

WORM WATCH

WHAT IS WORMWATCH?

WormWatch is a science based education program that makes learning about the soil ecosystem fun. It is also part of a national volunteer monitoring program used to identify ecological changes that may be affecting our environment.

When we are standing on the ground, we are really standing on the rooftop of another world. Living in the soil are plant roots, viruses, bacteria, fungi, algae, amoebae, protozoa, mites, nematodes, worms, ants, beetles, insect larvae (grubs and maggots), and larger animals. Soil is a habitat: let the WormWatch earthworms lead you through the maze of micro- and macro-pores that are the soil's super-highways. The WormWatch Web site has specific projects that invite participants to collect data on earthworm species and habitats, and more general multidisciplinary curriculum-linked kindergarten to grade 12 activities and investigations for teachers and students.

WHY MONITOR WORMS?

The WormWatch National Earthworm Survey will help scientists determine how many earthworm species are in Canada, and where they live.

This information is important. The number of worms in a specific volume of earth can tell us a lot about how the habitat is being managed, because earthworms are very sensitive to soil disturbance. Learning more about the distribution of earthworm species can be used to help improve soil health and reclaim degraded sites. Gardeners, naturalists, farmers, schoolchildren – everyone can participate in the WormWatch survey. The data you collect will be used to create a Canadian database of earthworm species and habitat distribution. We can't see the big picture without you!

DID YOU KNOW...?

Over half a million earthworms can live in just one hectare of soil. Together, they can eat nine tonnes of leaves, stems and dead roots a year, and turn over 36 tonnes of soil. Imagine how much dead matter would accumulate if all of the earthworms went on strike! Most members of the earthworm family (Lumbricidae) are thought to have disappeared from Canada during the last ice age. Native earthworms survived only in areas that were unglaciated, such as the west coast of British Columbia, parts of the Yukon, and the most southern parts of Eastern and Atlantic Canada. Many of the earthworms we find in Canada today were introduced by European settlers, who valued the ecosystem services provided by earthworms, particularly their role in producing good crops.

Worms are also beneficial to gardeners and fishers. The Dew-worm, or Nightcrawler (*Lumbricus terrestris* L.), is most favoured by these people. However, when introduced into new areas, this species can disrupt the native biodiversity. For example, forests in the northeastern United States of America are not regenerating because of changes caused to the soil habitat by this long-lived earthworm species (www.nrrl.umn.edu/worms). When you are finished fishing, what do you think you should do with the worms that are left over?

Many famous people have recognized the ecosystem services that earthworms provide. Cleopatra declared earthworms to be sacred, and forbade Egyptian farmers from removing them from the land. Aristotle called them the "intestines of the soil." Charles Darwin, who studied earthworms for 39 years, said, "It may be doubted whether there are many other animals in the world which have played so important a part in the history of the world than the earthworm."

WHAT ARE EARTHWORMS?

Earthworms are annelids (phylum Annelida) because they have segmented bodies, and Oligochaetes (class Oligochaeta) because they crawl using both circular and longitudinal muscles located under the skin, while a series of bristles, or setae, anchors each segment. The first segment is the peristomium or mouth. Protruding from the mouth is a tongue-like lobe called the prostomium: a very important characteristic for identifying earthworms to genus. About one-third of the way down the body from the earthworm's head is the clitellum. This saddle or band is definitely swollen and may be coloured white, orange, or reddish brown. Only adult earthworms that are ready to have offspring have a clitellum. And we all know what happens out of the last segment (the periproct) where the anus is located!

How many new words have you found so far?
Which words are written in Latin?

THE DIRT ON EARTHWORM BIOLOGY

The earthworm brain is actually a fused pair of nerve ganglia, mostly located in the third segment. There are three giant nerve fibres that run the length of the body, around the gut. These fibres transmit impulses from the brain which control rapid body movements. Unlike many other invertebrates, the circulatory system is fully closed. One large blood vessel runs the length of the body, immediately beside the gut. Two to five pairs of muscular blood vessels extend from the central vessel and function as hearts to drive the circulatory system. Earthworms, like other Oligochaetes, lack specialised organs for breathing; instead they breathe through their skin. The skin is kept moist by mucus and fluid secreted from the dorsal pore between segments allowing for continuous gas exchange.

