Adults are large mosquito-like flies sometimes called mosquito hawks.



16. Beetle Larva (Order Coleoptera)

Most beetle larvae seen in the Haw watershed are riffle beetle larvae (see #4, Riffle beetle). Some other types of beetle larvae are shown below.

What do they look like? Larvae are elongated and segmented, reaching ¾" in length, with relatively hard bodies. Their bodies can be flat or concave and look like they are covered by over lapping plate-like armor. The upper thorax has three pairs of segmented legs with claws on each. The back end has two tiny hooks, and short hairs (filamentous gills) that look like small tails (these may be difficult to see).

Riffle beetle larva

Hydrophilidae beetle larva--scavenger beetle

Dytiscidae beetle larva--predacious diving beetle

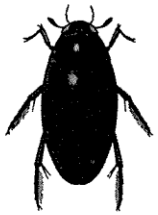
Gyrinidae beetle larva--whirligig beetle

Distinguishing features: Their armor-like covering and prominent clawed legs.

Where do they live? Riffle and other water beetle larvae can be found in shallow area on debris or vegetation or clinging to sticks or logs.

Do they look different as adults? Yes.

Riffle beetle adult



Hydrophilidae beetle adult--scavenger beetle

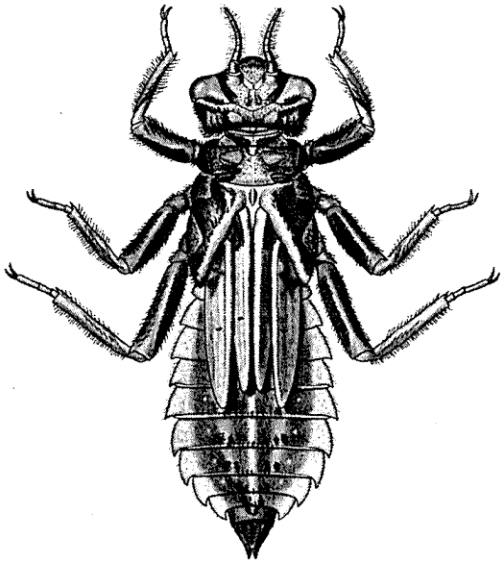
Dytiscidae beetle adult--predacious diving beetle

Gyrinidae beetle adult--whirligig beetle

17. Dragonfly Family Corydalidae, (Order Odonata, Suborder Anisoptera)

What do they look like? Dragonfly larvae are closely related to and somewhat similar in appearance to damselfly larvae (see page 15), and have the same hinged lower jaw. Dragonfly larvae are identified by their wider abdomen and hidden internal gills. They have a wide oval to round abdomen that may end in three wedge-shaped extensions, sometimes flattened. They do not have tail-like projections at the end of their abdomen (no caudal lamellae). They have large bulbous eyes.

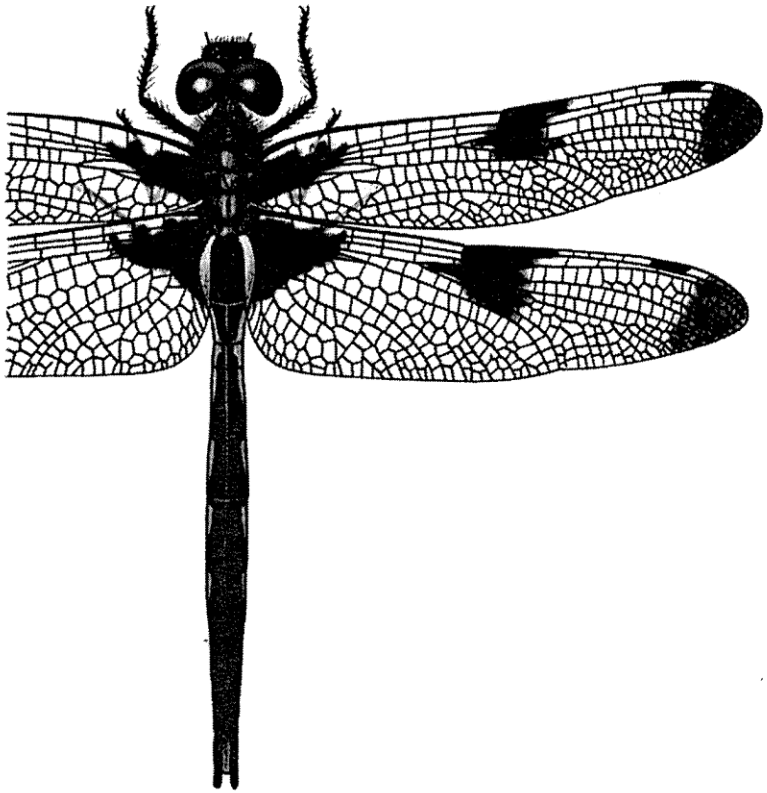
Distinguishing features: Large eyes, poor swimmers, and wide oval to round abdomen without tails.



Where do they live? Dragonflies live in submerged vegetation, and may be burrowed in the mud especially along the stream banks.

Where do River Watchers usually find them? Dragonfly larvae are usually found in the stream bank vegetation, so the stream bank scraping is the best method of finding them. They may also be found on the undersides of rocks.

Do they look different as adults? Yes, dragonfly larvae molt and become the commonly seen aerial dragonfly.

