OTOLITH THERMAL MARKING

WDFW OTOLITH LAB

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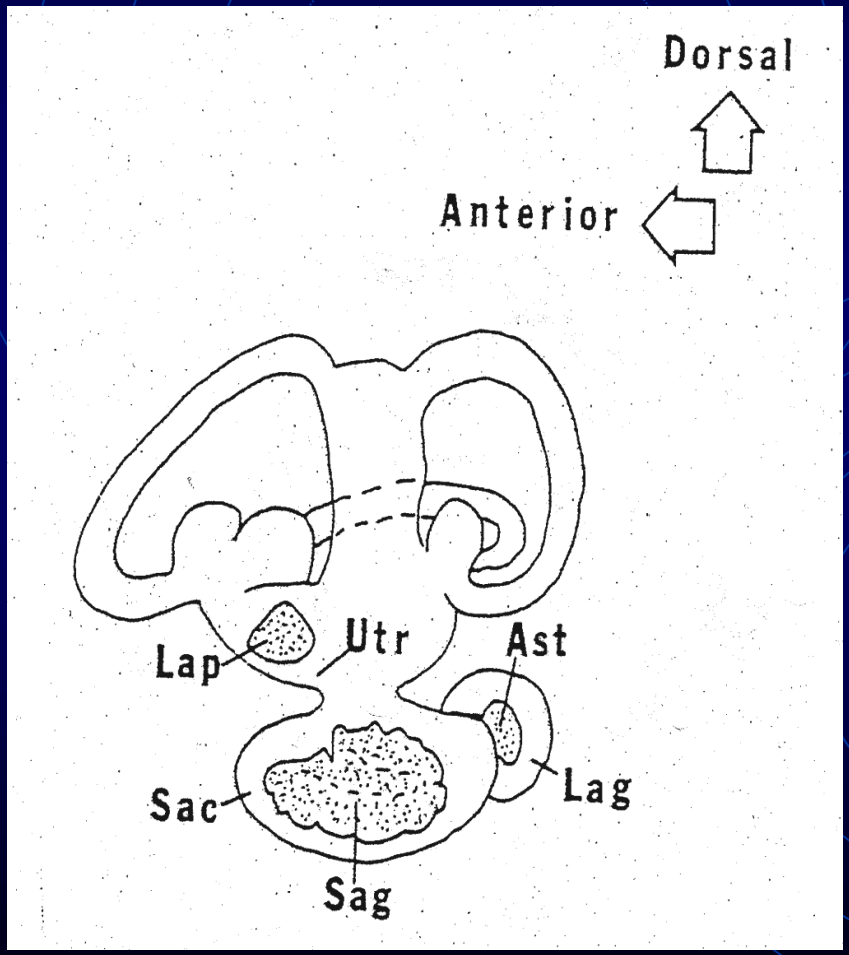
Teleost Inner Ear



Asteriscus (lagena)

Lapillus (utriculus)

Sagitta (sacculus)

(from Lowenstein 1971)

What is a Thermal Mark?

- A permanent biological “bar code” used for stock identification that can be recovered at any life stage from the otoliths of marked fish.

Topics to Cover Today

- How to apply the mark
- How to recover mark
- How to decode the pattern
- Benefits of thermal marking
- Constraints of thermal marking
- Current examples of thermal marking
- “New horizons”

How Do You Apply Mark?

Eggs + Cold = Stock ID

- Otoliths accrue daily layers of calcium carbonate on a protein matrix
- Decreased $T^{\bullet}$ creates dark layers
- Never have to physically handle fish
- The mark is cryptic

Creating Patterns

1. AVOID DUPLICATION

- NPAFC website
- Previous marks at specific facility
- Previous and current marks within species

2. CONSIDERATIONS

- # of mark groups
- # of incubation vessels
- Projected hatching date
- Development stage of release
- Eggtake spread

