

Fisheries and Oceans
CanadaPêches et Océans
Canada

Salmon Incubation Basics

Life-stage: Egg to Fry

Ted Sweeten

Fish Health & Hatchery Biology / Salmonid Enhancement Program
Fisheries and Oceans Canada

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Overview

Embryo Development

- Stage
- ATU
- Water Quality

Fish Culture

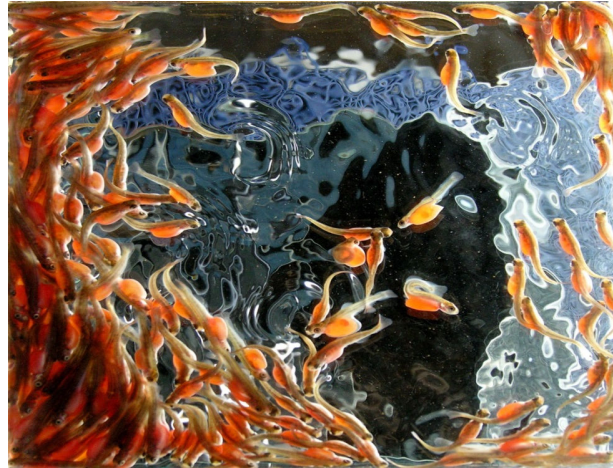
- Egg take
- Incubators
- Shocking
- Ponding



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Embryo Development Stages

- Green egg
- Yolk plug
- Eyed egg
- Hatch
- Emergence

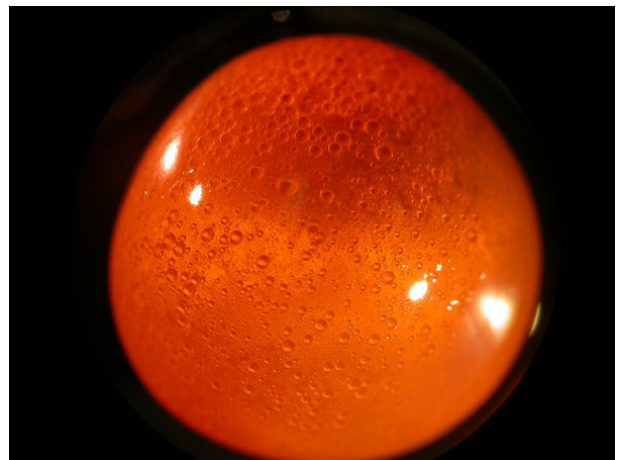


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Green Egg

Egg free from the skin

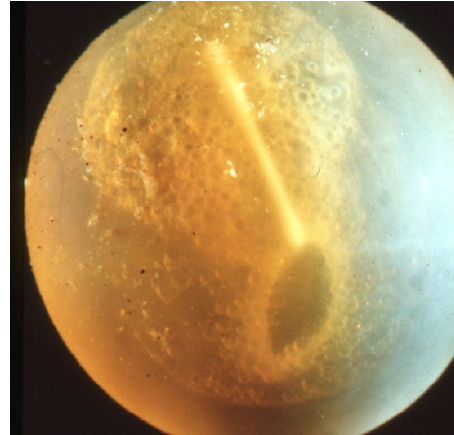
- Surrounded by Ovarian fluid
- Limited lifespan
- Can be reabsorbed
- Can be activated without fertilization (water harden)



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Yolk Plug Closure

- At 10°C, 12 days or 120 ATUs
- Single layer of cell growing around yolk starts to close
- Epiboly another name
- Time of maximum shock sensitivity just before yolk plug closure
- Stage used for Fertilization checks
- Clear with vinegar



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Eyed Stage

- At 10°C, 22.8 days or 228 ATU's
- Development of the eye is visible without magnification
- Egg is no longer sensitive to shock
- Stage where the eggs can be handled to remove any dead eggs, count, and transfer to other incubators

