

Stock-specific ocean distribution of immature chum salmon in the summer Bering Sea inferred from SNP markers



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NPAFC International Workshop on Explanations for the High Abundance of
Pink and Chum Salmon and Future Trends
October 30-31, 2011
Vancouver Island Conference Centre,
Nanaimo, BC, CANADA

Presentation Outline

1. Background and Objectives
2. Materials and Methods
3. Results
4. Summary

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1. Background and Objectives

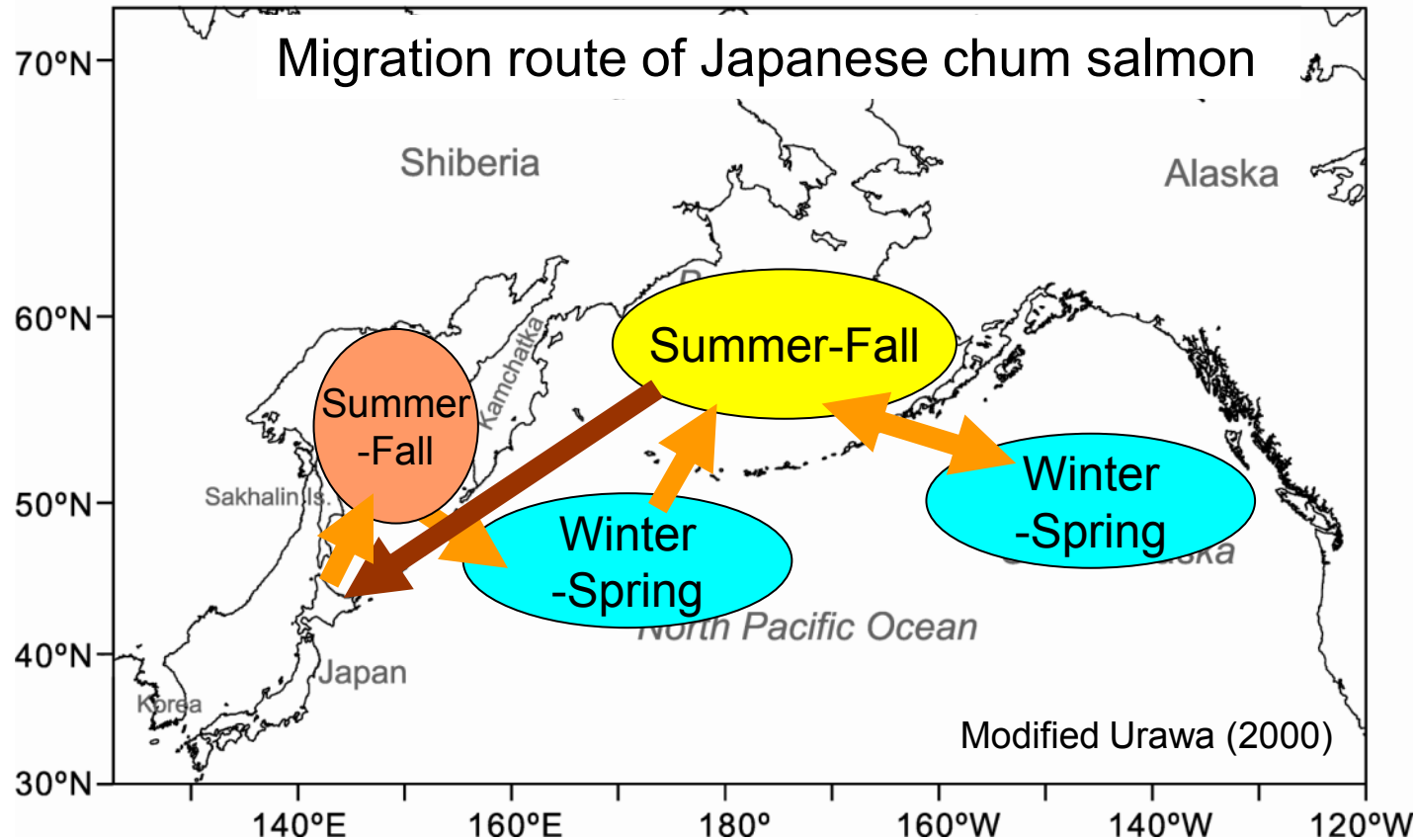
2. Materials and Methods

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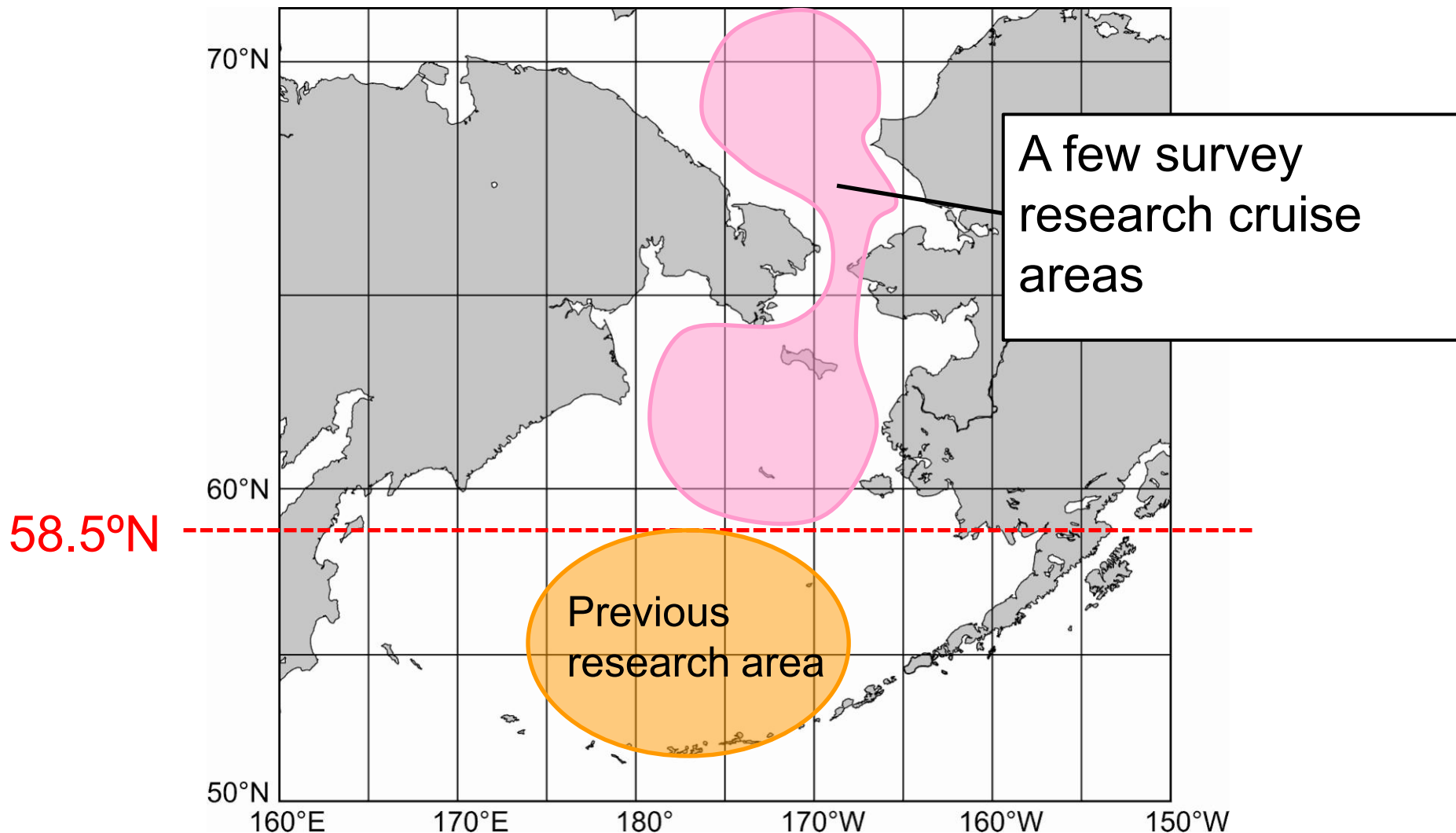
Background

