OTOLITH THERMAL MARKING

WDFW OTOLITH LAB

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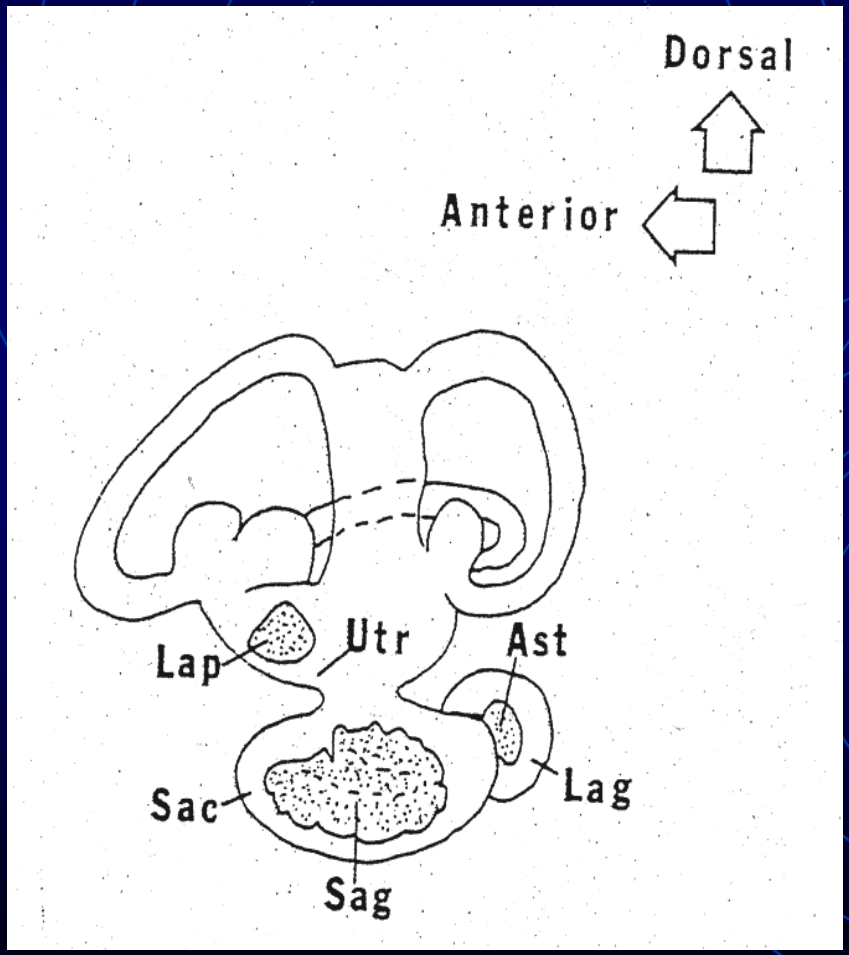
Otoliths 101
Teleost Inner Ear



Asteriscus (lagena)

Lapillus (utriculus)

