
2019 Arnold Arboretum Summer Institute
Investigating Ecosystems Through Field Work

Fieldwork

What is it?

- Practical work conducted by a researcher in the natural environment, to gain experience and knowledge through firsthand observation.

Why is it important?

- Provides students with place-based, real life inquiry opportunities to self-direct interest and engage in science practices.

How is it used?

- Fieldwork is used to understand how natural environments function.

What does it look like?

- That depends on the topic, area of inquiry, and location.

Preliminary Site Survey

Habitat analysis measures and describes the settings in which organisms live, while

Ecosystem analysis studies a system of exchanges and interactions between a community and its abiotic environment.

Document the following:

Type of habitat: describe vegetation, dominant physical and chemical factors

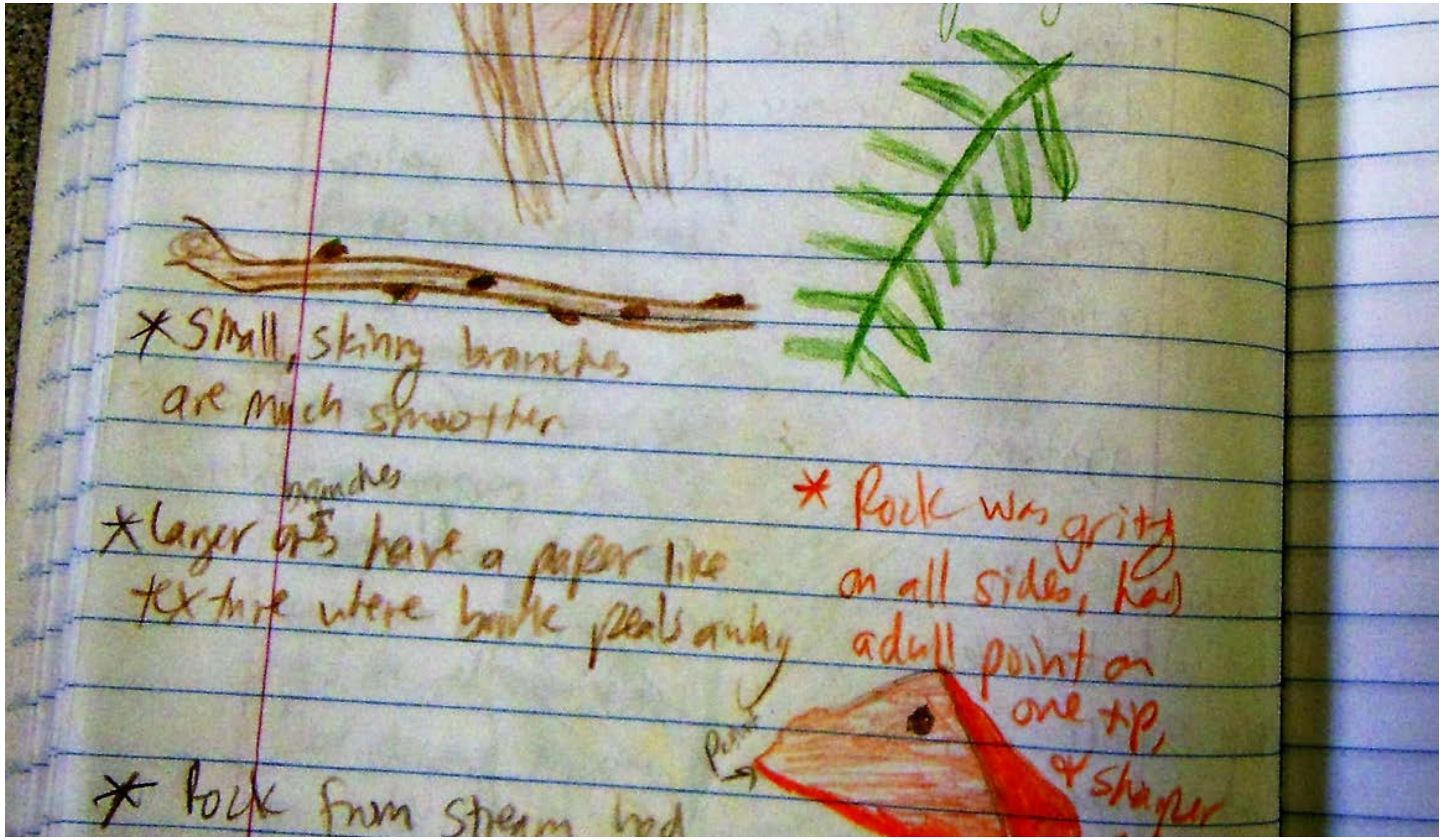
- Topography, surface features, elevation, bodies of water; cardinal direction, sun position
- Describe basic organization, general appearance, and specific forms of the vegetation; foliage density, coverage, plant heights/layers (stratification)

Animal sightings and evidence

Time, location, general weather conditions

Date and season

Record questions that arise



Field Journal

A field journal provides the foundation for the learning process. A place where students make their drawings, record their observations and questions, and keep a running record of their fieldwork.

