

# Life Cycle of Pacific Salmon and species information

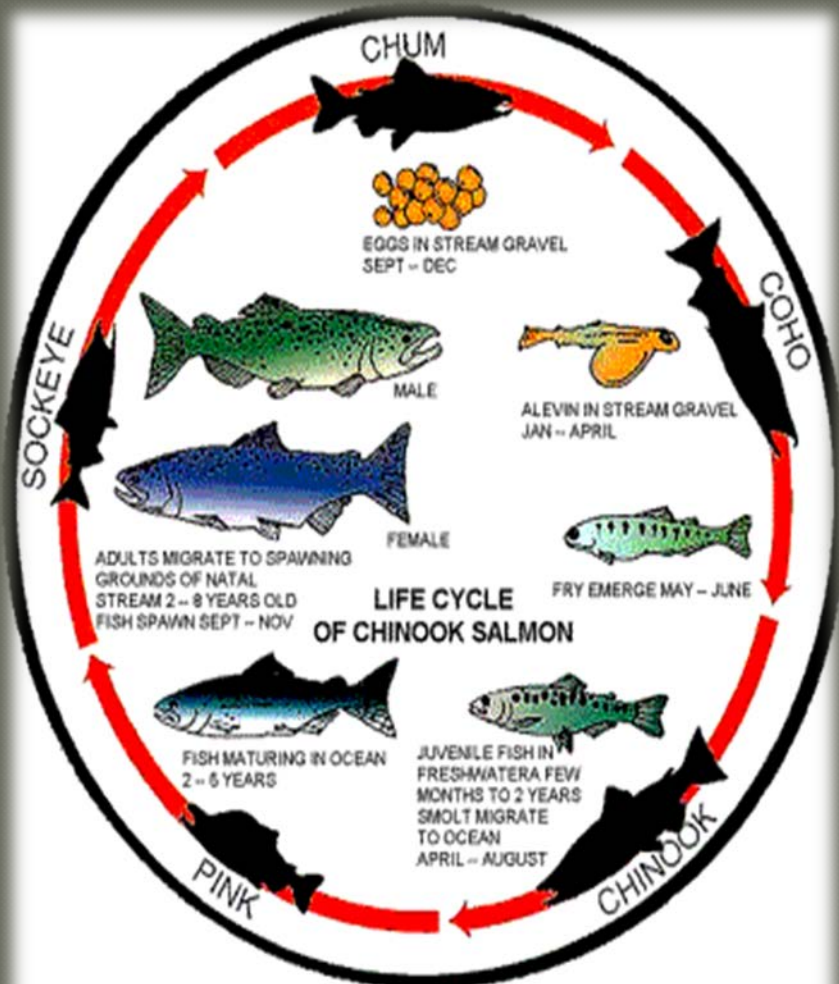


Image Courtesy of the Bonneville Power Administration

## Coho Salmon Alaska's Silver Treasure

**Spawners**  
Adult silver salmon die soon after they spawn. The carcasses are food for scavengers such as eagles and gulls. Drifted fish return to nitrogen and other essential nutrients to the environment which helps produce microinvertebrates for the following year's newly hatched salmon.

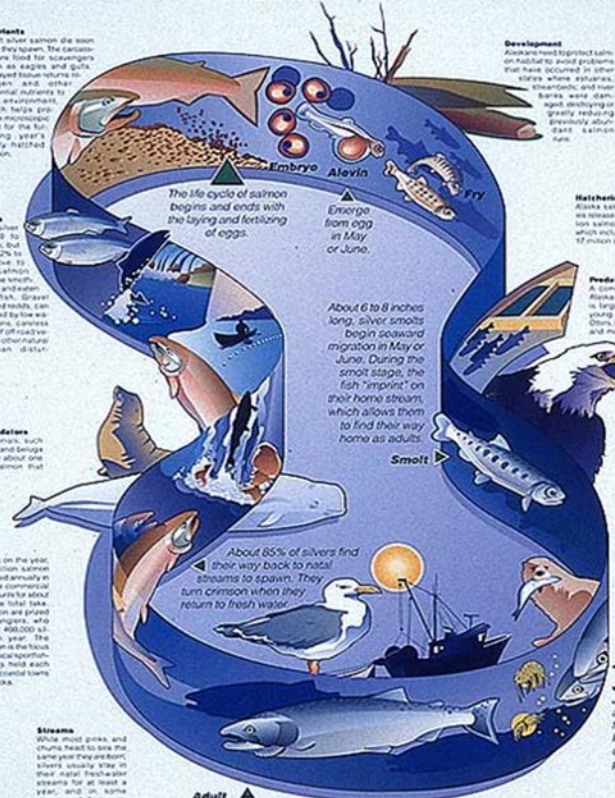
**Spawners**  
A female silver lays 2,000 to 5,000 eggs, but only about 2% to 10% survive. Salmon eggs can be washed and silt and eaten by other fish, larger insects, and birds. Salmon eggs can be destroyed by low water conditions, careless operation of off-road vehicles, and other natural and human disturbance.

**Marine predators**  
Marine mammals, such as sea lions and orcas, eat salmon. Birds, like bald eagles, also eat salmon that are in the water.

**Fishing**  
Depending on the year, about 8 million salmon are harvested annually in Alaska. The commercial catch accounts for about 95% of the total take. Silver salmon are prized for sport anglers. They catch over 400,000 silver salmon each year. The silver salmon is the focus of several local sportfishing derby held each summer in coastal towns around Alaska.

**Streams**  
While most pink and chum fish need to live the same year they are born, silver usually stay in their natal fresh water streams for at least a year, and in some streams up to four years, before heading down stream to saltwater.

**Adult** ▲  
Live at sea for about one year



### A cycle of risks

Coho (silver) salmon, like Alaska's other four salmon species—sockeye (red), chinook (king), pink (humpy), and chum (dog)—face a multitude of hazards in their journeys from home streams or lakes to the ocean and back. Because salmon are hidden by water, scientists have difficulty determining which hazards are most serious. Biologists do know that salmon require clean cold water, stable gravel spawning beds and pools, and a healthy ocean.



Illustration by Dennis Price and Steve Fisher. An illustration of the derelict fish house. Thanks to the Alaska Department of Fish and Game for the use of the photograph. All rights reserved. No part of this publication may be reproduced without the prior written permission of the University of Alaska Sea Grant.



# Medvejie chum egg collection FT students wanted this Friday!





Enhancement projects are intended to **reduce risks** to survival of salmon. What types of risks do they face during their lifetime?









# Comparison of “payoffs”

Wild Fry Production				Hatchery Fry Plant			
Adult Escapement		1,140					
Assume 50% females		570					
Minus 90 females for hatchery broodstock		480		90 females			
Eggs/female		3,400		Eggs/female		3,400	
Total eggs available		1,632,000		Total eggs available		306,000	
Resultant hatched wild fry @ 4%		65,000		Resultant hatchery fry @ 78%		238,600	
28% survival to fall fry		18,300		28% survival to fall fry		66,800	
70% survival fry to smolt		12,810		70% survival fry to smolt		46,800	
12% survival smolt to adult		1,500		12% survival smolt to adult		5,616	
			<b>Pre - Smolts</b>				
			90 females				
			Eggs/female		3,400		
			Total eggs available		306,000		
			Resultant hatchery fry @ 78%		238,600		
			95% survival to fall pre-smolt		226,600		
			80% survival to smolt		181,300		
			12% survival smolt to adult		22,000		