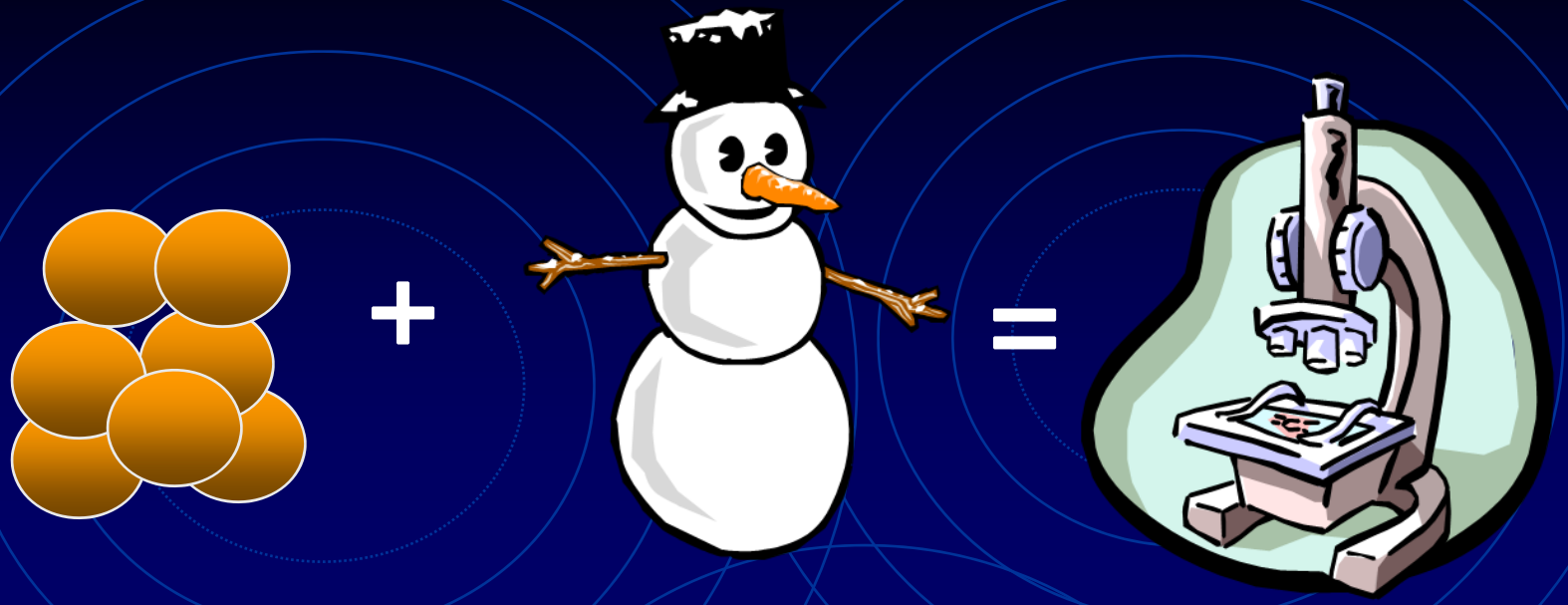
Sagitta (sacculus)

(from Lowenstein 1971)

What is a Thermal Mark?

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

How Does Thermal Marking Work?



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

-Rapidly reduce incubation water
8–12 F° (3–5 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

Thermal Marking Equipment

- 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
- 50,000 Nooksack River coho 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

