

## Help Fishery Biologist Jen



Fisheries biologists study the biology of fishes. They design studies to determine a species' population status, habitat requirements, life history, and forage base. Fisheries biologists conduct population estimates to estimate how many fish are in the environment. They conduct habitat surveys to describe the amount of habitat available to fish in their environment. They often study more than one species at a time to determine if species are competing with one another for either food or space.

Your mission, should you choose to accept it, and you shall,  
is to...

See if you can help Fishery Biologist Jen  
estimate how many Prickly Sculpin are in  
Mooselick Creek.



First of all, why is Fishery Biologist Jen interested in Prickly Sculpin?

Sculpin are often considered as an "indicator species". This is a species whose habitat requirements most reflect those of the species community in the habitat of concern, usually used to indicate habitat quality and to predict future conditions.

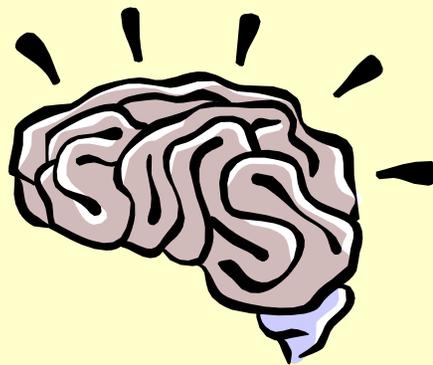
What is the first thing Fishery Biologist Jen should do to get started?:

- a. Gather her gear and go to Mooselick Creek
- b. Learn all she can about Prickly Sculpin
- c. Guess how many Prickly Sculpin are in Mooselick Creek

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The most important piece of gear for a fishery biologist is knowledge.



There are many ways to gather information. These are the methods Fishery Biologist Jen likes to use:

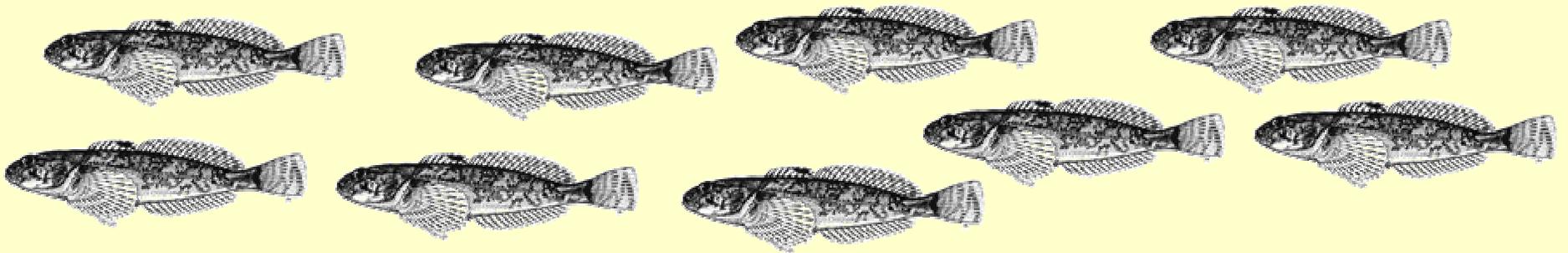
- Consult with other fishery biologists in the area:
  - [Washington Department of Fish and Wildlife](#)
  - [U. S. Fish and Wildlife Service](#)
- Read books:
  - Pacific Fishes of Canada
    - By J. Hart
  - Freshwater Fishes of Canada
    - By Scott and Crossman
- Search the Internet
  - <http://www.natureserve.org/explorer/>

Here are some important things Fishery Biologist Jen found out about the Prickly Sculpin...

- Identification:
  - ~ 30 cm long, covered with prickles, dark spot in the posterior first dorsal fin, long anal fin, mottled reddish brown to dark brown, belly white to yellow
  - When spawning, both sexes have an orange band on the edge of the first dorsal fin when spawning
- Distribution:
  - Pacific Slope drainages from Ventura River, California, to Seward, Alaska; east of Continental Divide in upper Peace River, British Columbia; occurs on Queen Charlotte and Vancouver islands
  - When they are found, they are usually found in great numbers
- Habitat:
  - Coastal and inland streams and sandy and rocky shores of lakes. Typically inhabits pools and waters of slight current in small to medium rivers and is often on bottom of fine materials, predominantly sand. Also occurs in tidewater areas; can tolerate brackish water (tidepools, estuaries).
- Reproduction:
  - Matures in 2nd-4th year. Spawning occurs in freshwater or intertidal zones that contain flat rocks and moderate current. Spawning may occur late February-June; most spawning in California probably occurs March-April. Males prepare nests under rocks, logs, cans, car bodies or other debris. Female deposits 280-11,000 eggs depending on her size and age. Males may spawn with more than one female. Larvae are pelagic for 30-35 days.
- Miscellaneous:
  - It is very difficult to differentiate the Prickly Sculpin from other species of sculpin

