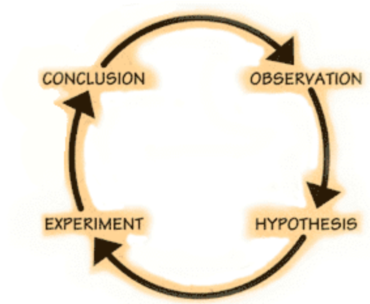


Human Ecology

Field Projects

June 26, July 12 & 24 & August 9, 2006

Juvenile Dungeness Crab Survey

SERVICE OBJECTIVES:

- Contribute to the efforts by Snohomish County Marine Resources Committee, Tulalip Tribes, Stillaguamish Tribes, and Washington Department of Fish and Wildlife to identify and assess habitat of Puget Sound Dungeness crab juveniles.
- Answer the following research questions:
  - Where is the juvenile crab habitat in Snohomish County marine waters?
  - Which types do they prefer?
  - How far into the lower rivers does it extend?
  - When do juveniles settle and reside in this habitat?
  - Is it comparable to areas of North Puget Sound in terms of density and timing?
  - How does growth proceed in this habitat and when do most juveniles move to habitat characteristic of adults?
- Help the county and state to develop public policy using the best available science.

LEARNING OBJECTIVES:

- Outline the steps of the scientific method and participate directly in collaborative field-based activities employing scientific approaches to ecological stewardship.
- Identify and assist government agencies and non-profit organizations involved in sustainable stewardship.
  - Familiarize yourself with the Northwest Straits Commission, Puget Sound Action Team, Snohomish County Marine Resources Committee, Washington Department of Fish and Wildlife, Tulalip Tribes, and Stillaguamish Tribe.
- Develop quantitative skills for application in scientific surveys.
  - Use tape measure and tide charts to set up transects at low tide
  - Use sampling to cover larger area while minimizing impact of survey on populations
  - Use random number tables to identify sample plots
  - Use calipers to measure the carapace width of juvenile Dungeness crabs
  - Distinguish between males and females

    - Record data on sheets and submit to Department of Fish and Wildlife
- Describe the significance of the intertidal zone to the ecosystem (including humans) of Western Washington.
    - Recognize and distinguish between the following eight species of crab (both adult and juvenile): Dungeness, Graceful, Red Rock, Northern Kelp, Helmet, European Green, Hairy Shore, and Hermit.
    - Recognize megalops larvae and distinguish first, second, and third instars of Dungeness crab.
    - Recognize and distinguish twelve common species of intertidal macrophytes in Puget Sound: Native Eelgrass, Surfgrass, Sea Lettuce, Green Ribbon, Rockweed, Nailbrush or Sea Moss, Turkish Towel, Turkish Washcloth (Black Tar Spot), Black Pine, Wireweed or Strangle Weed, Winged Kelp, and *Acrosiphonia coalita*.
    - Distinguish between the following eight habitat types: silt/sand and eelgrass; silt/sand and macroalgae; silt/sand and mixed vegetation; silt/sand and no vegetation; gravel/cobble and vegetation; gravel/cobble and no vegetation; mixed substrates with vegetation; and mixed substrates with no vegetation.
    - Use a key to identify other species of crabs as well as sponges, cnidarians (anemones, hydroids, jellies), worms, mollusks, crustaceans, echinoderms, and others marine animals.
- Maintain field notes recording your activities.
    - Start a new page of field notes for each day of service. Do not remove pages. If you make an error, cross it out, and proceed.
    - Include the following information for each service project:
        - Name of site where you are working.
        - Date and time of day.
        - Weather conditions.
        - Latitude, longitude, and altitude of one or more reference points. Include a description of the reference point(s) and relationship(s) to the work site.
        - Names of other volunteers with whom you worked.
    - Two to four paragraphs describing the day's activities and how they helped you meet the learning objectives outlined above.