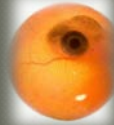


# Lifestages

● Adult



● Egg



● Alevin



● Fry



● Smolt





# Adults - Homing and straying

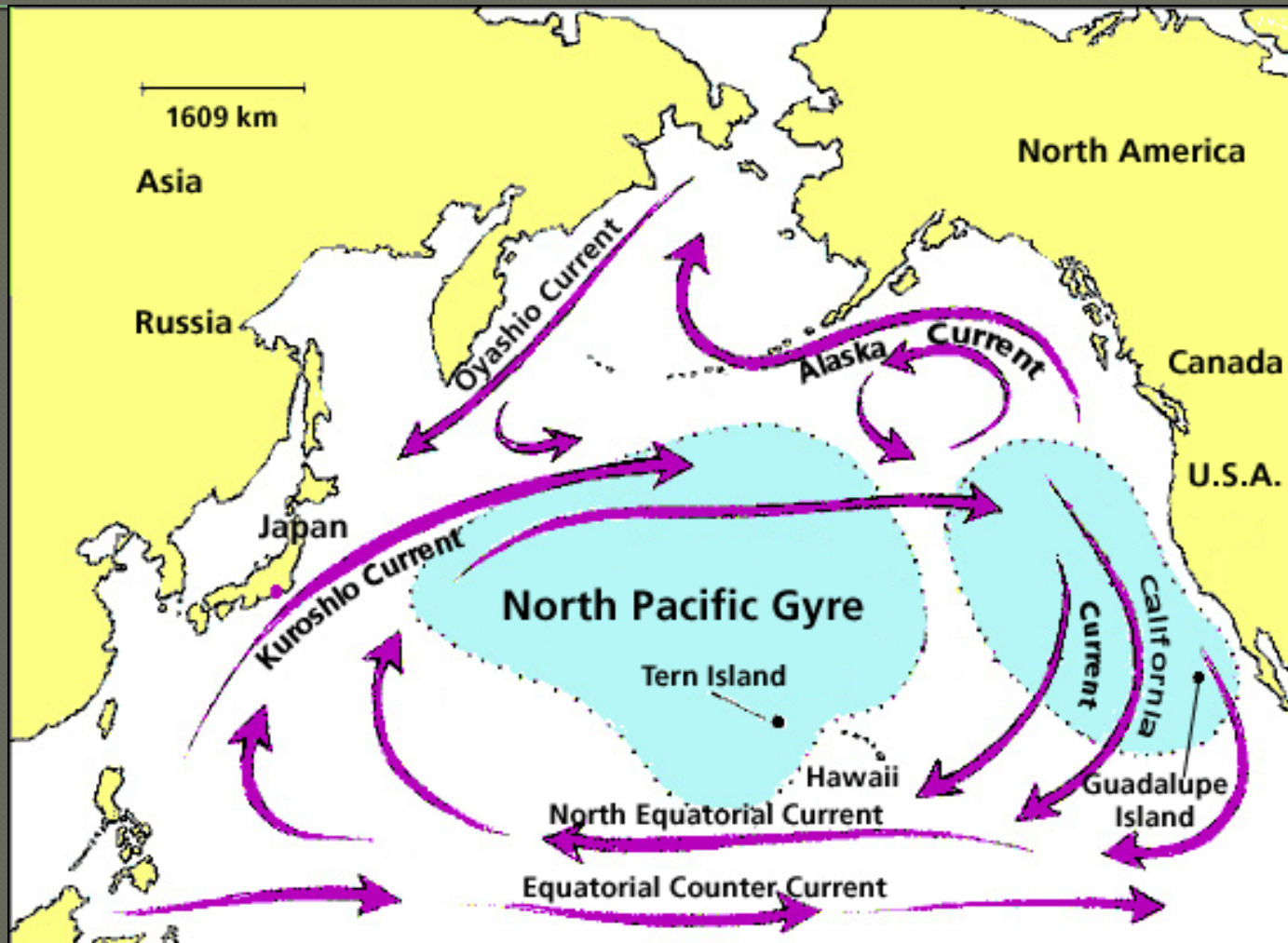
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- Homing – what is it?
- Straying – what is it?
- Are they mutually exclusive?
- A “less-than-perfect” system makes it perfect!
- What factors might influence homing/straying?
- What might some issues be with AK salmon hatcheries?

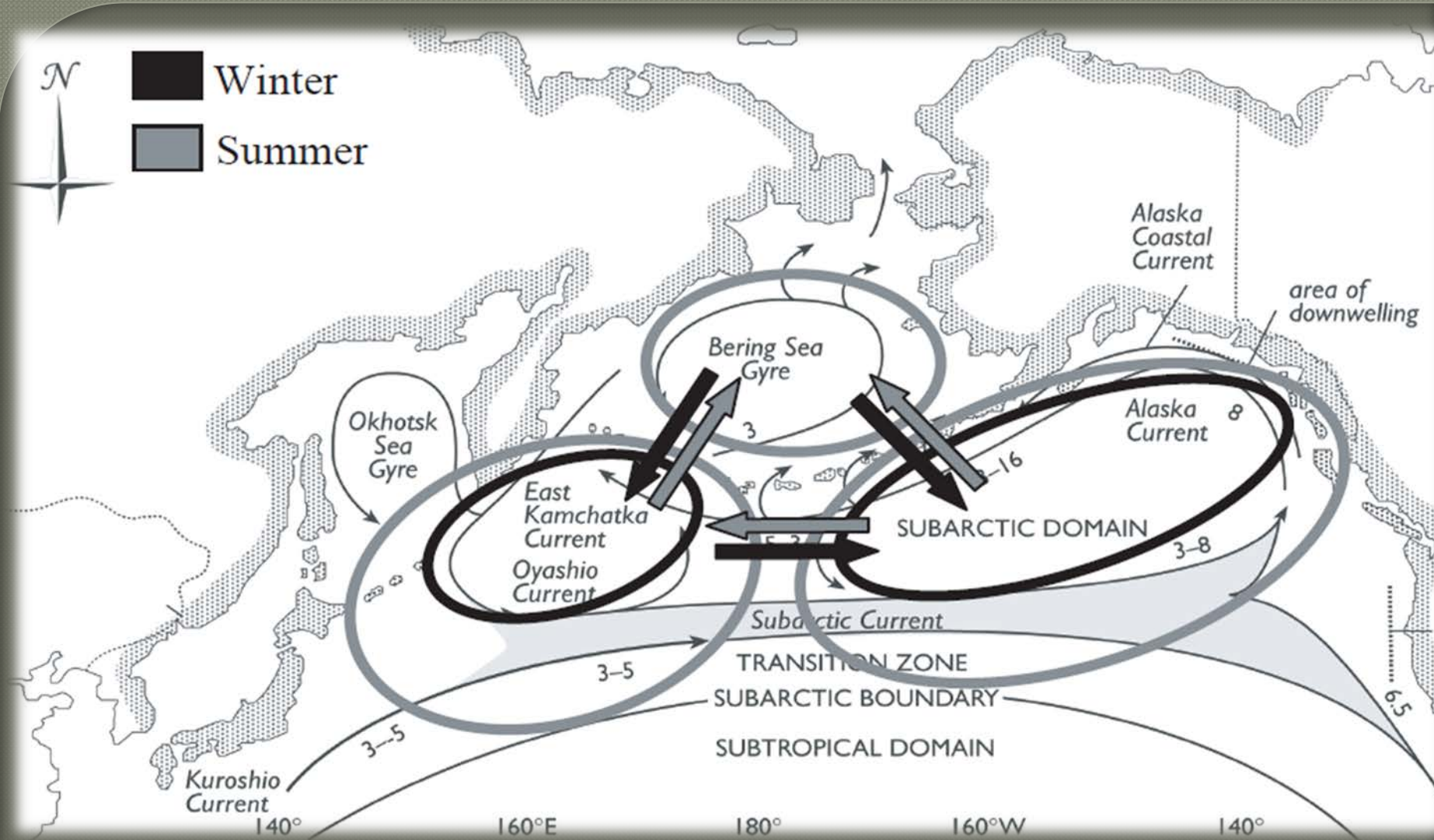




# Ocean currents play a huge role in determining migration patterns



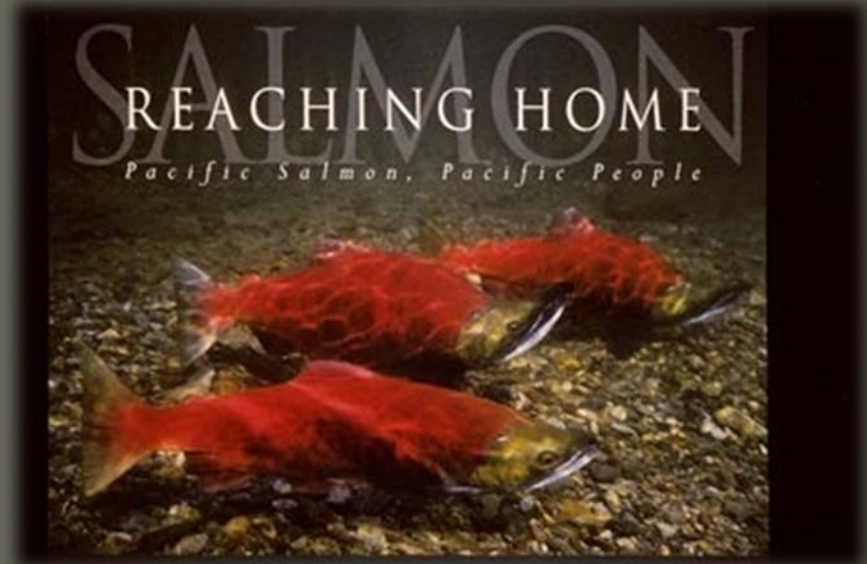




Asian and North American Pacific Salmon stock migrations through summer and winter



- Little is actually known about how they make such an amazing journey, when you think about the variations of temperature and currents at sea that they encounter and still meet **specific timing** each summer/fall it does not appear that they would be following some type of map but instead **orienteering** somehow.
- Experiments have shown salmon **orient with respect to the transit of the sun across the sky and the earth's magnetic field.**
- *Reaching Home – Pacific Salmon, Pacific People* by Tom, Jay, and Brad Matsen – an excellent reference.





