RACEWAY MANAGEMENT

Reference material for this lecture:Westers & Weeks "Principle of Intensive Fish Culture" workshop. Aquaculture Bioengineering Corp.

Many factors impact how many fish can be in a rearing container

- Species
- Lifestage
- Help me fill out the rest……

What is “carrying capacity?”

Carrying Capacity

- The production capability of a raceway is described as **carrying capacity**
- There are three important units of measure to determine carrying capacity:
  - Loading (or Ld)
  - Rearing Density (or D)
  - Turnover Rate (R)
- Why is this information important?

Rearing Density

- Rearing density is **kg. of biomass per unit of rearing volume.**
- Density and loading are *two different measures*.
- Density is measured in kg biomass / cubic meters of volume. 100,000 fish @ 8 grams
- Raceway measures 2m wide x 25m long x 1.5m of water depth. What is the volume?
- What is the density?
- Note: this is for rearing volume or what the fish are living in. Want to measure depth of water, not necessarily the total depth of a container.

Loading

- Loading (Ld) is measured in terms of **kilograms of biomass per unit of flow**.
- Ld = kg of fish / lpm (liters per minute of water flow)
- 100,000 fish at 8 grams = ?
- Flow rate = 800 lpm
- What is the Ld? Be sure to include unit of measurement.

Turnover Rate (R)

- Turnover Rate is a measure of how many times the complete volume of a raceway is displaced in one hour.
- To calculate this, you need to know:
  - Raceway volume (length x width x water depth) in cubic meters
  - The inflow of water in liters per minute
- Who knows how to figure out the rate of flow into a container?

Calculating an R of 1

An easy way to calculate an R of 1 (1 turnover/hr) when you know the RV rearing volume of the raceway……

1 cubic meter = 1000Liters

- Raceway measures 2m wide x 15m long x 1m deep
- Inflow = 500lpm
- What is the volume in cubic meters?
- How many liters of water is this equivalent to?
- How many liters *per minute* will it take to fill this raceway in *one hour*? This is the Turnover Rate or "R" value for this raceway

To Summarize:

- R = number of turnovers/hour of flow
  - Ideally in flow-through linear raceways strive to achieve an R of 2-4
  - Circulars can get by with less water based on more efficient flow patterns and higher velocities.
- Ld = Loading = kg/lpm
  - If water is available an ideal loading is 1.5kg/lpm
  - Takes metabolism of oxygen and also waste removal from the system into account
- D = Density = kg/m3
  - A measure of biomass per rearing volume
  - Dependent on water quality, species, developmental stage and other factors
  - We used 8kg/cubic meter but it varies significantly from place to place

Example

RV = 180m3

What flow would be required to get an R of 1?

Answer =

- Volume is 180 cu.meters
- 1 cu.m. = 1000L
- Water in 180cu.m = 180*1000 = 180,000L
- Need to add 180,000L in one hour for R=1
- 180,000L/60min/hr = 3000L/hour (R1)
- Convert lph to lpm: 3000lph/60 min/hr = 500lpm
- R1 = flow of 500lpm

What is the Rearing Volume? Example 1 Typical Raceway

- Flow = 2660 lpm
- 220,000 Coho @ 8grams
- Raceway is 3m wide x 1m water depth x 30m long

- Note: this is a situation where you are given ALL of the info. You may be asked to pick out the needed data for a particular question. Figure out what you need to answer the question.

Answer =

- V = 3m*1m*30m = 90cubic meters

What is the turnover rate (R) for this Raceway?

- Flow = 2660 lpm
- 220,000 fish @ 8grams
- Raceway LxWxd =3m x 1m x 30m
- Recall that "R" is for *1 hour* of flow
- 1 cubic meter = 1000 liters

Answer =

- R = rate of flow (lph) / total liquid volume
- Water added in one hour = 2660lpm*60min/hr = 159,600L in one hour
- Liquid volume in this container = 90cu.m. * 1,000L/1cu.m = 90,000L of water
- R = 159,600lph/90,000L of volume = 1.77

What is the Density?