- Chum salmon populations: widely distribution from Asia to North America
- Co-migrate in the North Pacific Ocean and Bering Sea



Summer Bering Sea: a important areas for all chum stocks

Previous ocean researches: survey areas are limited



Distribution and stock-specific composition of chum salmon in the northern areas of Bering Sea and Arctic Ocean are unclear.

Objectives

- Survey of chum salmon distribution from the southern Bering Sea to Arctic Ocean (Chukchi Sea) via the Bering Strait
- Estimation of the stock-specific ocean distribution of chum salmon in the Bering Sea by genetic stock identification (GSI) using single nucleotide polymorphisms (SNPs)

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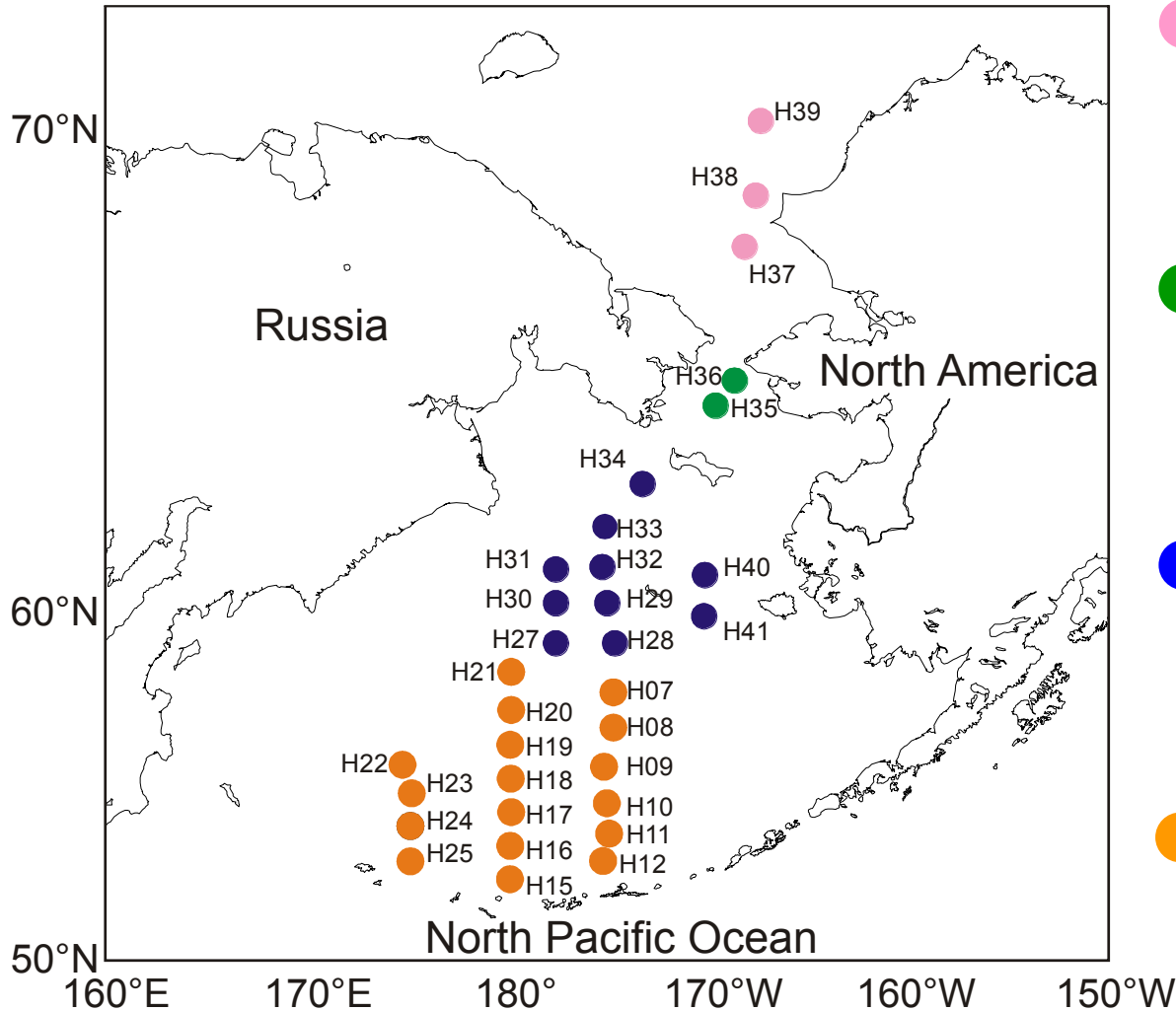
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Sampling locations of R/V *Hokko maru* during summer of 2009 (Jul.15-24/Jul.30-Aug. 9)