# Magnetite-based Magnetoreception and Magnetic Sensory Transduction in Chinook Salmon

Presentation to OHRC, September 20, 2010

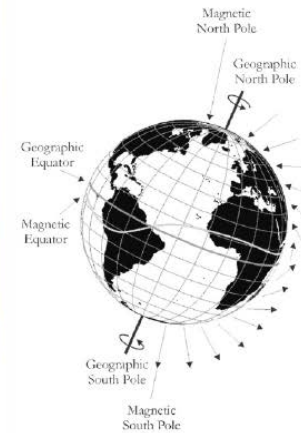
M. Renee Bellinger & Michael Banks  
Marine Fisheries Genetics Laboratory  
Hatfield Marine Science Center  
Oregon State University  
Newport, Oregon

200 nm

One theory.....

This article is now in the  
Course Content/Resources  
folder

## Magnetoreception



Earth diagram from Freake et al. 2006





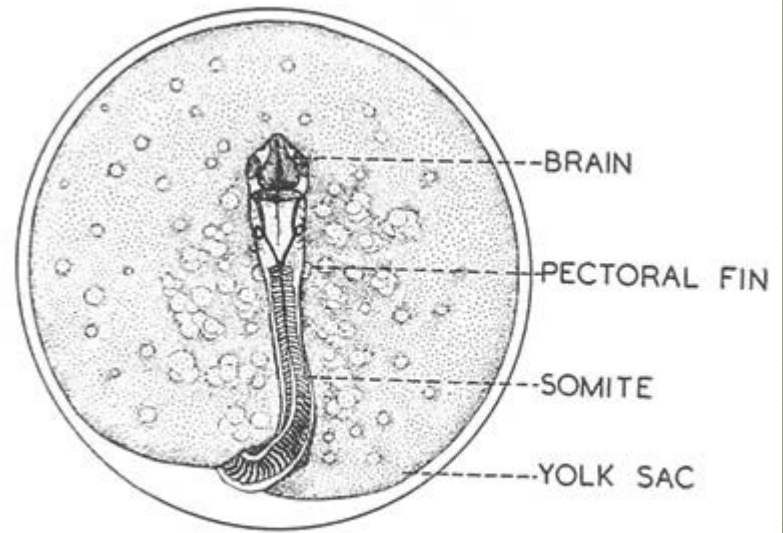
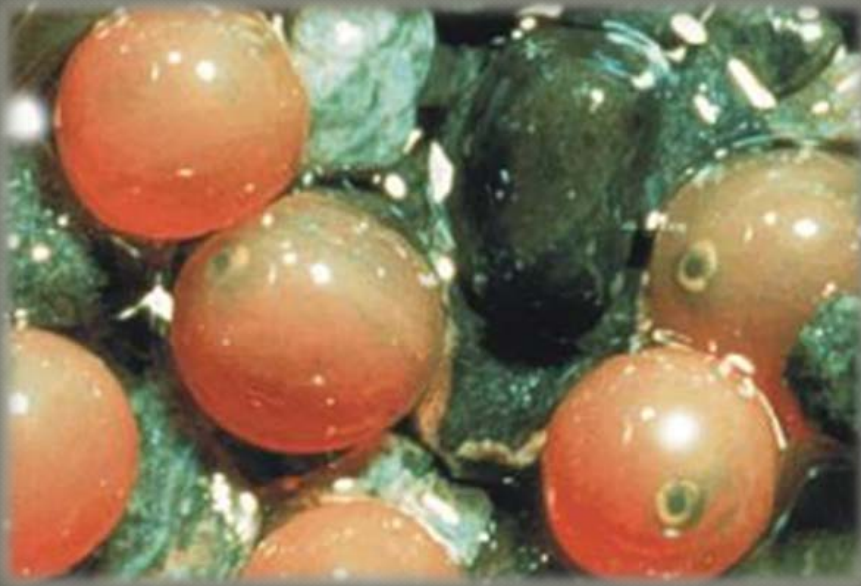
# Egg stage

[http://www.adfg.alaska.gov/index.cfm?adfg=viewing.salmoncam#!prettyPhoto\[gallery\]/0/](http://www.adfg.alaska.gov/index.cfm?adfg=viewing.salmoncam#!prettyPhoto[gallery]/0/) →





- Go through various stages of development
- Culturists need to take care at each stage



Dr. Battle often illustrated her publications with drawings rendered by her own hand. This drawing depicts a Salmon embryo at 43 days of age.



# Alevin Stage





# Fry Stage







## Parr/Fingerling/Pre-smolt Stage

- Parr marks provide natural camouflage in freshwater.
- An intermediate, freshwater phase



# Smolt Stage



- species/stock variations



How would you define the word “smolt”?

Do Pink and Chum salmon have a “smolt” stage?



# Let's re-visit: Risks to salmon survival

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- Adult phase:
- Spawning
- Eggs in stream



# Risks to salmon survival

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- Alevin:

- Fry

- Smolts



# Taxonomy!

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- ◉ Kingdom:
- ◉ Phylum:
- ◉ Class:
- ◉ Order:
- ◉ Family:
- ◉ Genus:
- ◉ Species:



# Taxonomy!

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- ◉ Kingdom: Animalia
- ◉ Phylum: Chordata
- ◉ Class: Actinopterygii – ray finned fish
- ◉ Order: Salmoniformes – grayling, salmon, trout, whitefish
- ◉ Family: Salmonidae
- ◉ Genus: Onchorhyncus
- ◉ Species:



# What is a “stock”?





# What is a “stock”?

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- Stocks of all species can mean a lot of variation in:
  - Return timing
  - Spawning dates
  - Emergence timing
  - Flesh quality
  - Size



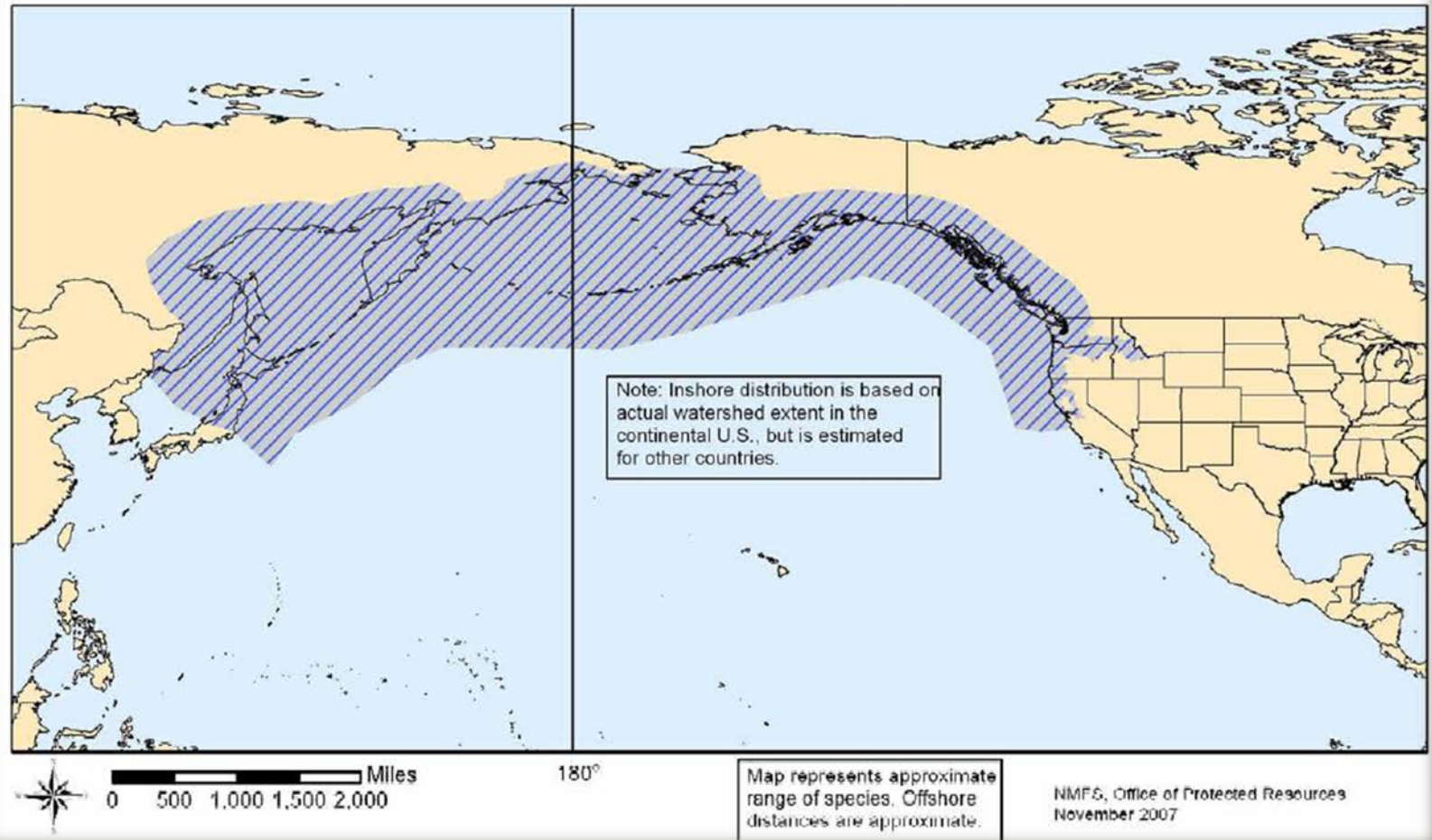
# Chinook, *Oncorhynchus tshawytscha*

*The best fish ever.....*





# Chinook Salmon Range



Range = Monterey Bay, CA – Chuckchi Sea, AK

In AK: SE to Yukon R

Main populations: Yukon, Kuskokwim, Nushagak,  
Susitna, Kenai, Copper, Alek, Taku, Stikine