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Hatch

- At 10°C, 45.9 days or 459 ATUs
- Embryo became oxygen limited, releases enzymes to dissolve the shell
- Hatching out will give the alevin more 2-4 more oxygen
- Low Oxygen in the incubator can cause premature hatch
- Handling egg at this time will also cause early hatch
- Shells dissolve in 1-2 days



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Eyed and Hatching Times

Species	Temperature °C	Time to Eyed		Time to 50 % Hatch	
		Days	ATUs	Days	ATUs
Coho	5.0	46.1	231	93.6	468
	7.5	31.5	237	63.1	474
	10.0	22.8	228	45.9	459
	12.5	17.1	214	35.6	445
Chinook	5.0	51.5	257	102.4	512
	7.5	34.2	257	70.3	528
	10.0	24.9	249	52.6	526
	12.5	19.2	240	42.1	526

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Emergence

- Yolk sac mostly absorbed:
Buttoned up fry
- In nature the time the fry emerge from the gravel and rise to surface
- At surface the fry will fill their swim bladder
- The fry will move in and out the gravel at this time learning to feed

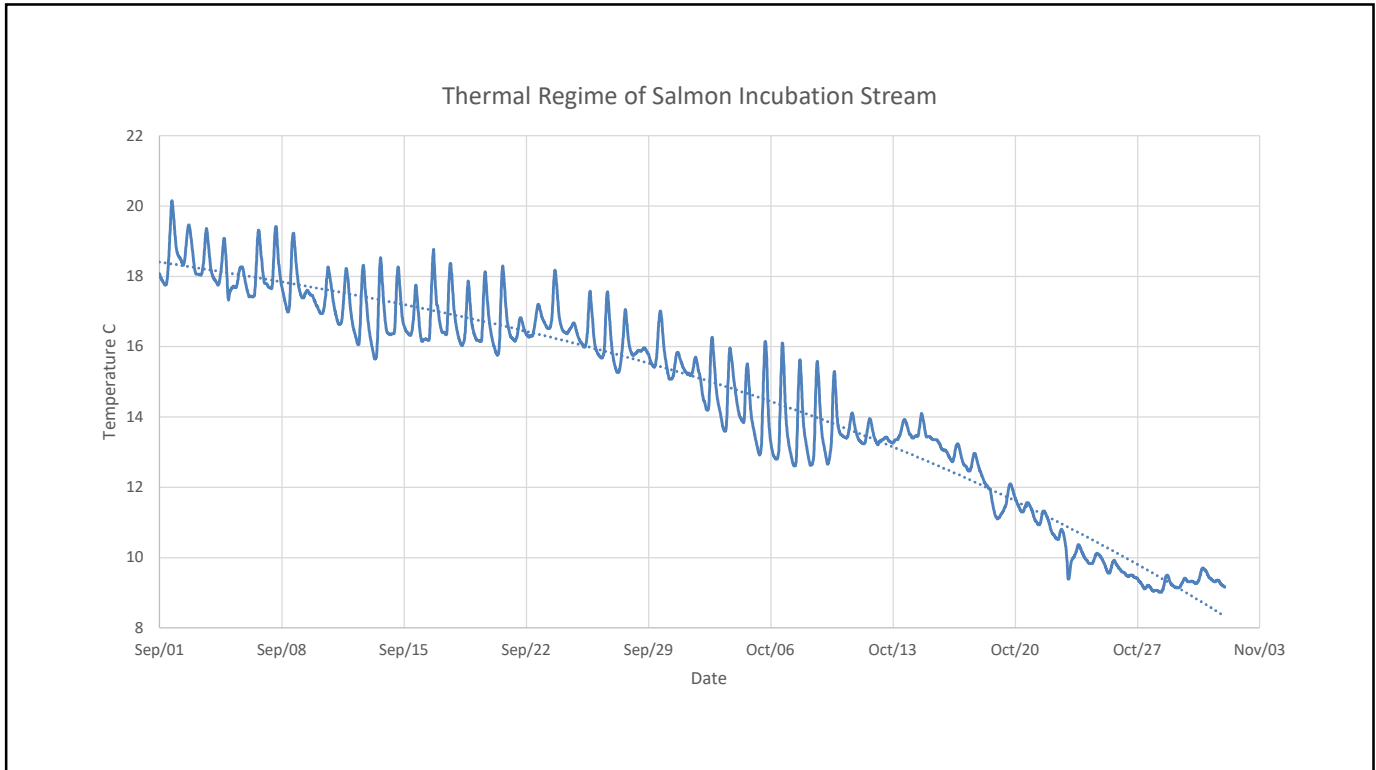


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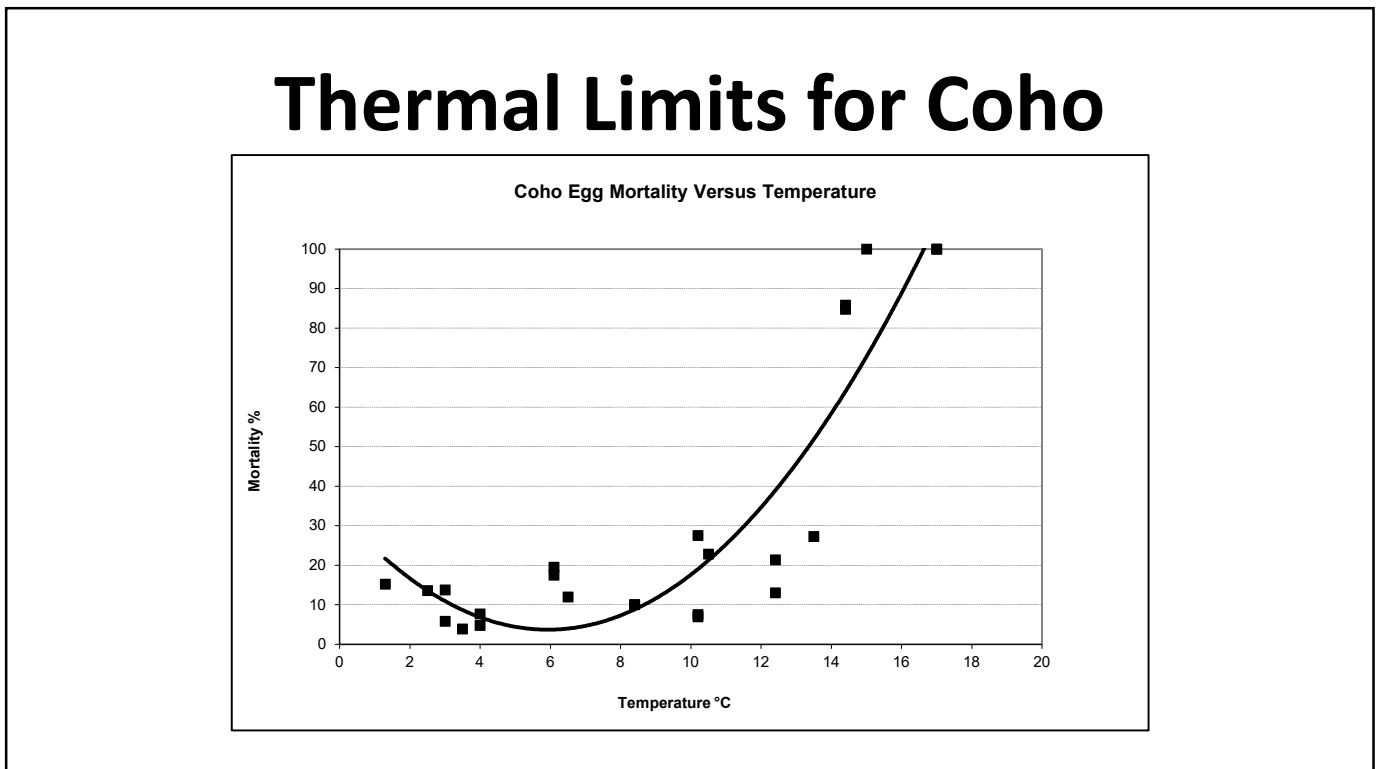
Water Temperature