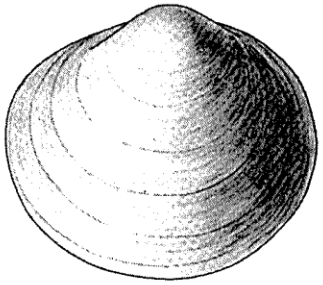


18. Clam (Class Bivalvia)

Clams have a wide range of tolerances to pollution, some being very sensitive to aquatic conditions, and some being tolerant.

Dead clams (empty shells) are significant to note, but should not be used in the macroinvertebrate count. Empty shells do not accurately reflect water quality because shells can persist for long periods regardless of water conditions.

What do they look like? Shells are variously shaped, but are usually oval and have concentric growth rings. Shells are very symmetrical, and consist of two shells attached by an external hinge. The soft, fleshy body (foot) may be seen extending from the shell. Shell color can range from black to white, including yellow green or brown. Freshwater clams are usually 3/4" in length.



Where do they live? There are usually found on or in the stream bottom.

Where do River Watchers usually find them? Clams are often seen on the stream bottom and on submerged rocks. Also, look for clamshells on the stream bottom and banks. This can be evidence of otters.

Do they look different as adults? No, this is their adult form.

River Watchers Identifying Macroinvertebrates

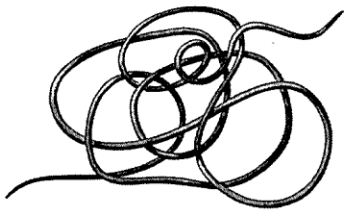
Haw River Facts: *The state of North Carolina uses a similar method to monitor streams, referred to as the family order macroinvertebrate count. This method takes a closer look at mayflies, caddisflies and stoneflies and counts the number of species present within these families.*

Group Three Taxa

Pollution tolerant organisms can be in any quality of water.

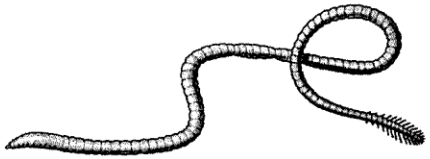
19. Aquatic Worms (Class Oligochaeta)

Aquatic worms are usually found in streams with high levels of silt or organic debris. Some resemble terrestrial earthworms, while others are narrower and threadlike. Aquatic worms can tolerate low dissolved oxygen, and may be found in large numbers in nutrient-laden polluted streams.



What do they look like? They generally have elongated, cylindrical bodies resembling long thin worms. Length can range from ¼" to 2"; their segmented body may reach 5" in length. They move by pulling along in worm-like fashion; they can also move in whip-like movements.

Color is variable and may be red, tan, brown, or black. Bright red forms indicate very low dissolved oxygen.



Distinguishing features: Long thin worm often squirming around in the tub.

Where do they live? Aquatic worms are found burrowed in the stream bottom, especially in silt, debris, and detritus.

Where do River Watchers usually find them? Aquatic worms are found in the stream bed sediment, especially in clay. Frequently, they are in the tub after a stream bottom scraping.

Do they look different as adults? No.

Haw River Facts: *There are 6 dams on Haw River- Glen Raven at Altamahaw, Swepsonville (2), Saxapahaw, Bynum, and the Jordan Lake Dam. All these dams except Jordan Lake were built in the 1800's to provide hydropower for textile mills, once a thriving industry on the Haw. Many of the mills are now closed, but hydropower is still produced at Altamahaw, Saxapahaw and Bynum. The 14,000-acre Jordan Lake reservoir was built by the Army Corps in the 1980's for flood control and recreation. It has now become a sought-after source of drinking water for many municipalities in this fast growing region, despite its water quality problems.*

20. Midge Fly Larva (Order Diptera, Family Chironomidae)

Midge is a large family with almost 2000 species in North America. They are adapted to a wide variety of aquatic environments, and may be found in all but the most degraded waters. They are indicators of high nutrient levels and organic pollution.

What do they look like? Midge fly larvae are small, slender, and worm-like, with slightly curved bodies. Often they are whipping back and forth.

They are very small, under 1/2" and usually less than 1/4" in length. The larva has a thin, slightly curved segmented inch-worm-like body with a dark head.

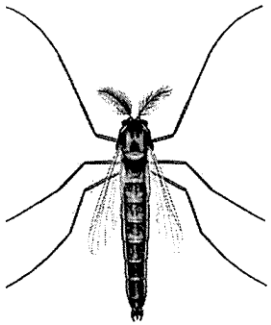
They have two pairs of tiny fleshy legs--one pair below the head (prolegs) and one pair on the back end (may be hard to see). The back end sometimes has a tiny pair of filamentous tufts. Often the guts can be seen inside the body as a dark line.

Distinguishing features: Look for the whipping action. Midges are distinguished from other aquatic fly larvae by the thin uniformly wide segmented body, and pairs of legs behind the head and on the posterior end.

Where do they live? Most species are bottom dwellers, and many live within tubes or loosely constructed silk-lined cases in and on the streambed. They can also be found in submerged vegetation.

Where do River Watchers usually find them? Midges are seen in the tub water after a stream bottom scraping.

Do they look different as adults? Yes. The adults are delicate flies. They are often confused with mosquitoes, but the females do not bite.



Haw River Facts: *The Haw Watershed is a mix of rural and urban landscapes: Agriculture (crop, pasture) 27%, Forest 43%, Urban 17.5%, Other 13%. Watershed Population as of 1990 - 551,716.*

21. Blackfly Larva (Order Diptera, Family Simulidae)

What do they look like? Blackfly larvae are caterpillar-like, 1/3" or less in length--usually less than a quarter inch long. They are usually light in color (occasionally brown, gray, or black) with a black head. The body is segmented. One very tiny leg-like appendage (proleg) is located directly under the head; otherwise no legs are present.