- Chukchi Sea
 - 3 stations
 - 67°53'N-70°05'N, 167°49'W-167°23'W
- Bering Strait
 - 2 stations
 - 64°48'N-65°14'N, 169°36'W-168°40'W
- Northern Bering Sea
 - 10 stations
 - 59°01'N-63°00'N, 177°28'E-170°05'W
- Central, southern, western Bering Sea
 - 17 stations
 - 52°30'N-58°23'N, 174°49'E-174°55'W

Materials and Methods

1. Sampling gears

- Two size trawl net were used.
- Mid-water trawl net : small size and used in 59°N-70°N areas
- Surface trawl net: large size and used in 52.5°N-58.5°N areas
- Catch number: surface trawl was approximately three times bigger than mid-water trawl

2. Sample collection and DNA extraction

- 2,256 adipose fin samples were collected
- DNA was extracted by Purgene DNA extraction kit (QIAGEN)

3. Genotyping assays

- Using 32 SNP markers
- TaqMan chemistry
- Genotyping data were pooled from 2 or 3 stations

Materials and Methods

4. Genetic stock identification analysis

- **SNP baseline dataset:** About 12,000 individuals from 146 populations around the Pacific Rim
(114 population data from Seeb et al. (2011) and added 32 Japanese population data)
- **GSI resolution:** More than 96% accurate
- **Estimation methods:** Bayesian procedure
 - *Estimation results by Bayesian procedure were similar to that by conditional maximum likelihood.

