

# A Conceptual Approach for Relating Fish Populations, Harvest, and Consumption



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# Why?

- Document increasing fish consumption as a function of increasing harvest to support water quality regulations that protect Tribes
- Harvest is extremely well documented on an annual basis.
- If consumption can be predicted from harvest data, then:
  - Possibly avoid resource intensive fish consumption surveys or reduce survey effort
  - Rapidly put forward new data for regulatory actions



# Relating Fish Resources and Average Consumption

1. Determine the harvest rate of each species of interest in mass units
2. Determine what fraction of the harvest of each species of interest is distributed to the tribal population AND consumed.
3. Determine the fraction of each species of fish that is edible meat (i.e. weight of edible tissue / weight of raw fish).
4. The average consumption rate is the mass of prepared fish divided by the population.
5. The total average fish consumption rate would then be the sum of the consumption rates for individual species.

# 1: Harvest Rate

- May require evaluation of commercial and individual angler harvest.



- Harvest rate or  $HR_i = N_{i, \text{fish}} \times F_{i, \text{taken}} \times M_{i, \text{fish, avg.}}$



- Where

- $N_{i, \text{fish}}$  is the number of fish of a particular species that are available for harvest
- $F_{i, \text{taken}}$  is the percentage of the available population that is captured
- $M_{i, \text{fish, avg.}}$  Is the average weight or mass of the species of interest



# 2: Fraction Distributed

- Not all of the fish that are taken are likely to be consumed.
- Some may be sold or traded to other parties.
- Some fish may be used for other purposes.



# 3: Fraction of Edible Meat

- What fraction of the weight of an individual fish consists of edible meat?



- Could vary among species.

- Could vary depending on preparation and hence be specific to particular tribes.



- Some default information is available in the literature:  
<http://www.fao.org/docrep/003/t0219e/t0219e01.htm>

# 4: Average Consumption Rate

- Harvest rate divided by the population.
- Important to define the population.
  - Only tribal members in close enough proximity to the harvest area to participate in consumption?
  - Fish consumers only or include non-consumers?
  - How to treat children?

# 5: Average Total Consumption Rate

Average total consumption is simply the sum of the average consumption rates for all species



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# Mathematically...

Species Harvest Rate or  $HR_i =$

$$N_{i, \text{ fish}} \times F_{i, \text{ taken}} \times M_{i, \text{ fish, avg}}$$

Average Total Fish Consumption Rate =

$$\Sigma(HR_i \times F_{i, \text{ distributed}} \times F_{i, \text{ edible meat}}) / N_{\text{pop}}$$

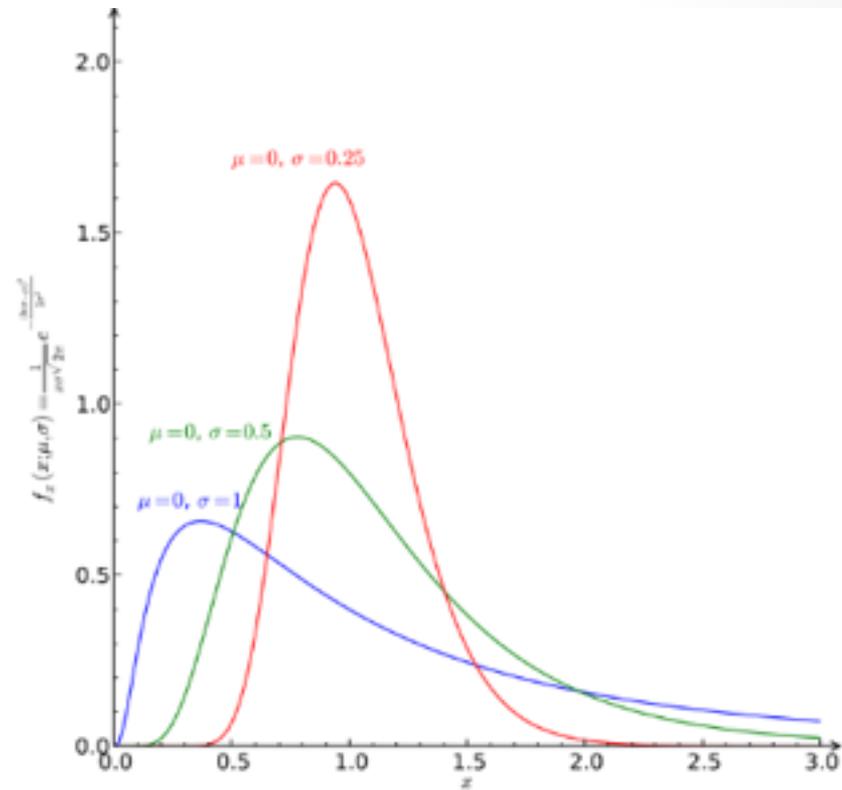
Where "i" indicates a particular species

# Going Beyond Average

The harvest analysis only provides averages. Can other statistics be estimated?

Given:

- The average from the harvest analysis
- Assumption of the log normal distribution for fish consumption
- Data from tribal surveys including information on variance



Predict a new fish consumption distribution

based on harvest information

# Issue with Consumption of Purchased Fish

- Harvest based consumption rates don't reflect consumption of fish from other sources
- Harvest based consumption rates likely underestimate overall consumption.
- Need to add consumption of purchased fish.
- Plausible that consumption of purchased fish would decrease as harvested fish became more available.
- Potential solution might be limited survey information.

# Predicting Improvements in Fisheries Resources and Impact on Consumption

$$HR_i = N_{i, \text{fish}} \times F_{i, \text{taken}} \times M_{i, \text{fish, avg.}}$$

$$\Sigma(HR_i \times F_{i, \text{distributed}} \times F_{i, \text{edible meat}}) / N_{\text{pop}}$$

- If quantitative relationships can be developed between hatchery operations / habitat improvement and fish numbers, it may be possible to predict consumption rates as a function of restoration efforts.
- The fraction of fish taken will likely be based on sustainability.
- The fraction of fish distributed may also change if increased fisheries resources result in more commercial sales of fish relative to Tribal consumption. Would tribal members choose dietary alternatives if fish were readily available?

# Next Steps

- Link extensive current fish consumption surveys, with fish population and harvest.
- Develop simple fish consumption survey methodology to update relationships between fish populations, harvest information, and fish consumption.
- Try to identify simple metrics relating fish populations and consumption rates with limited assumptions/ modeling that are defensible for use in regulatory efforts.

Thank you!