The posterior end of the abdomen is swollen. The swollen end of the abdomen is the best characteristic for identifying the blackfly larva. Blackfly larvae are often seen with their back ends attached to rocks or debris. These larvae have attachment disks on the posterior end of their abdomens.

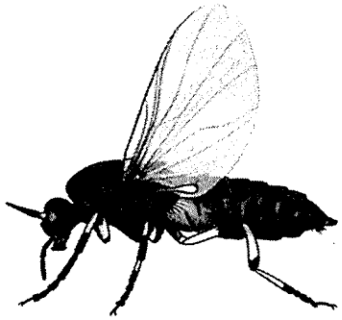
Larvae can move by drifting downstream on silken threads that extend from the tip of the abdomen.

Distinguishing features: Look for the enlarged (bulbous) back end stuck to the bottom of the sample tub or on rocks.

Where do they live? Blackfly larvae are generally attached to rocks, vegetation and woody debris in streams. These larvae attach themselves by a suction disk on the posterior end of their abdomen.

Where do River Watchers usually find them? Look for blackfly larvae on the bottom of the sample tray after doing a stream bottom scraping with the net.

Do they look different as adults? Yes. They are small black humpbacked flies that will swarm humans but rarely bite.

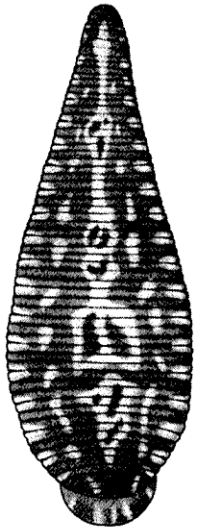


Haw River Facts: *The U.S. Dept. of Agriculture and the EPA have recognized for 20 years that sediment runoff resulting from human activities is the single most significant water pollutant. In 1982 the U.S. Soil Conservation Service estimated that 2 billion tons of sediment were being deposited in U.S. streams annually. Sediment impacts aquatic plants, adversely affects most aquatic animals (especially those with gills, including macroinvertebrates), and significantly alters the streambed, destroying habitat and spawning areas.*

22. Leech (Order Hirudinea)

There are over 63 species of freshwater leeches in North America. Twenty-five percent of these are not parasitic, and only a few are parasitic on humans. Very few leeches are encountered in fast moving riffle areas. Many are scavengers or feed on other macroinvertebrates.

What do they look like? Leeches are usually brown and end in suction pads. Suckers located at both ends are used for attachment, feeding, and locomotion; the sucker pad on one end is usually larger. Leeches are ¼ to 2 inches long. They have a worm-like segmented body, flattened, wider than it is tall. Leeches can swim gracefully--quickly in an up and down motion; or they may move by attaching suckers from end to end.



Distinguishing features: They are brown and slimy looking with a suction pad at each end.

Where do they live? They are usually found on the stream bottom or on vegetation.

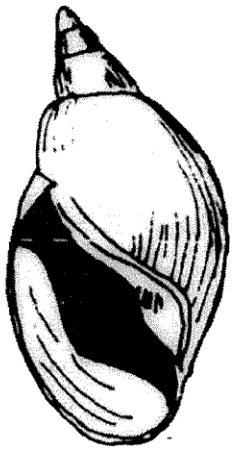
Where do River Watchers usually find them? Leeches can turn up in the tub after a bottom scraping, or on the underside of rocks.

Do they look different as adults? No.

23. Pouch Snail And Pond Snails (Class Gastropoda)

Pouch snails are lunged (pulmonate) and trap pockets of air in the space between their shell and body (the mantle cavity). Since lunged snails can get air from above the water surface, they are not sensitive to the high levels of organic pollution which can reduce dissolved oxygen levels in a stream.

What do they look like? Pouch and pond snails are similar to gilled snails, with a conch or limpet shaped shell, but their opening is on the left. Also, they do not have a plate-like covering over the shell opening as do gilled snails. To determine right or left opening, hold the shell with the tip pointing up and the shell's opening toward you.



Distinguishing features: Conch or limpet shaped shell, opening on the left. No plate-like covering over opening.

Where do they live? They are found on the stream bottom or attached to rocks.

Where do River Watchers usually find them? They are often seen on rocks and sometimes in the sample tub after a stream bottom or stream bank scraping.

Do they look different as adults? No.

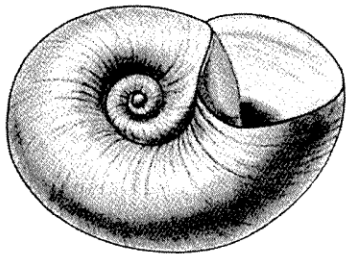
24. Other snails (Class Gastropoda)

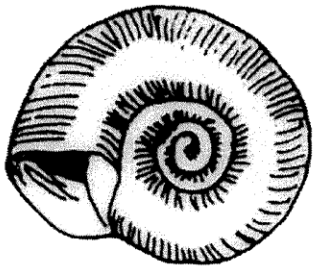
What do they look like? Snails with shell coils in one plane.

Where do they live? They are found in shallow freshwater habitats. Some are known to burrow in the soft stream bottoms or detritus.

Where Do River Watchers usually find them? They are often seen on rocks and sometimes in the sample tub after a stream bottom or stream bank scraping.

Do they look different as adults? No.





