

Southeast Alaska
chum salmon
(*Oncorhynchus keta*)
thermal mark identification
and agreement

2012 Pink and Chum salmon workshop, Juneau AK

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Introduction: Thermal marks

Salmonid otoliths are mass thermally marked

Temperature cycles → banding pattern

Applications:

- In-season sockeye management
- Hatchery return rates
- Hatchery stray rates
- Evaluate rearing strategies
- Validate model parameter estimates

Introduction: Detection and Identification

Mark detection

- Presence of thermal mark

- Hatchery vs. Wild

Mark identification

- Hatch code** → unique group

- E.g. **1,4,3H** chum means:

 - Thermal mark ID: NEETSBAY05SUM

 - Brood Year: 2005

 - Agency: SSRAA

 - Number released: 8,409,868

 - Stock: Neets Bay

Introduction: Chum study

Chum salmon stray study

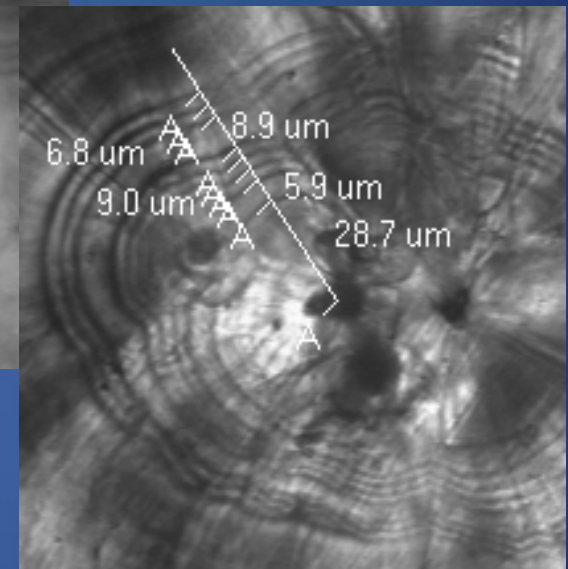
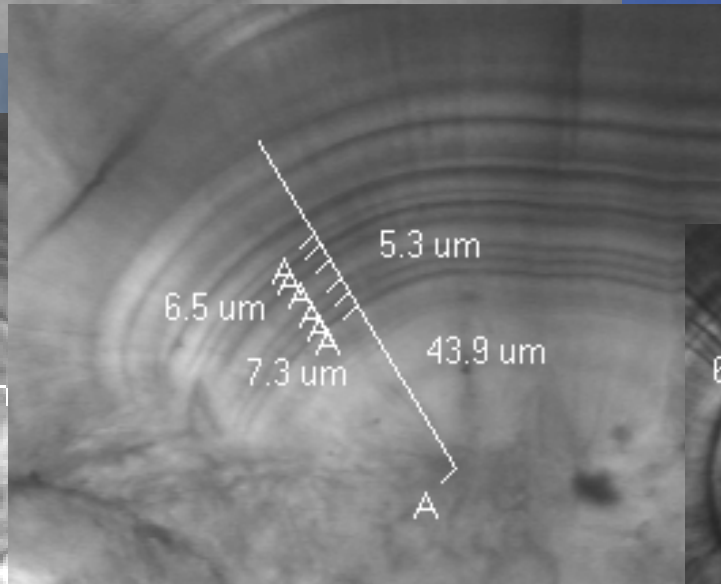
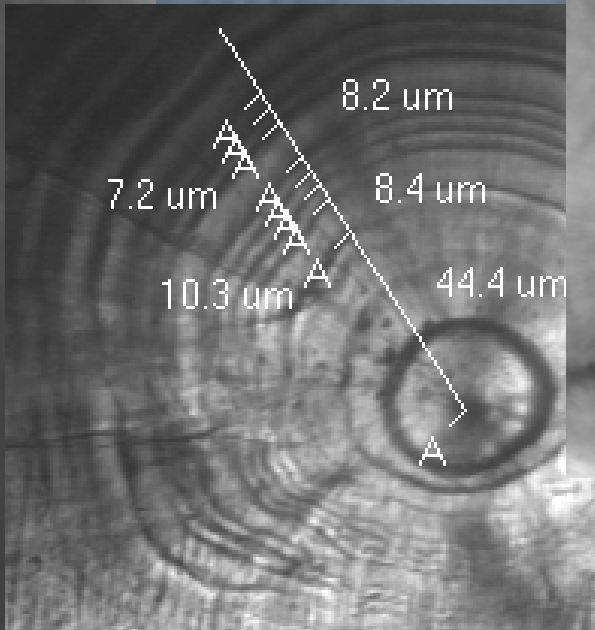
Mark ID recovery location →
distance from release