Worms are hermaphrodites, which means they are both male and female. Does that mean earthworms can reproduce without another earthworm partner or mate?

Earthworms reproduce from cocoons that contain embryos or fertilised eggs inside a shell made from the hardened gelatin-like material produced from the clitellum that insulated the mating earthworms. Some earthworm species, like *Aporrectodea trapezoides* do not require a mate to reproduce, but most species do require a mate to produce cocoons. Cocoons look a lot like popcorn seeds when they are first deposited, and are very resistant to drought, floods and freezing. When the temperature and moisture conditions are just right, there can be as few as one and as many as five tiny thread-like hatchlings that emerge. The WormWatch Web site has a fun classroom activity that demonstrates earthworm reproduction.

EATING RIGHT

Earthworms mostly eat organic matter (dead plant material and in some cases dung) that is in various stages of decay. There is good evidence that live bacteria and fungi, protozoa, nematodes and mites, and their dead tissues are also an important part of the earthworm diet. Earthworms don't have teeth. They suck food into their mouths with a very muscular pharynx. The virtual worm on the WormWatch Web site demonstrates earthworm digestion.

Earthworms have been further classified by what they eat. Those that live on and near the soil surface, feeding on plant litter, dead roots and/or animal dung in the rich organic matter layer of the soil, are called epigeic. Endogeic earthworms live deeper beneath the soil surface and feed mostly on soil and soil-enriched organic matter. The deep vertical burrowing earthworms, like *Lumbricus terrestris*, feed mostly on surface plant litter, dragging it down into the burrow or piles known as middens. They are called anecic.

Which earthworms on the front of the poster belong to these different ecological categories?

MYTHS ABOUT EARTHWORMS

Is it true that you can cut an earthworm in half and get two earthworms?

No, this is a myth. If you cut close to the end of the tail, the earthworm will regrow another tail. If the earthworm is severed anywhere else on its body, it will die. Please don't test this myth...all living creatures deserve our respect!

MAKING THE SOIL HOME

Earthworms are known to scientists as "ecosystem engineers" because their presence and activities have such a dramatic effect on the soil habitat. The underground burrowing systems that they create increase the amount of water and air that reaches the plant roots and other soil organisms, helping their growth. Most earthworms also mix the plant litter and organic matter into the soil, increasing the speed at which they decay and release nutrients into the soil. In these ways, earthworms recycle nutrients from dead plants and other soil organisms so that they can be used again.

COOL PROJECTS THAT YOU CAN DO WITH THIS POSTER

This poster explains and demonstrates how to use the WormWatch taxonomic key. Once you can identify earthworms, we want to know where you found them. If you don't know which species you found, no worries! On the Web site, just put your cursor on the map at the point closest to where you found the worm, and click.

HOW TO IDENTIFY DIFFERENT EARTHWORMS

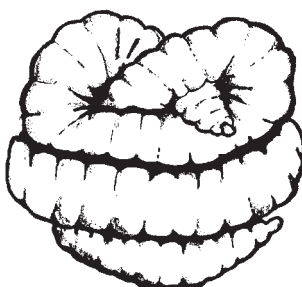
WormWatch uses a new taxonomic key that classifies the earthworms by size, colour, and the pattern of genital tumescences (GT) and tubercula pubertatis (TP) within the region of the clitellum on adult earthworms. Currently, 25 different earthworm species have been found and identified in Canada. Perhaps with your help we can find more! Seven of the 25 species are highlighted on this poster. They are the most common and widely distributed species. If the worms you find are not on this poster, use the key at www.wormwatch.ca.

ID TIPS TO REMEMBER...

Adult earthworms have a band, saddle, swelling or dark discolouration about one-quarter to one-third of the way from the head. Any worm that does not have a clitellum is a juvenile.