-Rapidly reduce incubation water
8–12 F° (4–6 C°) for 8–24 hrs

- Patterns require multiple T° treatments

4 prior to hatching
+ 6 after hatching
10 treatments standard

- Water-to-water T° change

- Air-to-water T° change

et	rel	gr	n	st	11 09/20	12 09/21	13 09/22	14 09/23	15 09/24	16 09/25	17 09/26	18 09/27	19 09/28	20 09/29	21 09/30	22 10/01	23 10/02	24 10/03	1 15 10/04	2 16 10/05	17 10/06	18 10/07	19 10/08	20 10/09	21 10/10	22 10/11	23 10/12	2 24 10/13	3 25 10/14	26 10/15	27 10/16	28 10/17	29 10/18	30 10/19	31 10/20
08/02	KCH 1	1	56,000	A1	x					x		x		x					x															
08/09	NF 1	2	72,000	A2								x					x		x		x					x									
08/09	NF 1	2	72,000	A3								x					x		x		x					x									
08/16	NF 2	3	70,000	A4															x					x		x		x					x		
08/16	NF 2	3	70,000	A5															x					x		x		x					x		
08/23	MFN	4	70,000	A6																						x					x		x		x
08/23	MFN	4	70,000	A7																						x					x		x		x
08/23	MFN	4	70,000	A8																						x					x		x		x
08/24	KCH 2	5	56,000	A9																							x						x		x	
08/30	NF 3	6	72,000	A10																													x			
08/30	NF 3	6	72,000	A11																													x			
09/06	KCH 3	7	56,000	A12																																
09/06	KCH 3	7	56,000	basket - terminal																																

Thermal Marking Requirements

- Insulated box with 3 portable chillers
- Inline chiller
- Moist Air Incubator Systems (MAIS)
- “Desiccation”
- Two water sources

WDFW Kendall Creek Hatchery

- 800,000 – 2,000,000 Nooksack River spring chinook per year
- 5,000,000 Samish River fall chinook per year
- 1,600,000 Whatcom Creek chum per year
- 15 portable chillers (6 inside + 9 outside)
- 5 cold water delivery hoses
- One hose per vertical stack @ 4 gpm (15 lpm)
- Three hoses per trough @ 12 gpm (45 lpm)

Water Chilling Systems

Old vs New

Temporary Chillers Cost

- Chiller (requires 3) ~$3,200 each
- Insulated box ~$6,000
- ½ hp pump ~$400

- Total ~$10,000

- Limited to 4 gpm at 10 F

Inline Chiller Costs

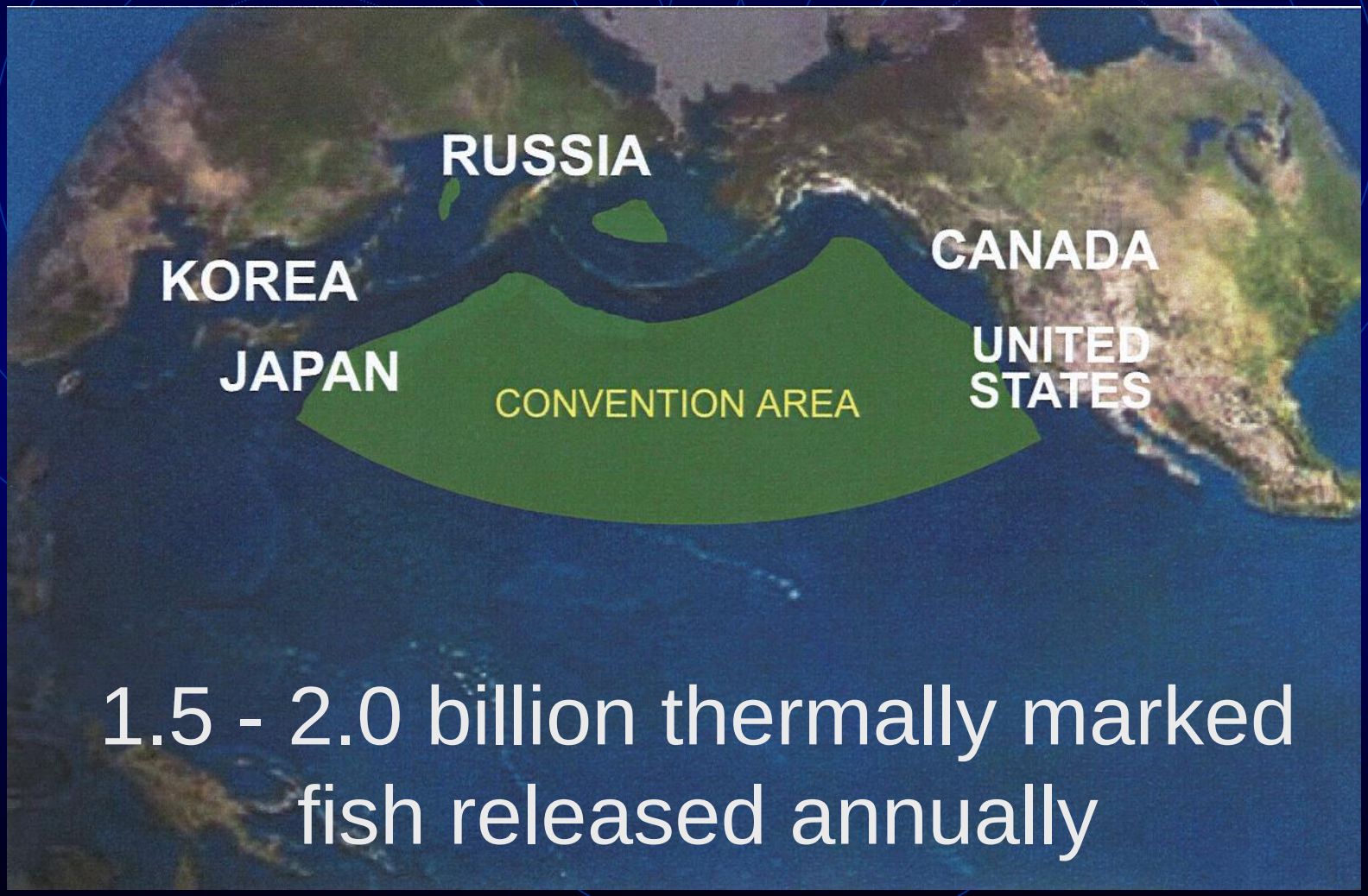
- 25 gpm at 10 F $45,000
- 35 gpm at 10 F $49,000
- 60 gpm at 10 F $70,000
- 350 gpm at 10 F $130,000