DESCRIPTION AND LOCATION:

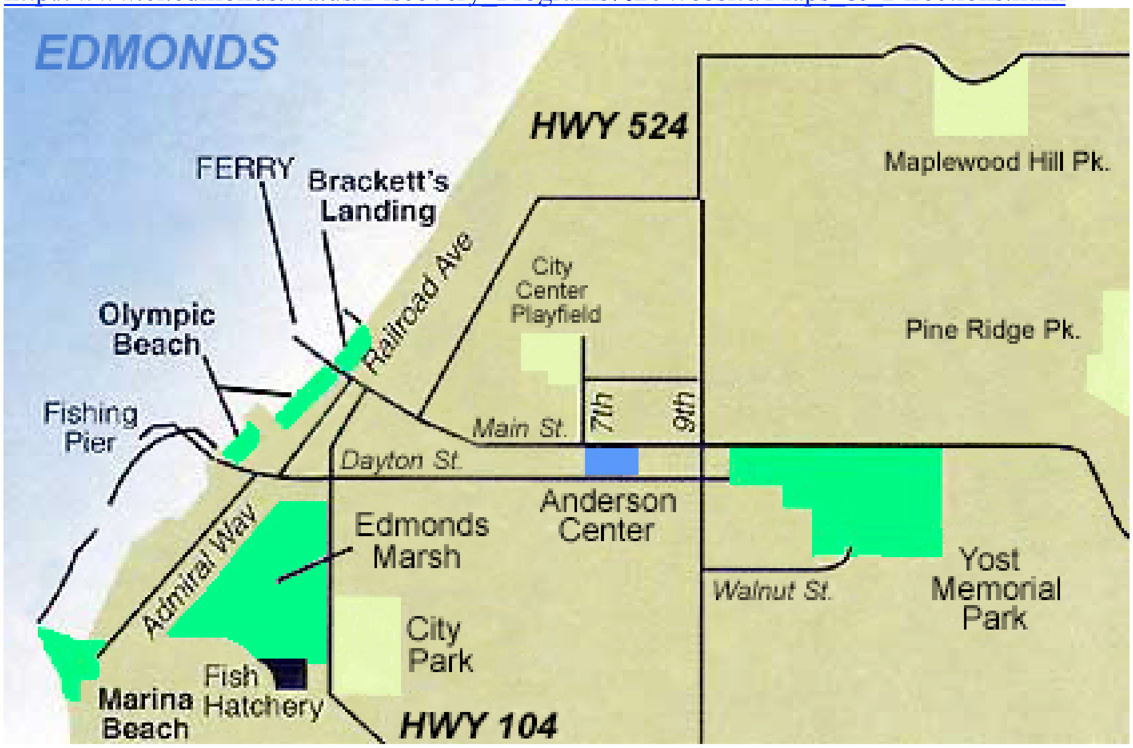
Half of the class will go to Picnic Point and the other half will go to Edmonds Marina Beach. We will decide in class on Monday who gets to travel to which site.

Directions from campus to Edmonds Marina Beach Park (from Map Quest, edited).

1: Start out going NORTH on 68TH AVE W toward 196^{th} St.
2: Turn LEFT onto 196TH ST SW / WA-524. Continue to follow WA-524.
3: Turn LEFT onto 3RD AVE N / WA-524. Continue to follow 3RD AVE N.
4: Turn RIGHT onto DAYTON ST.