Earthworms reproduce by laying a cocoon – a sac that contains the earthworm's eggs. The cocoon is formed at the clitellum and travels to the head. There it slides off the earthworm's body and is deposited into the soil. Cocoons have a slightly hard shell and look like a tiny seed when they are first deposited.

Earthworms can enter into periods of inactivity, or dormancy, as the result of unfavourable conditions (e.g. dry, cold or hot periods). This is known as aestivation. During aestivation the earthworm loses most of the water in its body, and curls up in a knot inside a mucus-sealed chamber.



An Aestivating Earthworm

HOW TO MONITOR WORMS

PICK A SITE

Your back yard, school yard, farmland, forest, grassland – anywhere will do! But remember, earthworms like moist, cool soil. You will probably find the most worms around at wetter, cooler times of the year, or near waterways, ponds, rivers, lakeshores and other consistently wet places.

If it is not your land, seek permission from the landowners or proper authorities to sample. Please never sample or remove anything from a national park. There should be very little evidence of your sampling efforts after you are done. Try to put everything back as you found it.

FLIP, STRIP AND DIG

WormWatch requires you to use the standardized National Sampling Method so that all participants collect data in the same way. Some earthworm species live on or very near the soil surface while others live under the bark of fallen trees and shrubs. To find these earthworms, you need to flip over rocks, logs and other bits of deadfall, and strip back the bark on the soil side of fallen logs that are within your sampling frame. For more information on sampling methods, educational activities and support materials, please see the WormWatch Web site.

EQUIPMENT YOU'LL NEED:

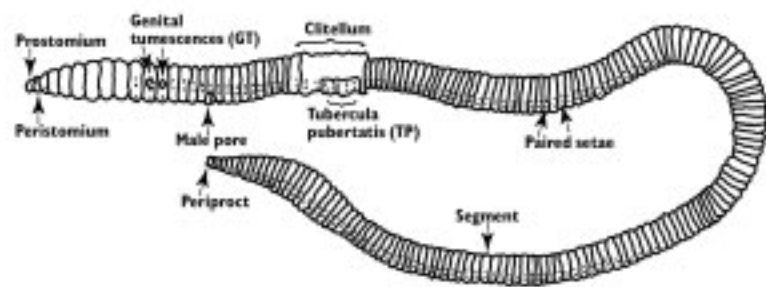
- clothes and shoes that can get dirty;
- partner(s);
- soil thermometer (if you have one – do not use a glass thermometer);
- a shovel or spade (or other tool to flip or strip);
- an Observation Form (for each location);
- a pencil;
- a sampling frame (25 x 50 cm);
- the taxonomic key to adult earthworms found on the WormWatch Web site. You can practice using the taxonomic key with the earthworms depicted on this poster;
- a camera (optional).

GET INVOLVED

The Canadian WormWatch program is a joint venture between Agriculture and Agri-Food Canada, Environment Canada's Ecological Monitoring and Assessment Network Coordinating Office (EMAN CO) and Nature Canada. The information you collect should be submitted directly via the Internet or by mailing your information to the address on the Observation Form.

For more information about earthworm monitoring in your area, go to the National WormWatch Web site at <http://www.wormwatch.ca> (English) or <http://www.attentionvers.ca> (French). Visit the site to register as a WormWatcher on-line, and to find out how to sample and identify earthworms using the taxonomic key provided. You can also use the site to send us your data electronically, which helps to cut costs and saves on paper use.

For additional copies of the WormWatch poster and Observation Form, contact Environment Canada's Ecological Monitoring and Assessment Network Coordinating Office 867 Lakeshore Road, Burlington Ontario, L7R 4A6 phone (905) 336-4411; fax (905) 336-4499; e-mail: info@eman-rese.ca



RECORDING YOUR OBSERVATIONS

Check the Web site for new monitoring protocols and projects!