# Species Characteristics & Biological & Habitat Requirements – Chinook

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- ◉ **Common names** = King, Tye, Spring, Blackmouth
- ◉ **Avg Wt/L** = 20 – 40lbs & 3 – 4'
- ◉ **Spawning colors & Characteristics** = Red to Copper almost black. Males are often more deeply colored (redder) than females. Ranges greatly in size
- ◉ **Spawning Habitat**
  - Main stem river





# Species Characteristics & Biological & Habitat Requirements – Chinook

- Emergence = March – April
- Freshwater Rearing Habitat = Main stem rivers
- Freshwater Residence = Variable, can be as little as 60 – 120 days or up to 2 yrs.
- Saltwater Residence = 2 to 6 yrs
- Spawning Migration = Begin entering freshwater in July. The earliest specie locally.
- Stock differences





# Are you awake?



- How do salmon navigate in open water?
- How do salmon find their way to specific stream system?
- Why are those guys dressed like that?



# Coho, *Oncorhynchus kisutch*





## Coho Salmon Range



Pt. Hope

Range = Coastal Washington to  
Yukon River

In AK: coastal waters from SE  
to Point Hope

Very “adaptable” fish



# Species Characteristics & Biological & Habitat Requirements – Coho

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- Common name = Silver
- Avg Wt/L = 8 to 12 lbs / 2 – 2.5'
- Spawning colors & characteristics =
  - Males and females both have dark backs and heads and maroon to reddish sides. Males also tend to redder than females.
- Spawning Habitat = tributaries to main stem rivers as well as lake tributaries. Can be in smaller streams
- Stream incubation period = 80 to 150 days
- Stock variations





# Species Characteristics & Biological & Habitat Requirements – Coho

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- **Emergence** = April to May
- **Freshwater Rearing Habitat** = Main stem side channels, slack water, lake & lake tributaries.
- **Feeding** = aquatic insects/plankton and then fish/squid
- **Freshwater Residence** = 1 to 2yrs.
- **Saltwater Residence** = 1 to 2 yrs. Local stocks are 1 yr ocean residence
- **Spawning Migration**
  - Generally late fall, locally we have summer coho stocks that enter freshwater in late June but will not  
Example Ward Lake.

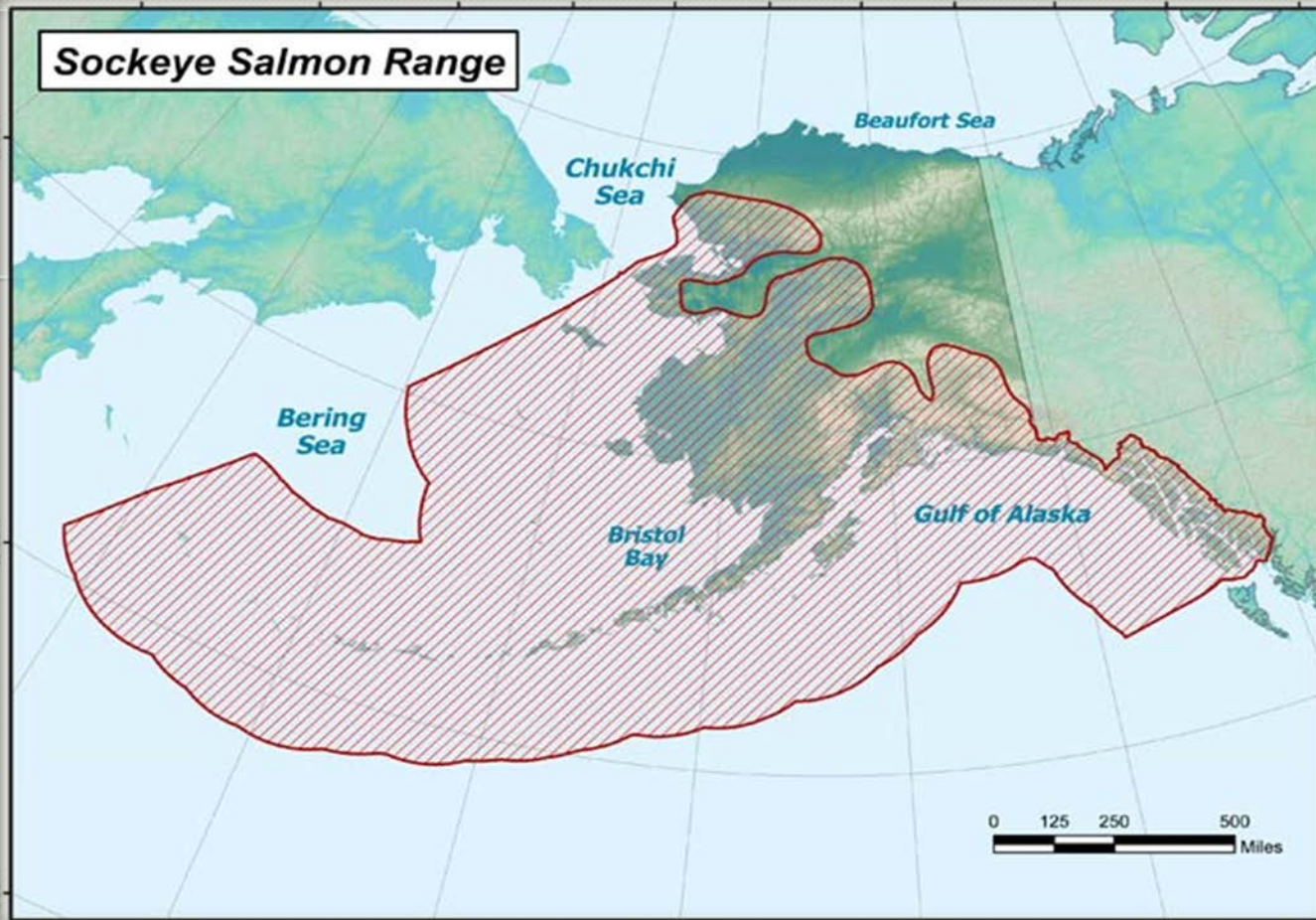




# Sockeye, *Oncorhynchus nerka*







- North Pacific & Arctic Oceans. South as far as Sacramento R. Calif to Canadian Arctic  
In AK: largest populations are in Bristol Bay: Kvichak, Naknek, Ugashik, Egegik, Nushagak Rivers



# Species Characteristics & Biological & Habitat Requirements – Sockeye

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- ◉ **Common names** = Reds, Blueback, Kokanee
- ◉ **Avg Wt/L** = 1.5 to 2' / 4 to 8 lbs
- ◉ **Spawning colors & Characteristics** = Brilliant to dark red body with olive green heads both males and females. Both sexes develop teeth but more pronounced in males.
- ◉ **Spawning Habitat** = Lakeshore and lake tributaries, some spawning occurs in lake outlet streams but fry will migrate upstream to rear in lake.
- ◉ **Stream Incubation Period** = 90 to 150 days





# Species Characteristics & Biological & Habitat Requirements – Sockeye

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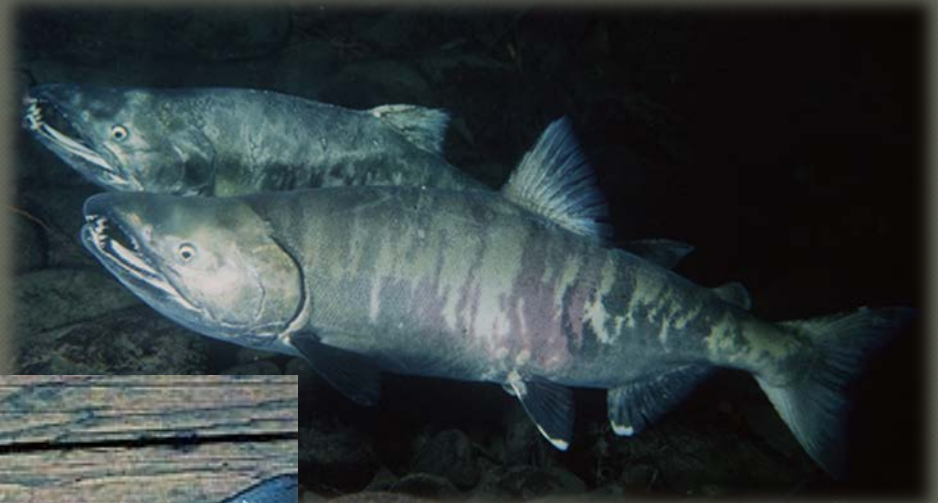
- ◉ Emergence = April to May
- ◉ Freshwater Rearing Habitat = Lakes
- ◉ Feeding = zooplankton/small crustaceans
- ◉ Freshwater Residence = 1 to 3 yrs.
- ◉ Saltwater Residence = 1 to 4 yrs.
- ◉ Spawning Migration = Begins as early as late June.





