Analysis and Interpretation of Biological Data

Objectives for this course (what you should know and be able to do by the end of it):

Questions that you may be having ...

What are statistics for?

Why should I be able to do statistics?

Will I ever use statistics outside of this course?

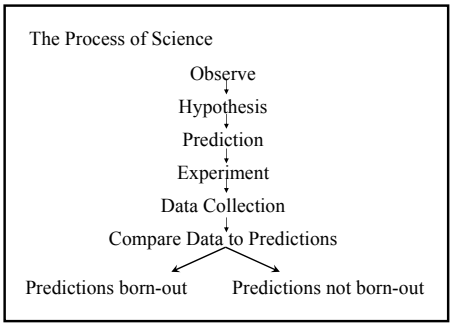
Can I really use statistics to say anything that I want about your data!!!

Under two sets of circumstances!

1) you know nothing about statistics

2) you lack integrity

Where does 'Statistics' fit?



Scientific Method

- Observe
  - observation can take several forms
    - you could see something happen
    - you could read about it in the scientific literature
    - ...

Scientific Method

- Hypothesis
  - an attempt to explain what you observed
  - these are tentative answers to 'why' questions
  - research hypothesis

Scientific Method

- Prediction
  - what you expect to see if your tentative explanation is correct
    - if my hypothesis is correct, then I predict that *insert what you think will happen* will happen
  - predictions lead to statistical hypotheses
    - null hypothesis
    - alternative hypothesis

Scientific Method

- Experiment/Survey
  - Design
    - What you want to measure
    - Sampling
    - How you want to measure
    - When you want to measure
    - Controls and treatments

Scientific Method

- Data Collection
  - Executing your experiment or survey

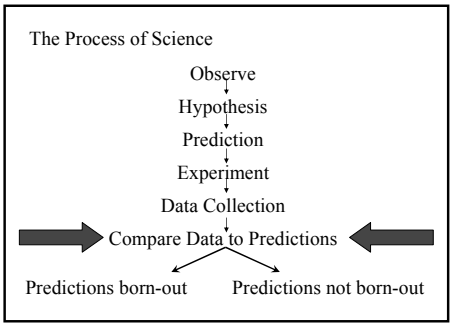
Scientific Method

- Compare data to predictions
  - Use statistical tests

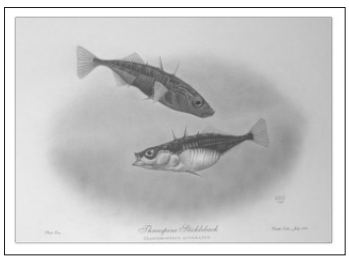
Scientific Method

- Predictions born out
  - Make your hypothesis more risky
- Predictions not born out
  - Hmm, that wasn't right, so maybe it's …

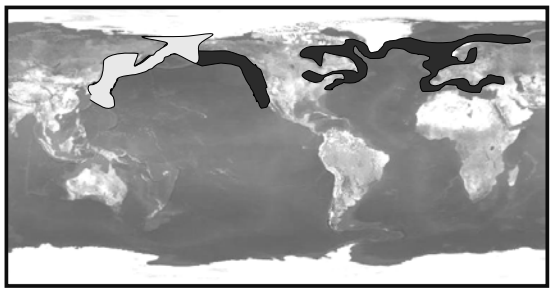
‘Statistics’ is used …



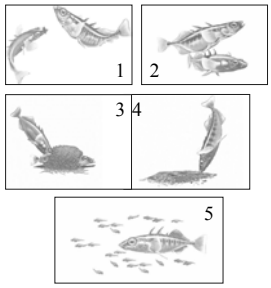
Population differentiation in threespine stickleback



Stickleback Species Complex



Reproductive behaviour and colouration



Chehalis River Stickleback

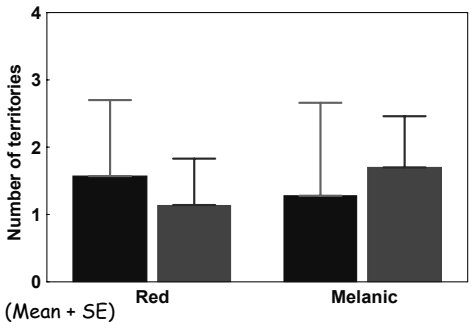
Chehalis River Stickleback

Interspecific competition?