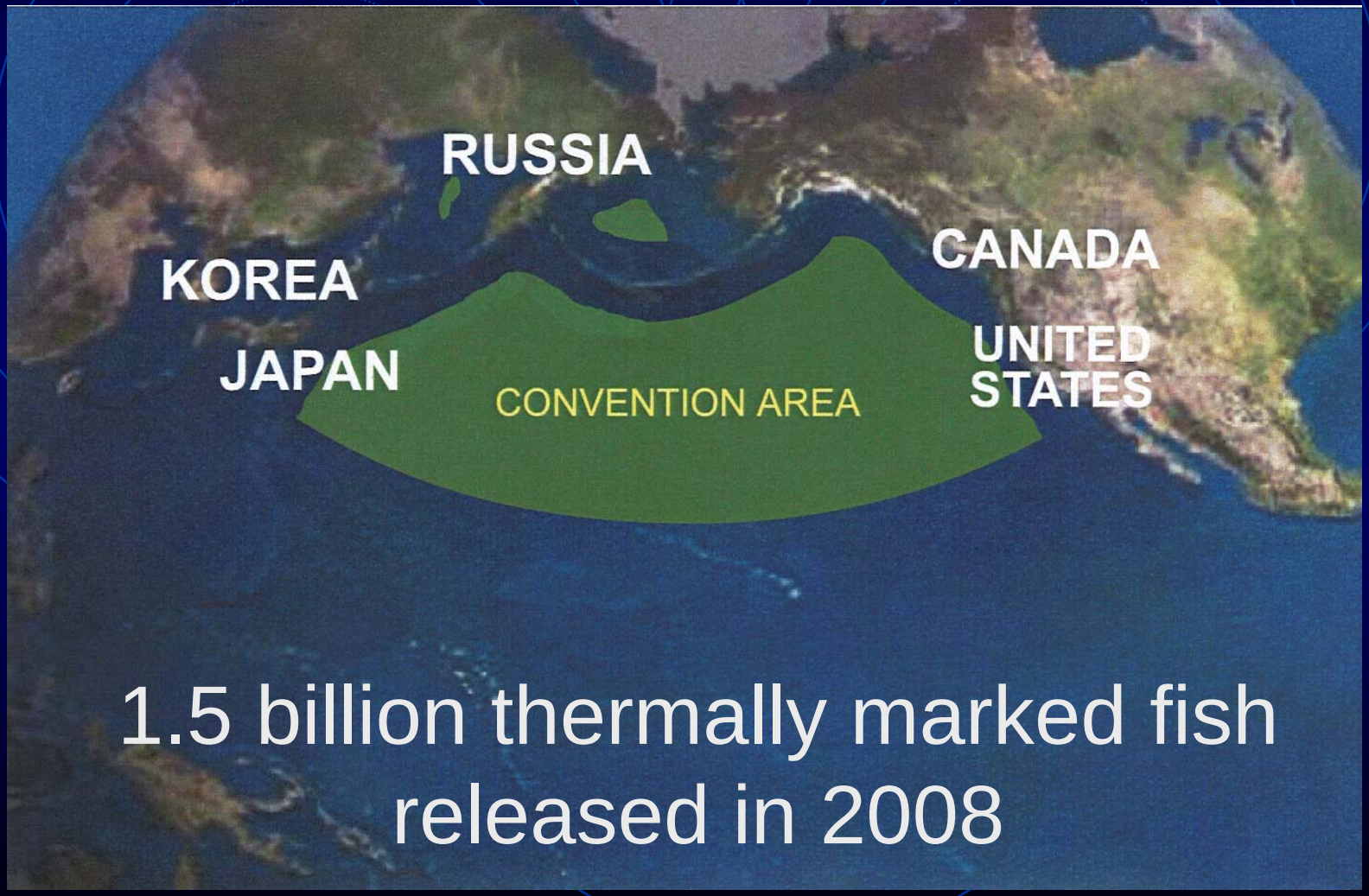
Old vs New

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 two 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