# Chum, *Oncorhynchus keta*

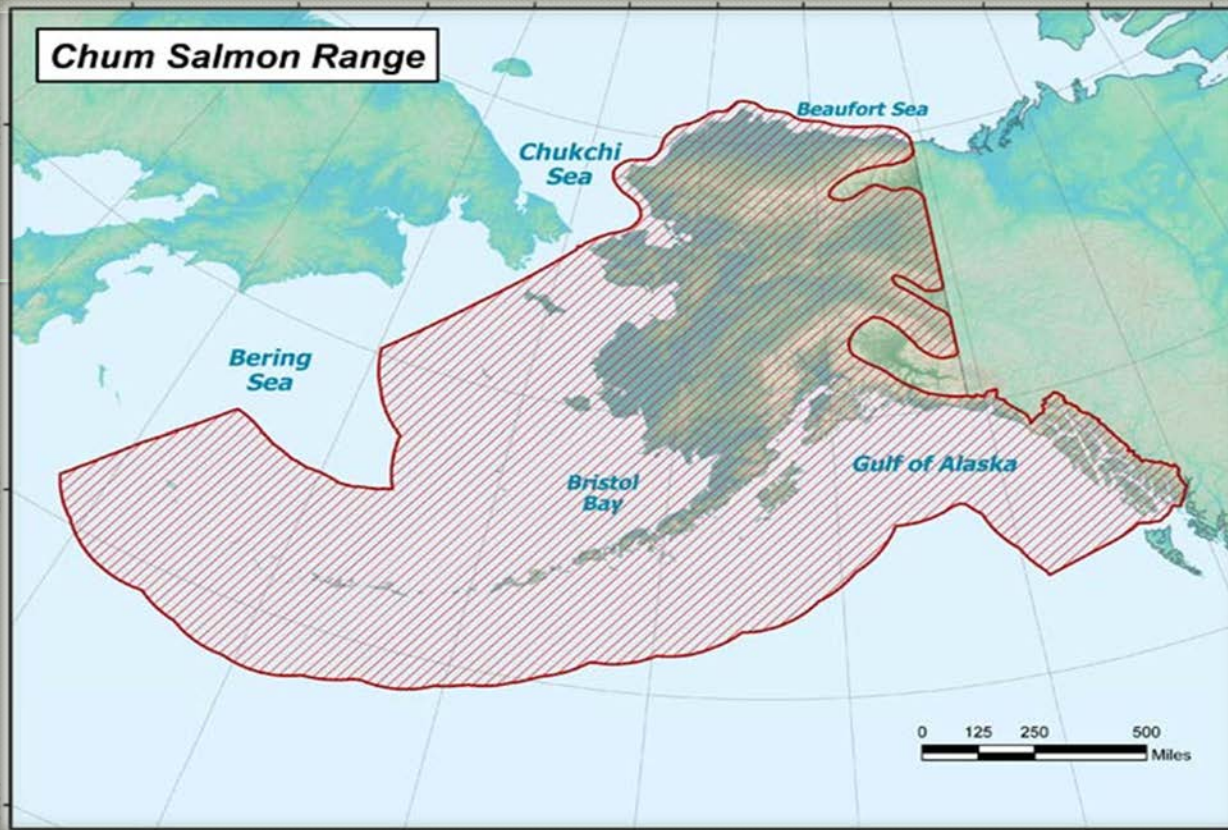
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© 2000 Jon Anderson







- Sacramento R. Calif to Mckenzie R. in Canada
- Most runs tend to stay in lower sections of rivers
- Some of the Yukon R chum may travel up to 2,000 miles
- Very adaptable, can be found in very small systems



# Species Characteristics & Biological & Habitat Requirements – Chum

- Common names = Dog, Calico, Keta
- Avg Wt/L = 7 to 18 lbs / 2 to 2.5'
- Spawning colors & Characteristics = Green & purple vertical bars, less obvious on females. Females also exhibit a dark horizontal band.
- Spawning Habitat = Main stem river tributaries and intertidal zone of coastal streams.
- “Summer” and “Fall” runs
- Stream Incubation Period = 90 to 150 days





# Species Characteristics & Biological & Habitat Requirements – Chum

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- Emergence = Late February through May
- Freshwater Rearing Habitat = Does rear in freshwater, generally very short-term
- Feeding = insect larvae; copepods, tunicates,, mollusks, fish
- Freshwater Residence = None
- Saltwater Residence = 2 to 3 yrs.
- Spawning Migration = Begins in late July and continues through late fall.

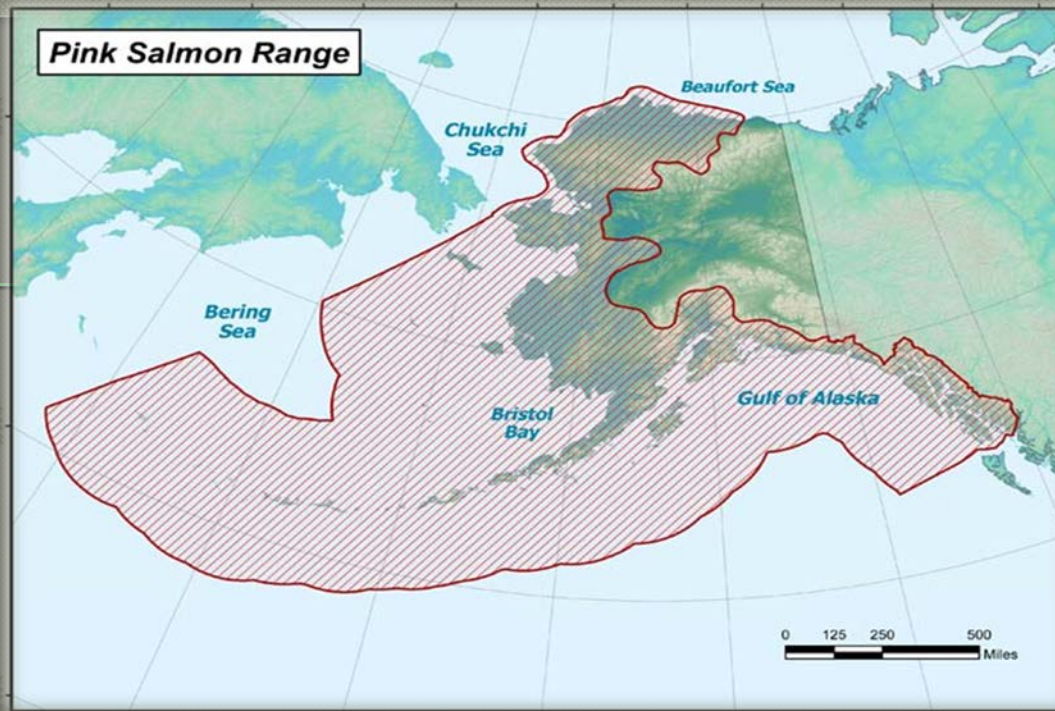


# Pink, *Oncorhynchus gorbuscha*

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- Pacific & Arctic coastal waters from northern California to Mackenzie R. in Canada.