1. When you arrive at your site, fill out as much information about it as you can on the Observation Form.
2. Rocks, pieces of wood, logs and old dung pats often have earthworms living under them in the cool, moist soil. Rocks beside streams and lakes are good places to look. Place the sampling frame on the ground and gently flip all the rocks that are within the frame to look for epigeic (shallow burrowing) worms. If you are searching under rotting wood, strip back the bark in moist areas and check for bark worms. They are usually small and very red. (Instructions to make a simple sampling frame are on the Web site.) We encourage you to sample several times in the same general area. Keep the data from each frame location separate.
3. Sort the worms into colour and appearance in a shady spot. Count the total number of adult worms of each species, and the total number of juveniles and cocoons and record the numbers on the data sheet.
4. If you have nothing to flip (rocks) or strip (bark on fallen trees), push the spade as far as you can into the soil, flip it and count the worms in the hole. When you're finished, put the soil back as you found it.
5. If you have a camera, take a picture of yourselves and your sites and submit them with your data sheets.
6. You can also illustrate the pattern of GT and TP in the area of the clitellum and include any other noticeable features.
7. Finish filling out the Observation Form and send us your information via the WormWatch Web site at www.wormwatch.ca or by mail.

WORM OBSERVATION FORM

WormWatch, c/o Agriculture Agri-Food Canada, Lethbridge Research Station, P.O. Box 5000 Lethbridge, AB T1J 4B1

Observer's Name(s): _____
Mailing Address: _____
Postal Code: _____ Telephone: _____ Fax/Email: _____

LOCATION OF YOUR SITE (please fill out a separate Observation Form for each site):

Site Number: _____ Latitude: _____° _____' _____" N Longitude: _____° _____' _____" W

Name of nearest road: _____ Name of nearest town: _____

Province: _____

Date (YYYY/MM/DD): _____ Time: _____ a.m. p.m. (circle one)

Habitat Description (Please check the descriptions that apply to your site. You can choose more than one):

- Hardwood Forest (deciduous) Softwood Forest (coniferous) Mixed Wood Forest
 Grassland Farmland Abandoned Farmland
 Marsh, Bog or Wetland Residential Gardens and Lawns School Yard Empty Lot

Soil Type (Please check the descriptions that apply to your site. You can choose more than one):

- Rich and loamy Rocky Sandy Water saturated/muddy Clay Moist Dry
 Other (please describe): _____

Soil Colour (Please check the descriptions that apply to your site. You can choose more than one):

- Light brown Dark brown Black Red
 Other (please describe): _____

Soil Temperature (if available): _____ °C

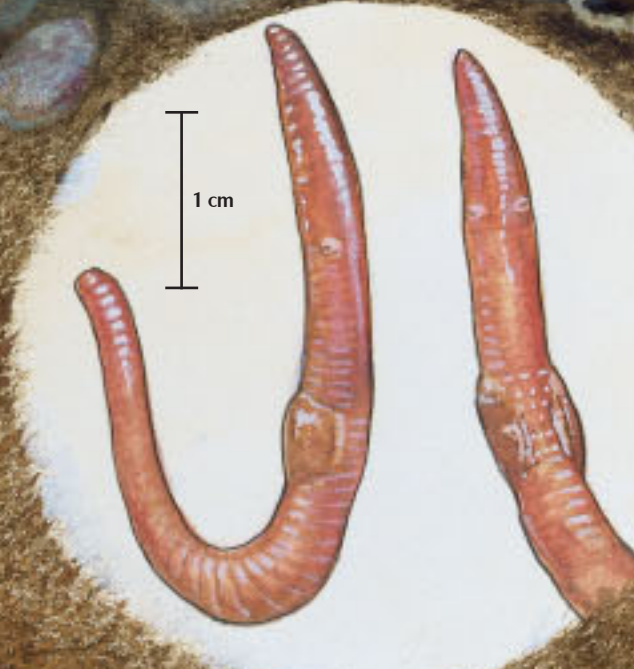
Weather Conditions:

Air Temperature: _____ °C Overcast (estimate cloud cover): _____ % Raining Y or N Dry Y or N Sunny Y or N Windy Y or N