Ok, Fishery Biologist Jen is now armed with information. Now she has to design her study. The first step in designing a study is to identify the question. Fishery Biologists Jen's question is:

How many Prickly Sculpin are in Mooselick Creek?



To answer this question, Fishery Biologist Jen should:

- a. Catch all the Prickly Sculpin in Mooselick Creek and count them
- b. Give up, because the question is impossible to answer
- c. Catch a portion of the population and use this information to estimate the true number

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Fishery Biologist Jen has several reasons why she wouldn't want to try to catch all the Prickly Sculpin:

- it would be impossible to do this, and very time-consuming to try (and time is money, even in the world of fishery biology)
- fish generally don't like to be handled, therefore Fishery Biologist Jen wants to handle as few fish as possible, while still answering her question

So how do fishery biologists estimate the population of fishes by catching only a portion of them?

Well, there are many different methods, but they all involve...

MATH



YUCK!

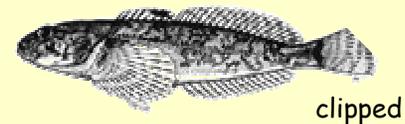
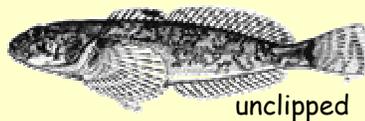
## Here is a simple example...

For this example, the question we are trying to answer is: How many fish are in this aquarium?



To start, let's use our sampling gear (aquarium net in this case) to catch as many fish as we can in 30 seconds.

We caught 20 sculpin! So what we are going to do now is mark those 20 sculpin in a way that will 1. Not harm the fish, and 2. Differentiate them from the fish that are remaining in the aquarium for the duration of the study. We will mark them using a small fin clip.



Now, we will put the marked fish back into the aquarium with the unmarked fish.

In the aquarium we use our sampling gear to sample the fish again for 30 seconds. We are getting better at this, so this time we catch 40 fish. Of these 40, 10 of them are marked. Through this effort we captured one-half of our marked fish (remember, we marked 20 fish). From this we assume that we are 50% efficient at catching fish ( $\frac{\# \text{ mark fish captured}}{\# \text{ of total fish marked}} = \frac{10}{20} = 0.5 = 50\%$ ).

So, we know that our sampling gear caught one-half of the fish. Since we captured 40 fish in our sample (marked and unmarked), we estimate the total number of fish in the aquarium to be:

a. 20 fish

b. 40 fish

c. 80 fish

We estimate the total number of fish in the aquarium to be:

- a. 20 fish   b. 40 fish   c. 80 fish

We caught 40 fish in our sample, we were 50% efficient, therefore there are 80 fish total.

Now, remember that this example was simplified for demonstration purposes. Most often, fishery biologists take multiple samples to get a more precise population estimate.

Fishery Biologist Jen is ready for the field, finally.

Instead of aquarium nets, she will be using minnow traps.



From her own experience, and from talking with other biologists, she knows that sculpin like to go into these traps to seek refuge. Where should Fishery Biologist Jen place the traps?

- a. In one spot in the creek
- b. In every pool habitat along the creek
- c. In a variety of habitats, throughout the creek

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Fishery Biologist Jen wants to sample of variety of habitats for several reasons:

- she wants to make sure she samples the species' preferred habitat (pools), as well as the habitats that are less preferred (riffles)
- She wants to make sure her samples are "representative" of the entire creek
- The more samples she gets, the more accurate her population estimate will be

Fishery Biologist Jen places 5 minnow traps throughout the stream (it is a small creek). The next day she checks all of her traps, and marks any Prickly Sculpin that she has captured. She places the marked fish back into the creek at the location where it was captured and resets her traps.

The next day she checks her traps, counts the number of marked and unmarked fish and puts the fish and the trap back into the creek.

She continues doing this for the rest of the work week.