Samples from around SE AK

25 unique marks identified in 2010

Most chum salmon marks have
variants

Introduction: Variants



How accurate are chum salmon thermal mark detections and identifications?

Introduction: Mark accuracy

ADFG laboratory data quality assurance methods:

Study and use known reference collection:

- 1) Mark variations
- 2) Mark measurements: to mark, between bands

Multiple independent reads to identify issues

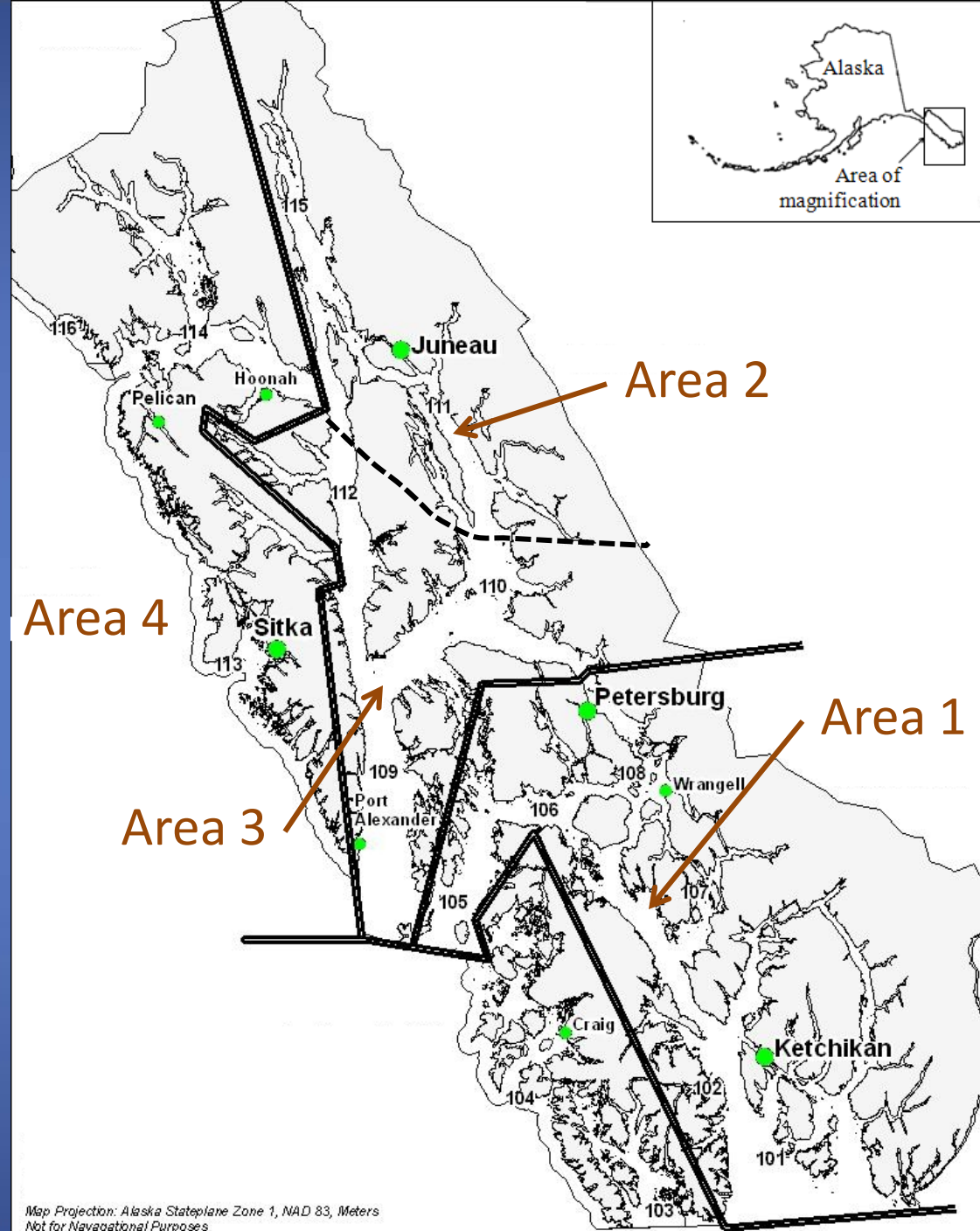
But... true reader error rate is unknown!