In AK: Widely distributed along the coastline  
Highly adaptable – can be in very small systems





# Species Characteristics & Biological & Habitat Requirements – Pink

- **Common names** = Humpback, Humpy
- **Avg Wt/L** = 3.5 to 4 lbs / 1.75 to 2'
- **Spawning colors & Characteristics**
  - Males are brown to black with a white belly, characteristic hump and hooked jaws. Females are olive green with dusky bars or patches and light belly.
- **Spawning Habitat** = Main stem river tributaries and intertidal zone of coastal streams
- **Stream Incubation Period** = 90 to 150 days

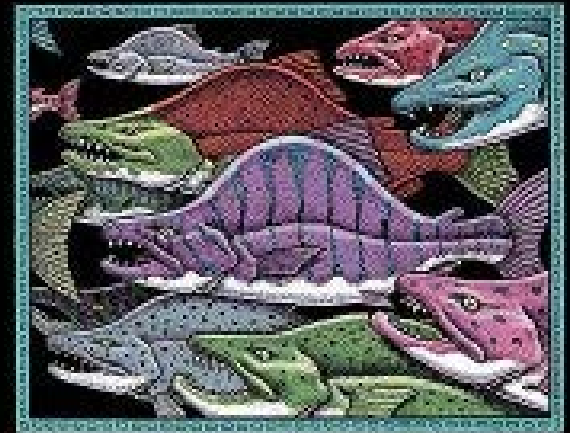




# Species Characteristics & Biological & Habitat Requirements – Pink

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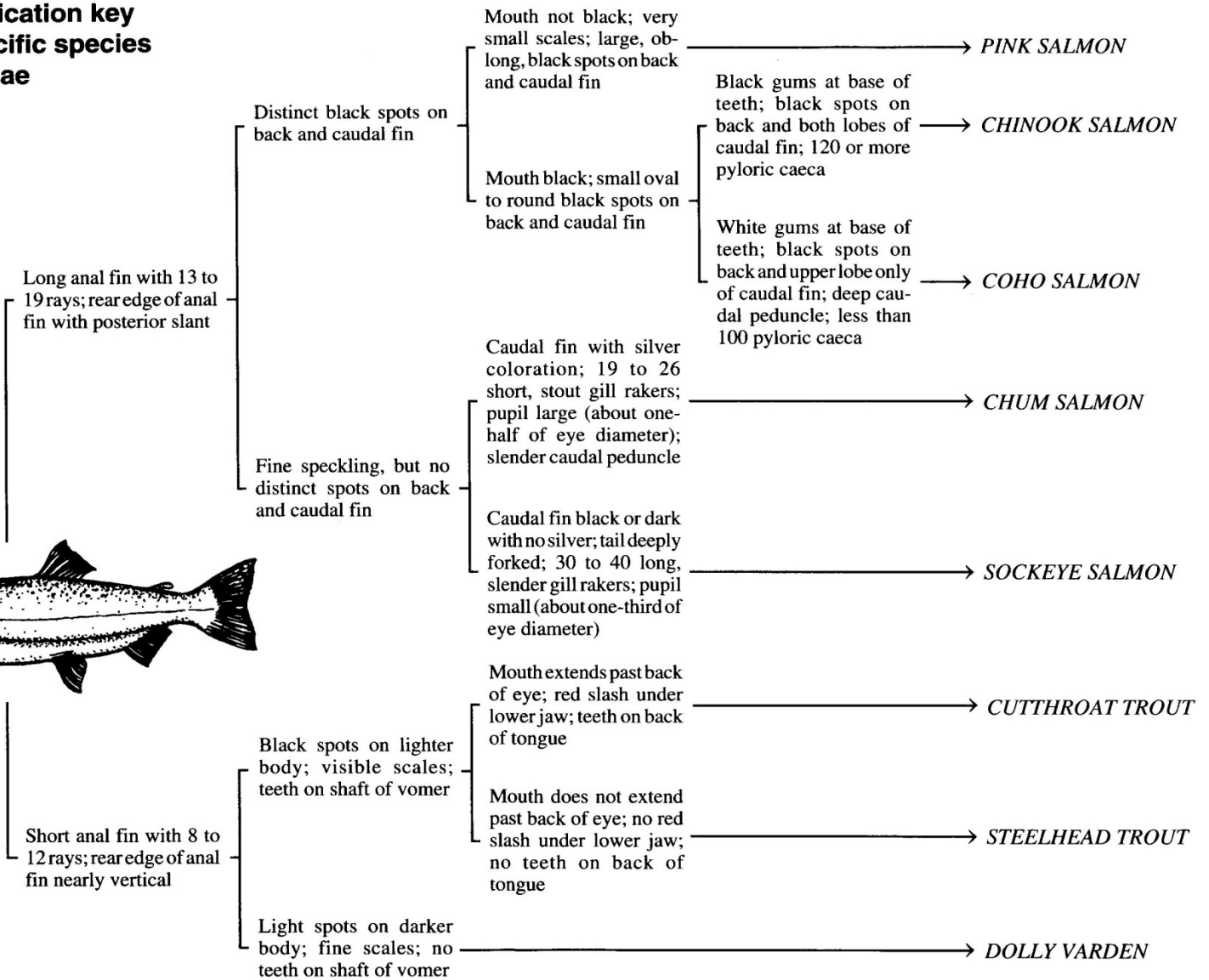
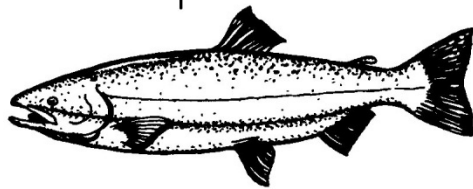
- Emergence = Late January to April – May
- Freshwater Rearing Habitat = Does not rear in freshwater.
- Feeding = plankton; fish, squid
- Freshwater Residence = None
- Saltwater Residence = 1 year
- Spawning Migration = Late summer



HUMPRIES FROM HELL



**Field identification key  
for eight Pacific species  
of Salmonidae**





# Anatomy!

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Name that fish part!

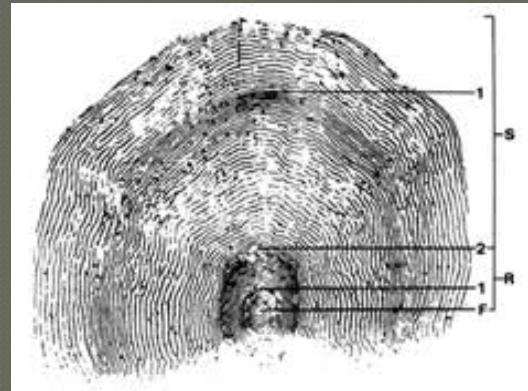




# External Anatomy

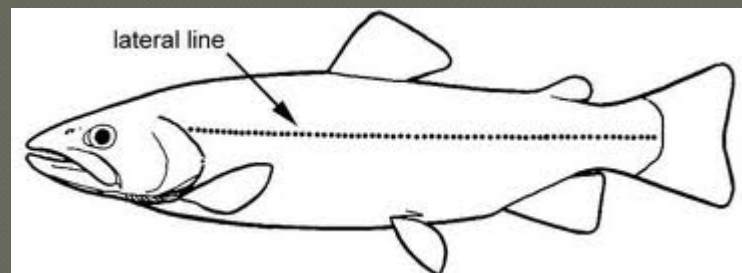
## ○ Scales

- Along with slime are the first line of defense
- Provide ageing/life history info