Related Web Sites

Identification Information on Macroinvertebrates

An Introduction To Benthic Macroinvertebrates: *Online version of McCafferty's identification key and illustrations.*
http://osf1.gmu.edu/~avia/intro.htm

Missouri Stream Team Macroinvertebrate Website: *Contains photos of macroinvertebrates.*
www.rollanet.org/~streams/macroinv/

Digital Dragonflies: *Information and pictures of different types of dragonflies.*
www.dragonflies.org/welcome.html

Leska Fore: *Field guide to freshwater invertebrates.*
www.seanet.com/~leska

General Information About Water Quality

EPA Office of Water: **www.epa.gov/owow**

Izaak Walton League Website: **www.iwla.org**

Clean Water Network: *Updates, action alerts, and information about water quality issues nationwide.*
www.cwn.org

Haw River Facts: *Threatened Species on the Haw include the Squawfoot mussel and Savannah Lilliput mussel.*

Initial Stream Assessment/ Documentation of Changes Occurring Overtime Monitoring Survey Section B

If there is foam, is it:

❑ivory brownish, less than 8" high, w/earthy, fishy, or fresh cut grass smell? [Natural foam]

❑ bright white, over 8" high, with perfumy or artificial "fresh" soapy scent? [Indicates pollution problem]

Wildlife

Mussel shells seen? ❑Yes ❑No

Fish seen? ❑Yes ❑No

Signs of beaver? ❑Yes ❑No

If Yes, describe:_____

Signs of other wildlife observed:

_____

_____

_____

Odor: (check one)

❑ rotten eggs
❑ musky
❑ petroleum
❑ sewage
❑ none
❑ other _____

_____

_____

Water Appearance: (you may check up to two items from the list below)

❑ clear ❑ clear but tea-colored
❑ cloudy ❑ muddy
❑ milky ❑ colored sheen (oily)
❑ grey ❑ black
❑ foamy ❑ green (suspended algae)
❑ other _____

SECTION B. *The following aspects of the stream don't change often. Fill in this section on your first survey, and be sure to keep a copy to refer to. Thereafter, fill in an item only if it changes. Photographs are very useful in recording changes to your stream.*

Stream Channel *Answer these questions for a stream length of four times the stream width, with monitored section close to middle.*

Average stream width _____ ft. Average stream depth _____ ft. Is stream channel natural and meandering? ❑Yes ❑No

Does stream have access to its flood plain (is there stream deposit or debris on banks, streamside trees & rocks)? ❑Yes ❑No

Has stream been channelized? ❑Yes ❑No Is there rip-rap in stream? ❑Yes ❑No Do manmade dams block flow? ❑Yes ❑No

Stream Buffer Natural vegetation (a mix of trees, shrubs, and ground cover), looking dowstream: _____ feet left bank; _____ feet right bank

Description of stream buffer: _____

Stream Sides

Are stream banks (sides) eroding? ❑Yes ❑No

_____% bare soil on stream banks (not covered by plants, rocks, and logs)

Is stream getting cut deeper? ❑Yes ❑No

Is stream widening? ❑Yes ❑No

Stream Shade

❑Best (25 - 90% shade--sun-dappled stream)
❑Good (>90% shade -- almost totally shaded)
❑Poor (<25 shade - almost no shade)

Stream Bed (bottom) (=100%):

_____% silt (mud)
_____% sand (1/16" - 1/4" grains
_____% gravel (1/4" - 2" stones)
_____% cobble (2" - 10" stones)
_____% boulders (>10" stones)
_____% dead leaves

Bed sinks beneath your feet in:
❑no spots ❑a few spots ❑many spots

Stream Buffer Composition (=100%):

_____% trees
_____% shrubs
_____% grass
_____% bare soil
_____% rocks
_____% other _____

Land Uses in the Watershed: *Record all land uses observed in the watershed area nearby (one mile upstream) and surrounding your sampling site. Indicate whether the following land uses have a High (H), Moderate (M), Slight (S) or No (N) potential to negatively impact the quality of your stream. If the land use is not present in your watershed, leave it unmarked.*

❑H ❑M ❑S ❑N Oil & gas drilling
❑H ❑M ❑S ❑N Housing developments
❑H ❑M ❑S ❑N Forest
❑H ❑M ❑S ❑N Logging
❑H ❑M ❑S ❑N Urban uses (highways, parking lots, etc.)
❑H ❑M ❑S ❑N Sanitary landfill
❑H ❑M ❑S ❑N Housing construction
❑H ❑M ❑S ❑N Road construction
❑H ❑M ❑S ❑N Mining (types _____)
❑H ❑M ❑S ❑N Cropland (types _____)

❑H ❑M ❑S ❑N Trash dump
❑H ❑M ❑S ❑N Fields
❑H ❑M ❑S ❑N Livestock pasture
❑H ❑M ❑S ❑N Animal operations (types_____)
❑H ❑M ❑S ❑N Other possible sources of pollution (describe: _____

_____

_____)
❑H ❑M ❑S ❑N Garbage/litter (Type: _____

_____)

Discharging Pipes Are there any discharging pipes? ❑Yes ❑No If Yes, how many? _____

What types of pipes? ❑runoff (field or stormwater?)_____ ❑sewage treatment ❑industrial (type of industry) _____

Other comments on your stream's health and condition: _____

_____

_____

_____

10.Examine rocks. Pick up 4 to 5 good-sized rocks from the stream-bed, one at a time, and look for macro-invertebrates living on the rocks. Identify and count the macro invertebrates. Record data on your survey form.