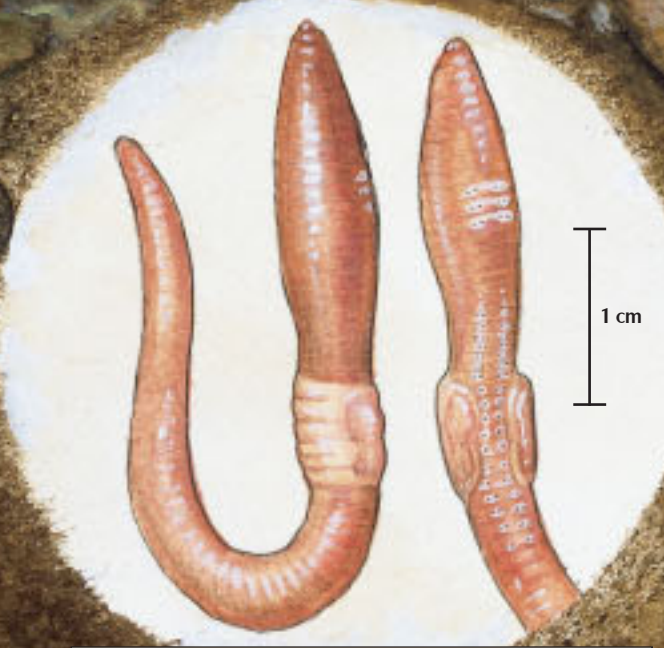
Other: _____

WORM SPECIES	Samples Enclosed	Number of Worms	Aestivating (Dormant)
Species A _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species B _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species C _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species D _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species E _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species F _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N

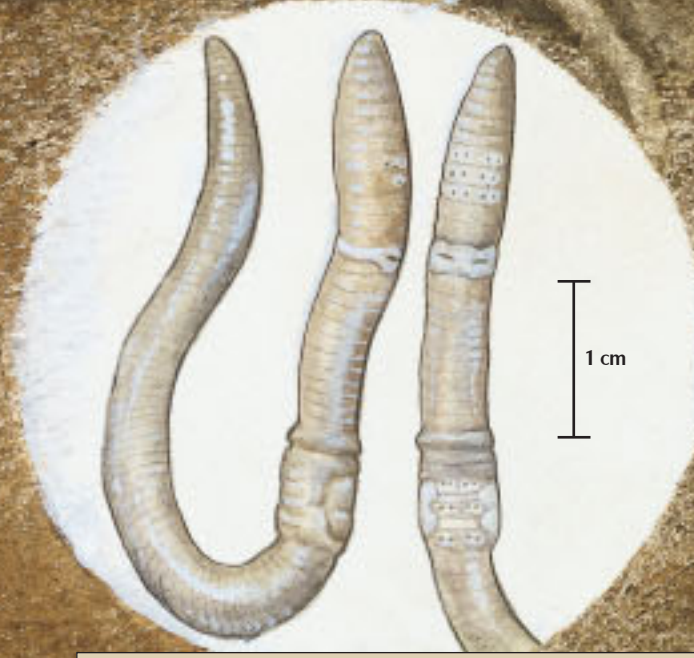
If you find an earthworm that cannot be identified using the taxonomic key, or if you need your earthworm identifications verified, please go to the WormWatch Web site for instructions.



Octagonal-tail Worm
Dendrobaena octaedra
 Length: small (up to 55 mm)
 Colour: varies from red, dark red, to purple
 Epigeic: (shallow burrower)
 ID Tip: The segments after the clitellum (all the way to the tail) have a slightly octagonal shape. Tip of tail same colour as body; GT in clitellum