Objective

Assess accuracy of thermal mark
detection and identification
among areas and labs

Study area

- 1) Southern Southeast
Northern Inside
- 2) Lynn Canal and
Stephens Passage
- 3) Chatham and Icy
straits
- 4) Northern Outside



Methods: Reads

2009 and 2010 recoveries

Read by:

AK Department of Fish and Game Thermal Mark Lab

ADF&G

Southern SE Regional Aquaculture Association

SSRAA

Douglas Island Pink and Chum Inc.

DIPAC

For:

Readability

Presence

Identification

Methods: LCM

Latent class models (LCM) estimate reader ability:
to detect marked fish when it is marked ($H | H$)
to detect wild fish when it is wild ($W | W$)

Using:

- Strata: area (e.g. Northern Inside waters)
- Reader pairs (e.g. ADF&G and DIPAC)

to estimate the true reader error rate.

Maximize likelihood function,

SE is estimated using jackknife method.

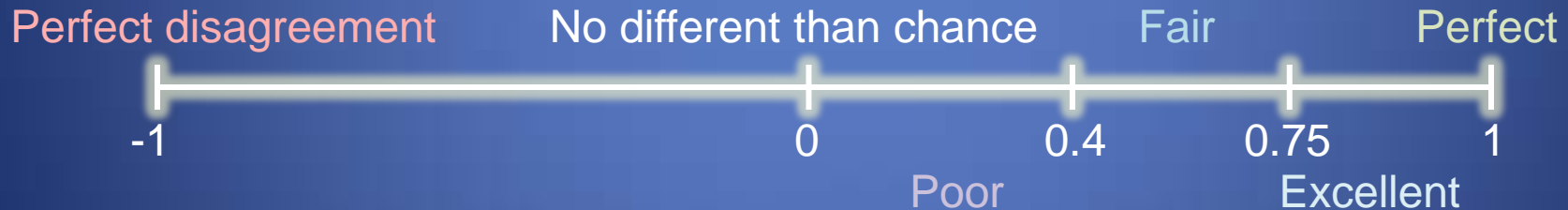
Methods: *Kappa*

Agreement between readers on two or more identifications

Accounts for agreement that occurs by chance:

$$\kappa = \frac{p_o - p_e}{1 - p_e}$$

p_o = observed,
 p_e = expected



$SE(\kappa)$

Overall κ = weighted average (κ)

Methods: Assumptions

1. Independent readings

Dependence is caused by:

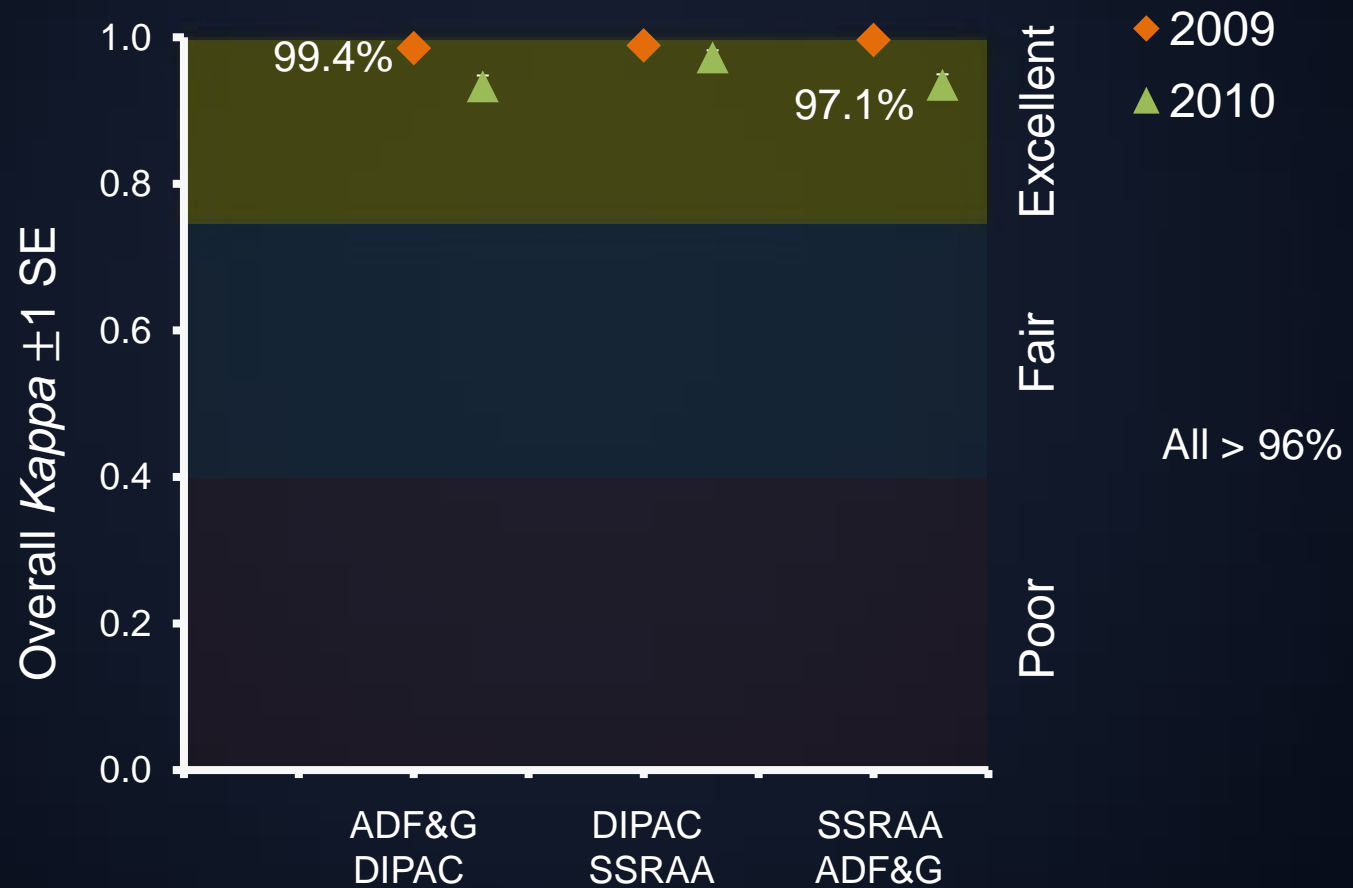
- a) Otolith preparation not independent.
- b) Marking process affecting readability of a mark grouping.