- Flow = 2660 lpm
- 220,000 fish @ 8grams
- Raceway L x W x water depth =3m x 1m x 30m
- What is the density?

Answer =

- Density = biomass(kg) / volume(cu.m)
- Biomass = 220,000fish*8g/fish = 1,760,000g
- Convert to kg: 1,760,000g/1,000g/kg = 1760kg fish
- Volume = 90cu.m.
- Density = 1760kg/90cu.m. = 19.6kg/cu.m.

What is the Ld

- Flow = 2660 lpm
- 220,000 fish @ 8grams
- Raceway L x W x water depth =3m x 1m x 30m

Answer=

- Ld = biomass / lpm flow into container
- Biomass = 1760kg
- Flow = 2660lpm
- Ld = 1760kg/2660lpm = .66kg/lpm

How about a circular tank?

- Flow = 1,130 lpm
- 220,000 Sockeye @ 8grams
- Tank = 6m diameter x 1.2 m rearing depth

A. 33.9m3

B. 28.4m3

C. 42m3

Who remembers how to figure out the volume of a cylinder?

Answer =

- Volume of a cylinder = pi(r^2)h where pi = 3.14, radius is half of diameter and h = height of water
- Diameter = 6m so radius = 3m
- H = 1.2m
- V = 3.14*(3m*3m)*1.2m = 33.9cu.m.

What is an R of 1 for this tank?

- Flow = 1,130 lpm
- 220,000 Sockeye @ 8grams
- Tank Dimension 6m dia x 1.2 m deep

    A. 1330 lpm

    B. 565 lpm

    C. 650 lpm

Answer =

- V = 33.9cu.m.
- Flow into container = 1130lpm
- R1 = total liquid volume of tank in one hour (expressed in lpm)
- Liquid volume = 33.9cu.m.*1000L/cu.m.=33,900L
- R1 = 33,900L in one hour= 33,900L/60min/hr = 565Lpm

What is the Density?

- Flow = 1,130 lpm
- 220,000 Sockeye @ 8grams
- Tank Dimension 6m dia x 1.2 m deep
- What is the density?

  A. 35.5

  B. 17.2

  C. 51.9

$$D = Kg/m3$$

Answer =

- Density = biomass fish(kg)/volume(cu.m.
- Biomass = 220,000*8g = 1,760,000g/1000g/kg = 1760kg (calculated earlier)
- Volume = 33.9cu.m. (calculated earlier)
- D = 1760kg/33.9cu.m. = 51.9kg/cu.m.

What is Ld?

- Flow = 1,130 lpm
- 220,000 Sockeye @ 8grams
- Tank Dimension 6m dia x 1.2 m deep
    A. .66
    B. .95
    C. 1.56

Answer =

- Ld = biomass(kg)/flow(lpm)
- Biomass = 1760kg
- Flow = 1130lpm
- Ld = 1760kg/1130lpm = 1.56

What is R for this Rwy?

- Flow = 1,130 lpm
- 220,000 Sockeye @ 8grams
- Tank Dimension 6m dia x 1.2 m deep
    A. 1.77
    B. 1.5
    C. 2.0

Answer =

- R = #complete turnovers of total liquid volume in one hour
- Volume = 33.9cu.m. so water volume = 33,900L using 1000L/cubic meter
- Amount of water added in 1hour = 1130lpm *60min/hour = 67,800L
- 67,800Lph / 33,900L total volume
- R = 2

What is the Density?