11.Catch critters with net. Find a good place to set the net so that:

- The net touches the bottom of the stream
- The net is in a fast flowing area
- There is a little channel leading to the net so that the critters cannot escape around the edges of the net.
- For 30 seconds, agitate the stream bed or river bottom so that the loosened material flows into the net.
- Put contents in a collection bin and begin identifying and counting the macro-invertebrates (Be sure to look at the net, as some critters tend to cling to them.)
- Repeat this process 2 more times, as well as for an equal amount of time, at different locations within your monitored section to remove biases and improve accuracy.

12. Pick up rocks from the stream-bed one at a time and rinse them thoroughly into collection bin for identification.

- Use petri-dishes to separate macro-invertebrates and identify with the hand lenses provided in your RW kit *(make sure to put water from your collection bin in the petri dish before placing the specimen in)*. Be mindful of which macro-invertebrates are aggressive to other macro-invertebrates and separate them as soon as possible to alleviate stress and competition for space of specimens.
- Use the pipet to collect smaller macro-invertebrates in order to avoid damaging them and then release them into a petri dish for identification. *(Do not use pipets to collect leeches, as they tend to get stuck inside the pipet.)*
- Keep collection bins out of the sun while identifying specimens, as it heats up the water and can kill the specimens.
- Return specimens as quickly as possible back into the stream or section of river from which you found them.
- Repeat this process 4 more times, as well as for an equal amount of time, at different locations within your monitored section to remove biases and improve accuracy.

13.Examine leaf habitats. Grab a clump of old leaves, not new ones, along with some sticks.

- Place in the tub and look for movement.
- Identify and record critter count.
- Return all leaves and macro- invertebrates back to the location where you found them.

- Repeat this step 2 more times at different locations within your monitoring section for the same amount of time to remove biases and improve accuracy.

14.Check stream bank. The goal is to find different habitats.

- Using your net, scoop in an upward motion along the edge of the stream or in another area different from other sample areas.

- Scoop the net back and forth a few times to catch the critters that have been dislodged.

- Put the contents in the collection bin, separate into petri dishes, and count the macro- invertebrates.

- Repeat this step 2 more times at different locations within your monitoring section for the same amount of time to remove biases and improve accuracy.

Once the collection portion of this process is complete, make sure to rinse out each bin thoroughly and make sure there aren't any macro-invertebrates left clinging to the bottom and sides. Make sure net is free and clear of specimens.

15.Record the water temperature on the survey form.

16. Record (if any) the type of algae you find.

(Note: The excessive growth of algae, called "algae blooms", can indicate an imbalance in the stream's ecology and can be harmful to the aquatic life.)

- Algal blooms can be caused by excess nutrients in the stream, from sources such as: fertilizer runoff, wastewater treatment plant discharges, failed septic systems or leaking sewer lines, industrial discharges, and excess organic matter. The bacteria that decompose algae suck oxygen out of the water, depleting the oxygen essential to aquatic life. This can cause fish and insect kills, and loss of species diversity.

- The most commonly found types of algae in our watershed are: phytoplankton type algae, filamentous type algae, periphyton type algae, and diatomaceous type algae.

- **Phytoplankton type algae**: Is the water discolored with green, bright blue, or red? Phytoplankton are algae that are suspended in the water. NOTE: Most phytoplankton are too small to be individually seen with the unaided eye. However, when present in high enough numbers, they may appear to discolor the water.

- **Filamentous type algae:** Is the algae in big, thick "hair like" mats (green, blue-green, black, yellowish)?

- **Periphyton type algae:** Are the rocks covered with a "bearlike" growth? Periphyton is a complex mixture of algae, cyanobacteria, heterotrophic microbes, and detritus that is attached to submerged surfaces in most aquatic ecosystems. It serves as an important food source for invertebrates, tadpoles, and some fish. It can also absorb contaminants, removing them from the water-column and limiting their movement through the environment. This type of algae is also an important

indicator of water quality; responses of this community to pollutants can be measured to indicate physiological to community-level changes.

- Diatomaceous type algae: Is there brown slimy algae on the rocks? Diatomaceous type algae become part of the "biofilm" that forms on rocks in the stream, and serves as an important food source for "grazers" such as snails and caddisflies.

17. Note the quantity of algae.

- Everywhere? In spots?

- What percentage of the stream is covered with algae? (for one stream width by one stream width area)- Are you seeing an unusual amount of algae for your stream or section of river?

We ask that all teams take pictures in addition to filling out this section.

Select a length of the stream, called a "reach", to evaluate.

The reach should be four times the stream width, with the monitored riffle somewhere in the middle.

For your stream's reach, estimate:

- Average stream width, in feet
- Average stream depth, in feet

Is the stream channel natural and meandering?

- A healthy stream will have curves and bends, called “meanders”.
- Meanders slow down water, decreasing stream channel erosion.
- Meanders help provide pools (stiller, deeper areas of the stream),and riffles (rapidly flowing, shallower, highly oxygenated areas).
- These are habitats for fish and different kinds of insects in the stream.

Does the stream have access to its flood plain?

At times of extremely high water, the Haw River here at Chicken Bridge can flood its banks easily.

- A healthy stream will be able to access its floodplain during heavy rain events, allowing it to release energy.
- Streams that cannot flood their banks get deeply incised, losing pool and riffle habitats.
    - Check for evidence of occasional flooding (every 1 to 2 years): stream deposit or debris on banks, streamside trees, and rocks.

Has the stream been channelized?

Decades ago, many urban streams were channelized.

Look for evidence that the stream was channelized: concrete stream banks, and/or an unnaturally straight stream.

