Otolith Thermal Marking and Ocean Salmon Management

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Discussion Points

- **Brief History and background**
- How Many Marks??
- Mark Detection Errors
- Coordination
  - Assigning marks

    Competing programs and goals
- Costs

1970

Early investigations into the impacts of environmental change on otolith structural attributes.

1980

Campana et al., 1985 Nielson and Geen (1985)
Moosegaard, 1985; Brothers, 1985

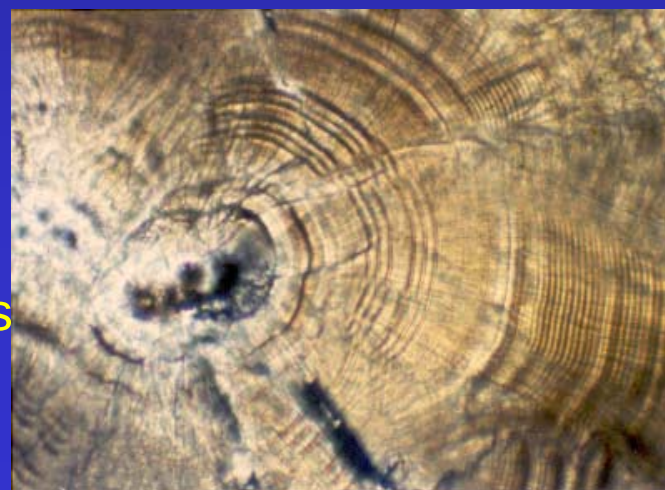
1990

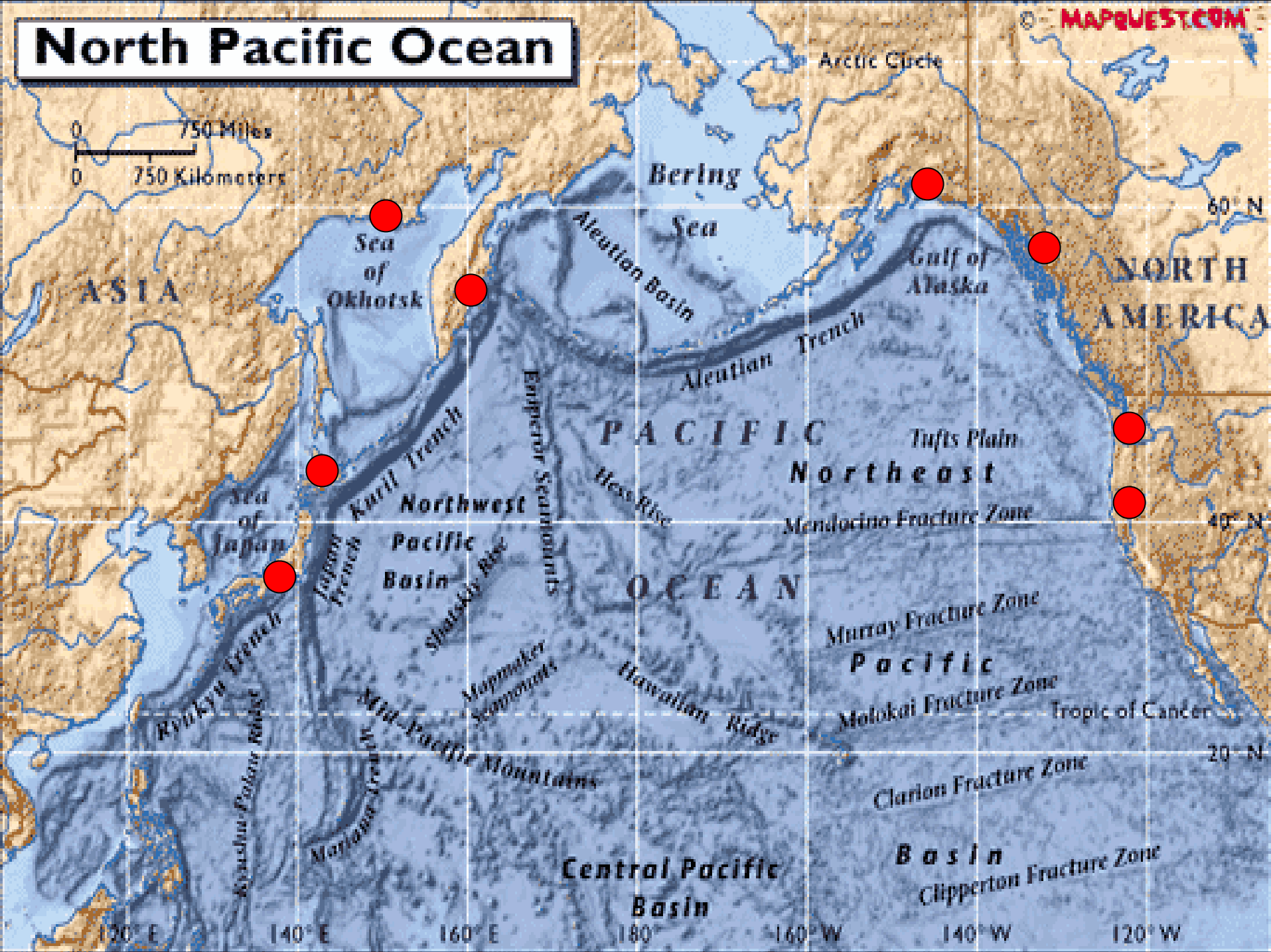
Brothers, 1990; Eschenroder et al., 1990; Volk et al., 1990