Otolith Recovery

Recovering Thermal Marks from Otoliths

- Grind and polish otolith, view under compound microscope.
  - WDFW Otolith Lab has three grinding stations equipped with dissecting microscopes and lapping/polishing machines
  - and three reading stations equipped with compound microscopes and a pc for data entry

NPAFC
http://npafc.taglab.org/



2007 Pacific Rim Releases (Brood Year 2006)

NPAFC not yet published.

Table 4. Number of otolith marked salmon released from Pacific Rim hatcheries in 2007.

	Sockeye	Pink	Chum	Chinook	Coho	Masu	Total
Canada	5,000,000	0	37,500,000	21,100,000	90,000	0	63,690,000
Japan	179,678	14,969,000	149,744,176	0	0	2,835,694	167,728,548
Korea			5,000,000				5,000,000
Russia	9,815,817	416,200	36,115,903	799,000	2,797,997	276,107	50,221,024
Alaska	59,412,316	703,145,453	507,328,218	5,850,716	7,747,567	0	1,283,484,270
WA,OR,NV,ID	12,100,000	0	1,038,000	16,743,000	156,000	0	30,037,000
Total	86,507,811	718,530,653	736,726,297	44,492,716	10,791,564	3,111,801	1,600,160,842

WA, NV, ID	**kokanee**	**cutthroat**	**atlantics**	**steelhead**
	13,165,000	33,500	6,000,000	24,000

Thermal Marking in Lower 48 Brood Year 2007

Species	# marked
Atlantic	6.0 million
Chinook	25.0 million
Chum	1.5 million
Coho	1.9 million
Cutthroat	345,000
Kokanee	7.6 million
Pink	30,000
Sockeye	2.6 million

Washington Marking Facilities

- 15 – 25 hatcheries per year
- All 6 WDFW regions
- All Hatchery Complexes except Eastbank and Lyons Ferry
- WDFW, Tribal, Universities, RFEGs, and Privates
  - Kendall Creek, Lake Whatcom, Whatcom Creek, Bellingham, Wallace River, Hoko, Makah Nat'l, Minter Creek, George Adams, Salmon Creek, Big Beef Creek, Quinault Tribal, Lilliwaup, Bingham Creek, UW-Seattle, Soos Creek, American Gold Seafood, Cedar River, Bernie Kai Kai Gobin (Tulalip), Skagit Coop, Sol Duc, Hurd Creek, Dungeness, Cowlitz, Cowlitz Trout, Spring Creek Nat'l, Carson Nat'l, Washougal, Grays River, Wells, Cle Elum, Priest Rapids, Spokane, Spokane Tribal