Is there rip-rap in the stream?

Rip-rap is a layer of large stones or broken rock placed on an embankment as erosion control and protection.

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Do man-made dams block the flow?

Evaluate your stream buffer.

- Buffers of natural vegetation along each stream bank are essential in protecting water quality.
- They hold the soil in place, filter pollution, and slow down stormwater runoff.
- **Looking downstream, estimate the number of feet of natural vegetation** (a mix of trees, shrubs, and ground cover), **for each bank**.

Evaluate your stream buffer (cont.).

Describe the stream buffer. For example, is it mostly forested, bare soil, pasture, or mown grass?

(At *left*) This ideal, naturally vegetated stream buffer is forested with a mix of trees and shrubs, with no bare soil.

(At *right*) The buffer for this in-town stream consists of mown grass and a few trees and shrubs.

(At *left*) The buffer for this urban stream consists of kudzu, an invasive plant.

(At *right*) This creek buffer in a newly constructed subdivision has bare soil, patchy grass, and rip-rap.

Evaluate the stream sides.

Stable stream banks are not eroding, have little bare soil, are not getting cut deeper, and are not widening.

- Are stream banks (sides) eroding?
- Enter the percentage of bare soil on stream banks. (What % is not covered by plants, rocks, and logs?)
- Is the stream channel getting cut deeper?
- Is the stream channel widening?

This stream bank is badly eroded. The stream channel is getting cut deeper (incised).

Describe the stream bed bottom.


Leaves in stream during drought.

- Using percentages, describe the composition of the stream bed (the bottom of the stream).
  - % silt (mud)
  - % sand (1/16” to 1/4” grains)
  - % gravel (1/4” to 2” stones)
  - % cobble (2” to 10” stones)
  - % boulders (over 10” stones)
  - % dead leaves
- How soft or hard is the stream bed bottom?
- The stream bed sinks beneath your feet in:
  - no spots
  - a few spots
  - many spots


Gravel in stream.


Cobbles in riffle.


Walking on boulders.

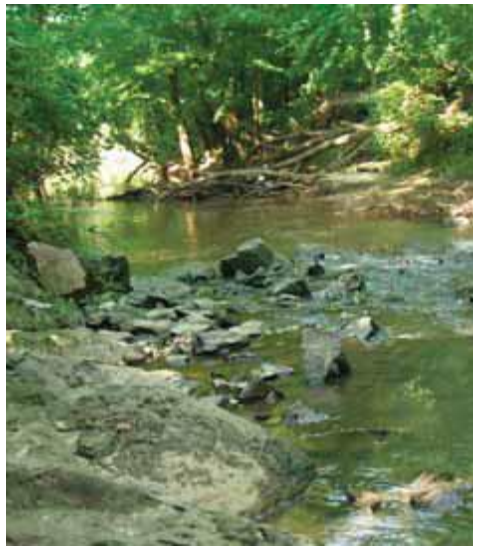
Describe the stream buffer composition.

Using percentages, describe the composition of the stream buffer.

- % trees
- % shrubs
- % grass
- % bare soil
- % rocks
- % other

Trees: A naturally vegetated stream buffer has lots of trees.

Shrubs: Native plants were planted in this stream's restoration.



Rocks: The left stream buffer consists of some rock.

Grass: This urban stream's buffer consists mostly of grass.

Bare soil: This buffer has been cleared down to the river.

Evaluate the stream shade.

Ideally, a stream will be "sun-dappled": not entirely shaded nor entirely in the sun. Some sun is helpful in promoting growth of algae, a necessary food source for aquatic life. Too much sun overheats the water which stresses aquatic life.

- Best (25 to 90% shade--sun-dappled stream)
- Good (over 90% shade--almost totally shaded)
- Poor (under 25 shade--almost no shade)

Poor: One of this urban stream's many problems is that it gets no shade.

Note land uses in the watershed.

- The intent of this section of the survey is to determine what nearby land uses negatively impact the health of your stream.
- For the area surrounding your site and including the area up to one mile upstream of your site, note land uses (see categories on the following page.) For each land use, check one of the following:
    - **H** to indicate a High potential negative impact; OR
    - **M** to indicate a Moderate potential negative impact; OR
    - **S** to indicate a Slight potential negative impact; OR
    - **N** to indicate No potential negative impact.
- NOTE: If the land use is not present in your watershed, leave it unmarked.

How do these land uses affect your watershed?

- Oil & gas drilling
- Housing developments
- Forest
- Logging
- Urban uses (highways, parking lots, etc.)
- Sanitary landfill
- Housing construction
- Road construction
- Mining (list types)
- Cropland (list types)

- Trash dump
- Fields
- Livestock pasture
- Animal operations (list types)
- Other possible sources of pollution (describe)
- NOTE: If you know of any sewer sludge application fields in your watershed, these are important to note.

The round hole in the culvert to the right of the stream is a pipe discharging urban stormwater runoff.

Note any pipes that discharge into your stream.

- Are there discharging pipes?
- If so, how many?
- What types of pipes are they?
- Runoff (note if field or stormwater)
- Sewage treatment plant discharge point Industrial (note type of industry)

Comment on your stream's health and condition.

There is space on your survey form to note any other information about your stream's health, or your monitoring session.

Additional Information: Riparian Buffers

What is a Riparian Buffer?

Riparian buffers are a river's best hedge against erosion and pollution. Riparian buffers are the single most effective protection for our water resources. These strips of grass, shrubs, and/or trees along the banks of rivers and streams filter pollution runoff and provide a transition zone between water and human land use. Buffers are also complex ecosystems that provide habitat and improve the stream communities they shelter.