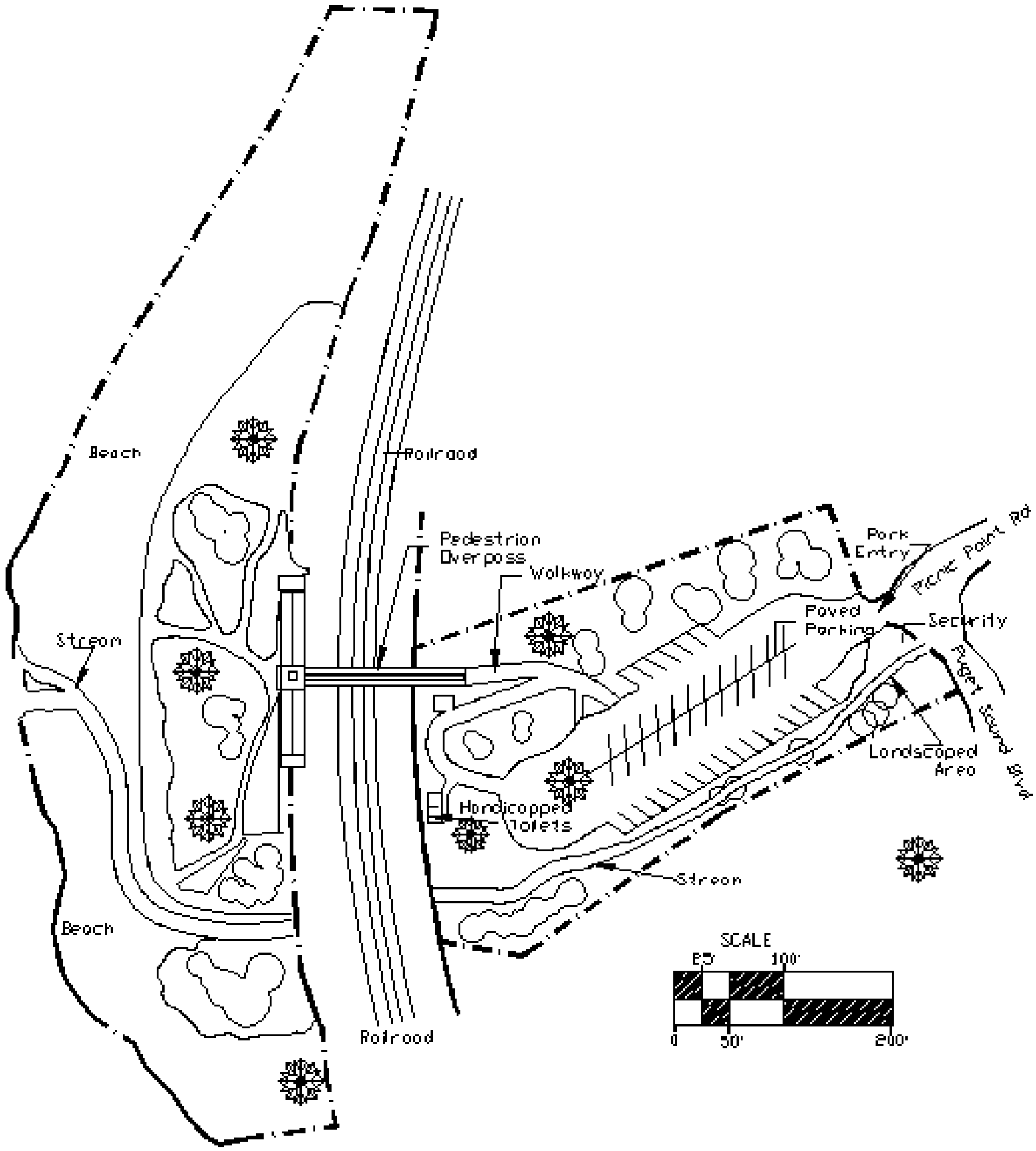
5: DAYTON ST becomes ADMIRAL WAY.
6: End at **Edmonds Marina Beach Park,** 498 Admiral Way, Edmonds, WA 98020, US

Map from the link below.
http://www.ci.edmonds.wa.us/Discovery_Programs%20Website/Maps_&_Directions.html



Directions from campus to Picnic Point Park (from Map Quest, edited):

1: Start out going EAST on 200TH ST SW
2: Turn LEFT onto WA-99. 2.2 miles
3: Turn LEFT onto 168TH ST SW. 0.4 miles
4: Turn RIGHT onto 52ND AVE W. 1.7 miles
5: Turn LEFT onto PICNIC POINT RD. 0.1 miles
6: Turn RIGHT to stay on PICNIC POINT RD.1.3 miles
7: End at **Picnic Point County Park**, 7200 Picnic Point Rd, Edmonds, WA 98026, US
8: Park in the parking lot and follow bridge across railroad tracks to the beach.



TRANSPORTATION:

On **Monday, June 26th we will meet at 8:00 AM in MLT 220** for a brief introduction to the class. We will then take vans from campus to two respective field sites (one in Edmonds and the other in Picnic Point) where we will conduct training and our first survey beginning at 9:00 PM. Trainings leaders will be Don Velasquez from Washington State Department of Fish and Wildlife and Stef Frenzl from Snohomish County Marine Resources Committee.

We will conduct the survey until we are finished. We will reach low tide about noon and will probably need to continue surveying for about an hour after the low tide. We anticipate breaking for a picnic lunch on the beaches between 1:00 and 1:30 pm. We plan to return to campus by 2:00 pm for additional training in MLT 214.

In the interest of minimizing pollution and enhancing your learning experiences we recommend traveling to and from the site in a pre-arranged campus van. The van will depart from the staff parking lot north of Mountlake Terrace Hall and west of Snoqualmie Hall. **The vans will leave at 8:30 am on June 26th and 7:30 am on all other survey dates.**

In an emergency you may contact Tom Murphy via cell phone, 425-478-5567.