- Accumulated Thermal Units (ATU)
 - Sum of mean daily water temperature ($^{\circ}\text{C}$)
- Temperature governs development
- Relationship works from 2 to 16 $^{\circ}\text{C}$
- Limits
 - Limits: Hot and Cold
 - Rate of change: Chilling and Heating

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Fish Culturist and Incubation

- Gamete collection
 - Egg-take methods
 - Broken eggs
 - Sperm numbers
 - Fertilization
- Incubation
 - Shock and picking
 - Fungus control
 - Flow and oxygen
- Ponding
 - When?

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Incubation Water Supply

- Best possible water
- pH in normal range (6.5 to 8.0)
- Flow as need to control:
 - Ammonia low as possible
 - Oxygen levels (95% saturation)
- Water Quality determines the size and type of incubator



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Types of Incubators

- Heath Stacks
- Hatch Jars
- Bulk incubators
- Gravel boxes



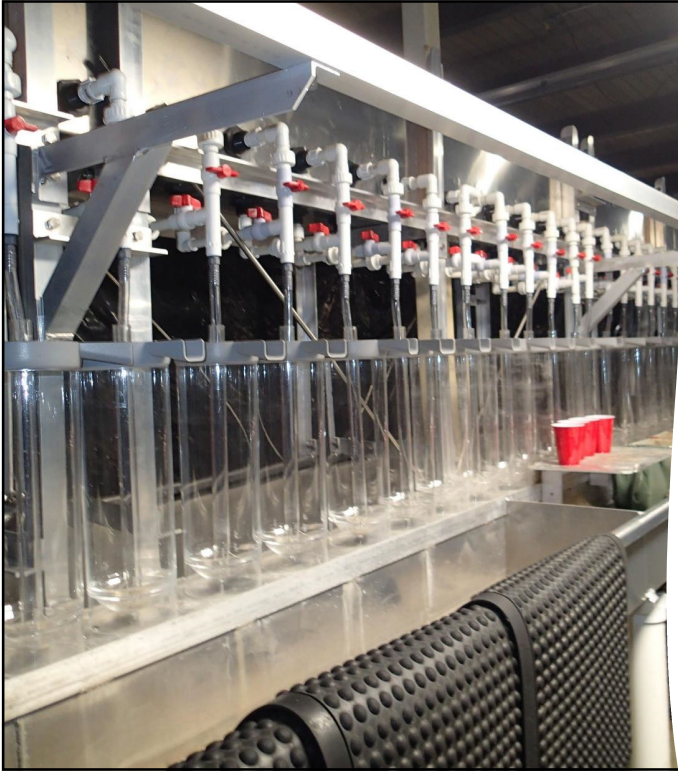
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Heath Stacks

- Standard Incubator
- Water flow from the top to the bottom
- Up to 10,000 egg per tray
- Divided trays or egg tubes
- Substrate addition
- Egg loading



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Hatch Jars

- Use for small eggs
- First used for Trout
- Water flow up from the bottom
- Low cost
- Make from a 2-litre bottle

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Big Incubators

- Big Upwelling incubators
 - 50 to 1000 litres
- Atkin Cells, Bulk Boxes
 - 100,000 to 500,000 egg lots
- Gravel boxes
 - Chum and Pink
 - Fry swim out when ready



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Egg-take methods

- Best practice
 - Controlling Broken Eggs
 - Sperm numbers
 - Activation
 - Zero-time disinfection
- Delayed Fertilization
 - Remote spawning
 - Activate in Field or wait till returning to incubation room



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Broken Eggs

- Handling stress, ripeness checks, expressing eggs
- Free yolk:
 - plugs the micropyle
 - deactivates sperm
- Sodium bicarbonate rinse pre-fertilization