The following page shows illustration that compare an intact and healthy riparian buffer (top) and a damaged buffer (bottom) as it might appear along a tributary stream to the Haw River.

The top left in the illustration is a representation of how a riparian buffer might appear in forest and woodlands. The top right side of this illustration shows how the buffer may appear along fields, piney woods and grasslands. In a healthy buffer in the woodlands (top left), there are tall and understory trees, plants and leafy ground litter. The slopes may be steep, but they are anchored by rocky outcrops, vines and small shrubs.

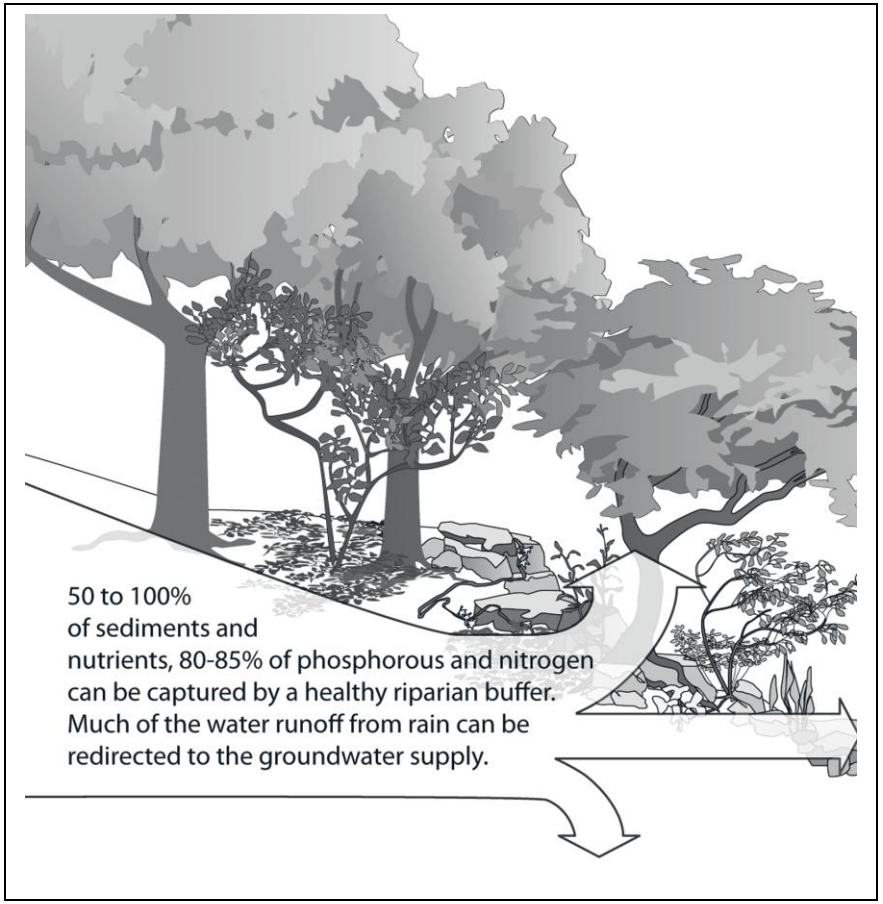
In a damaged riparian buffer (bottom left of the illustration), many of the plants and rocks nearest the water have been washed downstream, the banks are bare, steep and muddy. In many places the banks are deeply undercut, and the bare roots of the anchoring plants are hanging in the air. In the piney woods and grasslands buffers (top right) there may be a natural flood plain filled with many herbaceous and woody plants. The stream itself has gently sloping sides with many plants growing directly on its banks and it is not overly filled with sediment. In a damaged grasslands buffer (bottom right), the floodplain has been eroded away, the banks may be bare soil and there is no shade for the stream. The stream itself may be wider than normal and is full of sediment.

How Riparian Buffers Work to Protect Streams

Sediment Filter Riparian Buffers help catch and filter out sediment and debris from surface runoff. Depending upon the width and complexity of the buffer, 50 – 100% of the sediments and nutrients attached to them can settle out and be absorbed as buffer plants slow sediment – laden runoff waters. Wider, forested buffers are even more effective than narrow, grassy buffers.

Pollution Filter, Transformer, and Sink The riparian buffer traps pollutants that could otherwise wash into surface and groundwater. Phosphorous and nitrogen from fertilizer and animal waste can become pollutants if more is applied to the land than plants can use. Because excess phosphorous bonds to soil particles, 80-85% can be captured when sediment is filtered out of surface water runoff by passing through the buffer. Chemical and biological activity in the soil, particularly of streamside forests, can capture and transform nitrogen and other pollutants into less harmful forms. These buffers also act as a sink when nutrients and excess water are taken up by root systems and stored in the biomass of trees.

Stream Flow Regulator By slowing down the velocity of runoff, the riparian buffer allows water to infiltrate the soil and recharge the groundwater supply. Groundwater will reach a stream or river at a much slower rate, and over a longer period of time, than if it had entered the river as surface runoff. This helps control flooding and maintain stream flow during the driest time of the year.



Bank Stabilizer Riparian buffer vegetation helps to stabilize streambanks and reduce erosion. Roots hold bank soil together, and stems protect banks by deflecting the cutting action of waves, ice, boat wakes, and storm runoff.

Bed Stabilizer Riparian buffers can also reduce the amount of streambed\scour by absorbing surface runoff and slowing water velocity. When plant cover is removed, more surface water reaches the stream, causing the water to crest higher during storms or snowmelt. Stronger flow can scour streambeds and can disturb aquatic life.