- DATA

It is important to visit a site often. The journal will evolve as students become more familiar with their site, allowing room for wonderings, new noticings, and a sense of ownership.

Ecological Sampling

If we want to know what kind of plants and animals are in a particular habitat, and how many there are of each species, it is usually impossible to go and count each and every one present

This is solved by taking a number of samples from around the habitat, making the necessary assumption that these samples are representative of the habitat in general.

Samples are usually taken using a standard sampling unit of some kind. This ensures that all of the samples represent the same area of the habitat each time.

Sample size

Large numbers of samples/records are taken from different positions within the habitat.

At least 10% of the total area

Each group should assess the contents of around 10 quadrats to get a reliable estimate of the species distribution.

You can test whether your sample size is big enough by comparing the results from two groups sampling the same area. If their results are very similar, your sample size is big enough to be a good estimate of the populations in the area.

Quadrat

The usual sampling unit is a quadrat. Quadrats normally consist of a square frame, the most frequently used size being $1m^2$. The purpose of using a quadrat is to enable comparable samples to be obtained from areas of consistent size and shape.

Other sampling units:

- Standard size bottles or containers for water
- Individual animal for markings
- Individual leaves for parasites/pests

Basic Vocabulary

Species richness: the number of different species in a given, defined unit such as a quadrat, lake, county…

Abundance: total number of an individual species in a sample

***Density**: total number of an individual species per area sampled

***Frequency**: total number of samples in which at least one of this species occurs, expressed as %

***Coverage**: total area (or percentage) covered by an individual species per sample

Basal Area: commonly used for woody plants. The cross-sectional area of all trees of a given species combined

Basic Measurements

Density:

D = total number of an individual species/sample area

Frequency:

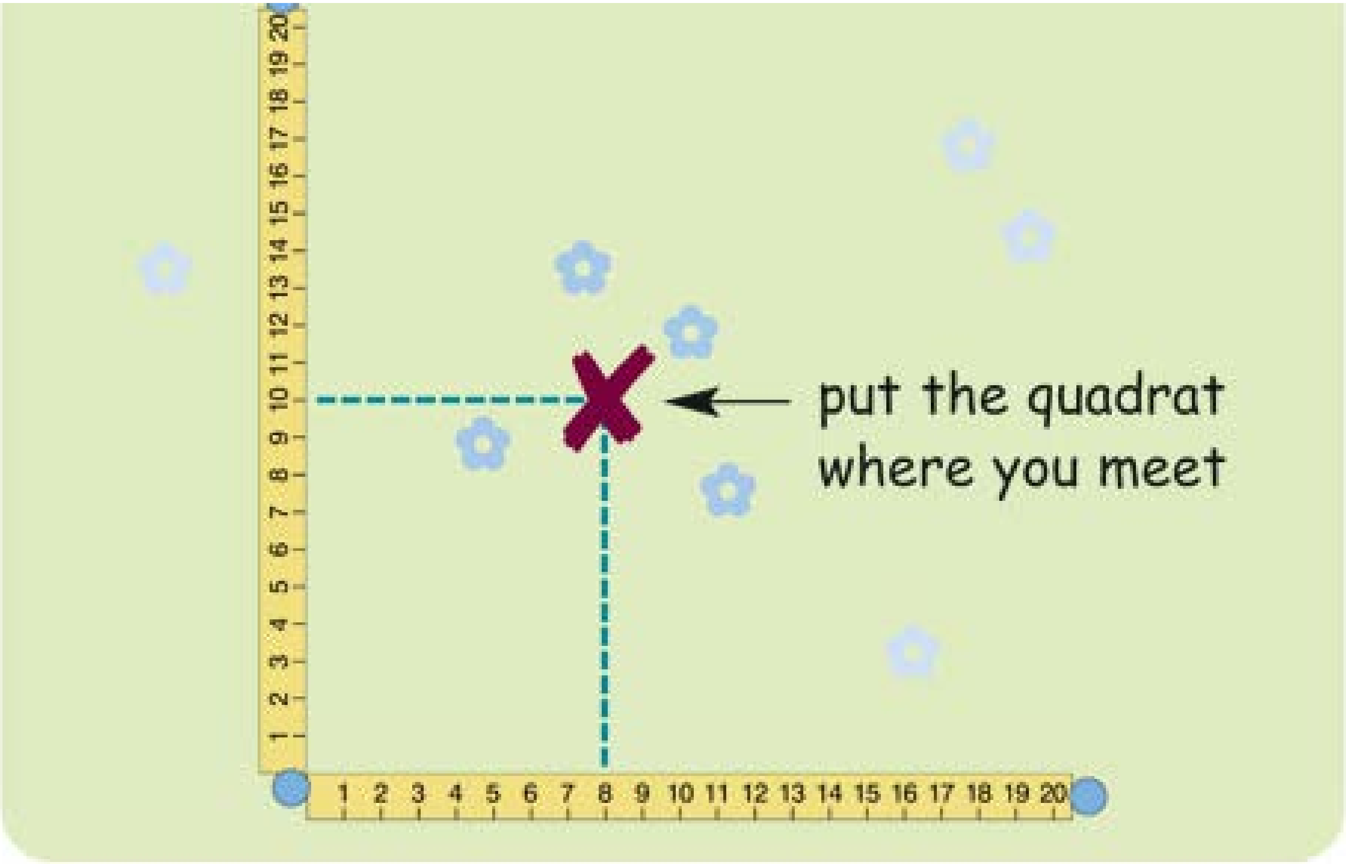
F = [# of quadrats in which an individual species occurs/total number of quadrat samples] x 100