- 220,000 Sockeye @ 8grams
- Tank Dimension 6m dia x 1.2 m deep
- What is the density?
  A. 28
  B. 52
  C. 40

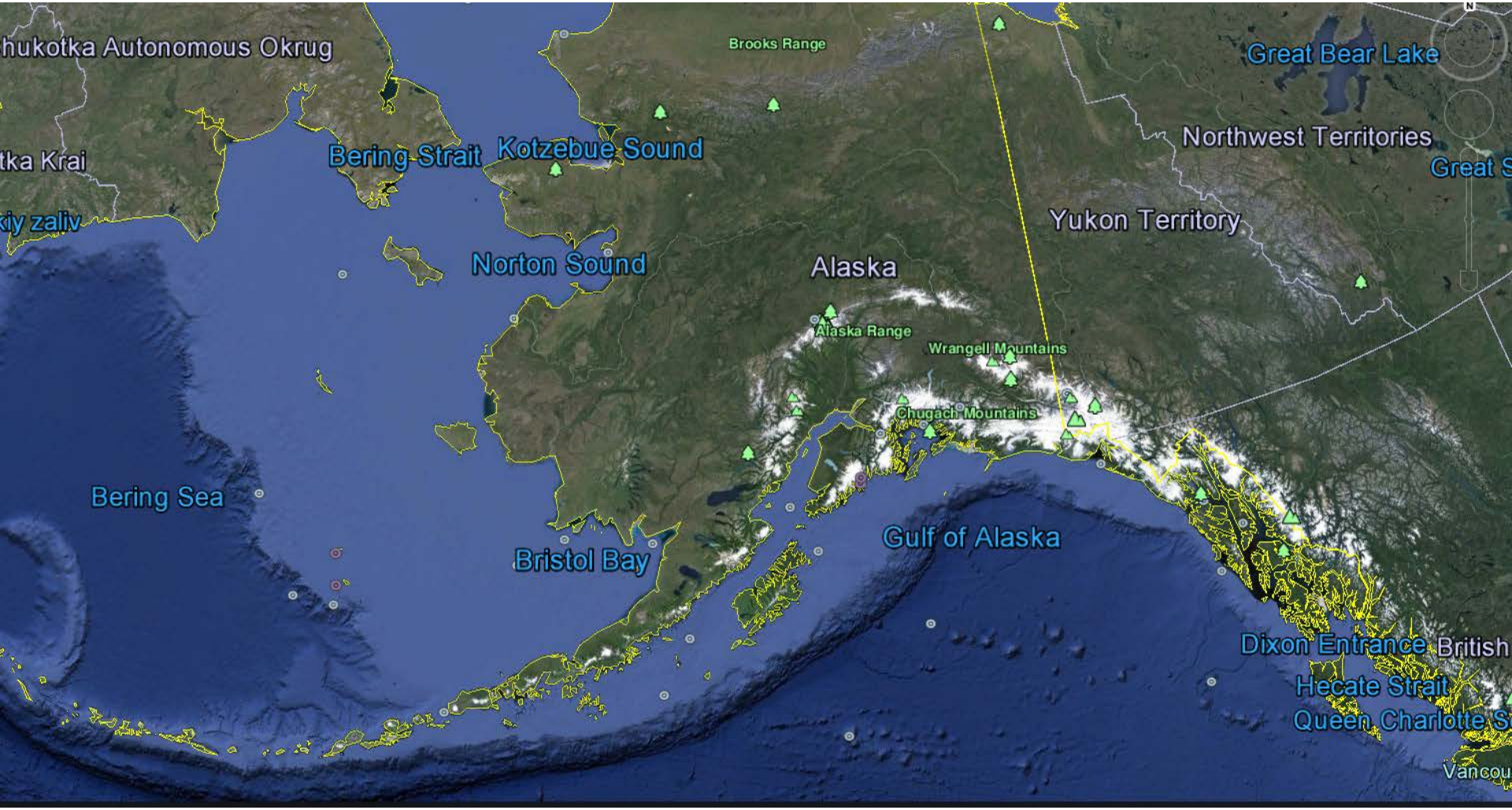
Answer =

- Density = biomass/volume of container
- Biomass = 1760kg
- Volume = 33.9cu.m.
- D = 1760kg/33.9cu.m. = 51.9kg/cu.m.

Saltwater netpens

- How might netpens differ when looking at the factors above?
- What are some of the challenges with netpens that we might not see in raceway/circulars?