Hagen and Munk, 1994
Volk et al., 1994
Hagen et al., 1995
Achinicheva and Rogatnykh, 1996
Munk and Geiger, 1998
NPAFC technical working group
Numerous documents and reports

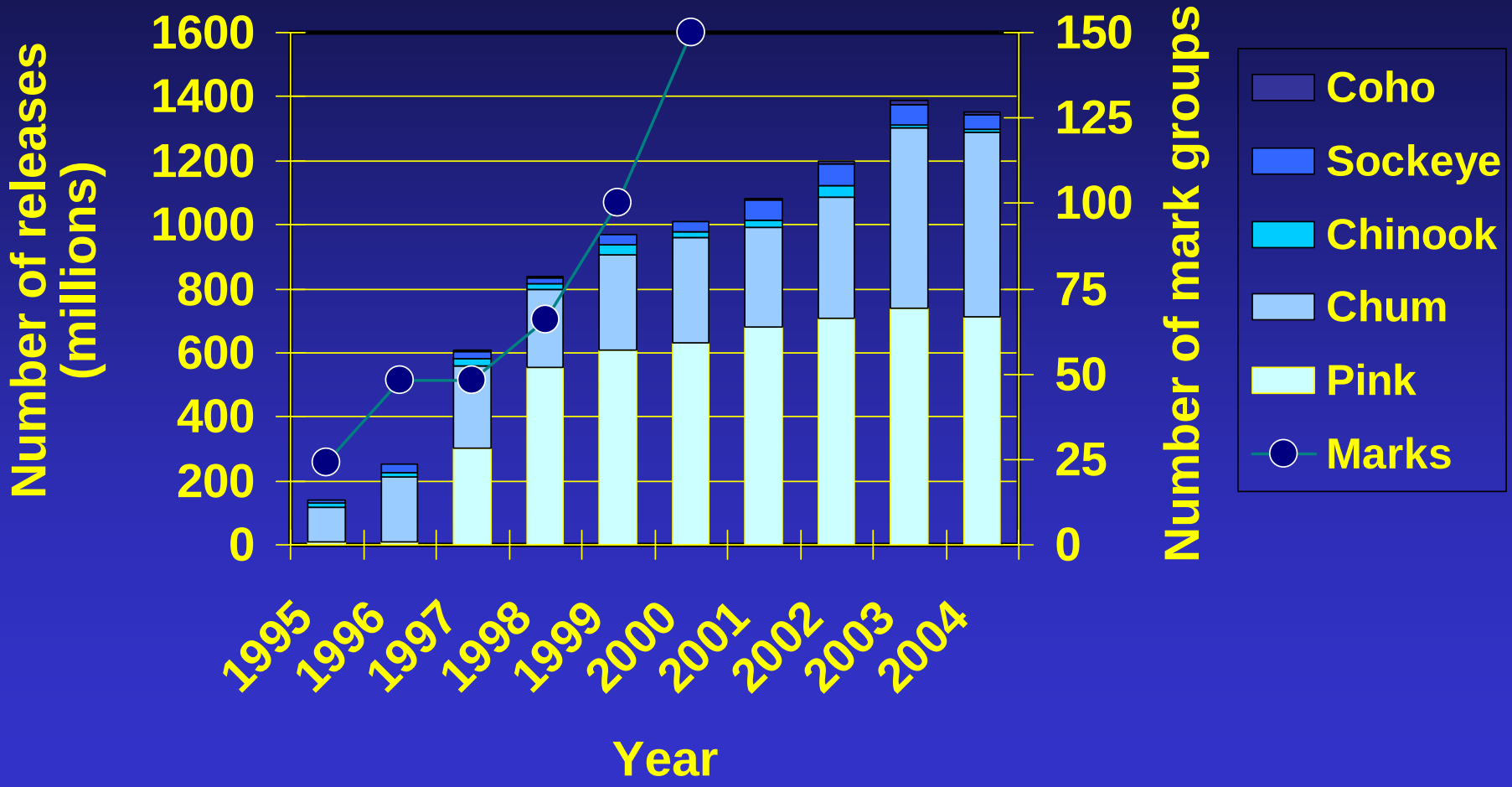
2000

Volk et al., 1999
Blick and Hagen (2001)
Otolith marking symposium (2001)
Volk et al. (2004) in Stock ID Methods

