

Fisheries Management Law & Economics

Traditional Fisheries Management

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Outline



Management

Informed + Uninformed

Stock Assessments

Fishery Dependent

Fishery Independent

Stock Assessments

Population (How Many)

Life History Data (size, weight, age, sex)

Catch Information (fish tickets)

Salmon Example

2016 Preliminary Alaska Commercial Salmon Harvest - Blue Sheet

The Blue Sheet reports cumulative salmon harvest during the commercial fishing season in thousands of fish. Historically, this information was updated each Friday between mid-May and September. Beginning with the 2013 season, these harvest estimates will be updated twice daily. Please note, inseason harvest estimates published in this report are preliminary and subject to change. Confidential catch information is not included in these cumulative totals. For more information on the Blue Sheet, inseason summaries, and harvest timing charts please see our [Blue Sheet, Inseason Summary, and Harvest Timing Charts Overview page](#).

[Inseason Salmon Summary](#) | [Inseason Harvest Timing Charts](#)

Harvest in Thousands of Fish

Region	Area	District or Fishery	Fishery Start Date	Chinook	Chum	Coho	Pink	Sockeye	Total
Arctic-Yukon-Kuskokwim (AYK) Region	Kotzebue			—	—	—	—	—	—
	Kotzebue Total			—	—	—	—	—	—
	Kuskokwim	Kuskokwim Bay		—	—	—	—	—	—
		Kuskokwim River		—	—	—	—	—	—
	Kuskokwim Total			—	—	—	—	—	—
	Norton Sound			—	—	39	189	2	230
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	Yukon River	Lower Yukon River	Jun 7	—	762	23	127	—	912
		Upper Yukon River		—	5	—	—	—	5
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	Bristol Bay Total			29	731	80	750	37,561	39,151

Student Learning Outcomes

- Summarize fisheries management strategies in data limited and data rich situations
- Compare and contrast fishery dependent and independent types of stock assessments
- Describe population or abundance estimates and their role in fishery assessments
- Summarize the importance of biological information in fishery stock assessment and provide examples of the types of information collected
- Describe the various types of catch information that is used in fishery stock assessments
- Summarize the way salmon assessments are conducted in Alaska

Recap

Traditional Fisheries Management

Population Dynamics

Carrying Capacity

Traditional Fisheries Management

MSY / Surplus Production

Quota

Legislation

Closures

Restrictions

Market Based Management

1 Fish 2 Fish Summary

- It put fish populations at too much risk;
- It did not account for variability in population productivity (loss of river habitat for salmon)
- It did not account for species other than the focus of the fishery (bears, seals, etc.)
- It considered only the benefits, not the costs, of fishing
- It was sensitive to political pressure

What do we need to manage a Fishery?

We have a bag of tools now what?

- Without materials tools won't build anything
- Data are the materials managers need to “build” or manage a fishery



Information / Data

- How Many
- What Kind
- How Big
- How Old
- Healthy

Types of Fishery Management

Uninformed – data limited

Informed

- MSY / Surplus Production
 - Quotas
 - Closures
 - Legislation
 - Gear Restrictions
- Which category do these fall under?

Data Limited Management

It can be too expensive or not feasible to collect information or conduct stock assessments on every population.

In many cases a conservative approach is taken and the stocks are monitored

- Quotas*
- Closures
- Legislation
- Gear Restrictions

*Typically harvest is set low or there are severe gear restrictions

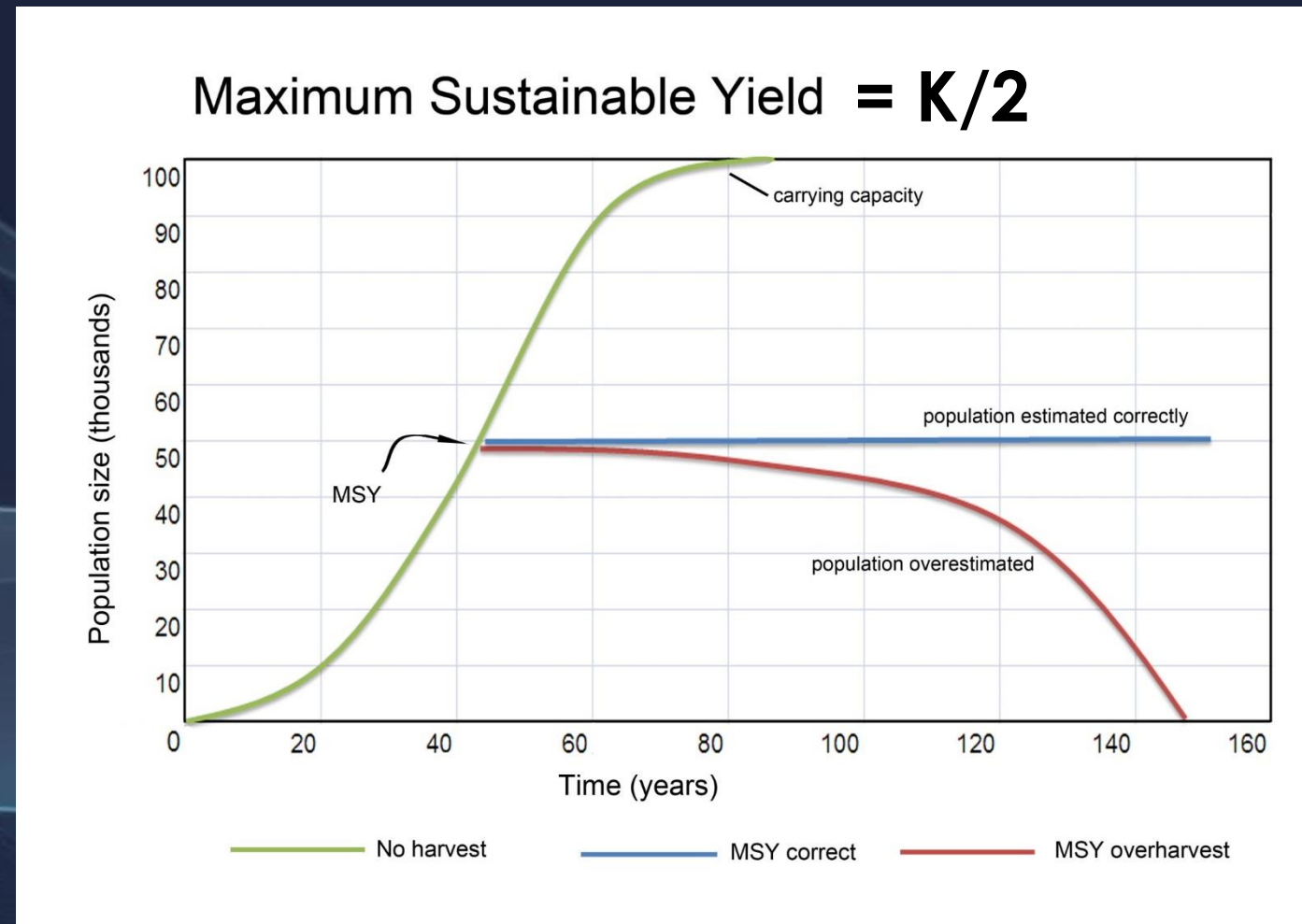
Informed Fisheries Management

With information we can set limits

- Maximum Sustainable Yield
 - Total Allowable Catch
 - Optimum Sustainable Yield
 - Guide Harvest Level
 - Etc.....
- These are all numbers or targets that need data to inform.
 - How much can we take??

Yield Models

- In order to manage a fishery for MSY we need to define K and $1/2 K$



Defining K

Carrying Capacity (K) is intrinsically difficult to define

- The target is always moving based on:
 - Survival rate
 - Mortality
 - Habitat characteristics
 - Environmental change
 - Anthropogenic factors
 - Exploitation, Bycatch, Pollution
 - Annual Variability

Self Check

- Carrying capacity is relatively easy to define once we have the appropriate information
 - True
 - False
- In data limited situations managers typically liberalize the fishery allowing for larger catches
 - True
 - False

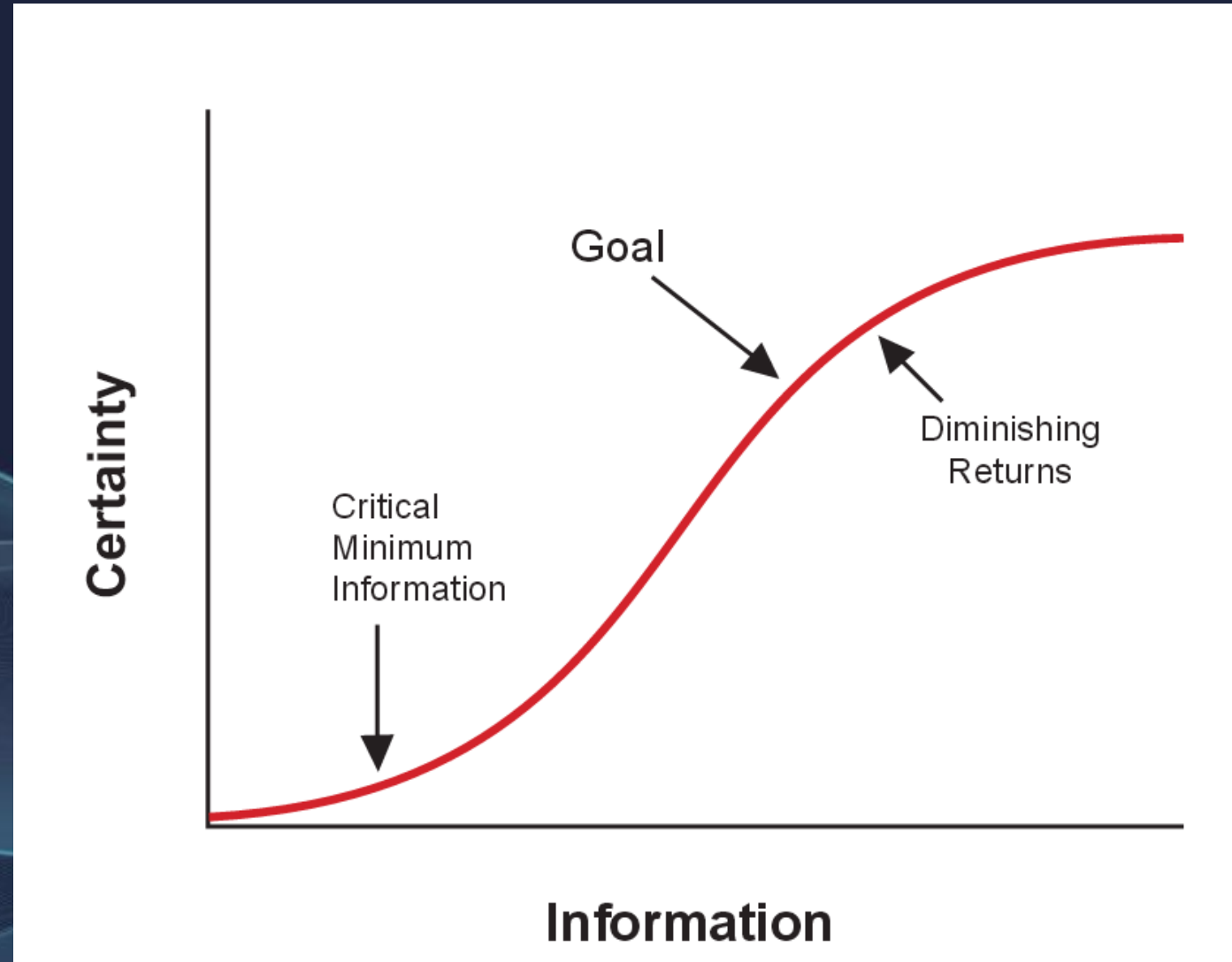
Stock Assessments

- Assessing a Fishery Stock
 - COLLECT DATA
- A way to describe the health, condition, and abundance of fishery stocks
 - Collect, Analyze and Report fishery information
- Information on: A B C's
 - Abundance - Population size
 - Biology - Life History data
 - Catch - Removals due to humans