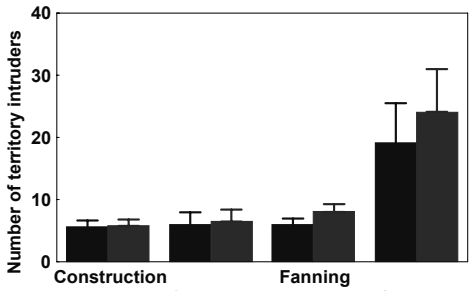
- Olympic mudminnows
- Threat display convergence
- Examination of competitive interactions
  - cage experiments
  - survey of wild nesting stickleback

Field Experiment

Stickleback nesting success



Territorial interactions

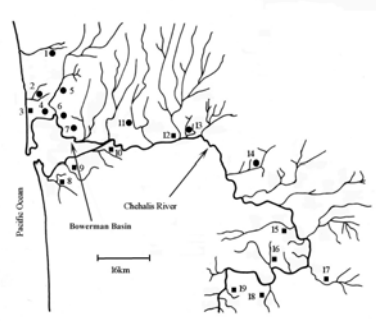


(Mean + SE)

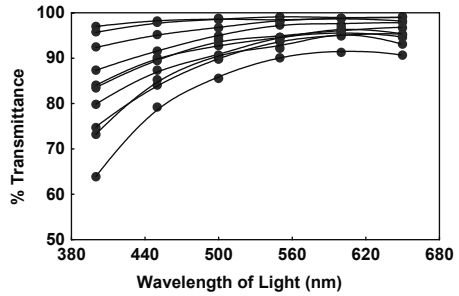
Sensory drive

- Environment influences signal transmission
  - change channels
- Tannin staining in Chehalis River tributaries
- Examine
  - distribution of stickleback with respect to staining
  - female preference

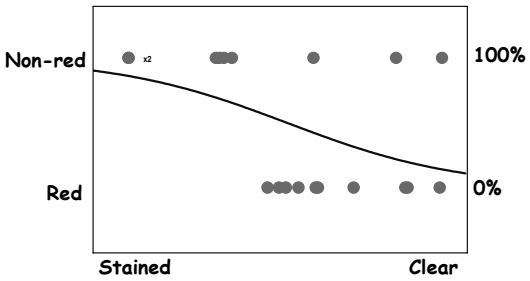
Sampling locations



Site variation in staining



Stickleback color and staining



An example of SciMeth

- Women are taller than men!!!

For example

Olestra --> a non-absorbable, energy-free fat substitute. Because it is not absorbed, it may cause digestive symptoms when consumed in large amounts.

6-week, double-blind, randomized, parallel, placebo-controlled trial.

Olestra corn chips | Regular potatoe chips

Results

619 of 1620 (38.2%) in the olestra group
576 of 1561 (36.9%) control group

difference, 1.3 percentage points [95% CI, -3.6 to 6.2 percentage points]; P = 0.60).

--> the groups did not differ significantly in the proportion of participants who reported individual gastrointestinal symptoms

How do we get to the point where we can make such comparisons or predictions based on our statistical tools?

We've got to collect some DATA.

"…observations consisting of numerical facts."

→ collection of values for a variable measured across one or more entities

eg. leg length for all of us in this class

ENTITY - can be any THING

--> physical objects
--> processes
--> forces
--> weather

Biostatistics --> deals with BIOLOGICAL entities

eg protiens, DNA, individuals, groups

Entities have properties --> called VARIABLES

eg height, hair colour, clot time, growth rate

and each variable has a VALUE

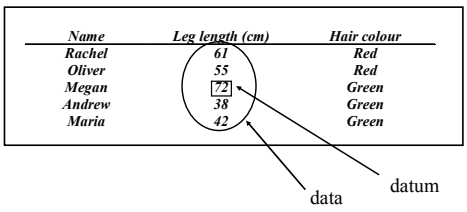
eg 172cm, red, 123 seconds, 11cm/year

Entity?

Variable?

Value?

Name	*Leg length (cm)*	*Hair colour*
Rachel	*61*	*Red*
Oliver	*55*	*Red*
Megan	*72*	*Green*
Andrew	*38*	*Green*
Maria	*42*	*Green*



Back to the Gender and Height issue

Women are taller than men

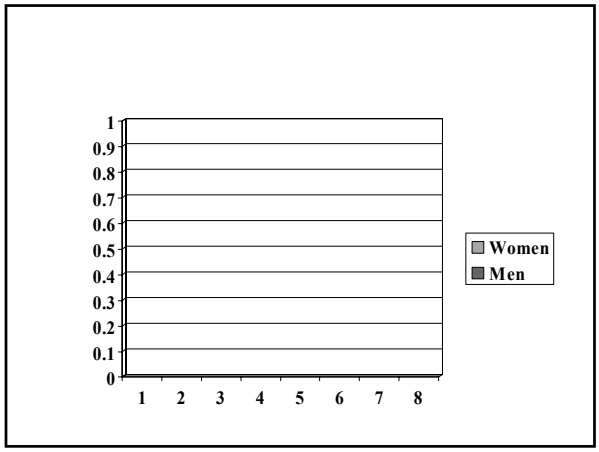
There is no doubt that SHE is taller than I am.

BUT…. What is the ENTITY at issue here?

WOMEN and MEN **NOT** SHE and I

It is easy for me to compare she and I
but how do I compare the entity comprising all women in the class to the group comprising all the men in the class?

Height	# women	# men
< 5’		
5’ to 5’2.9”		
5’3” to 5’5.9”		
5’6” to 5’8.9”		
5’9” to 5’11.9”		
6’ to 6’2.9”		
6’3” to 6’5.9”		
> 6’6”		


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8
Women
Men