Somewhat resolved with more strata

2. Accuracy rate is greater than error rate.

Results: Mark detection

Marked vs. Not marked



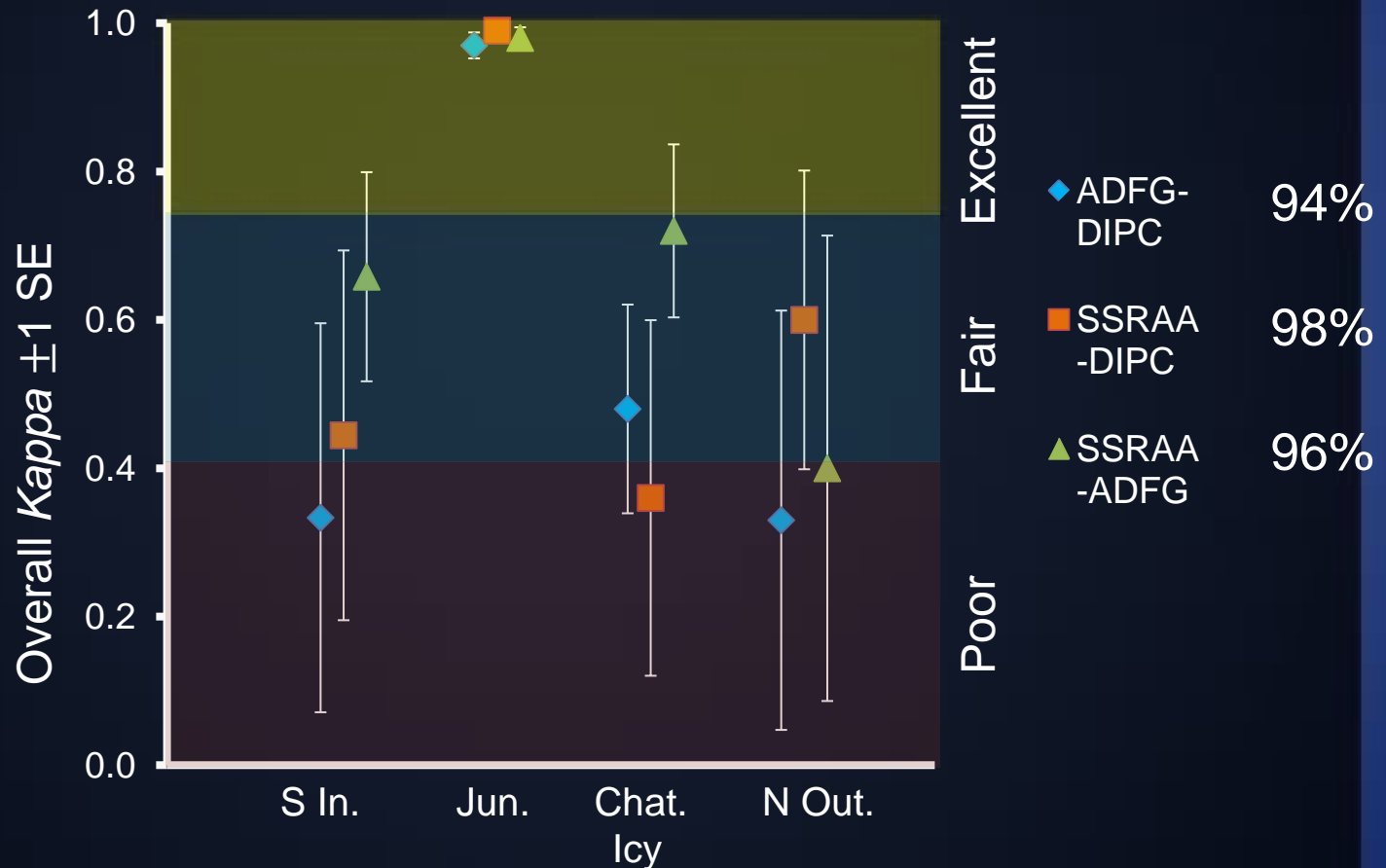
Results: Mark detection

LCM using reader pairs, 4 strata



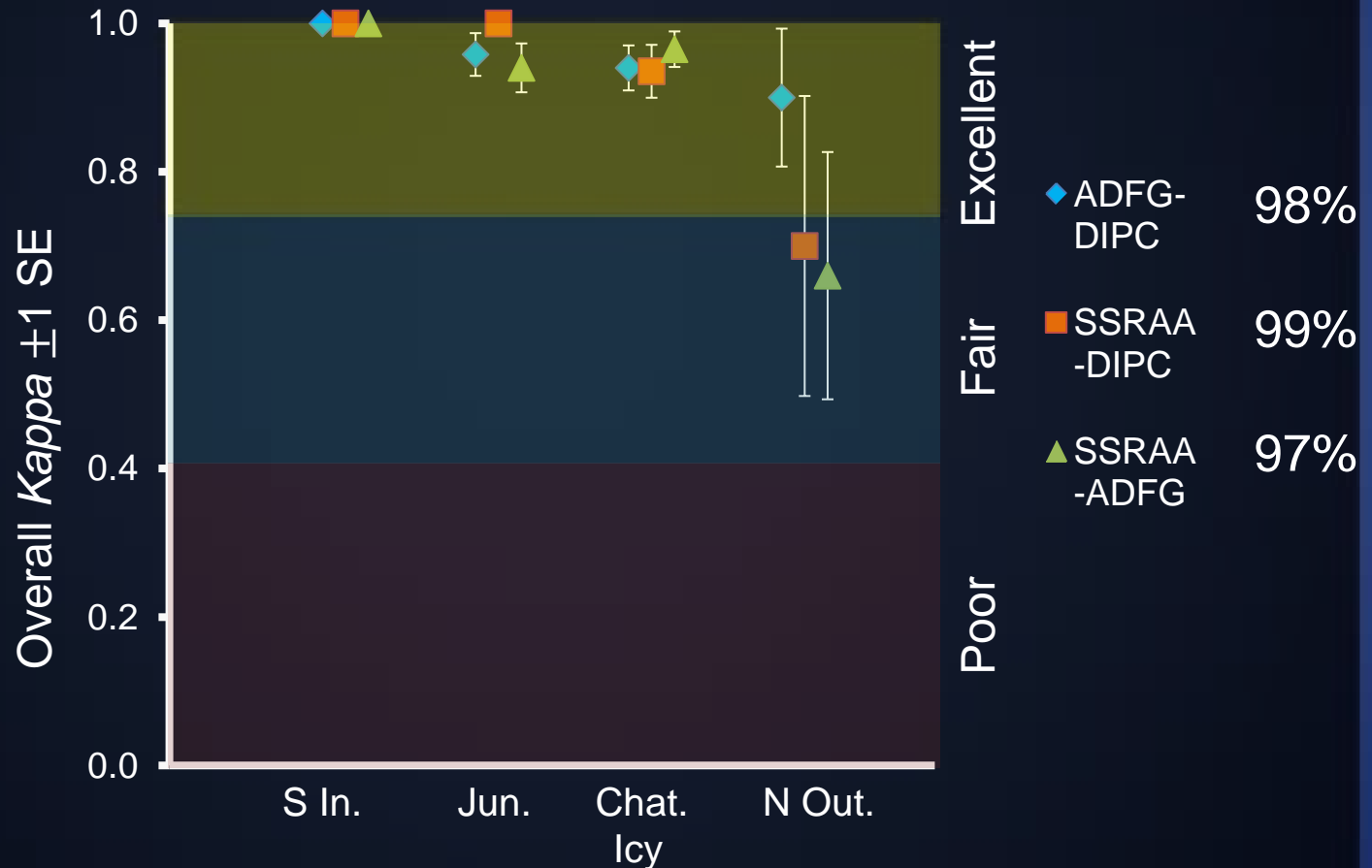
Results: Mark Identification

2009



Results: Mark Identification

2010



Results: Mark Identification

Increased thermal mark agreement related to:

Lower number of variants

Reader familiarity:

Dominant brood year

Number released

Further distance from primordia to mark
(based on southern inside study marks)

Discussion

Accuracy > error rate assumption met.

LCM and *Kappa* values are appropriate for assessing reader accuracy.