Types of Assessments

- Fishery Independent
- Fishery Dependent



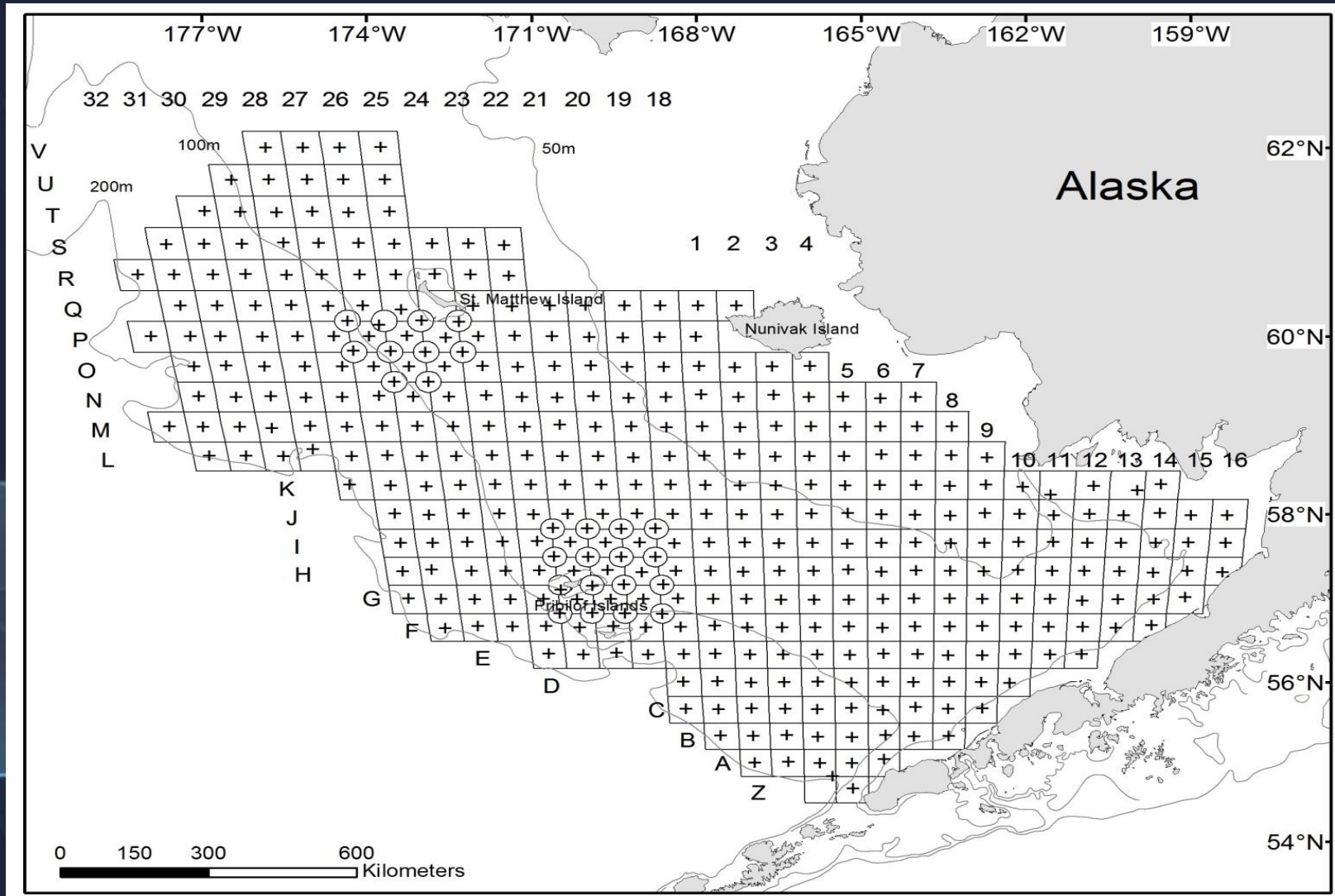
Fishery Independent

Management agency conducts survey

- Expensive \$\$\$
- More Systematic/Scientific
- Repeatable and comparable
- Allow for more biological information to be collected

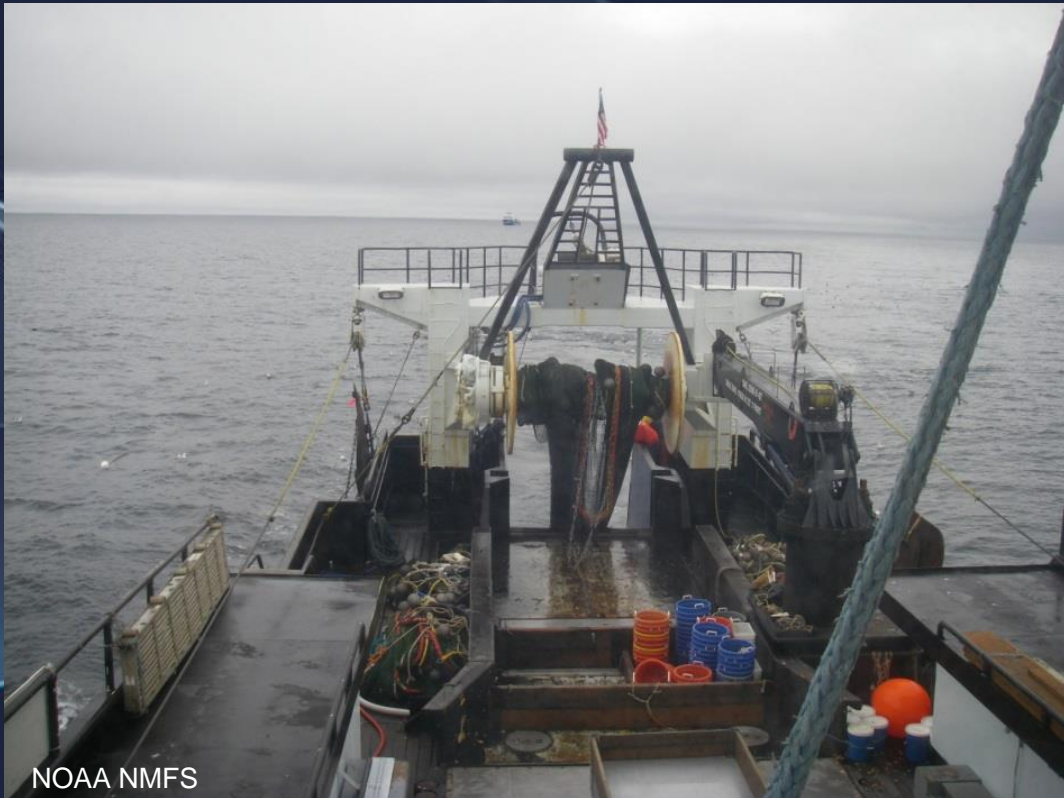


National Marine Fisheries Service Crab Surveys



Fishery Independent Survey

- Chartered vessel to conduct systematic trawl surveys



NOAA NMFS



NOAA Chartered Vessel Vesteraalen Photo: Jay Orr

Fishery Dependent

Dependent on the fishery to collect data

Collect data about fisherman's catch

- Less expensive
- Typically not systematic
- Can be biased
- Typically CPUE



Abundance - Population Size

Census - A census is the procedure of systematically acquiring and recording information about the members of a given population. It is a regularly occurring and official count of a particular population – US Census, Draining Lakes

Index - An index is an indirect shortcut derived from and pointing into, a greater volume of values, data, information or knowledge.

- This is an **Estimate**
- Almost all data are estimates

Variety of ways to estimate Abundance

Depends on:

– Species

- Salmon vs Halibut, Crab, Herring, Scallops, Shrimp, Urchins, Cucumber, Eulachon

– Habitat

- Lakes, Rivers, Ocean Deep vs. Shallow

– Life history

- Migratory, Range size,

– Life stage

- Juvenile vs. adult

Species

- Salmon



- Halibut



- Urchins

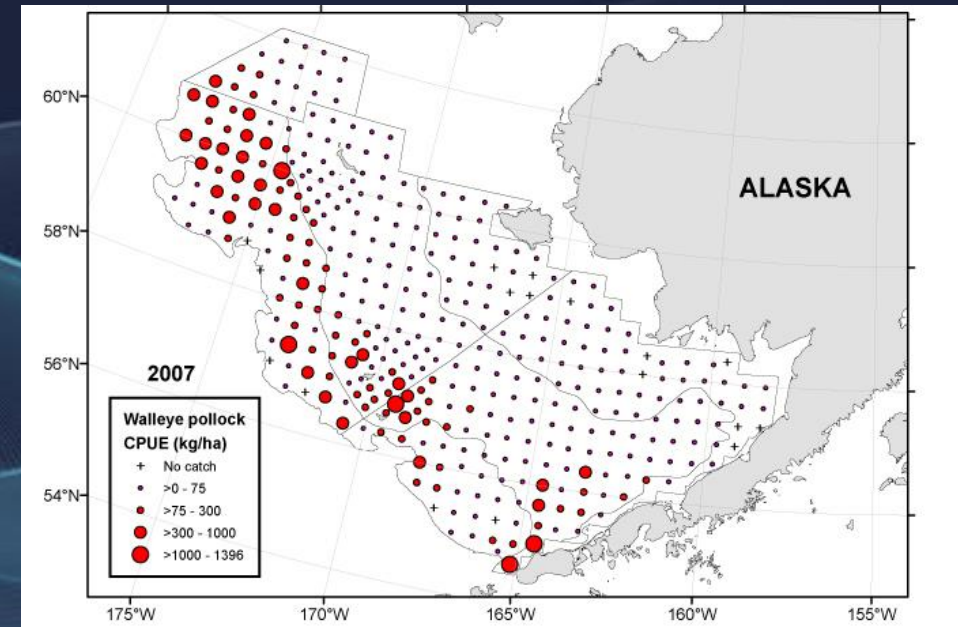


Abundance estimates by Spp.

- Halibut/Sablefish– Longline CPUE
- Crab – Pot Survey/Trawl CPUE
- Walleye/Cod – Trawl Biomass Acoustic?
- Salmon – Many
- Shrimp – Trawl/Pot Biomass/CPUE
- Scallops – Dredge
- Cucumber/Urchin – Dive Survey
- Herring – Dive Survey for egg deposition, Aerial, Sonar

Catch per Unit Effort CPUE

- What can CPUE Tell us?
- High CPUE = ?
- Low CPUE = ?
- Change from High to Low CPUE = ?



Boom & Bust fisheries & CPUE

- CPUE in these fisheries is usually high in early part of fishery
- Attracts more fishing pressure, CPUE levels off and overall catch increases
- Continue fishing and see CPUE decline and catch decline
- This indicates.....
- To remedy must remove fishing pressure until CPUE can return to earlier days of fishery
- Seem to simple?