Coverage:

C = area or percentage covered by an individual/sample

Basal Area:

BA = $[3.14*d^2]/4$ for each tree, add all tree values/sample area



Random Sampling

A random sample will give you descriptions characterizing an area. This is useful if you want to compare two contrasting habitats. You could make random samples on two different areas of grassland in the school – such as the playing field and any open areas that get less foot traffic, or two different parts of the playing field to see if there are any differences

Systematic Sampling

Systematic sampling is when samples are taken at fixed intervals, usually along a line. This normally involves doing transects, where a sampling line is set up across areas where there are clear environmental gradients.

- Sun into shade
- Elevation
- Distance from water source
- Changes between two habitats

Line Transect method

A transect line can be made using a 20m, 50m, or 100m nylon rope marked and numbered at 0.5m, or 1m intervals, all the way along its length.

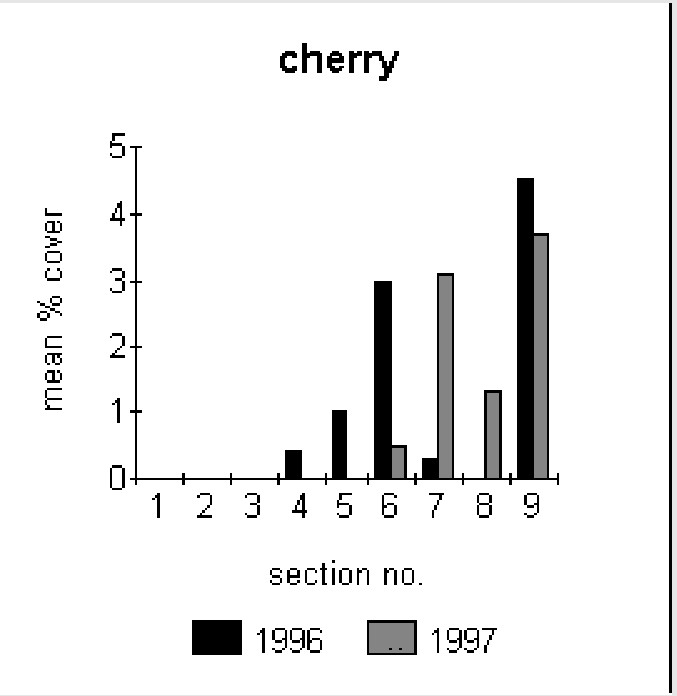
A line transect is carried out by unrolling the transect line along the gradient identified. The species touching the line may be recorded along the whole length of the line (continuous sampling). Alternatively, the presence, or absence of species at each marked point is recorded (systematic sampling)

