Biopotential of the common lawn pest *Taraxacum officinale*

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Standard Statements: 4.5.10.A – Identify similar classifications of pests that may or may not have similar effects on different regions
4.8.10.C - Analyze how human activities may cause changes in an ecosystem

Suggested Level: 9-12

Content Objectives:
Students will be able to
1. Sample non-mobile organisms and estimate populations from the samples
2. Determine factors effecting population growth rates
3. Evaluate existing practices of lawn care
4. Identify an exotic species and describe its life cycle

Assessment Strategies:
1. Correct calculations of data
2. Post lab analysis questions

Background:
When examining population dynamics of any organism you must consider the input from births/immigrations and output from deaths/emigrations. This activity will focus on the inputs specifically from births. A species has two values that must be considered when discussing births. They are the biopotential and actual potential of the species. Biopotential is the total number of offspring a species could produce throughout a time period if conditions were optimal. For example, a fenced deer population with no limits on food or water, no stress from disease and no predation from man has a biopotential of 1.7 fawn per doe per year. Most organisms do not live in environments in which conditions are optimal and therefore have a successful birth rate lower than the biopotential. This value we simply call the actual "birth" rate.

In this activity we will examine the common lawn pest the dandelion (*Taraxacum officinale)*. Each year, homeowners throughout the United States spend millions of dollars on broad leaf herbicides to kill lawn pests such as dandelion and plantain, both exotics. These herbicides when applied may linger in the environment form very long times. Often they will attach to soil particles in a process known as adsorption. Adsorption is the formation of a relatively weak chemical bond between a soil particle and a compound. Other times, these herbicides will runoff either into streams and eventually the Bay, affecting submerged aquatic vegetation (SAV) an integral part of the lower river and Bay ecosystem or into groundwater, which you may drink. The third possible avenue of these herbicides is the air. When herbicides are sprayed onto fields, some of the "fine mist" will be in such small droplets that they may be blown for miles.

Learning Objectives:
1) Learn how to sample non-mobile organisms
2) Learn about the factors affecting biopotentials and actual birth rates.
3) Learn alternative methods of controlling weeds
4) Learn the structure and life cycle of the exotic species *Taraxacum officinale*

Materials Needed:

1. Metric rulers
2. Strings cut to 1 meter lengths
3. Petri plates
4. Razor blades or scalpels
5. Hand lenses
6. Plastic Bags
7. Forceps

Timeline: 135 minutes (three class periods)

Procedure:

Day One Procedure: Steps 1-7

1) Get into your assigned groups of two or three. In the front of the schoolyard, randomly pick a spot and mark off a ~1 meter square plot using the four strings provided.

2) Inside your plot, count the number of dandelion (*Taraxacum officinale*) plants. Be sure to count plants without flowers (look at the leaves) as well as plants with flowers and record the value below.

Dandelions per meter square =_____

3) Now fold your string in half and make a half-meter square. Repeat step two and record the number of dandelion plants below.

Dandelions per .5 meter square =_____

4) Multiply the above value by four and record below.

Dandelions per .5 meter square X 4 =_____

Is this value the same as your 1 meter square value? (YES or NO)

Since you examined one quarter of the area and multiplied by four, should have the values been the same? (YES or NO)

5) Using a metric ruler, mark off an area 20 centimeters (cm) by 20 cm. This is one twenty-fifth of a meter square. In your plot, count the number of blades of grass (I know there's lots but DON"T cheat, do your best) and record the value below.

Blades of Grass per .2 meter square =_____

6) Pick and place into a plastic bag a flowering dandelion head (yellow flower), label the bag with your name and place in the classroom for later use.

7) Being careful NOT to knock off any seeds until they are in the bag, pick and place into a plastic bag a seeding dandelion head (fuzzy, white seeds on it), label the bag with your name and place in the classroom for later use.

Note: Procedures 6 and 7 may be a homework assignment if the school lawn has recently been mowed.

Post lab analysis Part 1

1. Estimate the number of blades of grass in the entire meter square area by taking the value from step 5 and multiplying it by 25 (the square of 5). Record the value Estimated number of blades of grass per meter square =_____

2. As sample size gets smaller does your estimate get closer OR farther from the actual value?

3. Name one way a field biologist might be able to use this method for estimating organisms.

Day two - Biopotential

We will now determine the biopotential of dandelions. In other words, how many offspring can they produce and compare this to the question, how many offspring do they actually produce.

Form a hypothesis and pick one of the statements below by circling it.

1) The dandelions will produce as many offspring as they possibly can.

2) The dandelions will produce fewer offspring than they possibly can.

Procedure

1) Place your dandelion flower in a dissecting pan and carefully slice its ovary (the green part below the flower) in half. Using a hand lens notice the small white, spheres inside the ovary, these are called ovules and they will develop into seeds after fertilization and pollination. Using forceps (tweezers), CAREFULLY remove all the ovules from the ovary. As you are doing so, count them and place them in one corner of your pan. Record the number of ovules below and clean out your dissecting pan.

One dandelion has _____ ovules

2) Place your seeding dandelion head in your dissecting pan. If any seeds are stuck to the bag, count them while removing them and place them in one corner of you pan. Using a hand lens notice the small seeds and parachute like structures used for dispersal. Using forceps (tweezers), CAREFULLY remove all the seeds from the seeding head. As you are doing so, count them and place them in one corner of your pan. Record the number of seeds below.

One seeding head has _____ seeds

3) Obtain a petri dish and place a small piece of paper towel in it. Moisten the towel and place 5 of the seeds you counted in the plate. Place a cover on the dish and label the dish with a piece of tape and your name. Moisten the towel and observe every day and record germination rates.

After 5 days the number of seeds that germinated is _____

Post Lab Analysis Part 2

1. Do all of the ovules develop into seeds according to your data? (Step 1 value = step 2 value) Explain a possible reason as to why.

2. Do all of the seeds germinate? Explain a possible reason as to why.

3. Calculate the biopotential of your square plot: Take the number of ovules in one dandelion and multiply it by the number of dandelions in a one-meter square.

Biopotential of 1 meter square is_____

4. Calculate the actual "birth" rate of your plot: take the number of seeds that germinated divided by five =_____.

Multiply this decimal to the number of ovules in one flower =_____.

Multiply this value to the number of dandelions in your plot =_____ (# of offspring produced in a square plot).

5. What are other factors that control the population of this common lawn pest besides fertilization and germination?

6. How could you control this lawn pest other than herbicides?

Resources and Related Web Sites:

1) "Non-toxic weed control in the lawn and garden" by William Quarles, Common Sense Pest Control XV(3) Summer 1999
2) http://www.pested.psu.edu
3) http://paipm.cas.psu.edu
4) http://www.acb-online.org/bayscapes.htm