Habitat

- Deep Ocean
- Rivers
- Lakes



Life History

- Migratory
- Range size



Life Stage

- Juvenile
- Adult



Self Check

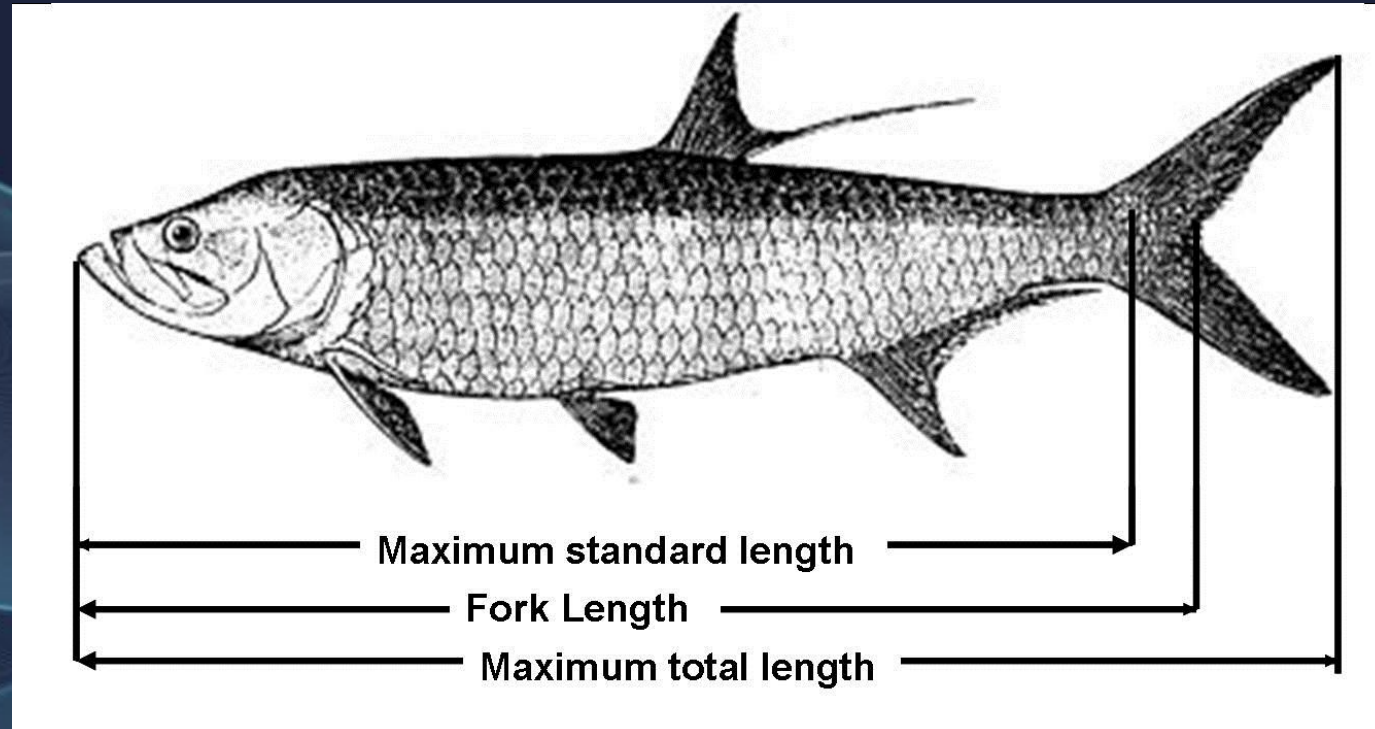
- A census is a an indirect shortcut derived from and pointing into, a greater volume of values
 - True
 - False
- How might you conduct an abundance estimate for Weathervane Scallops
 - **Pot Survey**
 - **Mark Recapture**
 - **Trawl Survey**
 - **Dredge Survey**
 - Acoustic Survey
 - Dive Survey

Biological information

- Size
- Weight
 - Size weight ratio?
- Age
 - Age composition
 - Length at age?
- Sex composition
 - What if changes?
- Fecundity - is the actual reproductive rate of an organism or population, measured by the number of gametes (eggs), seed set, or asexual propagules.

Fish Size

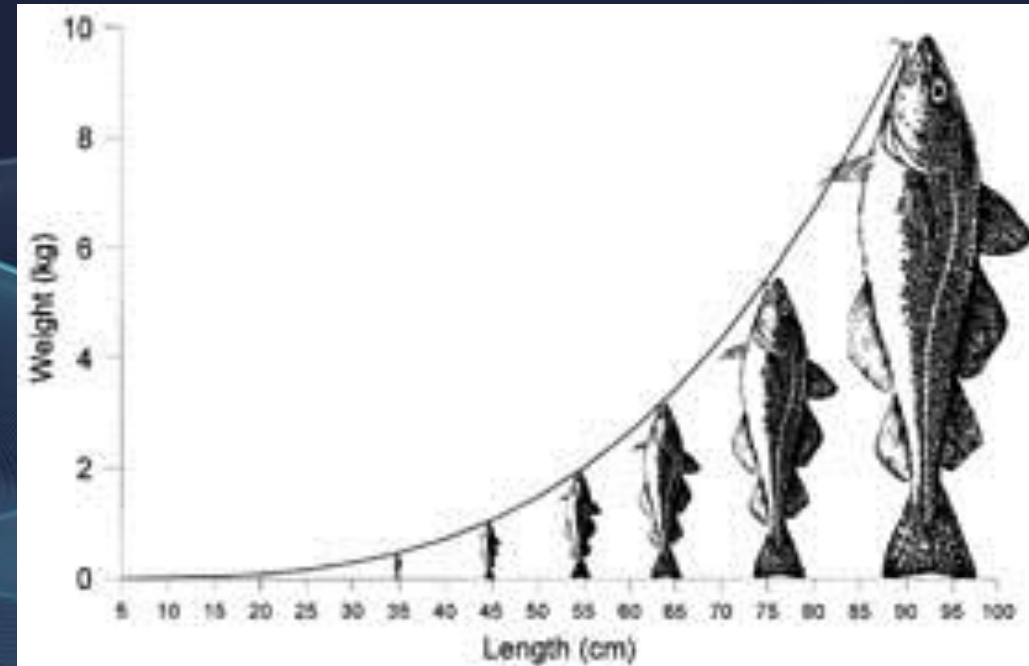
- Length defines legal size for harvest
- Relative number of fish in certain size categories
 - Reproductively Mature
- Determine Standing stock (metric tons)
 - L/W History - Ponds



Length & Weight

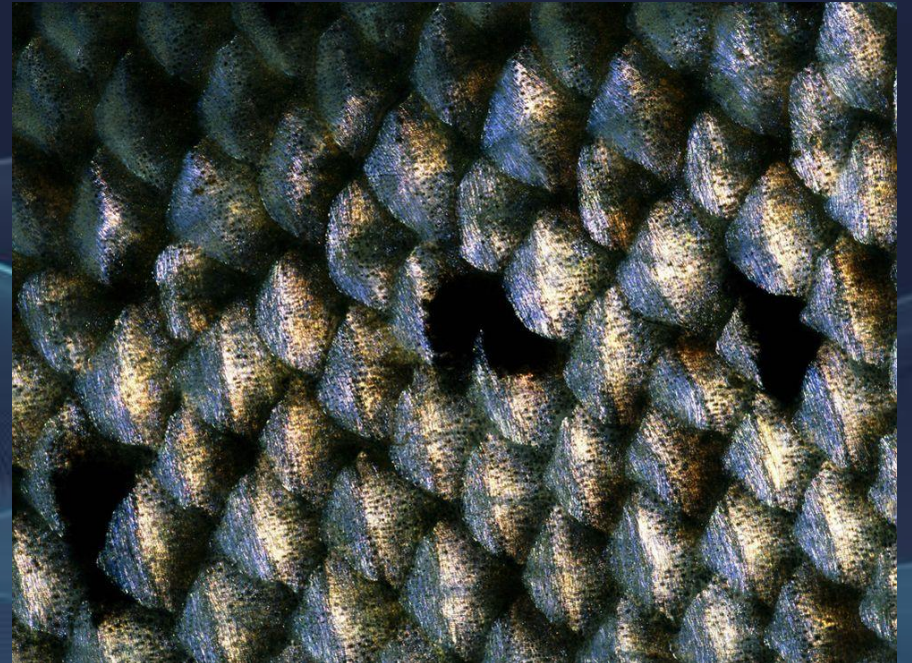
Provide information that are cornerstones of fisheries research and management

- Estimates of:
 - Growth
 - Biomass of Standing Crop
 - Production (tissue Growth kg/ha/yr)



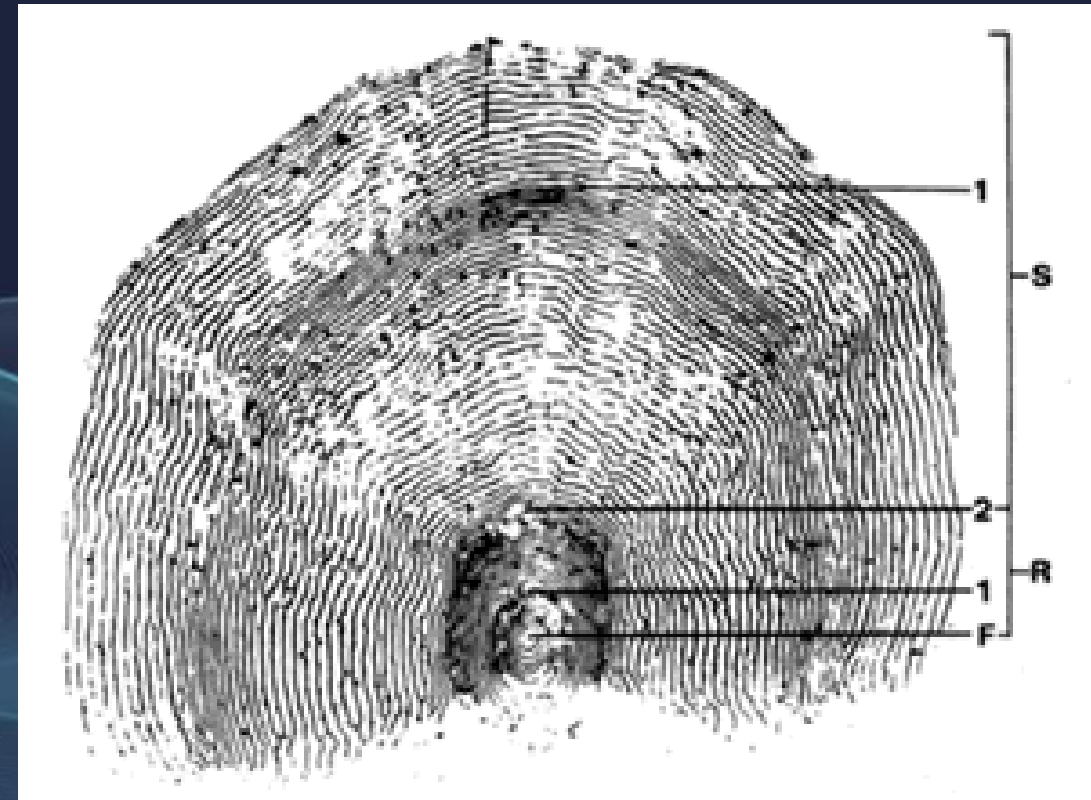
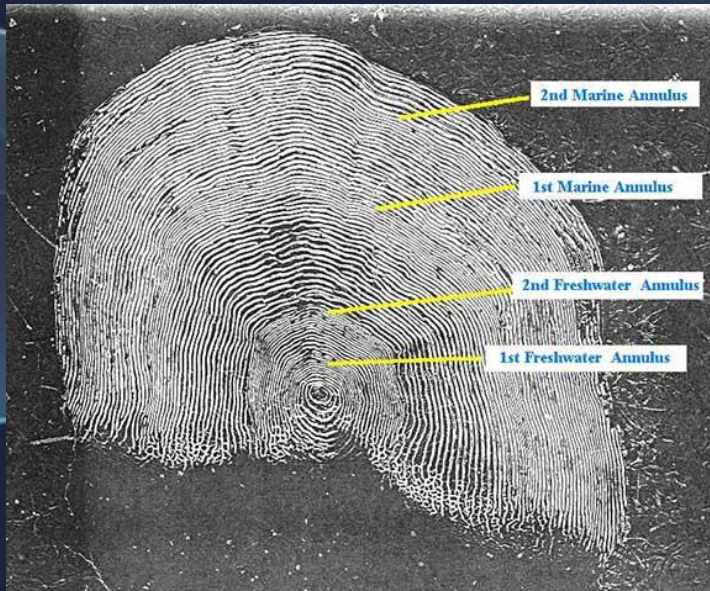
AGE