WHAT TO BRING:

Please come prepared to get dirty, rain or shine. Bring the following items.

- One pair of rubber-palmed gardening gloves.
- Water-resistant coat and pants (if raining).
- Knee-high rubber boots.
- Lunch.
- Water or a non-disposable mug or cup.
- Hat (recommended).
- Pojar & Mackinnon's *Plants of the Pacific Northwest Coast* (recommended).

After the first day of class you should also bring your field manual (including this field packet) in a three-ring binder, "Rite in the Rain" All-Weather Spiral Notebook and a pencil. You may leave the binder in the vans but should keep the notebook and marker with you.

PRE-FIELD ASSIGNMENTS:

- Read this field packet, especially the section introducing the scientific method.
- Read assigned material as indiciated on the syllabus.
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- Read Snohomish County Marine Fact Sheets for Dungeness Crab and Eel Grass (linked below and in Blackboard).
    - http://www.co.snohomish.wa.us/documents/Departments/Public_Works/surfacewatermanagement/marine/2001_06DungenessCrab.pdf
    - http://www.co.snohomish.wa.us/documents/Departments/Public_Works/surfacewatermanagement/marine/2001_06Eelgrass.pdf
- Before the second survey date visit Oregon State University's Tide Pool Page and review the main features of the interactive site (also linked to your Blackboard classroom). http://hmsc.oregonstate.edu/projects/rocky/intro.html
- Visit the web pages for the Northwest Straits Commission and Snohomish County Marine Resources Committee. Read the introductory pages fully and browse other sections of the sites.
    - http://www.nwstraits.org/nsi.html

- http://marine.surfacewater.info/

INTRODUCTION TO THE SCIENTIFIC METHOD:

The scientific method is a systematic and usually mathematical way to think critically about problems. The power of this way of thinking lies in its ability to generate accurate and repeatable predictions given good data collection and analysis.

There are two distinct classes of investigation within the scientific method, termed descriptive (or inductive) and experimental (or deductive). The inductive method is used for investigating associations between classes of facts, and infers generalities from a particular collection of observations or facts. For example, a study that attempts to determine what habitats a particular animal prefers would be an inductive study. The deductive method is used to determine cause-and-effect relationships, and involves comparisons of manipulated situations to an undisturbed “control” situation. For example, once you have determined what habitat a particular animal prefers, you could manipulate variables (such as food availability) within the habitat to see specifically how it affects the population of this animal. As you can see, inductive studies often set the stage for deductive studies, which are in turn meant to refine and improve the knowledge acquired from inductive studies.

There are two basic prerequisites to consider a theory, statement, or hypothesis scientific. First, it must be falsifiable: one must be able to pose the statement in such a way that it can be disproved by experiment. Second, it must be replicable; that is, the methods used to gather data during the course of the experiment must be explained in enough detail to allow other, independent researchers to duplicate the original experiment. Only after a great deal of replication has occurred can a hypothesis, statement, or theory be considered reliable knowledge.

The steps of the scientific method include:

1. Observation
2. Hypothesis Formulation
3. Methods
4. Data Collection and Analysis
5. Results
6. Conclusions and Implications

OBSERVATION

Observation is the first step of the scientific method. Observation can be as simple as seeing some sort of interaction, and deciding to study this interaction scientifically, or can be as complicated as exploring the finer points of an existing scientific theory.

For example, you might observe a correspondence between two events, and wish to see if they are connected. Or you might have already seen some sort of association, but wish to establish whether or not there is a cause-and-effect relationship. Specifically, you might observe that people living in cities with high levels of air pollution seem to have higher rates of cancer. Or you might observe that a particular species of tree grows better in rural areas than it does in the city. Or perhaps you have seen examples in your own work that seem to contradict an existing scientific theory.

HYPOTHESIS FORMULATION

Once you have determined the specific area of scientific interest you wish to study, you must then form hypotheses about your idea. A hypothesis is a statement about relationships derived from observation or theory that can be falsified by experiment. In order to test an idea using the scientific method, you must form a set of two contradicting hypotheses: the null hypothesis (symbolized by H0) and the research hypothesis (symbolized by H1)

The research hypothesis is a generalized statement about cause-and-effect processes or relationships derived from observation or theory.