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Checking for Free Yolk

- Turbidity check of Ovarian Fluid
- Add 1 drop in 20 mls of distill water
- Wait 5 minutes and read with portable turbidity meter
- If turbidity greater than 5 NTU → rinse eggs



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Egg Rinse to Reduce Free Yolk

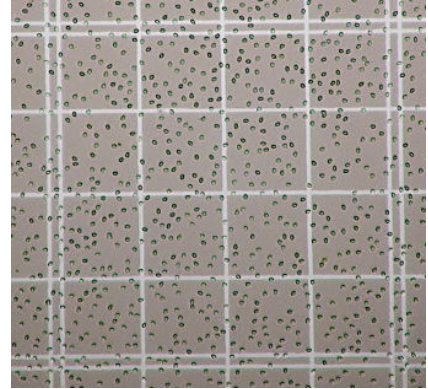
- Use artificial ovarian fluid
 - Sodium Bicarbonate rinse 13.6 g/litre
- Wash green eggs, decant before mixing in sperm



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Sperm

- Collect good Milt (no blood, bile, or urine)
 - Store in dark cooler, not directly on ice
- Sperm Number
 - Simple, thicker than 2 % milk
 - 500,000 to 1,000,000 sperm = 1 to 2 mls sperm per litre eggs
- Active for 60 to 90 seconds in ovarian fluid, less time in freshwater
- Broken eggs shut down sperm activity



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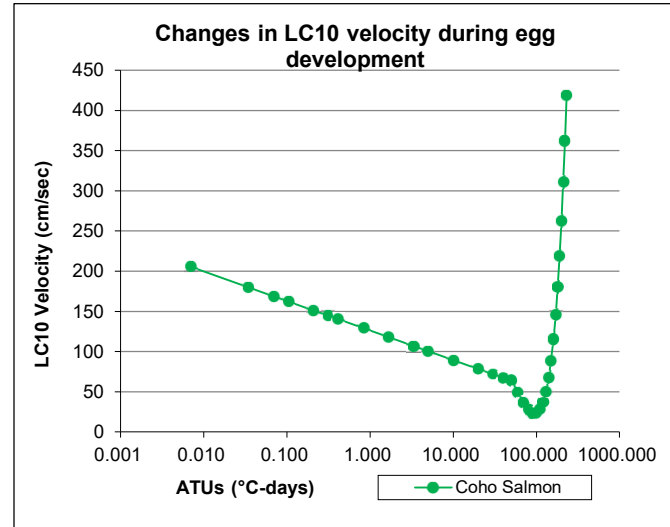
Fertilization

- Mix eggs and sperm together in a container
- Wait 60 seconds, add water to height of eggs
- Wait 60 seconds, decant and rinse
- Zero-time disinfection
 - 100 ppm Ovadine preloaded into incubator
 - Add eggs, soak for 10 to 30 minutes
 - Start at top and work down
 - **Restore water flow**
 - **Leave them alone until eyed**

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Handling Shock

- Green eggs have high shock tolerance
- Rapid drop once fertilized
- First 8 hours: drops down 30 %
- Yolk plug closure (most sensitive)
 - 94.7 ATUs for Coho
- Eyed Egg are highly tolerant
 - 200 ATUs for Coho



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Shocking Eggs

- Shock the eyed eggs
- Used to ID dead eggs
- Enough force to break inner egg membrane
- Yolk turns in 24 hours
- Pick and Count
- Place in clean incubator