- How old is the Fish
- How old can it get

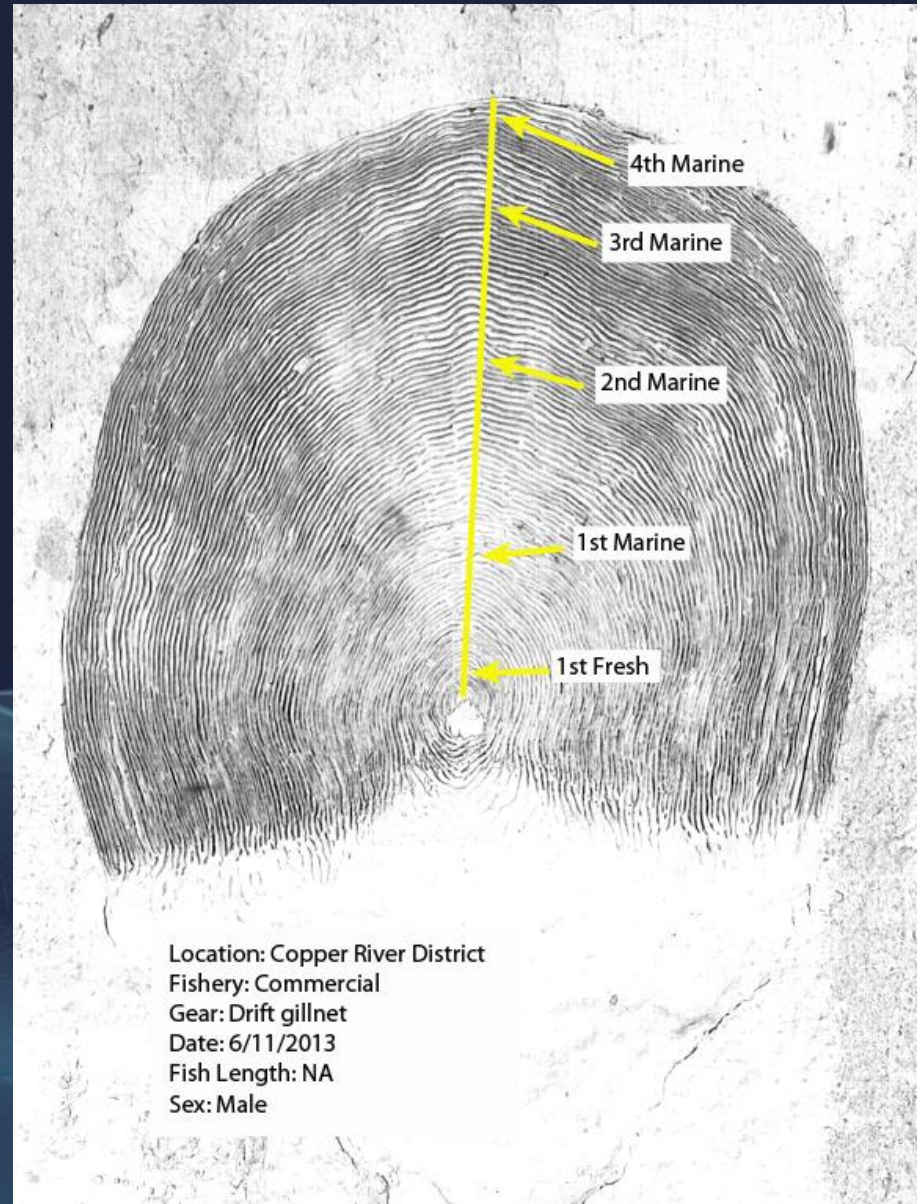
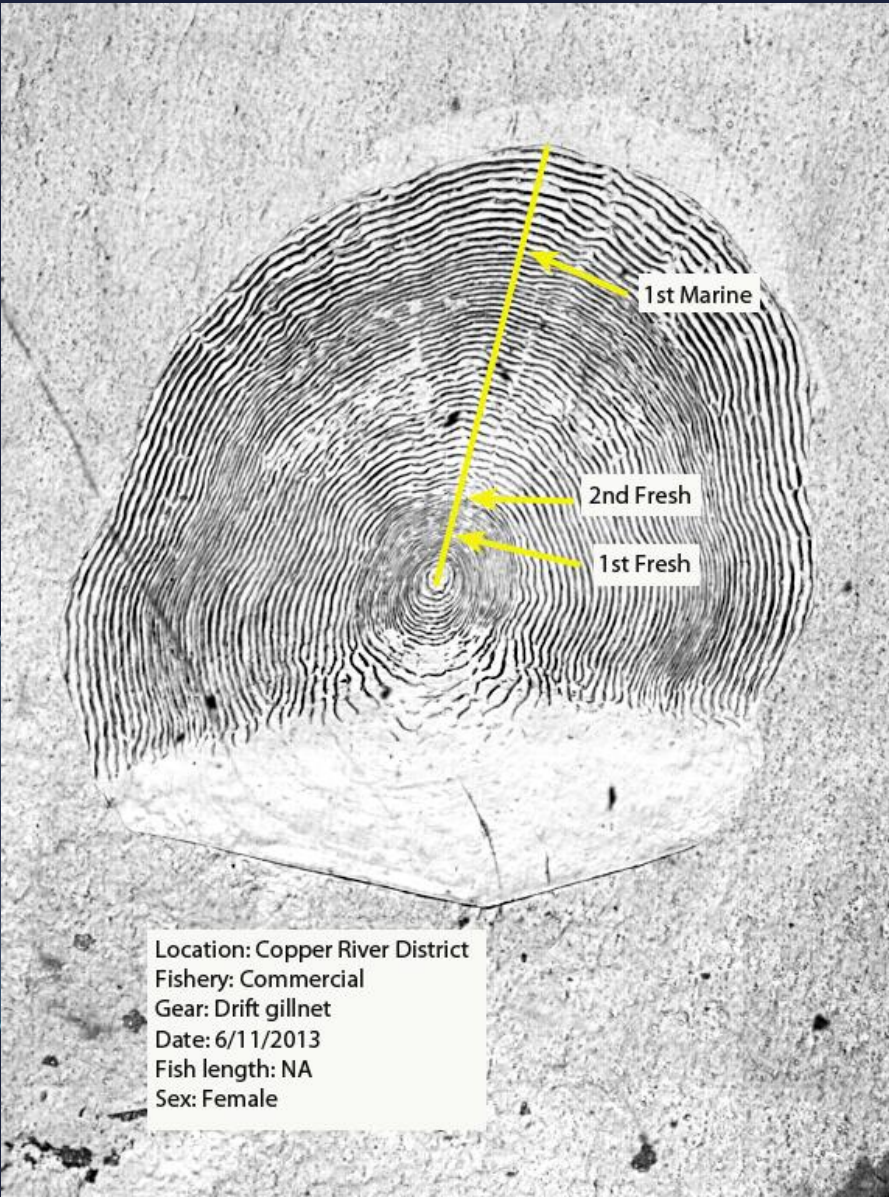


Aging Scales

- Scales are like rings on a tree
- Fish grow faster in summer than winter
 - Faster in Salt also
- Scales go on scale cards
- Use microfiche machine to read