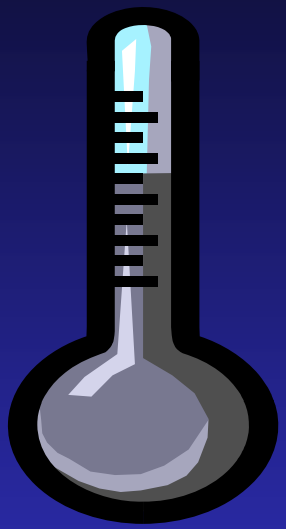


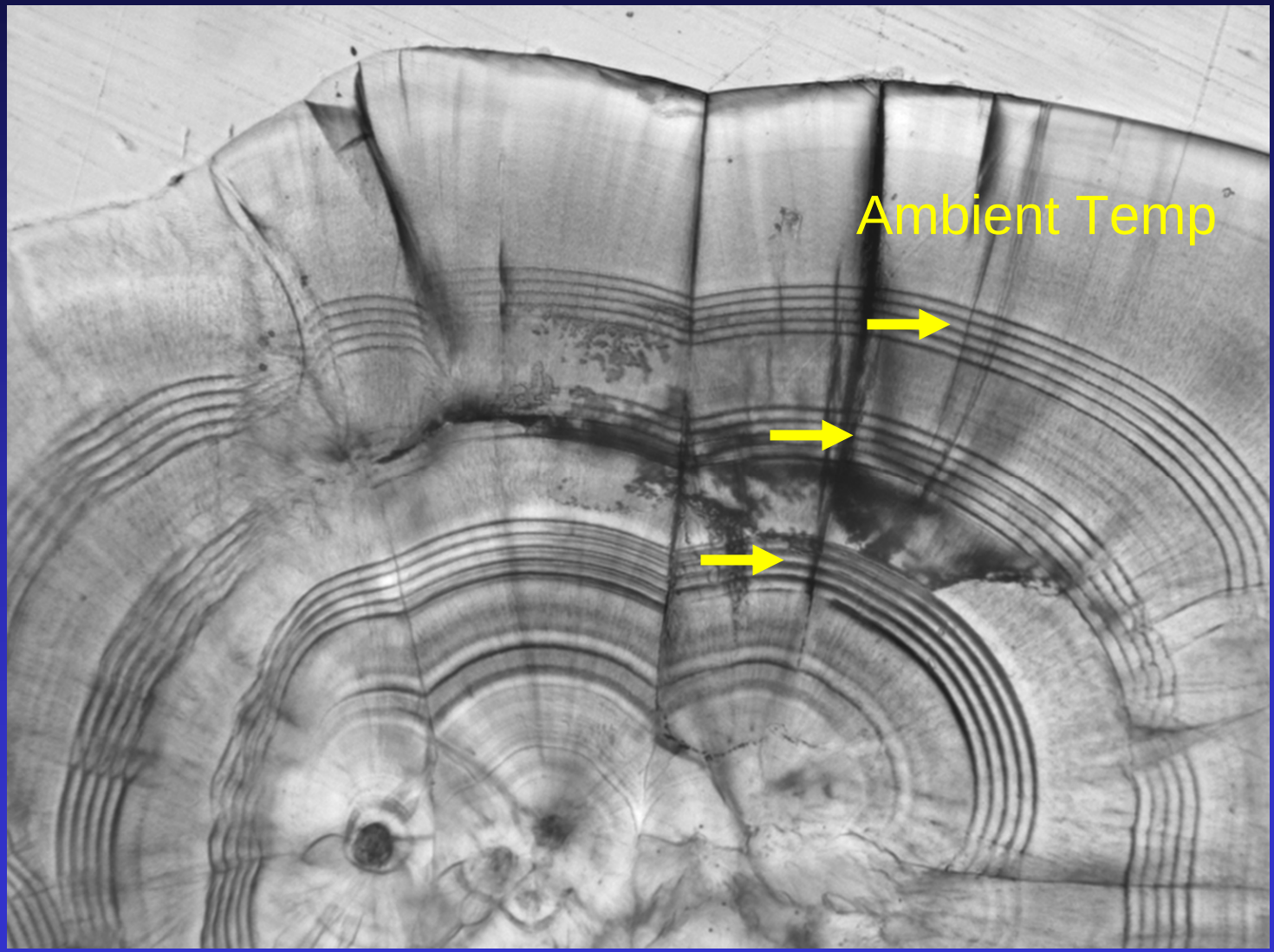

North Pacific Ocean
© MAPQUEST.COM
0 750 Miles
0 750 Kilometers
Arctic Circle
Bering Sea
Aleutian Basin
Gulf of Alaska
Sea of Okhotsk
ASIA
NORTH AMERICA
Aleutian Trench
Emperor Seamounts
Kuril Trench
PACIFIC OCEAN
Tufts Plain
Northeast Pacific Basin
Hess Rise
Mendocino Fracture Zone
Sea of Japan
Japan Trench
Northwest Pacific Basin
Shatsky Rise
Murray Fracture Zone
Ryukyu Trench
Mid-Pacific Mountains
Hawaiian Ridge
Molokai Fracture Zone
Tropic of Cancer
Clarion Fracture Zone
Kyushu-Palau Ridge
Mariana Trench
Central Pacific Basin
Clipperton Fracture Zone
60° N
40° N
20° N
120° E
140° E
160° E
180°
160° W
140° W
120° W

Hatchery releases of otolith marked salmon by species, and number of mark groups in the North Pacific rim countries, 1995-2000



Otolith Thermal Marking




Ambient Temp

Otolith Thermal Marking

Fisheries Research 43 (1999) 205-219

and

In: Stock Identification Methods (2004)

Eric C. Volk, Steven L. Schroder* and Jeffrey J. Grimm*

*Washington Department of Fish and Wildlife

Important Considerations for Otolith Thermal Marking

Some modification of facilities usually required
Power, Water, Space

Meshing with normal hatchery operations

Recovery of marks requires specimen preparation

Lethal sampling *

No external mark *
(but 100% marked)

Otolith Thermal Marking Advantages

- Conceptually Simple
- No Specialized Equipment
- Method is Freely Available
- No Permits Necessary
- Amenable to Situation Specific Adaptation
- 100% Marking *
- Appears to Cause no Harm

Otolith Thermal Marking Problems

- Conceptually Simple
- No Specialized Equipment
- Method is Freely Available
- No Permits Necessary

Discussion Points

- Brief History
- **How Many Marks??**
- Mark Detection Errors
- Coordination
  - Mark assignments
  - Other programs and goal
- Costs

How Many Marks?

- Volk et al. 1994. 1000 marks possible.
  - Ten unique marks in each of three otolith regions
- Practical limits may be less depending on;
  - Incubation time available for marking
  - Marking/Ambient thermal regime (mark quality)
  - Capabilities of physical plant

How many marks needed?