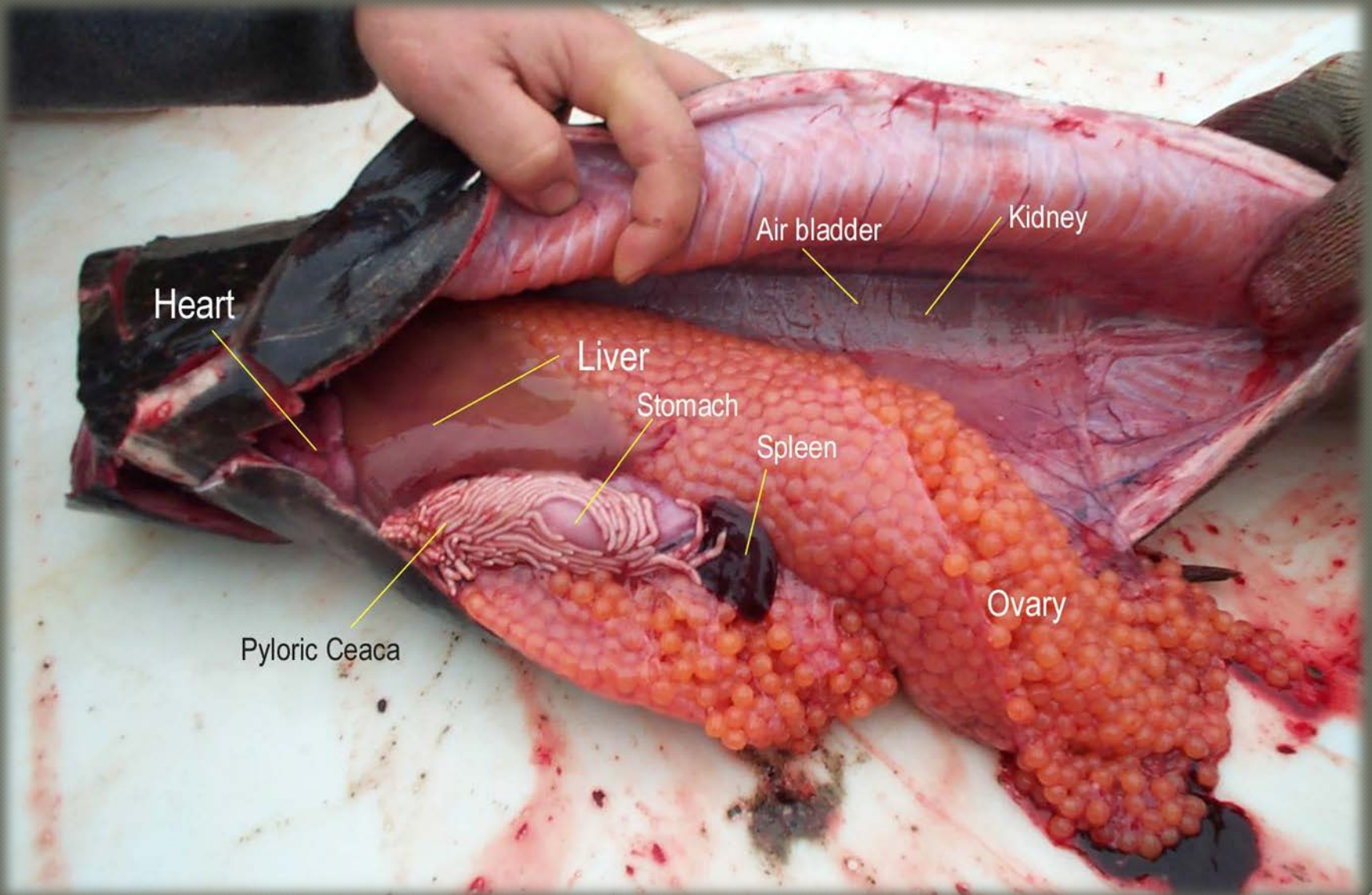
## ○ Lateral Line

- Highly innervated
- Tunes the fish into its external environment





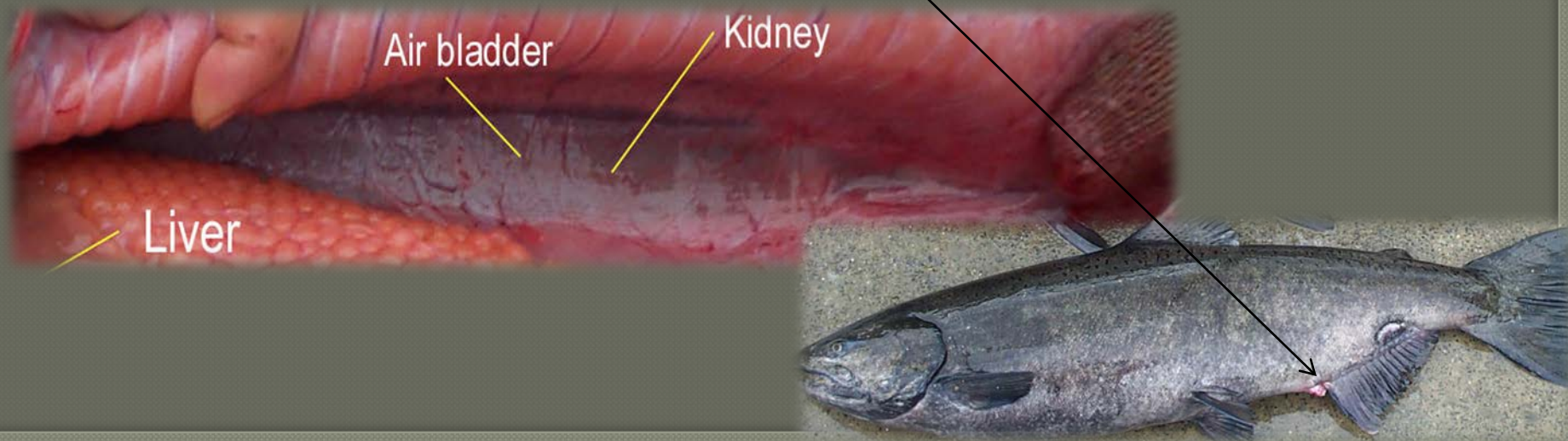
## Some basic internal anatomy





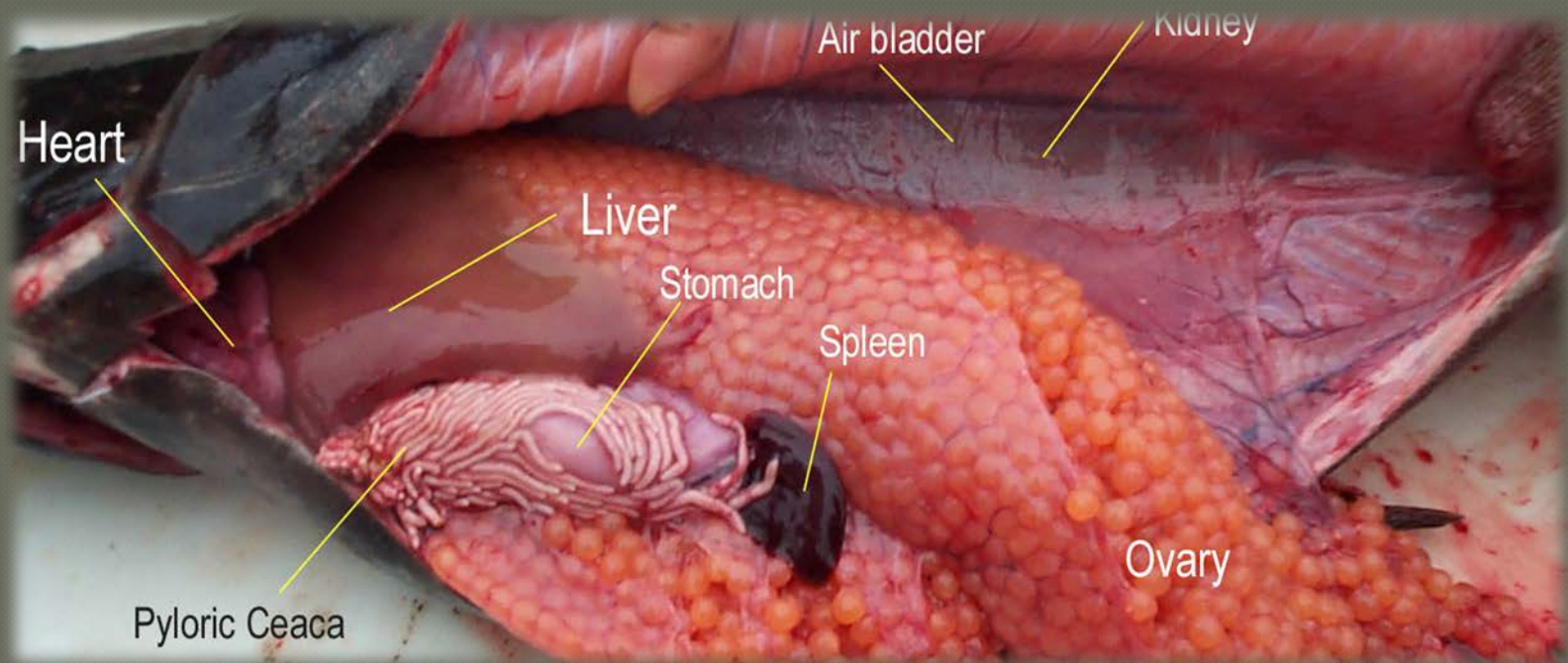
# Internal Anatomy

- **Air Bladder** - A membranous sac filled with gas, situated in the body cavity of fish, ventral to the vertebral column, used to control buoyancy.
- **Kidney** - These organs remove waste from the blood and produce urine.
- **Ovaries** - The female reproductive organs which produce eggs.
- **Brain**
- **Vent** - The external opening of the alimentary canal. Urine, feces, eggs and milt exit here.