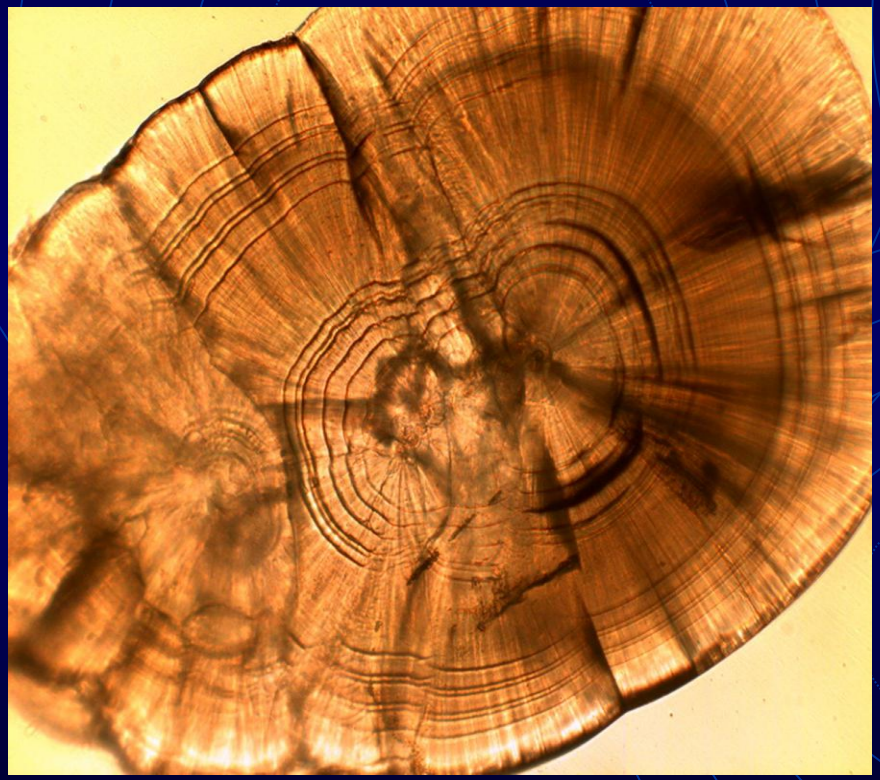
ODFW Marking Facilities

- 6,000,000 spring chinook at Willamette Hatchery
- 250,000 spring chinook at Marion Forks Hatchery
- 1,600,000 spring chinook at McKenzie Hatchery (real time otolith reads for RY 2010)