Belt Transect method

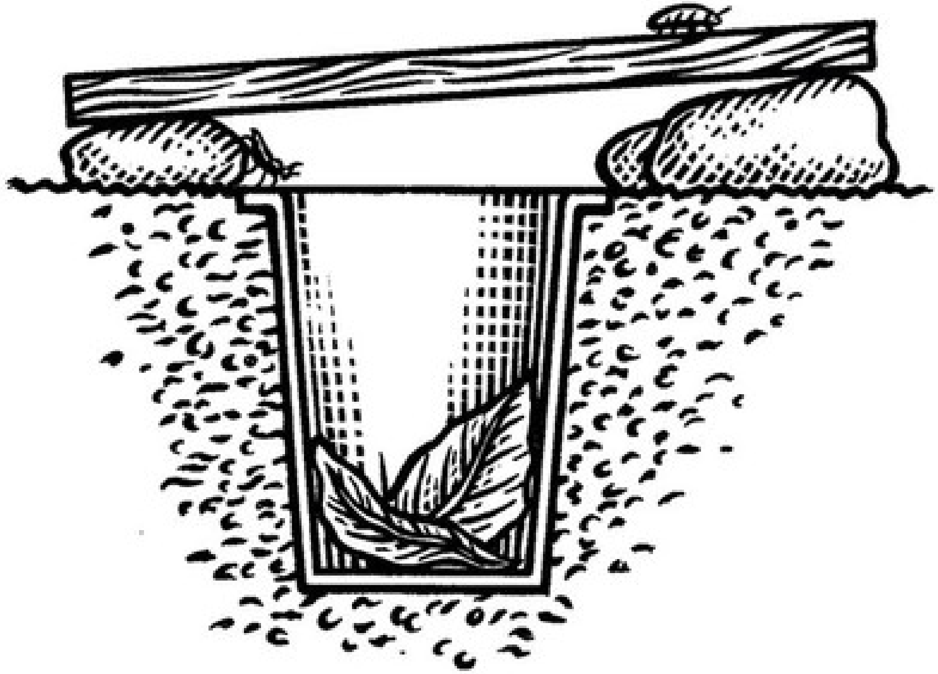
In this method, the transect line is laid out across the area to be surveyed and a quadrat is placed on the first marked point on the line. The plants and/or animals inside the quadrat are then identified and their abundance estimated.

Quadrats are sampled all the way down the transect line, at each marked point on the line, or at some other predetermined interval (or even randomly) if time is short.

Belt Transect data example



This figure illustrates the distribution and abundance of cherry seedlings along a transect line. The parent cherry trees were adjacent to section number 9. The gradient of distribution apparent in the figure is a result of the dispersal of seeds outwards from this point.

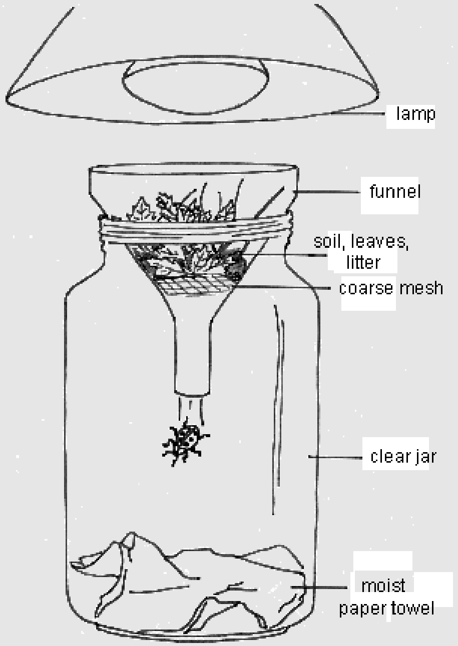


Pitfall Trap

Pitfall traps are containers, such as glass jars and plastic cups, sunk into the soil for animals to fall into. They work for running or crawling invertebrates. Place a cover, raised on stones, above the trap to keep out the rain.

Pitfall traps can be baited - for example, beer attracts slugs and snails, fermenting fruit attracts flies, and bacon attracts spiders and beetles.

Berlese Funnel



Used to extract invertebrates from samples of soil or leaf litter brought back from the woodland to the lab. The sample is placed in a funnel above a perforated disc and the whole apparatus placed under a low-powered electric light bulb. The rise in temperature and the drying effect encourage the animals to move away from the source of heat, downwards through the holes in the perforated disc, into the funnel and so to the collecting vessel underneath. They can be collected alive or killed by adding detergent to water in the vessel. Leave the funnel for at least 3-4 days.