At the end of the study she reviews her data. This is what it looks like:

Monday	
Trap	Originally Marked
a	56
b	1
c	3
d	25
e	10

Tuesday				
Trap	Fish Captured	Recaptured	Efficiency	Estimate
a	50	20	36	140
b	0	0	0	
c	0	1	33	
d	20	15	60	33
e	12	5	50	24

Wednesday				
Trap	Fish Captured	Recaptured	Efficiency	Estimate
a	48	18	32	149
b	10	0	0	
c	5	0	0	
d	15	16	64	23
e	6	3	30	20

Thursday				
Trap	Fish Captured	Recaptured	Efficiency	Estimate
a	60	22	39	153
b	8	0	0	
c	3	0	0	
d	13	14	56	23
e	4	1	10	40

Friday				
Trap	Fish Captured	Recaptured	Efficiency	Estimate
a	50	23	41	122
b	12	1	100	12
c	7	0	0	
d	17	10	40	43
e	8	2	20	40

Fishery Biologist Jen has generated an estimate for each trap, for each day. The estimate is based on the efficiency of the trap (#recaptured fish/# of fish marked) and the number of fish captured that day.

Let's work through the data for trap "a" on Tuesday. Fishery Biologist Jen captures and marks 56 Prickly Sculpin. On Tuesday she captures 50, of which 20 were marked (recaptured). Her sampling efficiency is 35.7% ( $20/56 = 0.357 = 35.7\%$ ). That day, she captured 50 total fish, which represents 35.7% of the entire population. Therefore the total population for that day was really 140. Here's how Fishery Biologist Jen figures that out: If 50 fish represent 35.7% of the total population, then "x" fish represents 100%, a simple ratio! Fishery Biologist Jen solves for "x" using the following equation:

$$\frac{50}{35.7} = \frac{x}{100} \qquad 35.7x = (50 \cdot 100) \qquad x = \frac{(50 \cdot 100)}{35.7} \qquad x = 140$$

She then averages the estimates for each individual trap, and then adds the average estimates for each trap together. Wha-la, she has a rough population estimate for the creek. There are approximately 215 Prickly Sculpin in Mooselick Creek! What are some things Fishery Biologist Jen notices about her data.

# Fishery Biologist Jen looks at the data collected on Monday and Tuesday.

Monday	
Trap	Originally Marked
a	56
b	1
c	3
d	25
e	10

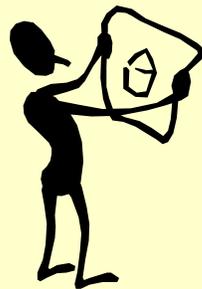
Tuesday				
Trap	Fish Captured	Recaptured	Efficiency	Estimate
a	50	20	36	140
b	0	0	0	
c	0	1	33	
d	20	15	60	33
e	12	5	50	24

- She notices that she can't calculate a population estimate when no fish are captured or recaptured. This happens most frequently when few fish are marked initially
  - The more fish she marks, the better chance she has at recapturing marked fish
- She also notices that the population estimates for each trap are not the same
  - Different traps caught different numbers of fish
    - Perhaps trap "a" was in the Prickly Sculpin's ideal habitat (pools) and trap "b" was in a riffle section, the less-preferred habitat

Fishery Biologist Jen has achieved her goal...but what is next?

Well, having an estimate of the number of Prickly Sculpin in Mooselick Creek is a good thing, but what does it mean? Fishery Biologist Jen might want to consider doing the following:

- Determine why certain traps captured more than others
  - Is it habitat related?
- Monitor these populations over time (seasons, years, etc)
  - Are they stable, are they declining, are they increasing?
- Compare these population estimates to other creeks
  - Are there more or fewer Prickly Sculpin in Mooselick Creek as compared to others, and why?
- Further investigate the Prickly Sculpin population in Mooselick Creek
  - Age distribution, diet, competition with other species, habitat use, reproductive success...



Fishery Biologist Jen always needs your help!! Be sure to check back to see what else you can help her with!

Sources:

Hart, J. L. 1973. Pacific Fishes of Canada. Fisheries Research Board of Canada Bulletin 180.

Markle, D. F.; D. L. Hill, Jr; C. E. Bond. 1996. Sculpin identification workshop and working guide to freshwater sculpins of Oregon and adjacent waters. Oregon Chapter of the American Fisheries Society, U. S. Environmental Protection Agency, U. S. Fish and Wildlife Service, Department of Fisheries and Wildlife at Oregon State University