Washington Species

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

Creating Patterns

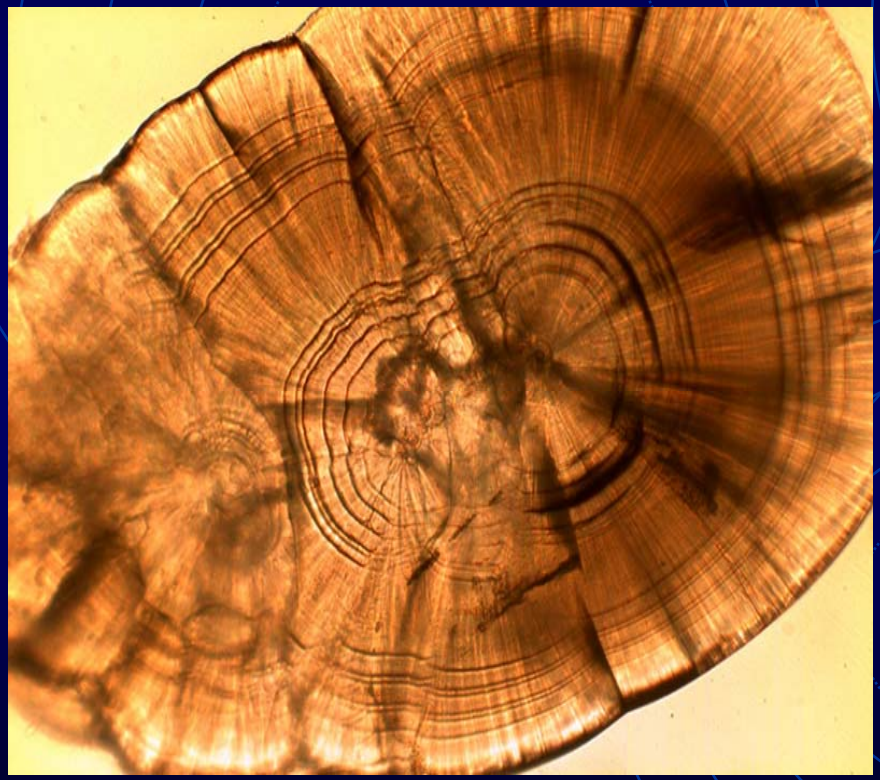
1. AVOID DUPLICATION

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

2. CONSIDERATIONS

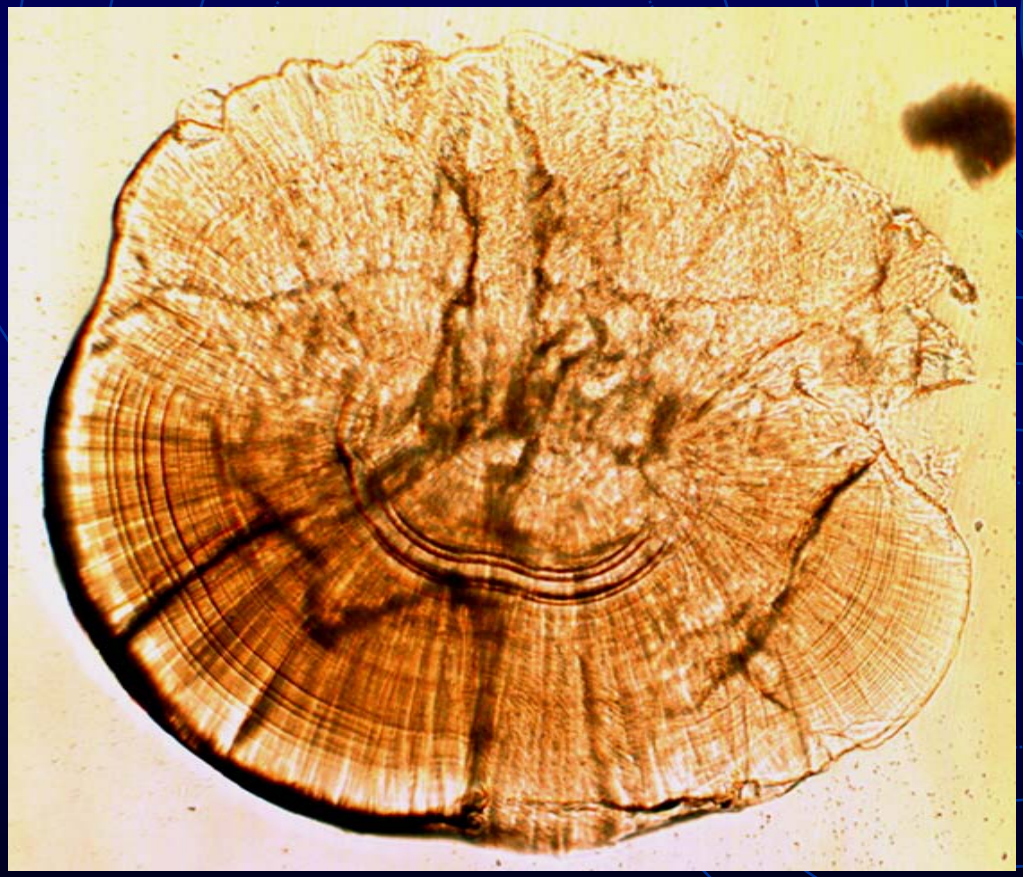
- # of mark groups
- # of incubation vessels
- Projected hatching date
- Development stage of release
- Eggtake spread

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 is the Impact to Hatchery Staff?