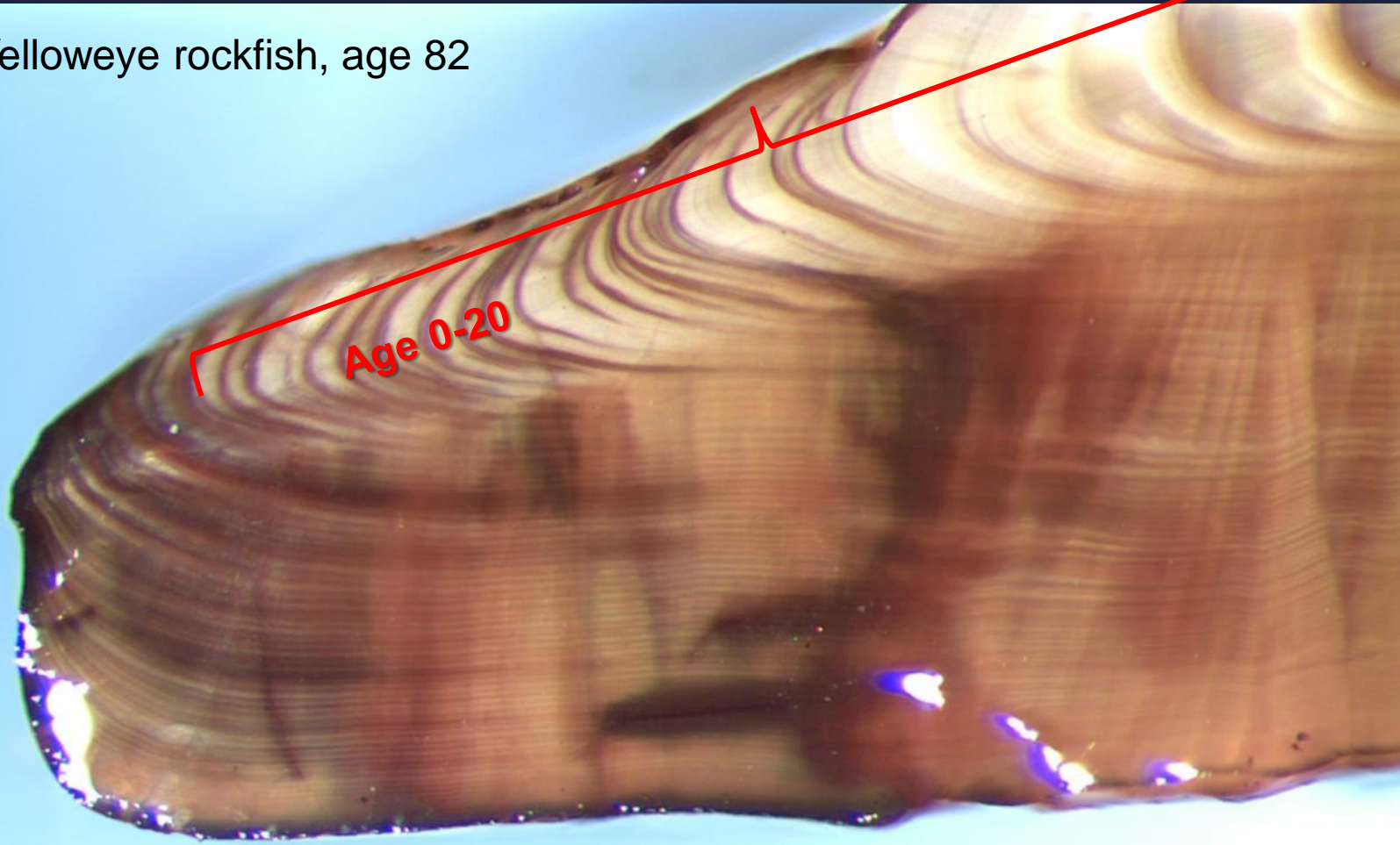


Scale Jail



Otoliths

Yelloweye rockfish, age 82

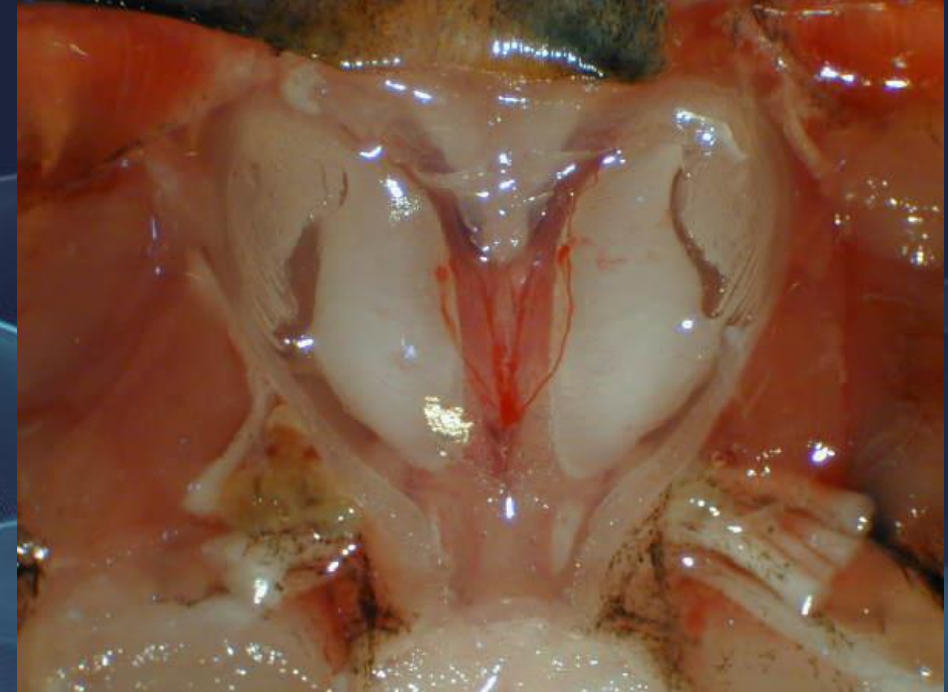


Courtesy ADFG ADU

Warning: Exceptionally easy specimen chosen to demonstrate

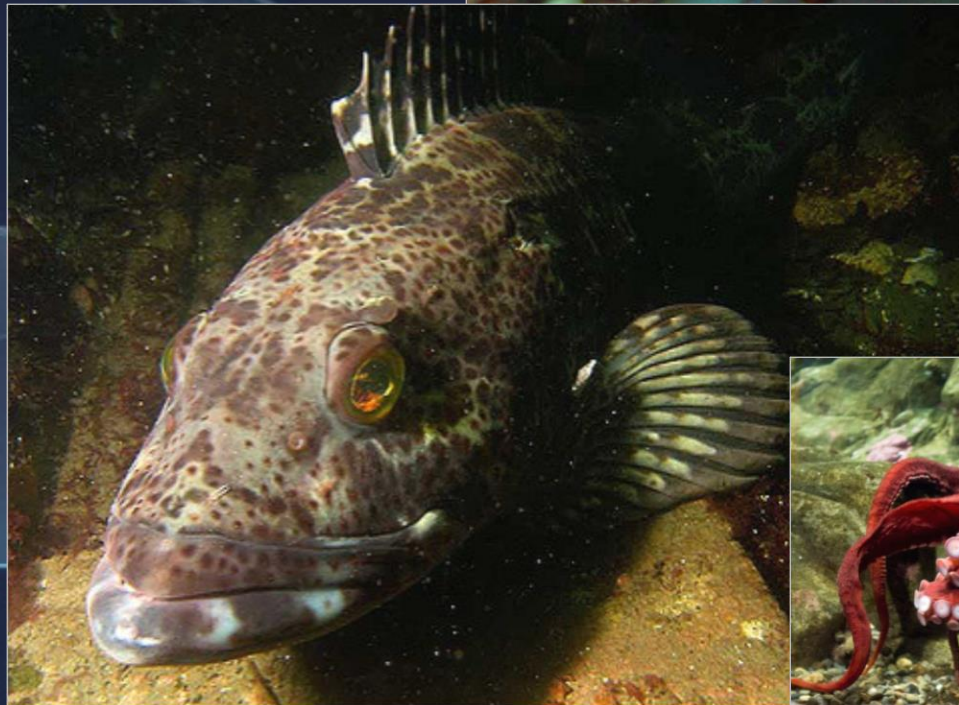
Otoliths and fisheries science

- Unique properties:
 - Otolith growth is continual
 - Lack of resorption
 - Complete growth and environmental record
- Allows scientist to:
 - Determine temperature (Sr:Ca)
 - Determine salinity throughout life history
 - Anadromous migrations



Other Species?

- Rockfish
- Sharks
- Octopus
- Lingcod
- Crabs
- Shrimp
- Clams



Age Structure

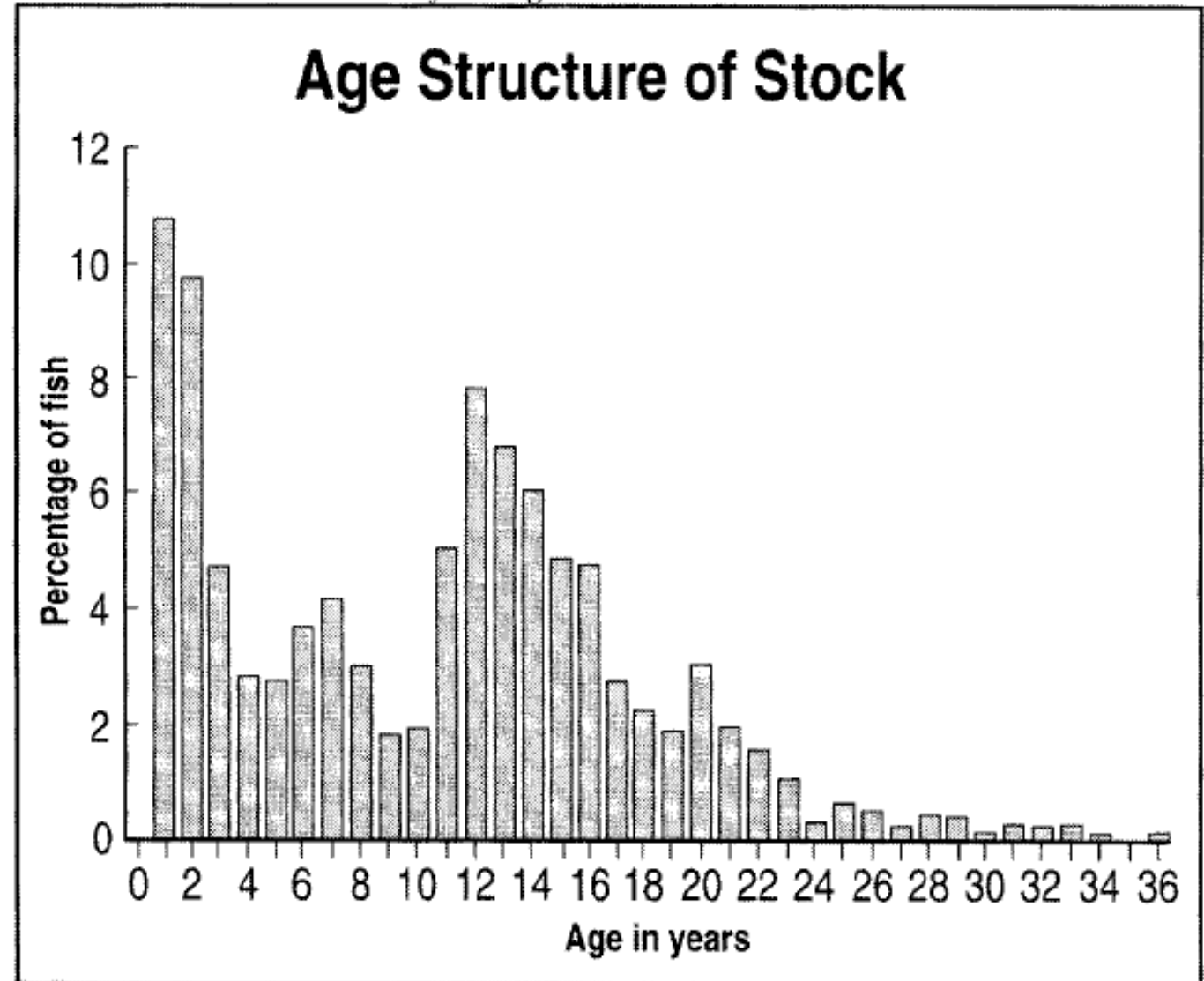
- Age Structure of Imaginary Catch



Age Structure

- Can see pulses or gaps in recruitment
 - 11 – 15 yr good age class

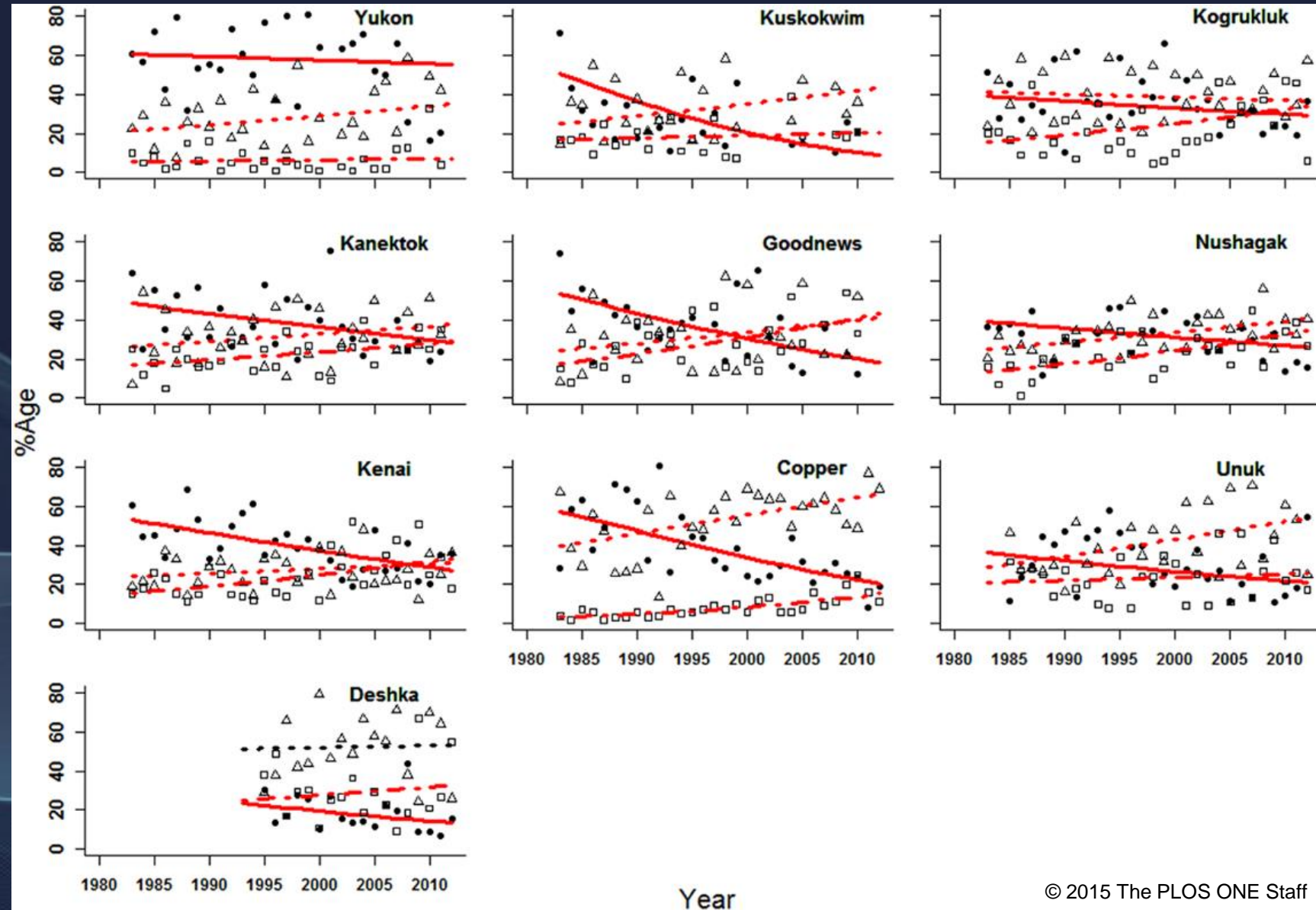
Source: Gulf of Mexico Fishery Management Council