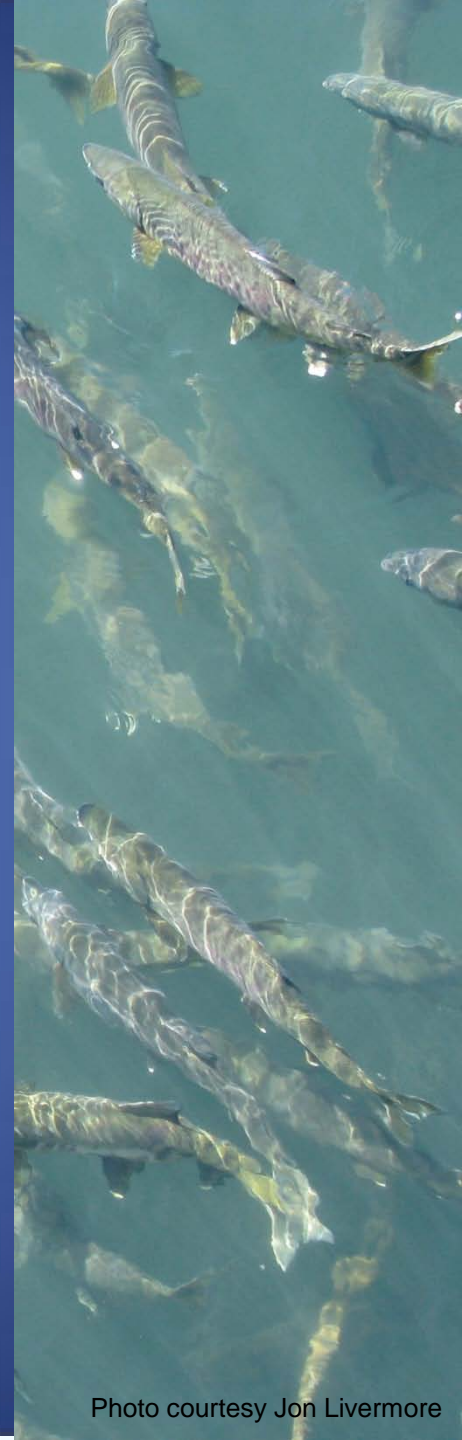
Reader ability to detect a mark higher in 2009 than 2010, but individual mark identification was lower. This possibly due to:

- Fewer marked fish in 2009

- Better mark quality in 2010

- Increased reader ability

- Sample loss due to over-grinding



Discussion

Overall, reader ability to detect and identify chum salmon thermal marks is high.

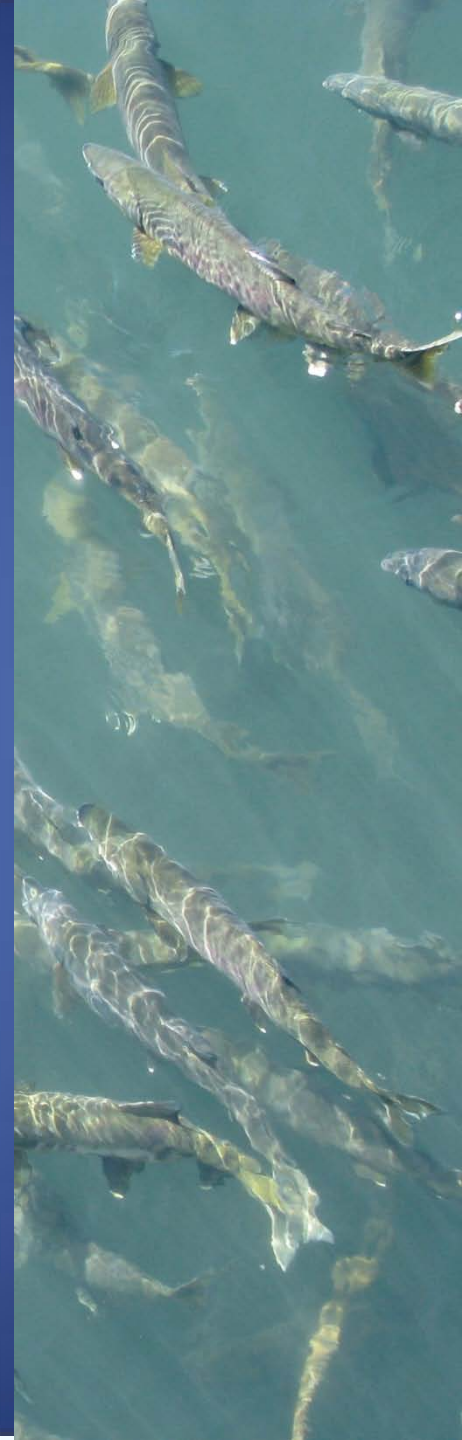
Second reads are essential for assessing reader accuracy.

Reader ability to detect and identify marks increases with:

- Mark assignment

- Mark quality

- Training



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