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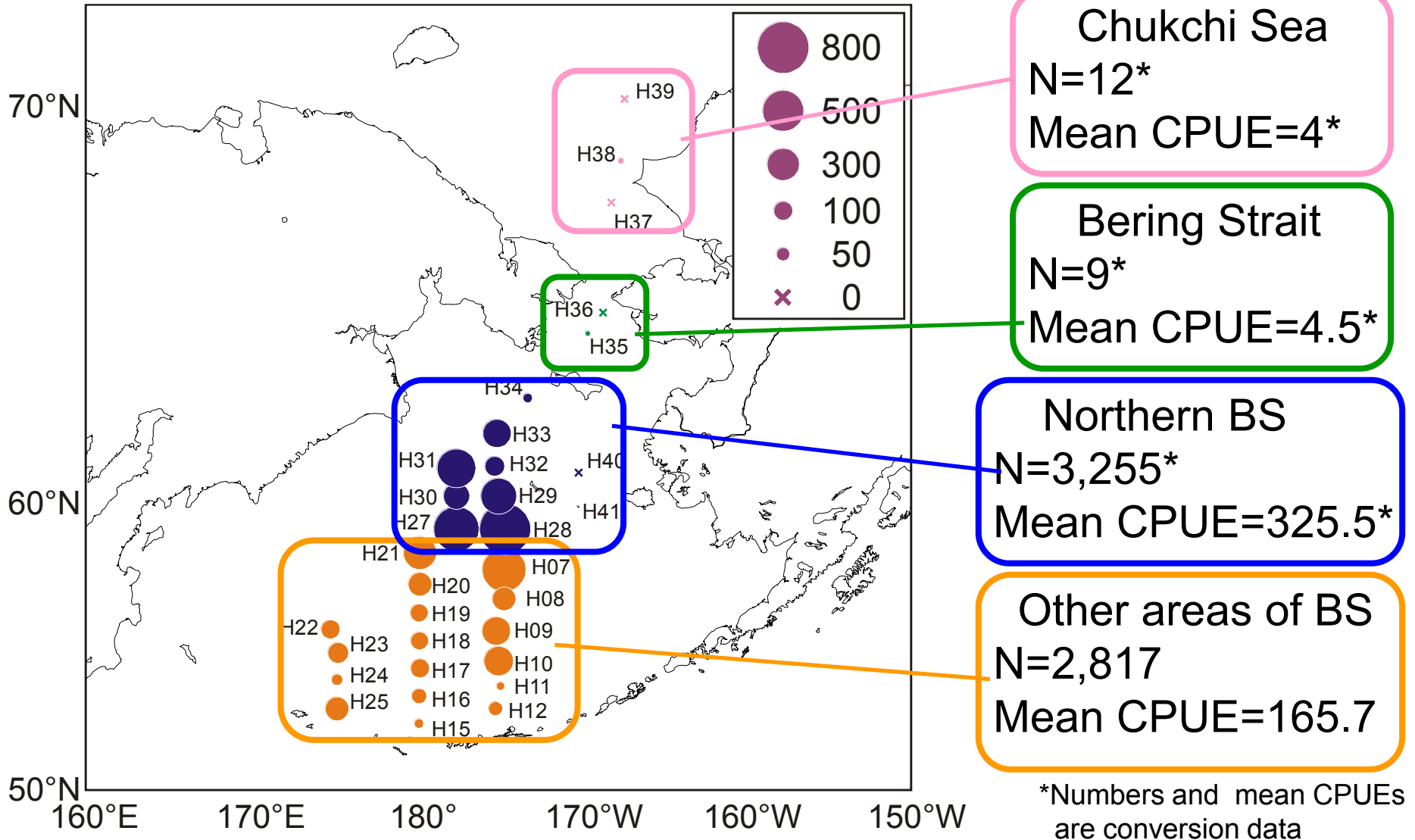
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CPUE distribution of chum salmon in the survey areas during summer of 2009