Age Structure

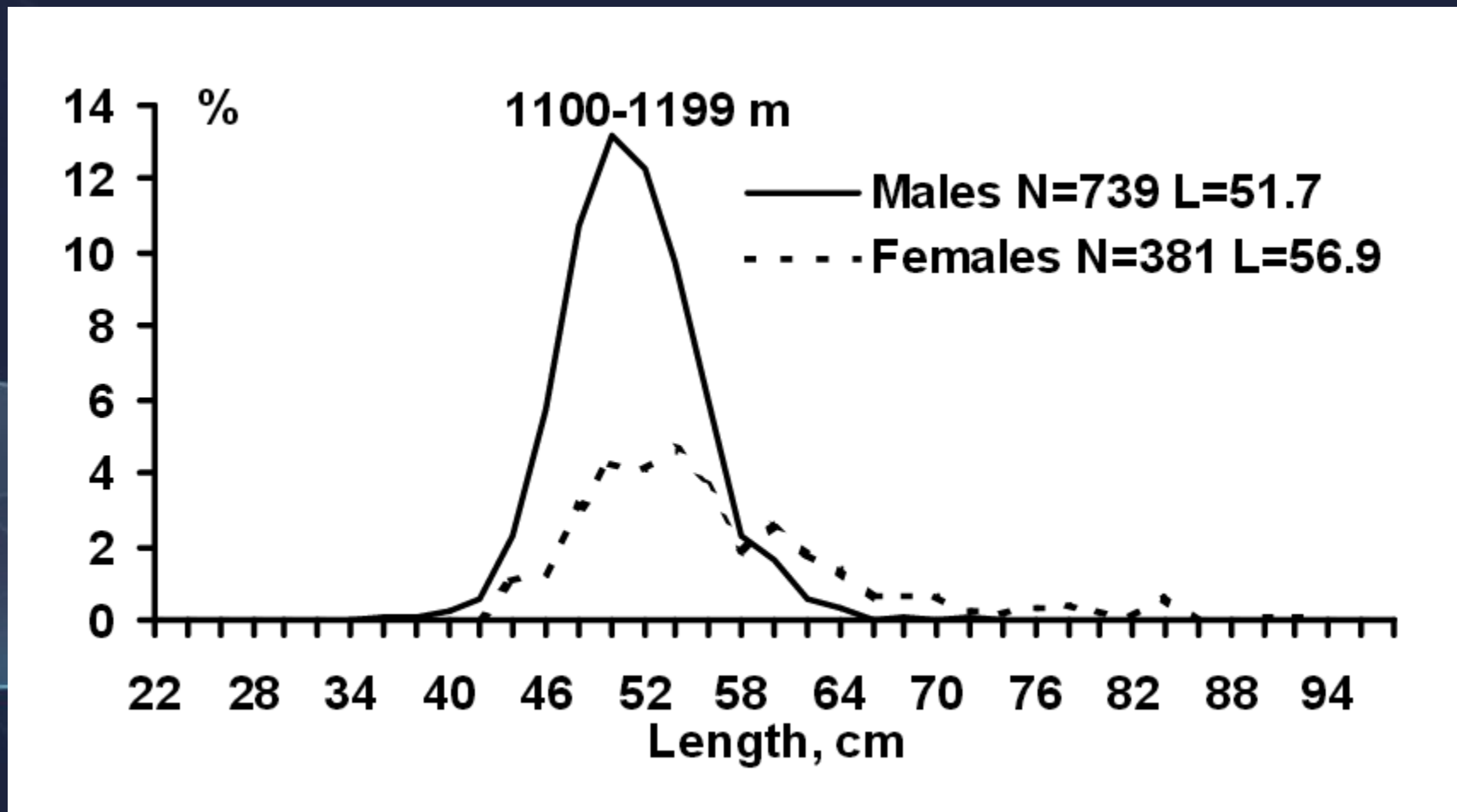
Chinook Salmon proportional age class

- Solid 4-Ocean
- Triangle & Dotted line
 - 3-Ocean
- Square & Dashed
 - 2-Ocean
- More young fish



Sex Composition

- Greenland Halibut



Fecundity

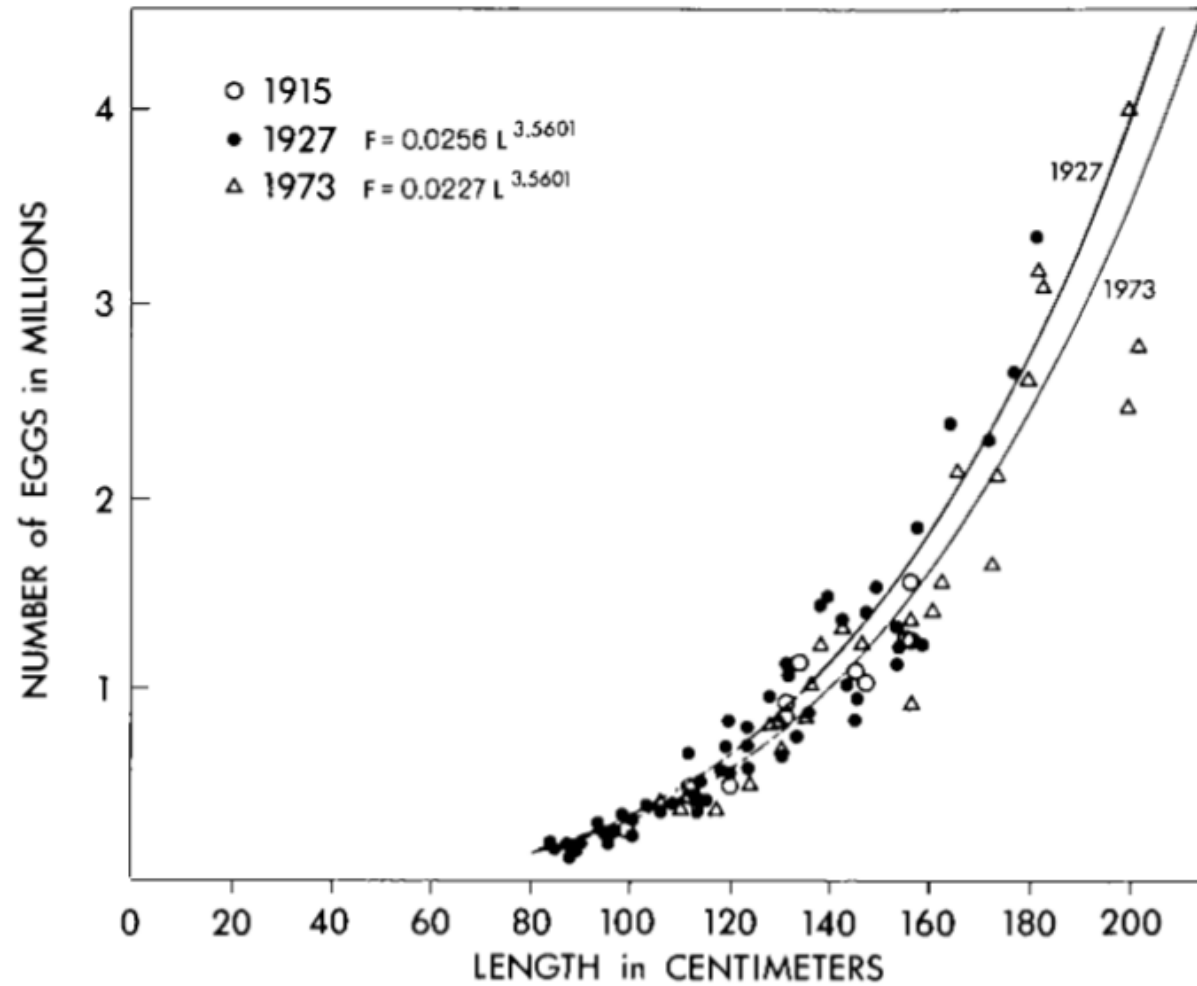


Figure 4. Fecundity-length relationship in 1927 and 1973, Area 3. The data from 1915 are presented for comparison. Standard lengths measured in 1915 were converted to fork lengths.

Self Check

- All of the following are types of biological information that are collected that are important in managing fisheries
 - Age
 - Sex
 - Length
 - Abundance
 - Weight
- One way to measure fecundity or the reproductive potential of an individual would be to count eggs
 - True
 - False

Catch Data

Dockside monitoring

- Records commercial catch receipts (Fish Tickets)
 - Measure of commercial landings
 - Biological samples of the length, sex, and age of fish

Logbooks

- Records location, gear, and catch

Observers

- Collect data on catch, bycatch, discards
 - Biological samples of the length, sex, and age of fish

Recreational/Subsistence Sampling

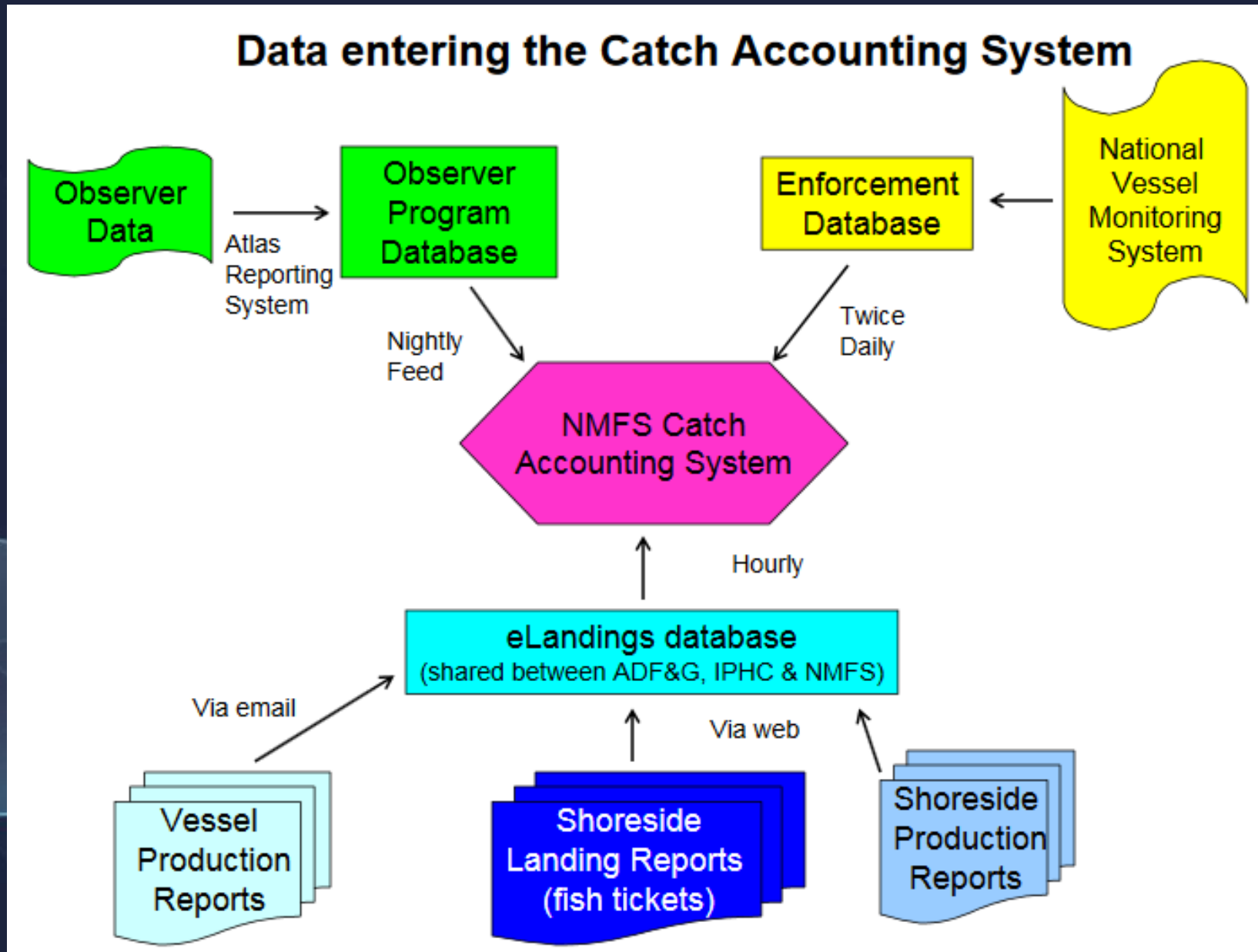
- Mail & Telephone interview surveys
- Dockside sampling