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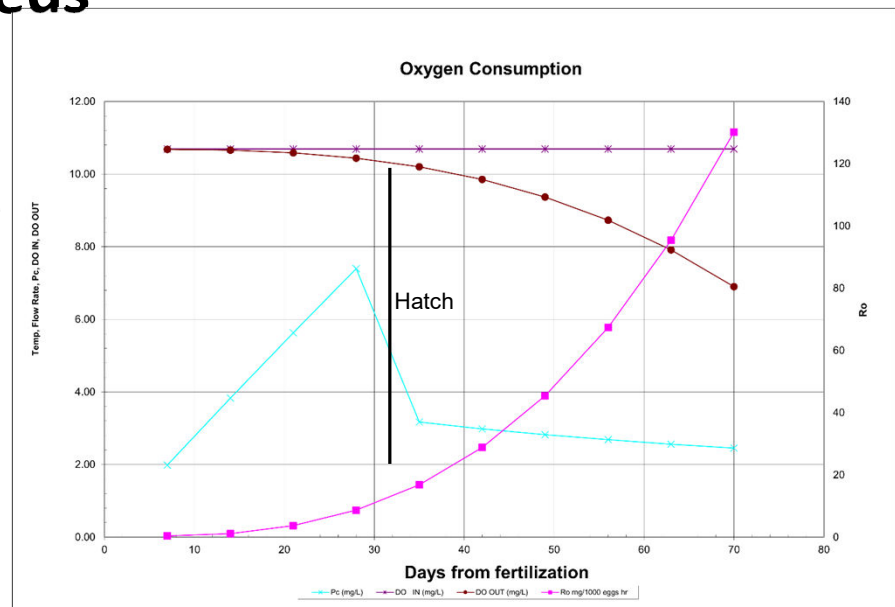
Picking the Dead



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Oxygen Needs

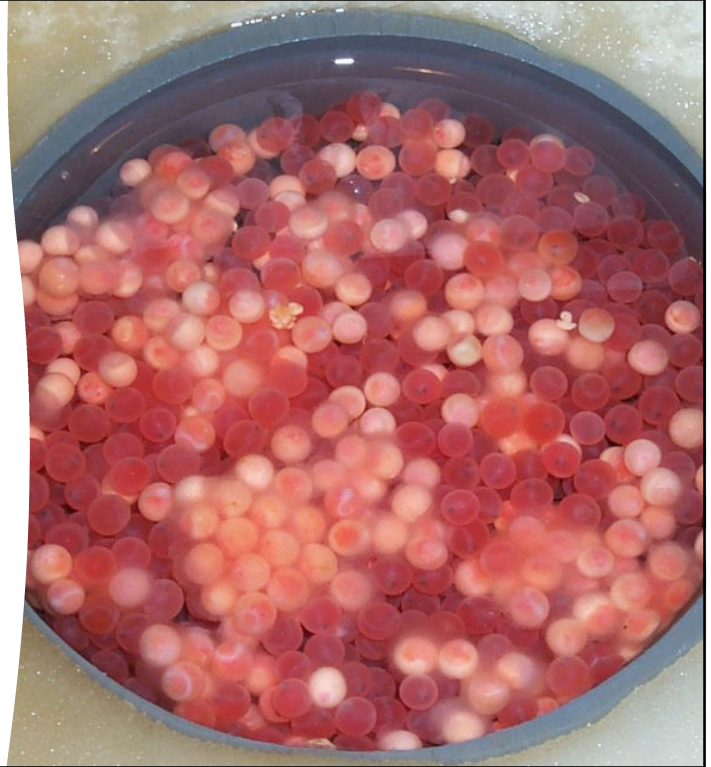
- Oxygen demand greatest just before hatch
- Flow must be increased before hatch
- 12 lpm to start and 15 lpm before



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Fungus control

- Mechanical Control
 - Picking
- Chemical Control
 - Salt
 - Hydrogen Peroxide
 - Formalin



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Abnormals Embryos

- Genetics
- Oxygen Levels
- Stress
- Development Problems



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Ponding

- Timing ponding is the art part of fish culture.
- Differs by stock, site and season
- Function of egg size
- Yardsticks:
 - 1 mm yolk suture
 - 10% yolk remaining

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For More Information

- Contact info
 - Ted.Sweeten@df-mpo.gc.ca
 - Pacific Biological Station
 - Nanaimo, B.C



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