CPUE: central and northern BS are higher than other areas¹²

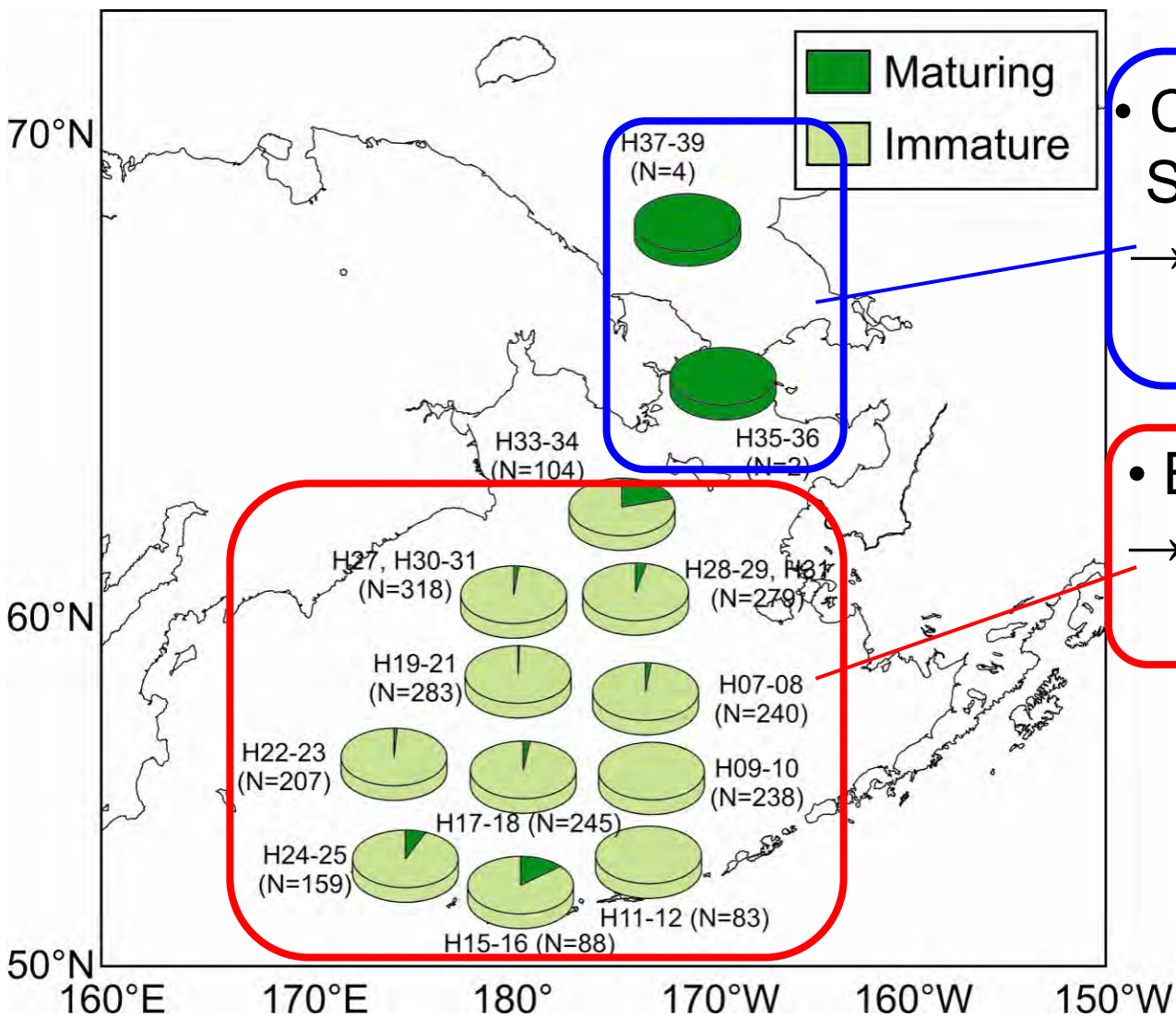
Four chum salmon caught in the Chukchi Sea (68° 46' N, 167° 49' W)



(Photo by K. Morita)

Mean FL : 641 ± 66 mm Mean BW: 3.97 ± 1.33 kg
All fish were maturing male

Percent of maturing and immature fish of chum salmon in the survey areas during summer of 2009