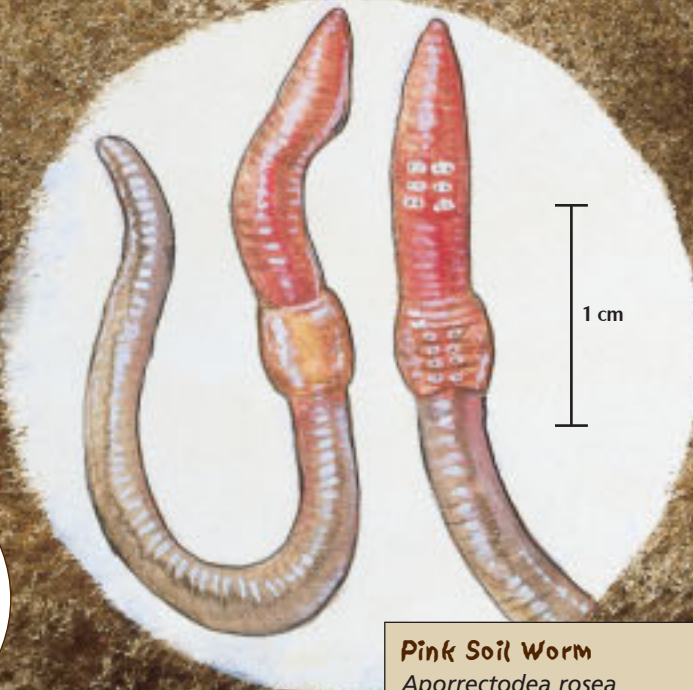


Dew-worm or Nightcrawler
Lumbricus terrestris
 Length: large (111-300 mm)
 Colour: brownish-red or violet colour on its dorsal (top) side; yellowish-orange on its ventral (under) side
 Anecic: (deep burrower)
 ID Tip: More than 2 cm between nose and start of clitellum; the segments located behind the clitellum to the tip of tail are often quite flat



Canadian Worm
Aporrectodea tuberculata
 Length: medium (56-110 mm) to large (111-300 mm)
 Colour: white or greyish
 Endogeic: (mid burrower)
 ID Tip: Alternating pattern of three pairs of GT; TP look like pyramids with their points facing into non-GT segments

Pasture Worm
Aporrectodea turgida
 Length: medium (56-110 mm) to large (111-300 mm)
 Colour: brownish to greyish
 Endogeic: (mid burrower)
 ID Tip: Pattern of GT (three pairs together at the tail-end of the clitellum): one part of the TP pointing to the middle pair of GT, and the other pointing to the non-GT segment before the group of GT



Pink Soil Worm
Aporrectodea rosea
 Length: small (up to 55 mm)
 Colour: nose is bubble gum pink, the rest of the body is a greyish colour
 Epigeic: (shallow burrower)



Woodland White Worm
Octolasion tyrtaeum
 Length: medium (56-110 mm) to large (111-300 mm)
 Colour: grey-white, bluish-grey, may have white patches near tail
 Endogeic: (mid burrower)
 ID Tip: No GT within the clitellum area; long, whitish, pencil-thin TP along the edges of the clitellum



Red Marsh Worm
Lumbricus rubellus
 Length: medium (56-110 mm)
 Colour: varies from ruddy brown to red-violet. It is iridescent dorsally and pale yellow ventrally
 Epigeic: (shallow burrower)
 ID Tip: GT on all segments in clitellum and on segments surrounding clitellum

HINTS TO HELP YOU IDENTIFY YOUR WORMS...

- You can only identify adult earthworms that have a band, saddle, swelling or dark discoloration about one-quarter of the way down from their heads. This is the clitellum.
- Different types of earthworms are often different sizes. How big is your worm – small (up to 55 mm), medium (56-110 mm) or large (111-300 mm)?
- What colour is your earthworm? Use the illustrations on this poster to help you decide. Make sure you look at the top (dorsal) and under (ventral) sides of the worm. Look at the colour of the earthworm between the head and the clitellum. Is it dark red or red-violet (like *L. terrestris*)? Is it green? Or is it some other colour (like *A. rosea*)? Is it solid or striped? Is the tail the same colour as the rest of the worm (like *D. octaedra*) or is it different?
- Where are the GT (genital tumescence) and the TP (tubercula pubertatis)? To find them, look on the ventral side of the clitellum. Pay close attention to the patterns they form. Are the GT on alternating or consecutive segments? Are the GT located outside the clitellum as well as inside (like *L. rubellus*)? Or are there no GT inside the clitellum (like *O. tyrtaeum*)? What shape are the TP – lobed (like *A. turgida*), long and indistinct, or pyramid-like (like *A. tuberculata*)?



Illustration by Wallace Edwards