~1 minute per day

per treated incubation vessel

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

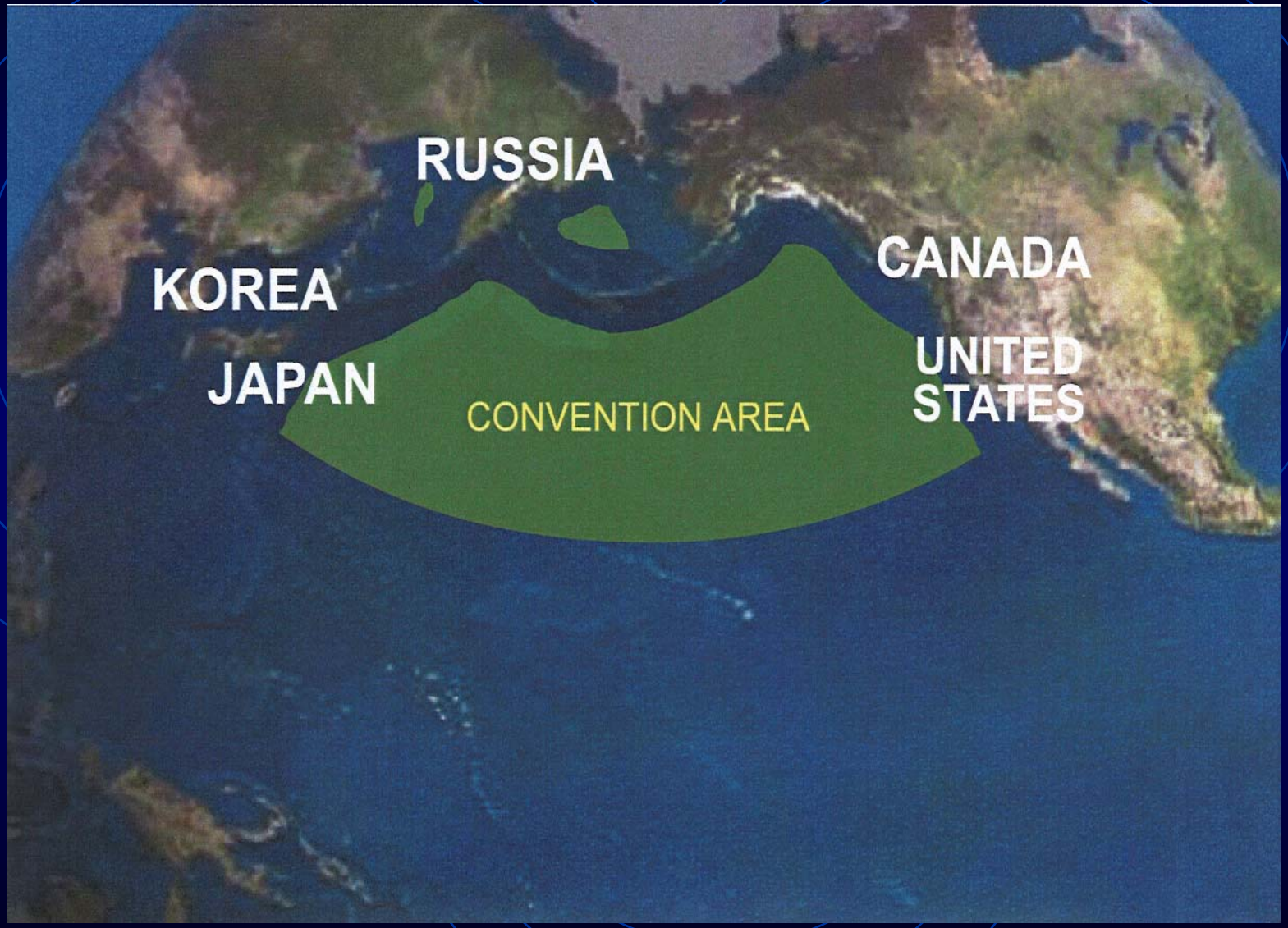
WDFW Otolith Lab Cocktail Trivia

- 3 FTEs with over 50 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 juvenile otoliths and determine NOR v HOR at a rate of 1200 fish/hr
- Analyzed 500 chinook otoliths in eight hour day for in-season fishery management


NEW HORIZONS.

Brood Year 2007
Thermal Marking in Lower 48

Species	# marked
O. tschawytsha	25.0 million
O. keta	1.5 million
O. kisutch	1.9 million
O. gorbuscha	30,000
O. nerka	10.2 million
S. clarkii	434, 000
S. solar	6.0 million


RUSSIA
KOREA
JAPAN
CANADA
UNITED STATES
CONVENTION AREA

- ~1 minute per day

per treated incubation vessel

Common Factors Effecting Mark Quality

- mark execution
- power outages
- weather
- available chilled water
- ambient incubation water


ALREADY
DISTURBED.
MAY TURN
VIOLENT
AT ANY TIME.