Washington Species

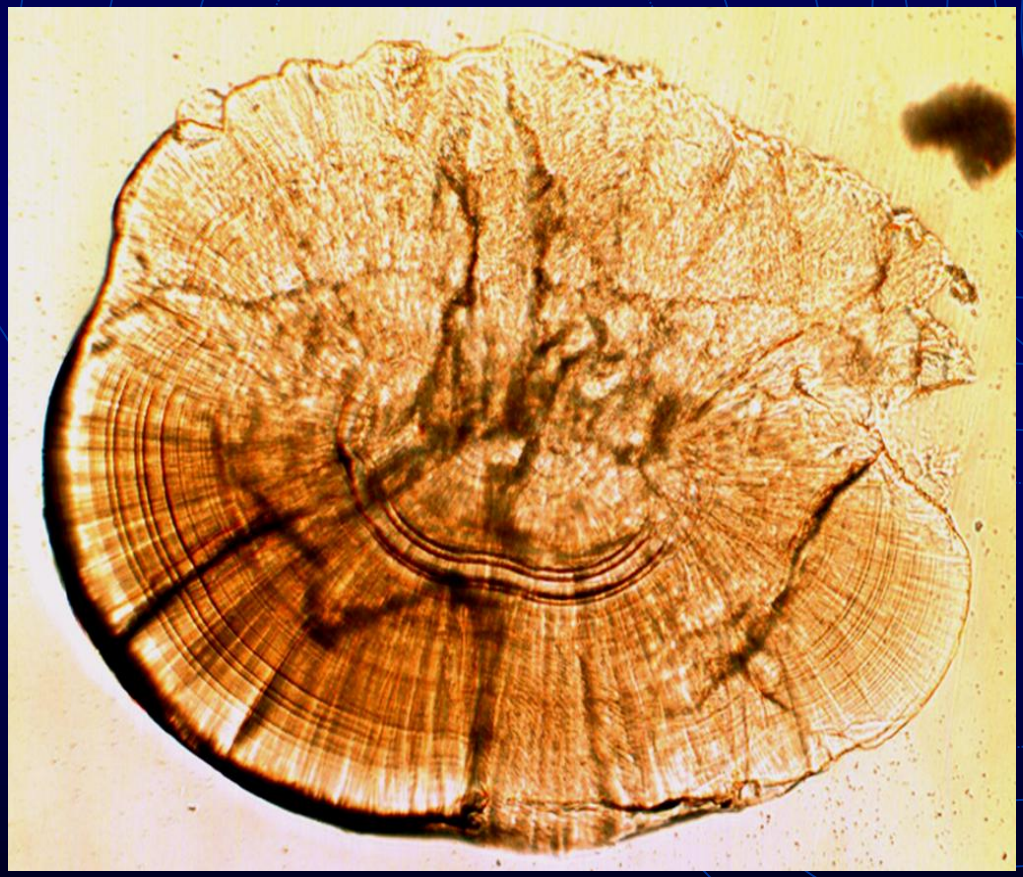
- 30 – 50 stocks per year
  - All 5 Pacific salmon spp
  - Atlantic salmon
  - Kokanee
  - Cutthroat
  - Steelhead/rainbow

Nooksack River Spring Chinook at Kendall Creek Hatchery



- Age information
- 8-12 release groups with pre-hatch and post-hatch patterns

Cedar River Sockeye



- **Each Brood Year: 6–46 patterns (ave = 20)**
- **Each Run Year with typical three ages classes: 39–105 patterns**
- **Each Run Year with four age classes: 60–120 patterns**

Information from Cedar River Otolith Patterns

Release Time: ***Early, Middle, or Late***

Release Area: ***Lower, Middle, or Upper River***

Rearing Type: ***Unfed Fry or Fed Fry***

Release Flow: ***River Volume at Release***

Age: ***Brood Year Identifier***

What are the benefits of this kind of marking technology?

- Natural
- Don’t touch/handle fish
- 100% marked – easy on the statistics
- Easy for hatchery staff

What is the Impact to Hatchery Staff?

~1 minute per day

per treated incubation vessel

What are the constraints of this kind of marking technology?

- Challenges with surface water
- One more entrée on a full plate at the hatchery
- Cryptic – no external identifier
- Power outages
- Power supply
- Sticker shock

Top 10 List of Misconceptions About Thermal Marking

1. Causes triploidy.....No
2. Favors male development .....No
3. Causes cold water disease .....No
4. Causes bent spines .....No
5. It's a lotta work .....No
6. Mark recovery costs a lot .....No
7. Otolith thermal patterns are temporary .....No
8. Increases mortality .....No
9. Depresses instinct to swim up .....No
10. It's gross! You gotta pick thru fish brains .....Yes

WDFW Otolith Lab Cocktail Trivia

- 3 FTEs with over 60 yrs Otolith Lab experience
- Annually coordinate marking for 40-80 million salmonids including listed stocks
- Analyze 20,000 – 50,000 specimens per year
- Annually perform real time otolith analyses at Kendall Creek Hatchery
- From fish head to data in less than 1 minute
- One person can section 500 – 1000 fry otoliths and determine NOR v HOR per hour
- Analyzed 500 chinook otoliths in eight hour day for in-season fishery management

Examples of where this marking technology would be as effective

- Most effective as a tool to mark hatchery fish though it has worked in the field on wild fish
- Anywhere the hatchery/facility has the necessary hardware (electrical, water chilling source, etc)


NEW HORIZONS.