Catch Data

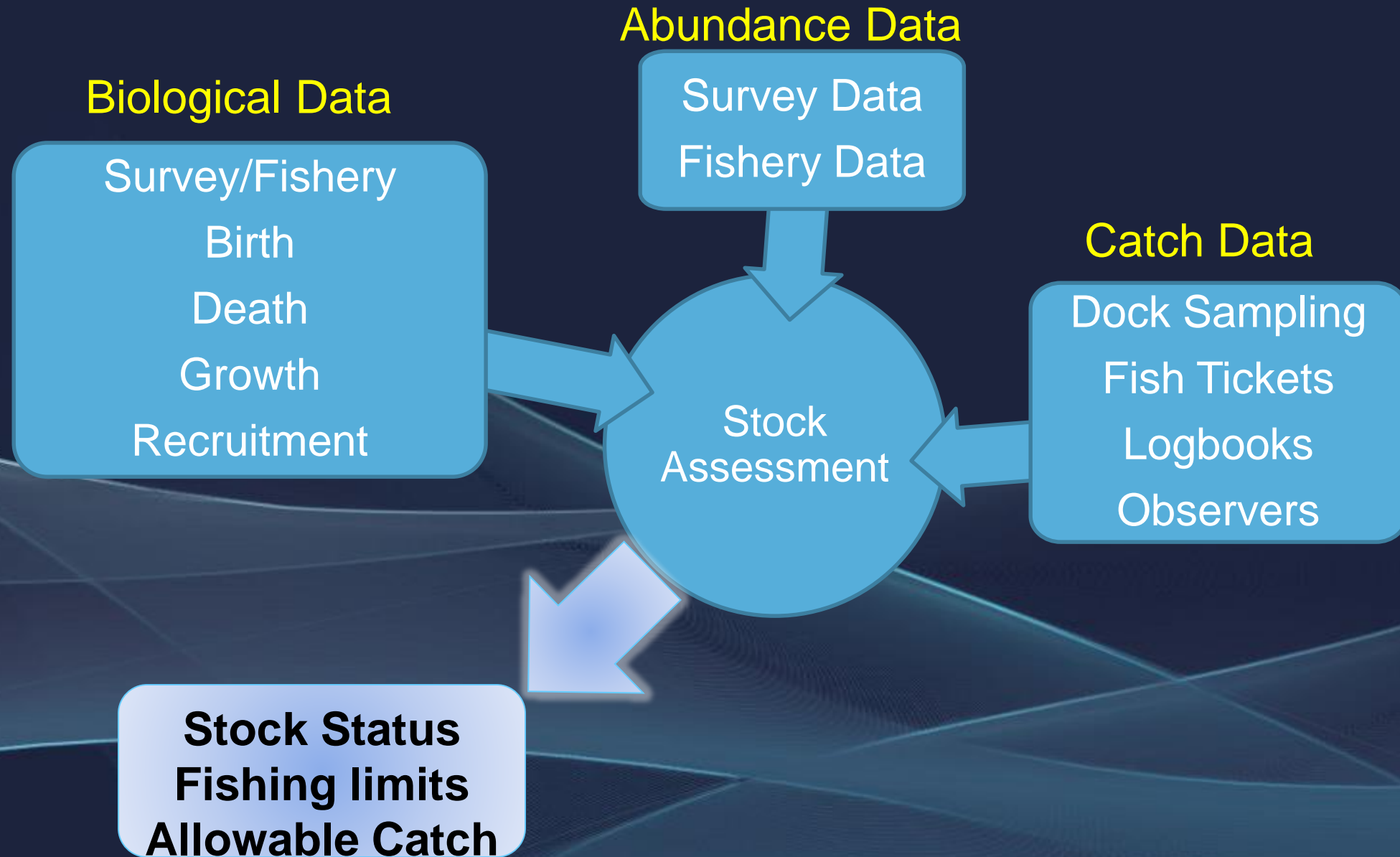
- Fisherman Sell Fish to Canaries
- Fish tickets
 - Electronic fish tickets
- This tells us how many fish are removed
 - What about Bycatch?

The image shows a form titled "ALASKA DEPARTMENT OF FISH & GAME SECONDARY TICKET". The form is for recording catch data. It includes fields for "Name", "Address", "City", "State", "Zip", "Phone", "E-mail", "Date of Birth", "Sex", "Height", "Weight", "Blood Type", "Eye Color", "Hair Color", "Complexion", "Occupation", "Education", "Experience", "License No.", "Expiration Date", "Type of License", "Type of Vessel", "Vessel No.", "Vessel Name", "Vessel Length", "Vessel Width", "Vessel Height", "Vessel Weight", "Vessel Capacity", "Vessel Type", "Vessel Material", "Vessel Construction", "Vessel Registration", "Vessel Insurance", "Vessel Safety", "Vessel Maintenance", "Vessel Inspection", "Vessel Certification", "Vessel Compliance", "Vessel Safety", "Vessel Maintenance", "Vessel Inspection", "Vessel Certification", "Vessel Compliance". The form also has a table for recording catch data with columns for "Date", "Time", "Location", "Species", "Quantity", "Weight", "Length", "Girth", "Sex", "Age", "Maturity", "Fecundity", "Survival", "Mortality", "Cause of Death", "Remarks".

NOAA's Catch Accounting

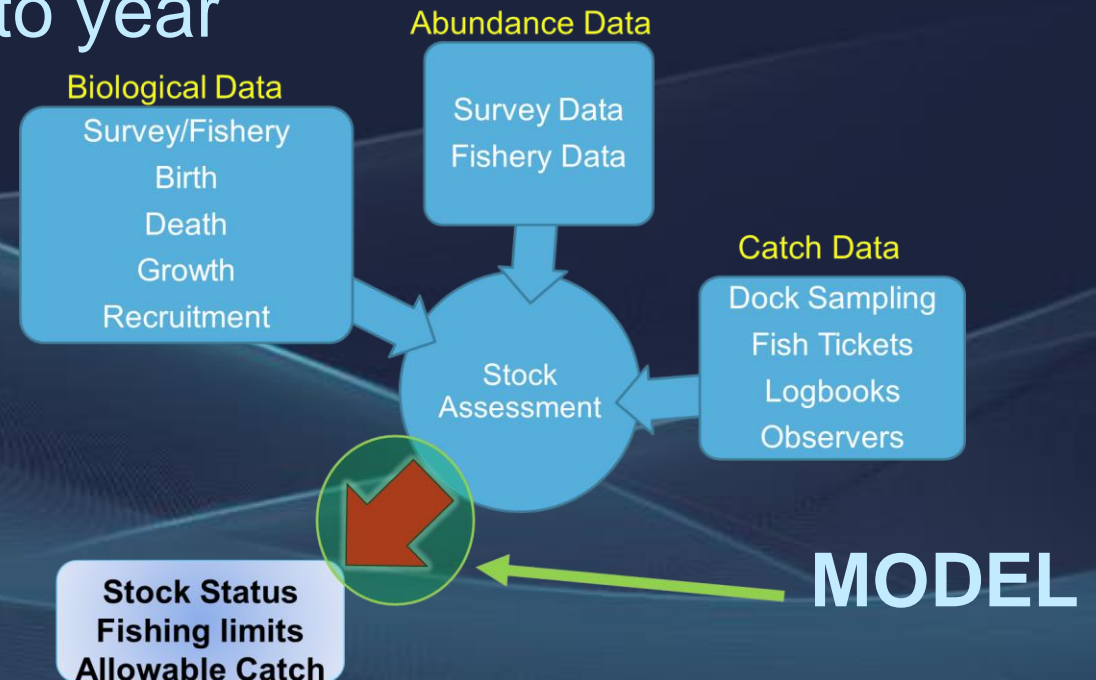


Have Data Now What?



Have Data Now What?

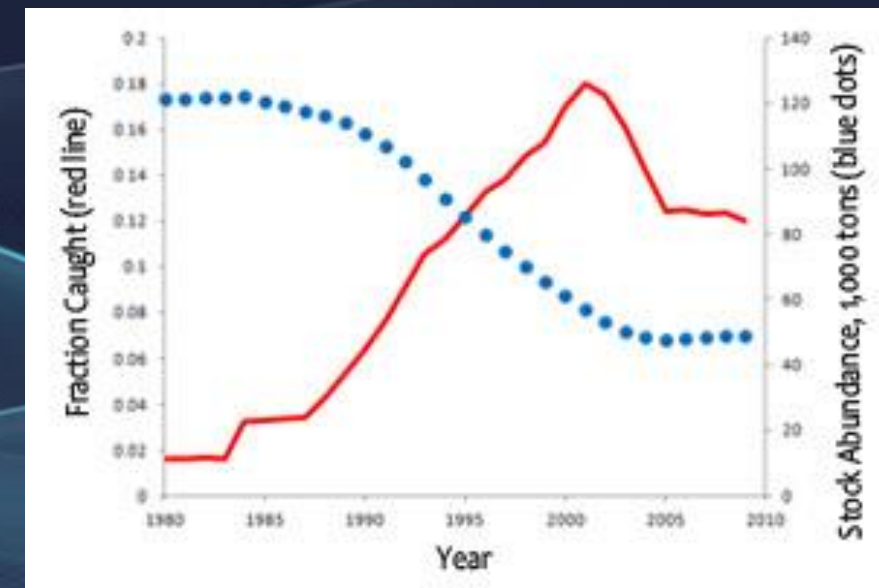
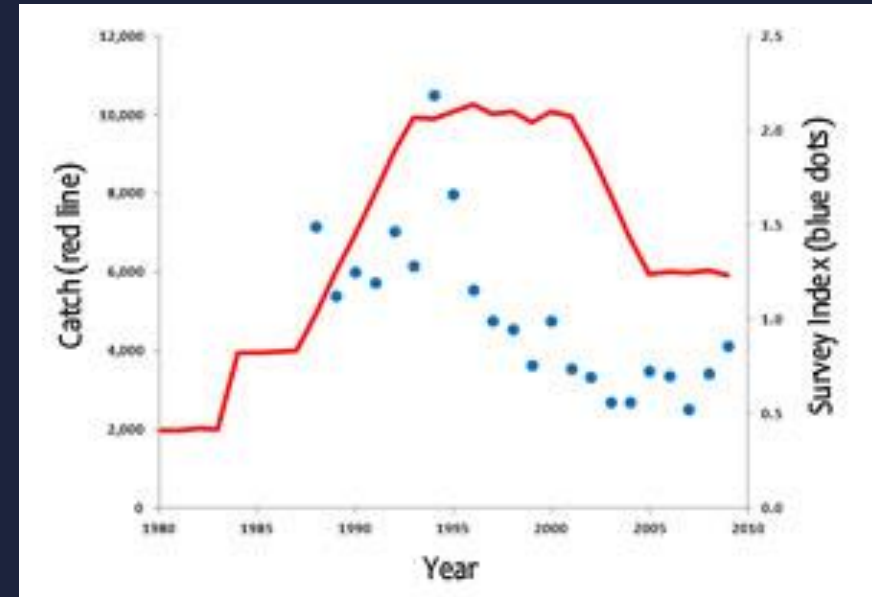
- Stock assessment information is typically put into some kind of model
 - These models vary widely
 - Incorporate different variables
 - Some models change from year to year



Stock Assessment Models

Simple to complex

- Population Model (1)
 - Abundance, mortality, growth, reproduction, movement
- Observational Model (2)
 - Predictions from population model on things measured
 - Abundance, catch, size, age composition
- Statistical Model (3)
 - Compares predictions to actual data and makes adjustments



Stock Assessments

- NMFS prepares SAFE reports
 - (Stock Assessment and Fishery Evaluation) Reports
 - Intended to summarize the best available scientific information concerning the past, present, and future condition of the stocks, marine ecosystems, and fisheries
 - *“The Guidelines for Fishery Management Plans published by the National Marine Fisheries Service require that a stock assessment and fishery evaluation report (SAFE) be prepared and reviewed annually for each fishery management plan”*