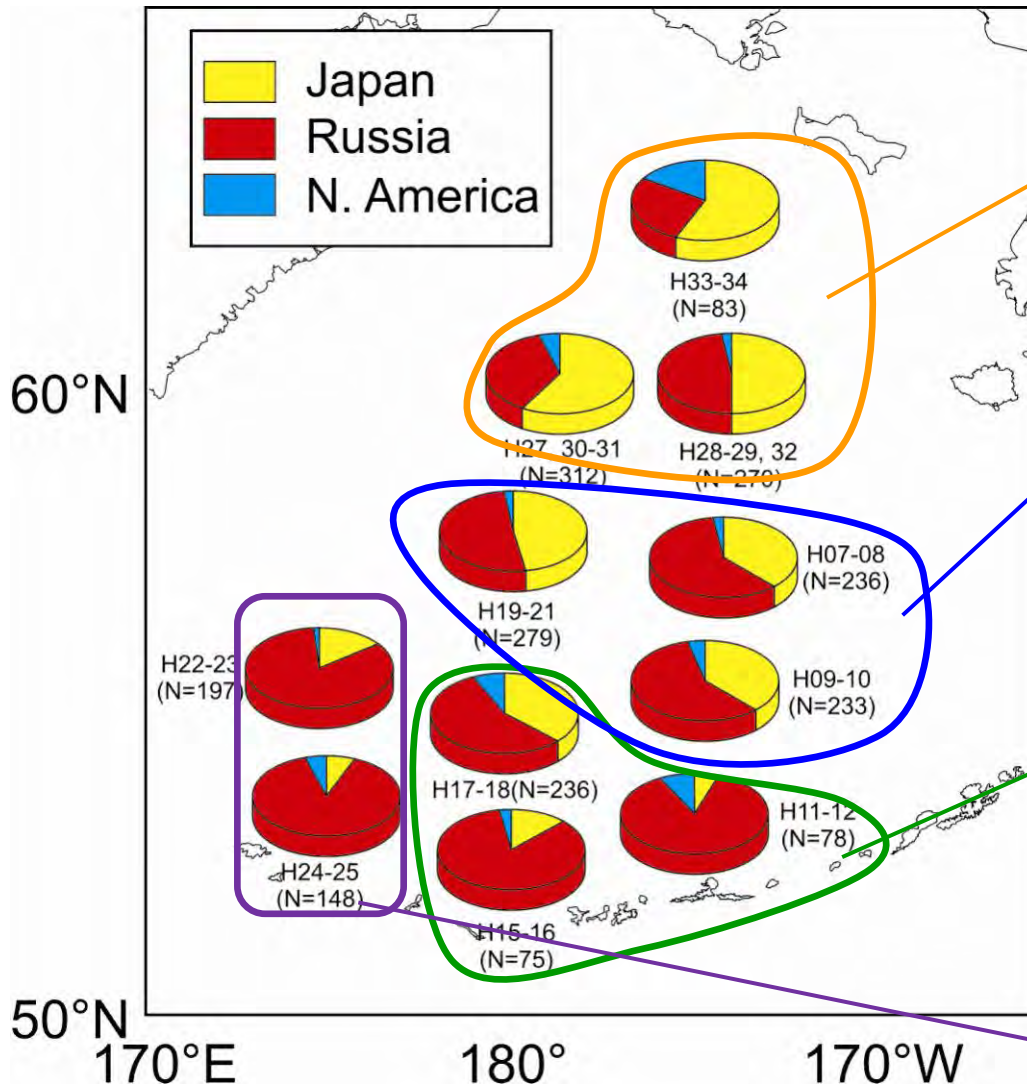


• Chukchi Sea/Bering Strait
→ All fish were maturing fish

• Bering Sea
→ Most fish (96%) were immature fish

Maturing fish were excluded from GSI estimation

GSI-estimated stock composition of immature chum salmon in the Bering Sea during summer of 2009