Wildlife Habitat The distinctive habitat offered by riparian buffers is home to a multitude of plant and animal species, including those rarely found outside this narrow band of land influenced by the river. Continuous stretches of riparian buffer also serve as wildlife travel corridors.

Aquatic Habitat Forested riparian buffers benefit aquatic habitat by improving the quality of nearby waters through shading, filtering, and moderating stream flow. Shade in the summer months maintains cooler, more even temperatures, especially on small streams. Cooler water holds more oxygen and reduces stress on fish and other aquatic creatures. A few degrees difference in temperature can have a major effect on

their survival. Woody debris feeds the aquatic food web. It also can create stepped pools, providing cover for fish and their food supply while reducing erosion by slowing flow.

Recreation and Aesthetics Forested buffers are especially valuable in providing a green screen along waterways, blocking views of nearby development, and allowing privacy for riverfront landowners. Buffers can also provide such recreational opportunities as hiking trails and camping.

Materials in this manual are drawn from several sources:

We are grateful for permission to use illustrations from **Aquatic Entomology** by Patrick McCafferty, Illustrated by Arwin V. Provonsha, Copywrite 1981, Published by Jones and Bartlett, 40 Tall Pine Drive, Sudbury, MA 01776, info@jbpub.com. We recommend **Aquatic Entomology** as a thorough and accessible reference for all stream watchers.

We thank the **Izaak Walton League** for their excellent stream watch method and materials, on which we have based this manual. Izaak Walton League of America, 707 Conservation Lane, Gaithersburg, MD 20878-2983, 1-800-BUG-IWLA

We are very appreciative for the River Network's wealth of resources on riparian buffers, which we have included in our manual. **River Network: Banks and Buffers, Introduction to Riparian Buffers** / Part of the Living with Rivers Series: **www.rivernetwork.org**

Related Web Sites

-An Introduction to Benthic Macroinvertebrates: *Online version of McCafferty's identification key and illustrations.* **www.osf1.gmu.edu/-avia/intro.htm**

-Missouri Stream Team Macroinvertebrate Website: **www.rollant.org/-streams/macroinv/**

-Field Guide to Freshwater Invertebrates Lesca Fore: **www.seanet.com/-leska**

-North Carolina State University, College of Agriculture and Life Sciences, NCSU Water Quality Programs

-CAPE FEAR RIVER BASIN; **www.water.ncsu.edu/capefear.html**

General Information about Water Quality

EPA Office of Water: **www.epa.gov/owow**

Izaak Walton League Website: **www.iwla.org**

Clean Water Network: **www.cwn.org**

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SPOTTED A POLLUTION PROBLEM? TAKE PICTURES AND REPORT IT!

To effectively protect our watershed, ***we need citizens like you*** to keep their eyes on the river and let the proper authorities know when you see a water pollution problem. Use the information below to ask stream related questions or to report water quality problems, stream mismanagement, or emergencies on a local and state level. ***Your voice counts!***

When calling in a report, please try to do the following: include **the date you saw the problem, the location, description, and digital photographs** if possible. Please also inform the Haw River Assembly of any pollution problems observed; as we keep a record of water quality problems in the Haw watershed ***Thank you for your help and dedication in protecting the river!***

State Government Resources:

For NC Environmental Assistance and information:
Department of Environmental Quality
(877) 623-6748 http://deq.nc.gov/

Regional Contacts for Water Issues:

For Water Quality Questions and Water Pollution Problems, including reporting fish kills, poor stream conditions, turbidity, point and non-point source pollution, chemical spills and other emergencies:

Raleigh Regional Office: (919) 791-4200 **for Chatham, Durham, Orange and Wake counties**

Winston-Salem Regional Office: (336) 776-9800 **for Guilford, Rockingham, Caswell and Alamance counties**

During business hours (M-F, 8am-5pm) call appropriate DEQ regional office listed above.

AFTER HOURS FOR ENVIROMENTAL EMERGENCIES: (such as large pollution spills, dam breaks, major pipeline or sewage spills)

Emergency Management Hotline: (800) 858-0368

Highway Patrol (spills on roads): (919) 733-7952

Sedimentation and Erosion

Local Contacts for Sediment Runoff and Erosion Reporting
City of Burlington: (336) 222-5050
City/County of Durham: (919) 560-0739
City of Greensboro: (336) 373-2158
City of Reidsville: (336) 349-1065
Town of Apex: (919) 249-3413
Town of Cary: (919) 469-4347
Town of Chapel Hill: (919) 245-2586
Chatham County (including Pittsboro): (919) 545-8343
Guilford County: (336) 641-3803
Orange County: (919) 245-2587
Wake County: (919) 856-5531

If no local program is listed, see county list at left to call the Division of Land Quality at the State Regional Office :
Raleigh Regional Office: (919) 791-4200
Winston-Salem Regional Office: (336) 776-9800

Agricultural or forestry practices are exempt from the NC Sedimentation Control Act, but erosion resulting in sediment deposited in streams should be reported to the Raleigh or Winston-Salem Regional offices and to:
NC Division of Soil and Water Conservation: (919) 733-2302 ***or***
NC Forest Service Contact Information: (919) 857-4811

Sediment Runoff/ Erosion Reporting and Prevention
State Office http://deq.nc.gov/about/divisions/energy-mineral-land-resources/erosion-sediment-control
To phone in a report to the state: ***1-866-STOPMUD***