The null hypothesis is simply the research hypothesis phrased in the negative, that is, it falsifies the research hypothesis in order to test it.

These hypotheses can be as general or as specific as needed in order to examine accurately the idea under consideration. However, the more specific your hypothesis, the more chances you have to obtain useful information.

General example:
H1: Air pollution causes cancer.
H0: Air pollution does not cause cancer. (Air pollution has no effect on cancer.)

Specific example:
H1: The new growth of sweetgum trees that live in an urban environment will be different from the new growth of sweetgum trees that live in a rural environment.
H0: The new growth of sweetgum trees that live in an urban environment will not be different from the new growth of sweetgum trees that live in a rural environment.

You might wonder: why bother with the tedium of research and null hypotheses, since they are saying almost the same thing? It is a common misconception that science proves things, particularly cause-and-effect events. However, the human mind, for all its achievements, is finite, and because of the limitations of our understanding and ability to store and process information we cannot know everything about any particular situation. In other words, science can never prove anything. However, we are able to disprove things through the process of replication, which is why we use a null hypothesis to test our ideas. Scientific experiments are set up so that if we can disprove our null hypothesis, we can—by inference—support the research hypothesis (the original idea under consideration). Put into scientific terminology: if we are able to reject the null hypothesis, we can support the research hypothesis. This may seem confusing at first, but it does become clearer with practice.

Finally, scientists always speak in terms of probabilities. Since science cannot prove anything and must accept the validity of its research hypotheses by inference, scientists use statistics to give their results a certain level of confidence (which are based upon probabilities associated with the experiment). For example, after rejecting a null hypothesis, a scientist might report the results as follows: there is a 95% probability that cause x leads to effect y given situations like z. This also means that there is a 5% probability that cause x leads to effect y given situations like z due to chance alone.

METHODS

It is extremely important to understand the necessity for accurate and specific methods and measurements; without such attention to detail there could be little hope of replicating the results of a particular study. Without replication, a scientific study can be discredited easily, resulting in a waste of time, energy, and money, and—in extreme cases—a career.

Methods are simply the means by which a scientist gathers and analyzes data. This includes such things as how something is measured, what units it was measured in, and what techniques (such as statistics) are used to analyze the data that is gathered. The metric system of measurement is the international standard for scientific work, and will be employed throughout this course. Because it is impossible to measure everything, simplifying assumptions are often made, which might include measuring certain attributes of an object while purposefully ignoring other attributes. These assumptions must be made explicit prior to conducting the experiment, and must be made explicit in the methods section of any resulting report. Without such clarity, it could be extremely difficult to replicate the experiment.

DATA COLLECTION AND ANALYSIS

Data collection is just what it sounds like: the collection of data using predetermined methods. In order to maintain scientific credibility, scientists must stick rigorously to the methods they have decided to use for data collection. Once again, other scientists who try to replicate the experiment will definitely derive different results if they stick to the methods that the previous study claimed to use but did not.

Analysis of data is done typically through the use of mathematics and statistics, which are often able to reveal patterns in the data that may not be apparent through the study of the data alone. The patterns that statistics reveal may or may not reveal something in nature, so it is up to the scientist to determine whether or not these patterns are natural or an artifact of the mathematical manipulation.

RESULTS

Results are an explanation of what happened during data collection and analysis. Scientists generally emphasize the important results, that is, the results that bear directly on the hypothesis, idea, or question under consideration. They do not say everything about all of the data: at best that would be tedious and unnecessary. These important results are used to explain what the data mean or imply in terms of the scientific topic under consideration.

Graphs realize the adage that a picture is worth a thousand words. A good graph can explain the important results of your experiment in far less space than writing out the results. Graphs are an integral part of any scientific report, so interpreting their meanings is an important and useful skill.

CONCLUSIONS AND IMPLICATIONS

The conclusions of a scientific study are oriented around relating the results of the particular experiment to the scientific field of interest.

One of the things that distinguish good scientists is how they derive implications from their data. Good scientists are often able to take the results obtained from a specific study and make a convincing argument applying their results to a much broader problem or situation. In environmental science, implications are often used to discuss what the results imply in terms of the human relationship with the rest of the environment. Some scientists also use this section to make policy recommendations or specific suggestions on adjusting human activities to help restore or protect environmental health.