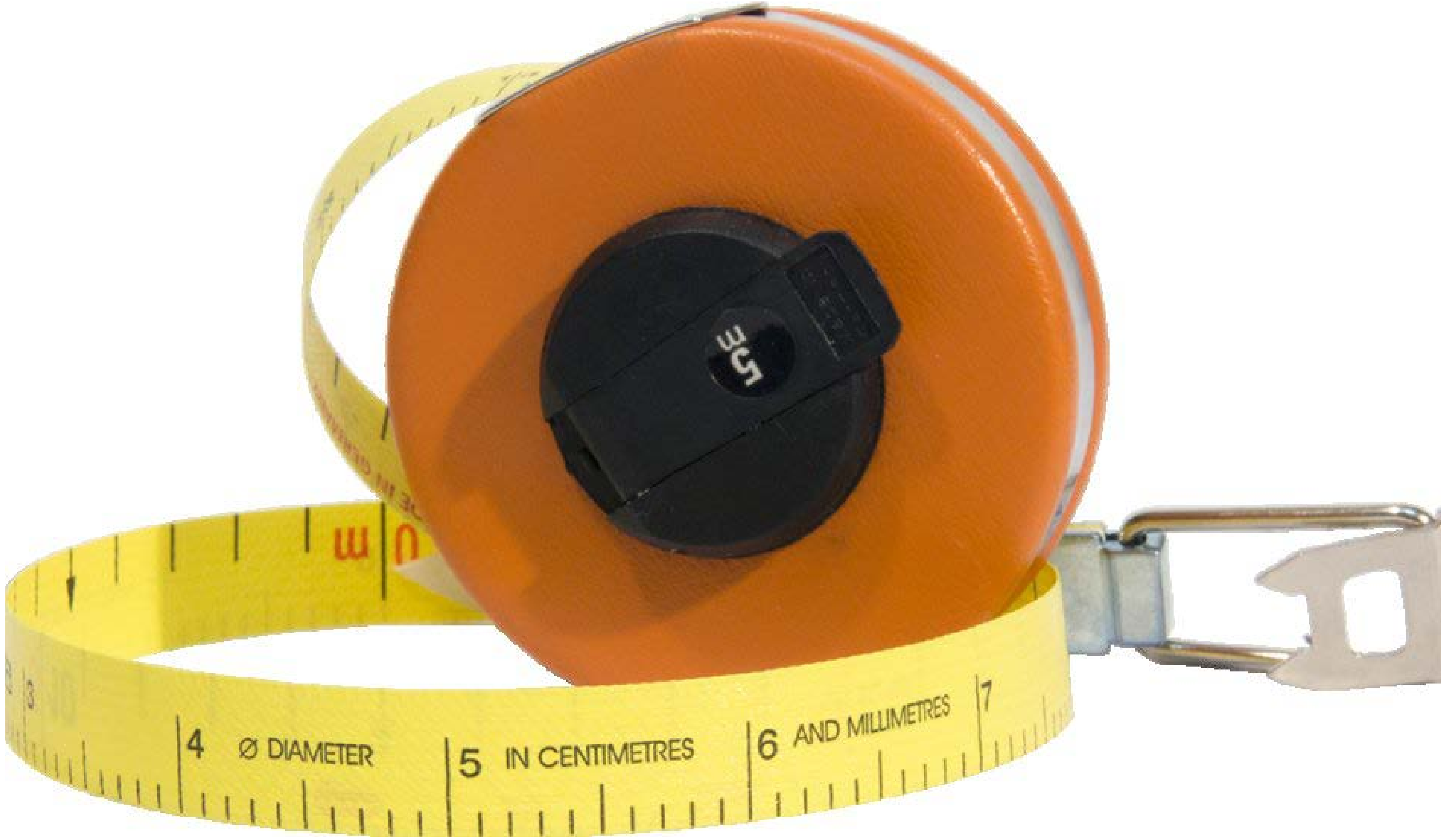
Plant Press

Each specimen should consist of a stem with attached leaves and, if at all possible, flowers and/or fruits.

Also include roots for herbaceous plants.

Careful arrangement: spread out leaves, flowers with no overlap and to show different perspectives. Press some leaves showing reverse side.

Tighten press as material dries.



DBH Tape

DBH refers to the tree diameter measured at 4.5 feet above the ground. DBH can be measured quickly with a specially calibrated diameter tape, often referred to as a d-tape, that displays the diameter measurement when wrapped around the circumference of a tree.

Probes

Abiotic data measurements

- Temperature
- Light
- Moisutre
- pH

- Soil compaction

Leaf Transpiration

Cobalt Chloride test paper: tape to underside of leaf and time how long it takes to turn pink.

TRY THIS: OBSERVE WATER LOSS FROM LEAVES

Skills Focus: observing, measuring, hypothesizing

Find a tree with large leaves. Put a small plastic bag around one of the leaves (**Figure 3**). Use a twist tie to gently close the bag. Put another bag over a small branch of a tree with needles (**Figure 4**). Leave the bags on the trees overnight. The next day, carefully pour the water from each bag into a graduated cylinder and measure it. Which type of leaf lost the most water? Create a hypothesis to explain the difference.

Figure 3

Figure 4