- Hatchery versus Wild
  - Few marks, but all target hatcheries marked
- Age determination
  - Marking at index hatcheries
    - ~40 * 4 brood years ~ 160 patterns

Strontium & Thermal marks

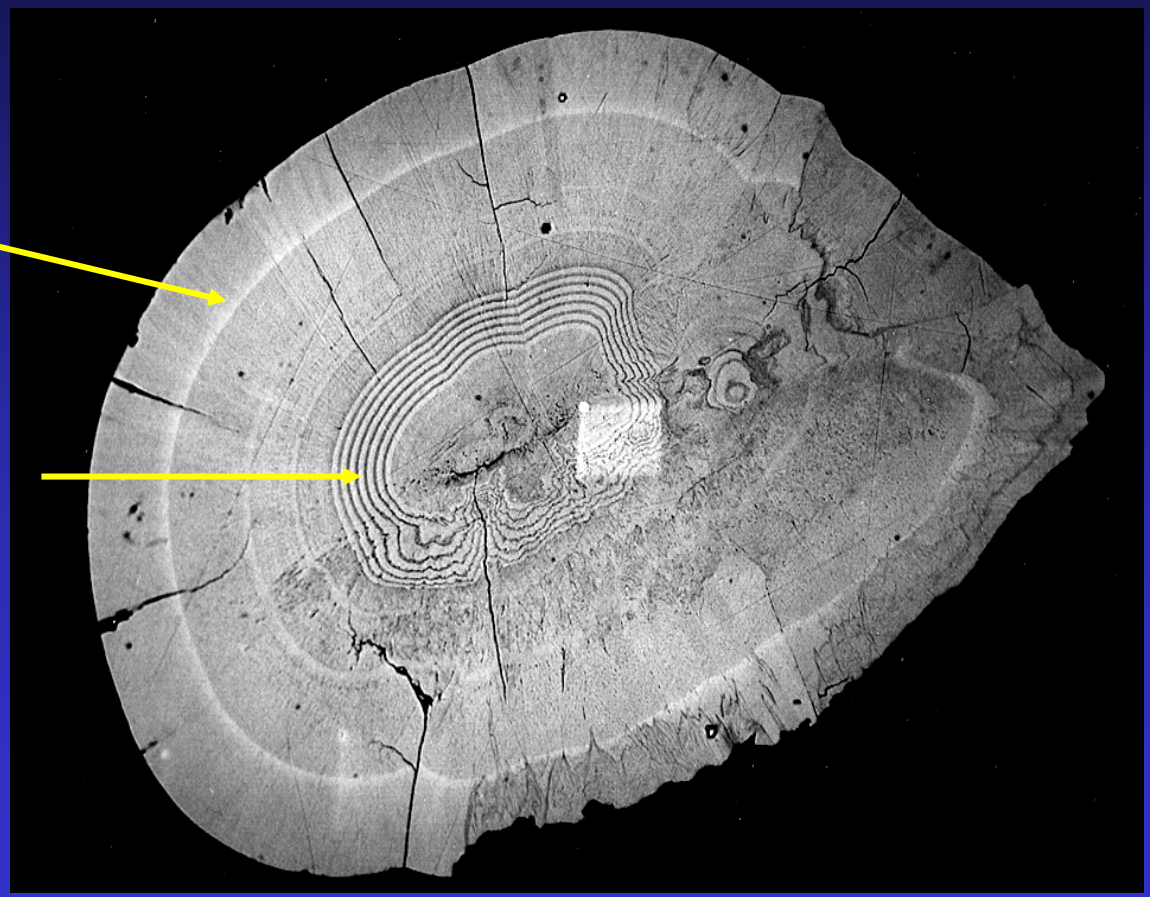


Photo by P. Hagen

Backscatter SEM

Discussion Points

- Brief History
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- **Mark Detection Errors**
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  - Other programs and goal
- Capital Costs

Mark Detection Errors

- Mark Quality
  - Interaction of Planned Events with Ambient Conditions
- Natural Mimics of Patterns
- Recognition Errors
- Clerical Errors

Discussion Points

- Brief History
- How Many Marks??
- Mark Detection Errors
- **Coordination**
  - **Mark assignments**
  - **Other programs and goal**
- Capital Costs

Coordination and Logistics

- Interaction with other objectives
  - Research
  - Local Issues
- Marking by other countries and overlapping migratory patterns (Russia)
- Assigning and ensuring mark patterns
  - NPAFC
- Mark recovery and tracking
- Impact on product
- Turnaround time

Discussion Points

- Brief History
- How Many Marks??
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  - Mark assignments
  - Other programs and goal
- **Costs**

Recommendations

- 100% marking of index hatcheries is feasible
  - Hatchery specific or general?
  - Reserve PSC index mark identifier
- Coordinate with NPAFC thermal mark WG
  - Institute specific quality control measures to assess intended versus actual marks
- Identify funding mechanism for hatchery modifications
- Establish regional or centralized laboratory for processing and recovery of otolith marks

Thanks!