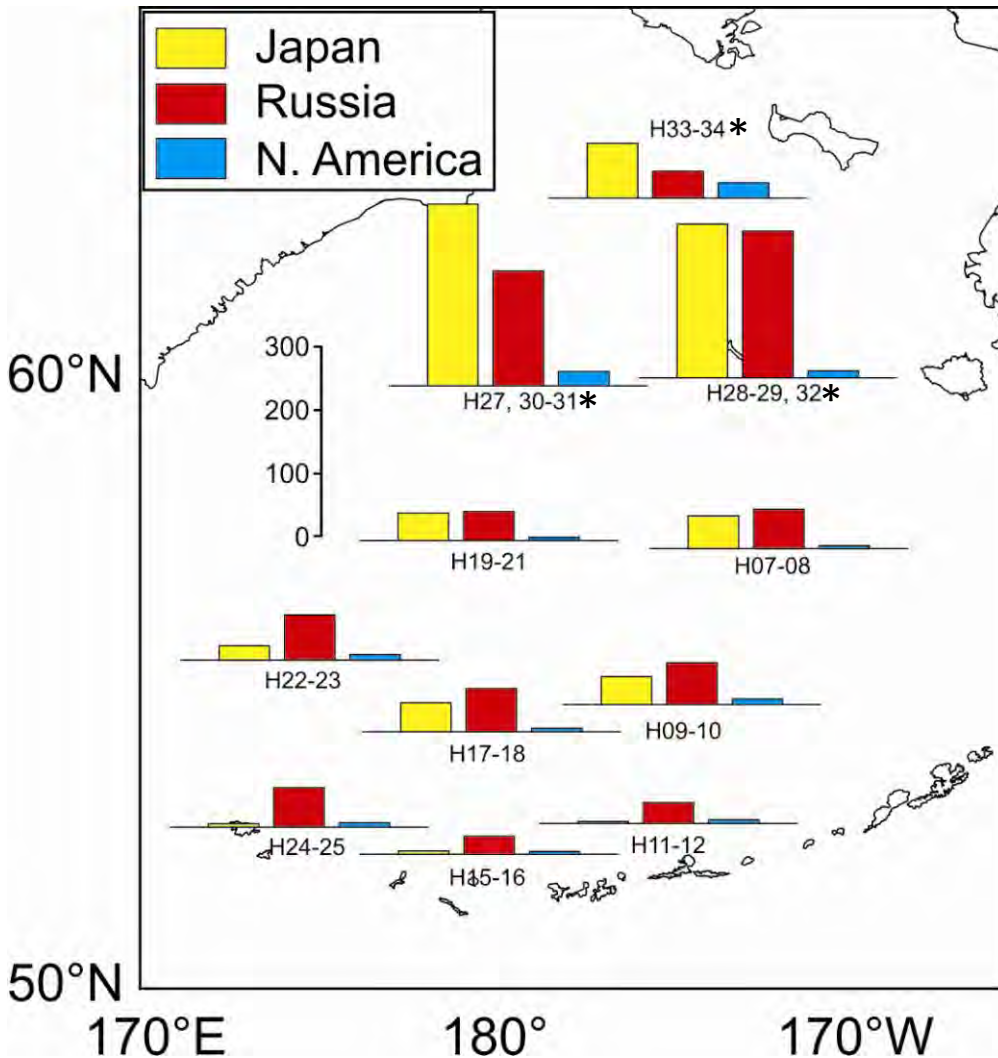
- Northern BS (59°N-63°N)
 - Japan: 49.2 - 58.4%
 - Russia: 27.6 - 47.0%
 - N. America: 2.2 - 15.8%

- Central BS (56°N-58°N)
 - Japan: 37.9 - 47.1%
 - Russia: 50.5 - 59.7%
 - N. America: 2.0 - 3.8%

- Southern BS (52°N-55°N)
 - Japan: 5.3 - 37.1%
 - Russia: 55.8 - 86.9%
 - N. America: 2.6 - 7.7%

- Western BS (53°N-56°N, 175°E)
 - Japan: 6.3 - 14.7%
 - Russia: 84.0 - 88.9%
 - N. America: 1.3 - 4.7%

Estimation of stock-specific CPUE of immature chum salmon in the Bering Sea during summer of 2009



Abundance

- Japanese stocks:
Increased gradually from southern to northern areas
- Russian stocks:
High abundance in northern BS and predominant in the southern and western BS
- N. American stocks:
Less abundant than Asian stocks in the survey areas

*Used CPUE were conversion data

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Summary

1. CPUE distribution

- Widely distributed in the southern BS to Chukchi Sea
- Mainly distributed in central and northern BS

2. Maturity

- Bering Strait/Arctic Ocean: all fish were maturing
- Bering Sea: most fish (96%) were immature fish

3. GSI estimation

- Northern BS: Japan > Russia >> N. America
- Central BS: Russia > Japan >> N. America
- Southern and western BS: Russia >> Japan >> N. America

4. Stock-specific CPUE

- Japan: increased gradually from southern to northern BS
- Russia: high in northern BS and predominant in the southern and western BS
- N. America: less abundant than Asian stocks

Summary

- Stock distribution pattern and abundance:
Difference among stocks between the southern and northern Bering Sea
- Japanese stocks utilized wide range of the Bering Sea, including northern waters, as summer feeding ground.