Now just relax and take some deep breaths…….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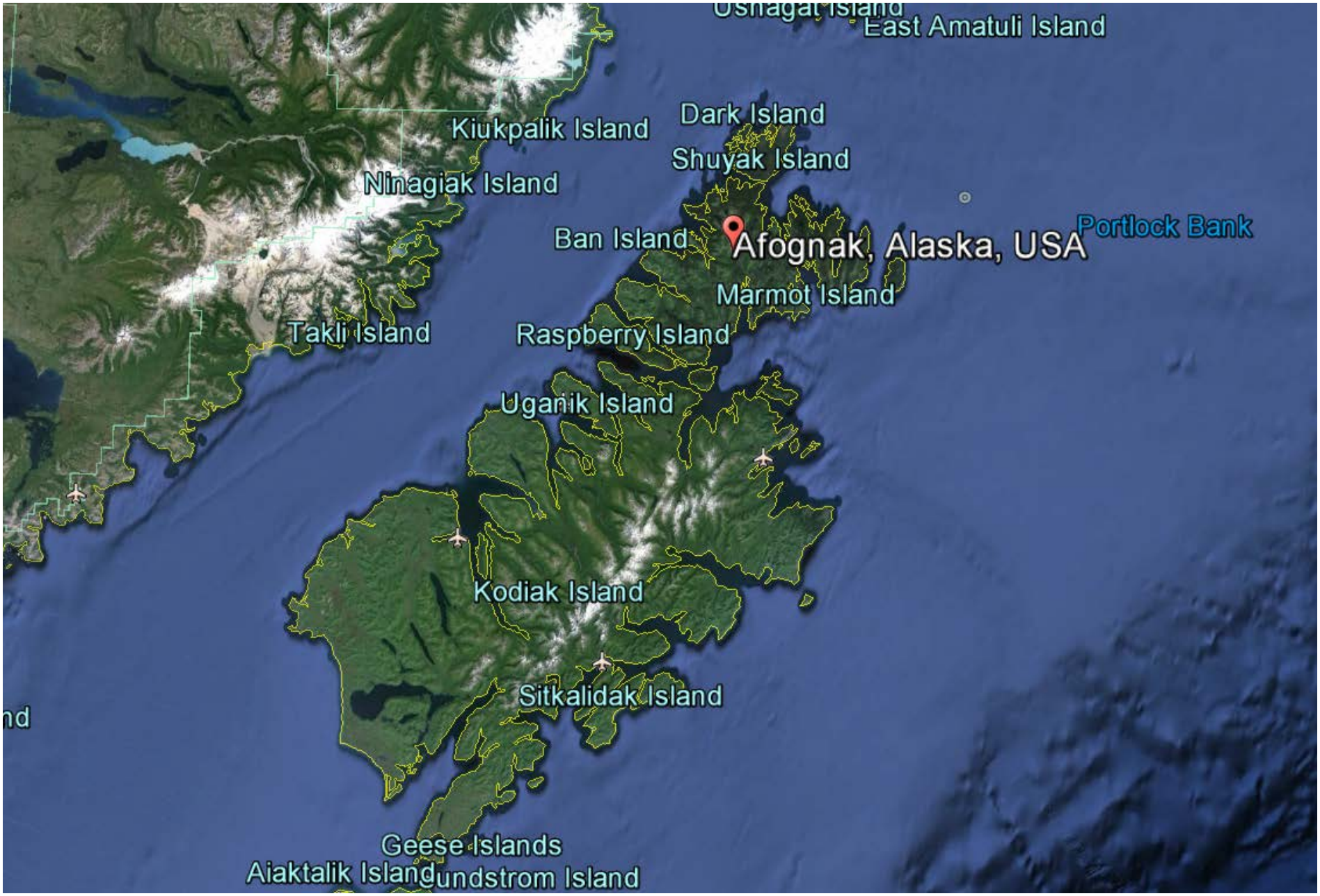
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Portlock Bank
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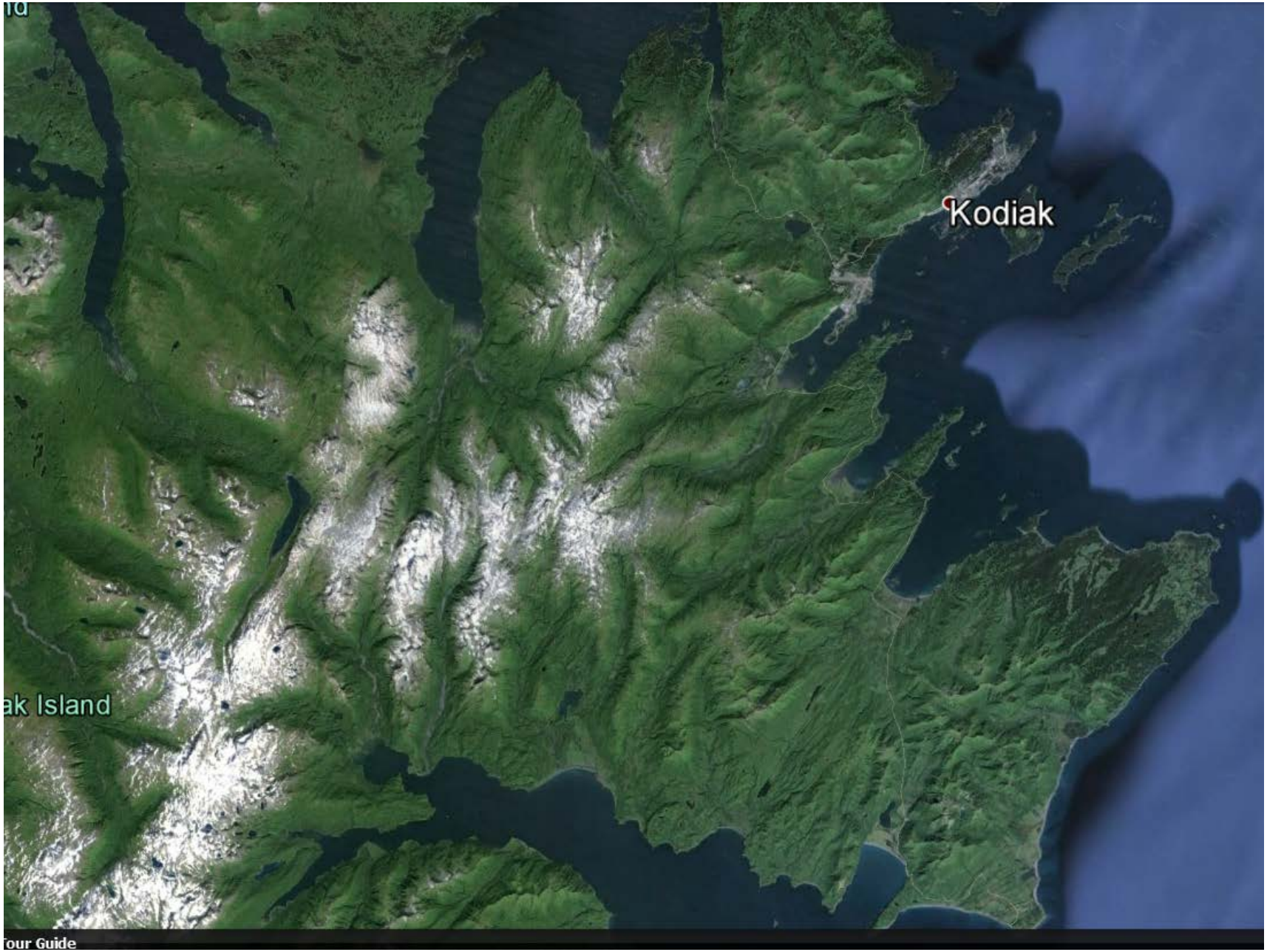
Kodiak road system



Kitoi Bay Hatchery location

Assignment for 2/10/14

- Find some "real" data either using your local facility or from other sources.
- Gather the following information:
  - Container dimensions
  - Water flow
  - Population and weight of fish in the container

  Calculate: density, loading and turnover rate