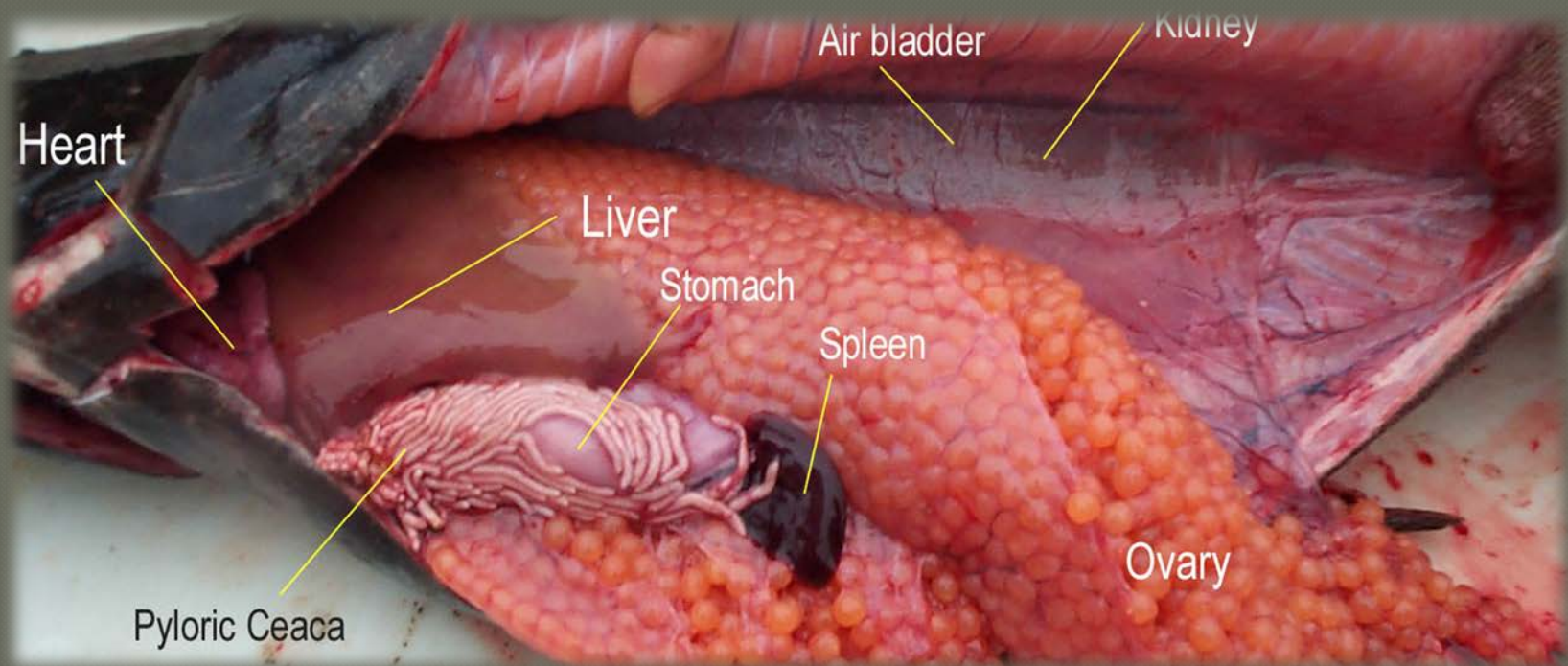


- **Intestine** - The intestine is found in the lower part of the alimentary canal extending from the pyloric end of the stomach to the anus.
- **Testes** - The male reproductive organ in which milt is produced.
- **Spleen** - The organ in which white blood cells are produced and red blood cells are destroyed in vertebrates.





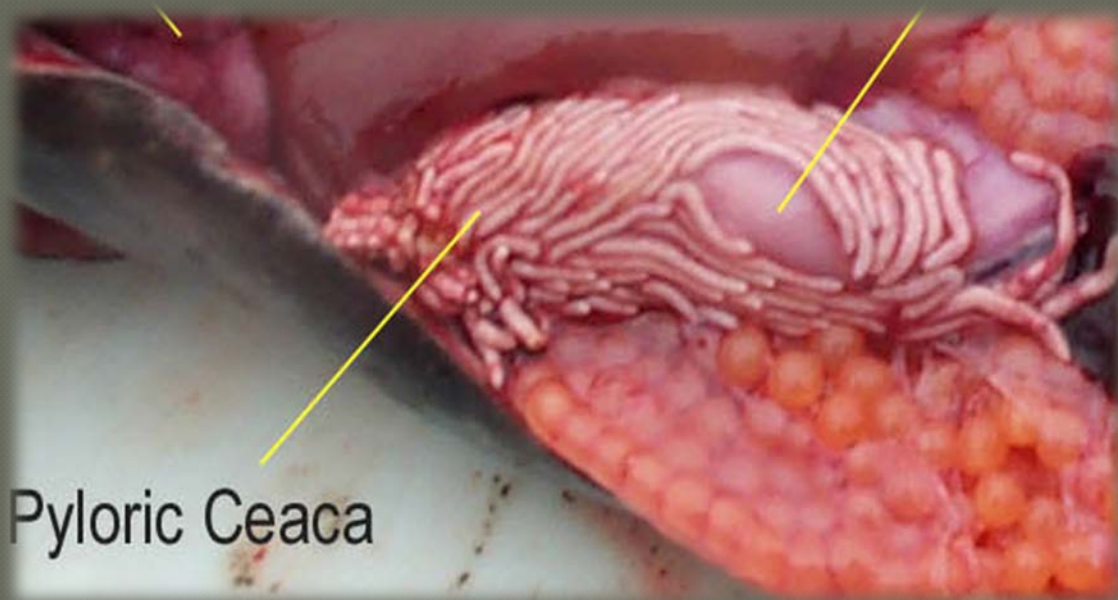
- **Stomach** - A sac-like digestive organ receiving food from the esophagus and opening into the intestine.
- **Liver** - A digestive organ, stores and secretes essential nutrients obtained from food. Helps maintain a proper balance of chemicals and sugar in the blood.
- **Heart** - A hollow, muscular organ located where the gill covers come together high up in the body cavity.





# Internal Anatomy

- **Pyloric Caeca** – where digestion takes place.





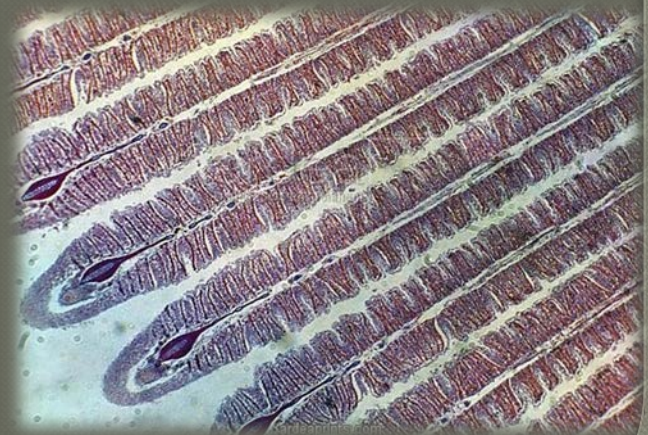
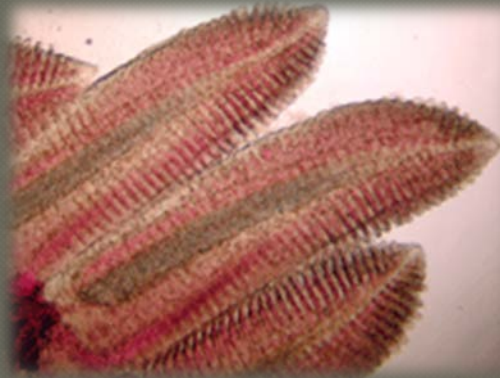
- **Operculum – or gill plate.**

- **Protective mechanism**
- **Acts like a pump**



- **Gills – absorb oxygen**

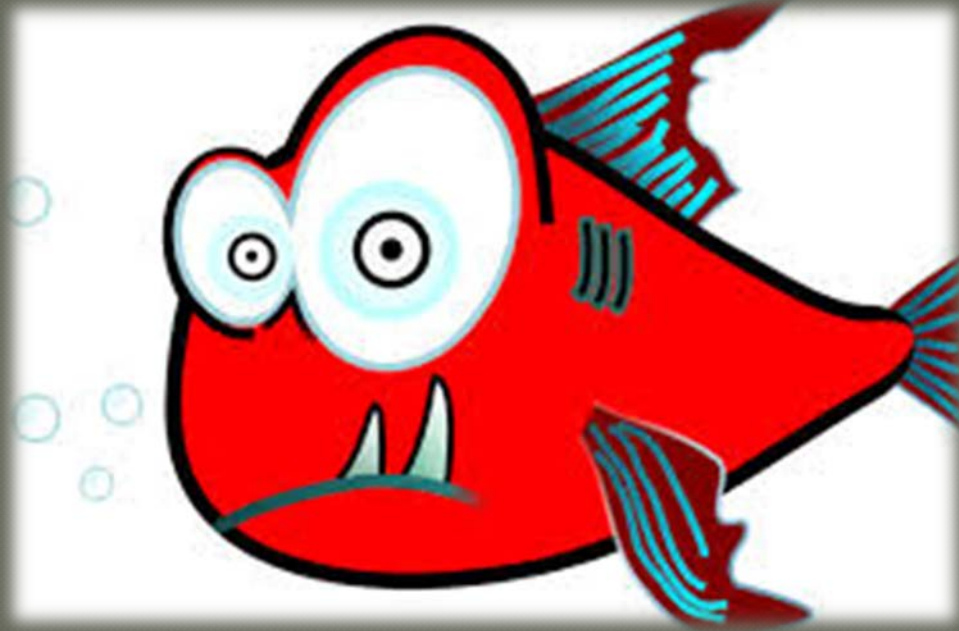
- **Very efficient! 80% vs. 25% w/human lungs**
- **Also for waste disposal**
- **Delicate and vascular**





# Questions?

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What else can you do with salmon besides eat them? LOTS!!

















# Assignment 3

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- ◉ Watch the short videos on eggtake demonstrations
- ◉ Found under Course Content/Resources/Videos
- ◉ Short summary – if you have questions, submit them and we'll go over in class