Self Check

- What is the next step after a stock assessment and before catch limits can be set?
 - Fishery Dependent Survey
 - Catch Recording
 - Statistical Modeling
 - Habitat Classification
- Information on the ABC's of a fishery is critical in conducting an accurate assessment and determining catch limits
 - True
 - False

Salmon Assessment

Salmon are different – come home

Most salmon fisheries in the state are managed for escapement

Escapement Goals (target just like MSY)

- Estimation of escapement
- Estimation of harvest (also called “catch”)
- Estimation of age composition

What a Manager Needs

Accurate assessment of the Stock (health of Fishery)

- Three components of stock assessments:
 - Estimation of escapement (abundance)
 - Estimation of age composition (biology)
 - Estimation of harvest (catch)
- All have uncertainty, some more than others
 - Can assess stock with just one, more are better

Salmon Assessment

Estimation of escapement... Abundance

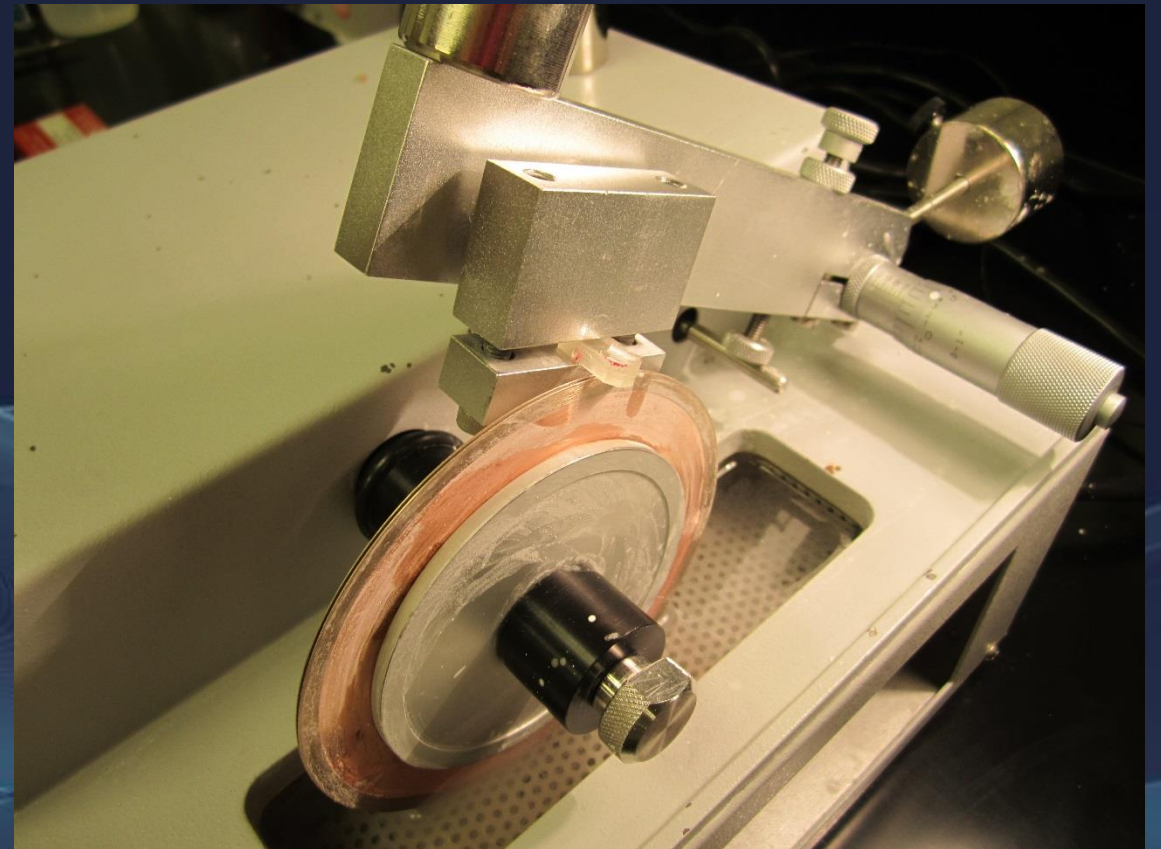
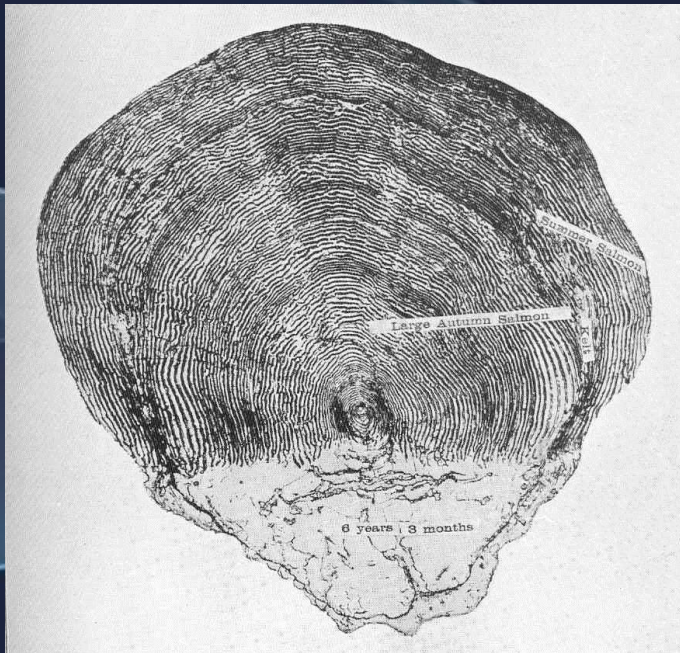
- Can be measured as total (Census) or index
- Best = weirs, towers, video = counts of true (?!) escapement
- Good = sonar, mark-recapture = estimates of true escapement
- OK = aerial, foot, snorkel surveys = index of escapement



Salmon Assessment

Estimation of Age Composition... Biology

- Salmon scales and otoliths primary means of estimation of AGE
 - Tells us Year Class
 - Years Fresh & Salt



Salmon Assessment

Estimation of Harvest or Landings.... Catch

Fish Tickets

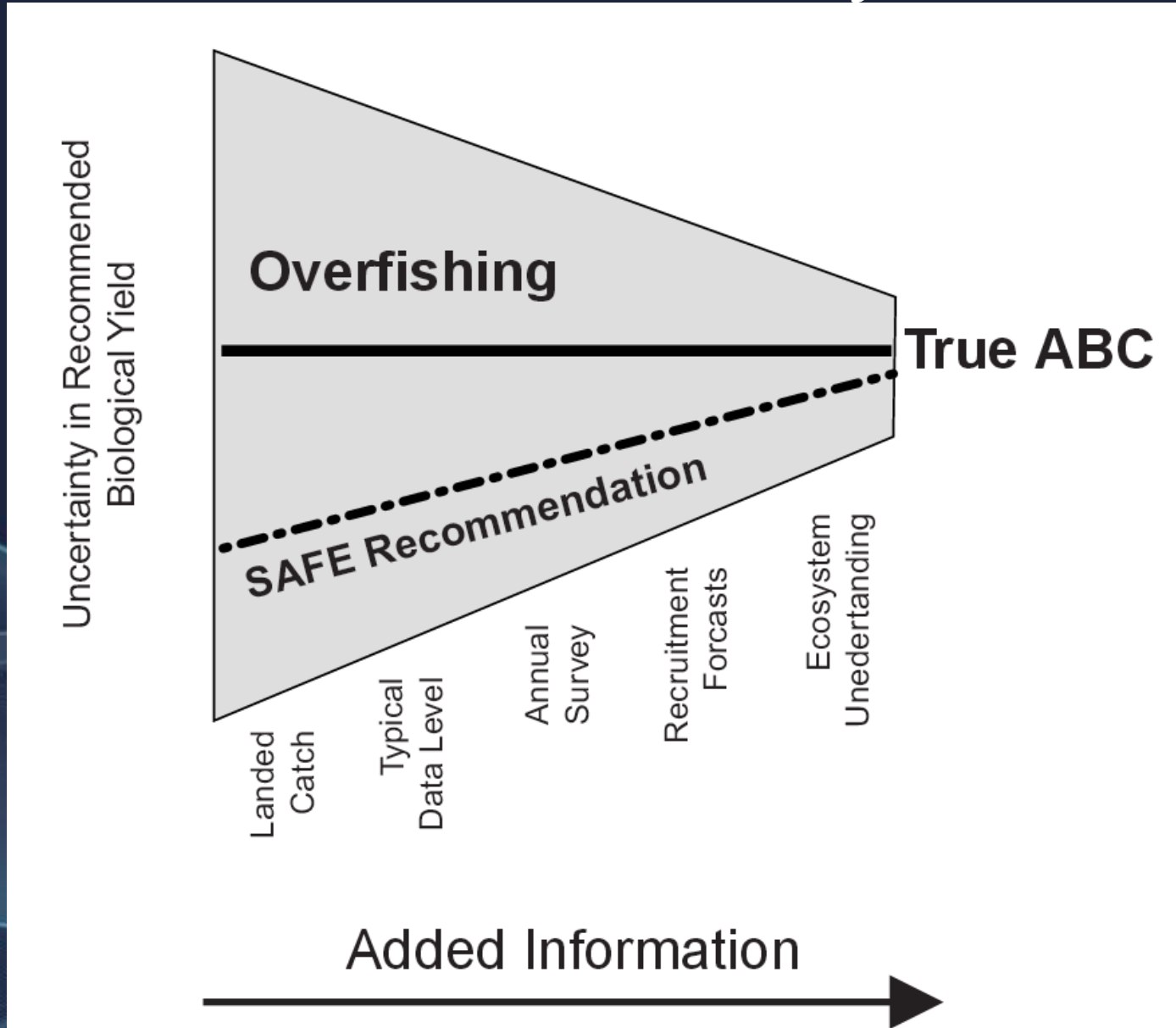
- This is a receipt of the fish sold from the fisherman to the processor
- ADF&G receives a copy (most of the time)
- Now paper, but moving to eLandings

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Harvest in Thousands of Fish

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	Upper Cook Inlet	Central District	May 30	7	121	102	371	2,334	2,935
		Northern District	May 30	2	3	23	8	48	84
	Lower Cook Inlet	Eastern District	May 15	—	—	—	—	61	61
		Kamishak Bay District		—	3	—	—	61	64
		Outer District		—	56	—	5	—	61
		Southern District	Jun 2	1	2	1	89	94	187
	Cook Inlet Total			10	185	126	473	2,598	3,392
	Prince William Sound	Bering River Drift	May 23	—	—	—	—	9	9
		Coghill District Drift	May 30	—	1,834	—	9	67	1,910
Copper River Drift		May 16	12	6	40	35	1,137	1,230	
Eshamy District Drift/Set		May 30	—	98	—	60	656	814	
Montague District Drift		May 30	—	200	—	21	3	224	
PWS General Seine		Jun 2	—	344	20	7,856	62	8,282	
PWS Hatchery		Jun 2	—	942	—	3,497	—	4,439	
Unakwik District Drift		Jun 16	—	1	—	—	—	1	
Prince William Sound Total			12	3,425	60	11,478	1,934	16,999	

Fishery Assessments Take Away

- With less information we have to be more conservative
- As we build our knowledge base we become more confident in our estimates



Self Check

- Since salmon return to their natal streams we estimate _____ instead of abundance
 - Mortality
 - Catch
 - Escapement
 - Outmigration
- With less information about a fishery we have to be more _____ when setting catch limits
 - Liberal
 - Conservative

Summary

Management

Informed + Uninformed

Stock Assessments

Fishery Dependent

Fishery Independent

Stock Assessments

Population (How Many)

Life History Data (size, weight, age, sex)

Catch Information (fish tickets)

Salmon Example

Readings

- 2015 Crab SAFE report

Stock Assessment and Fishery Evaluation Report
for the
KING AND TANNER CRAB FISHERIES
of the
Bering Sea and Aleutian Islands Regions

2015 Final Crab SAFE

Compiled by

The Plan Team for the King and Tanner Crab Fisheries
of the Bering Sea and Aleutian Islands

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