

Stock identification and abundance of immature chum salmon in the summer Bering Sea during five survey years using SNP markers

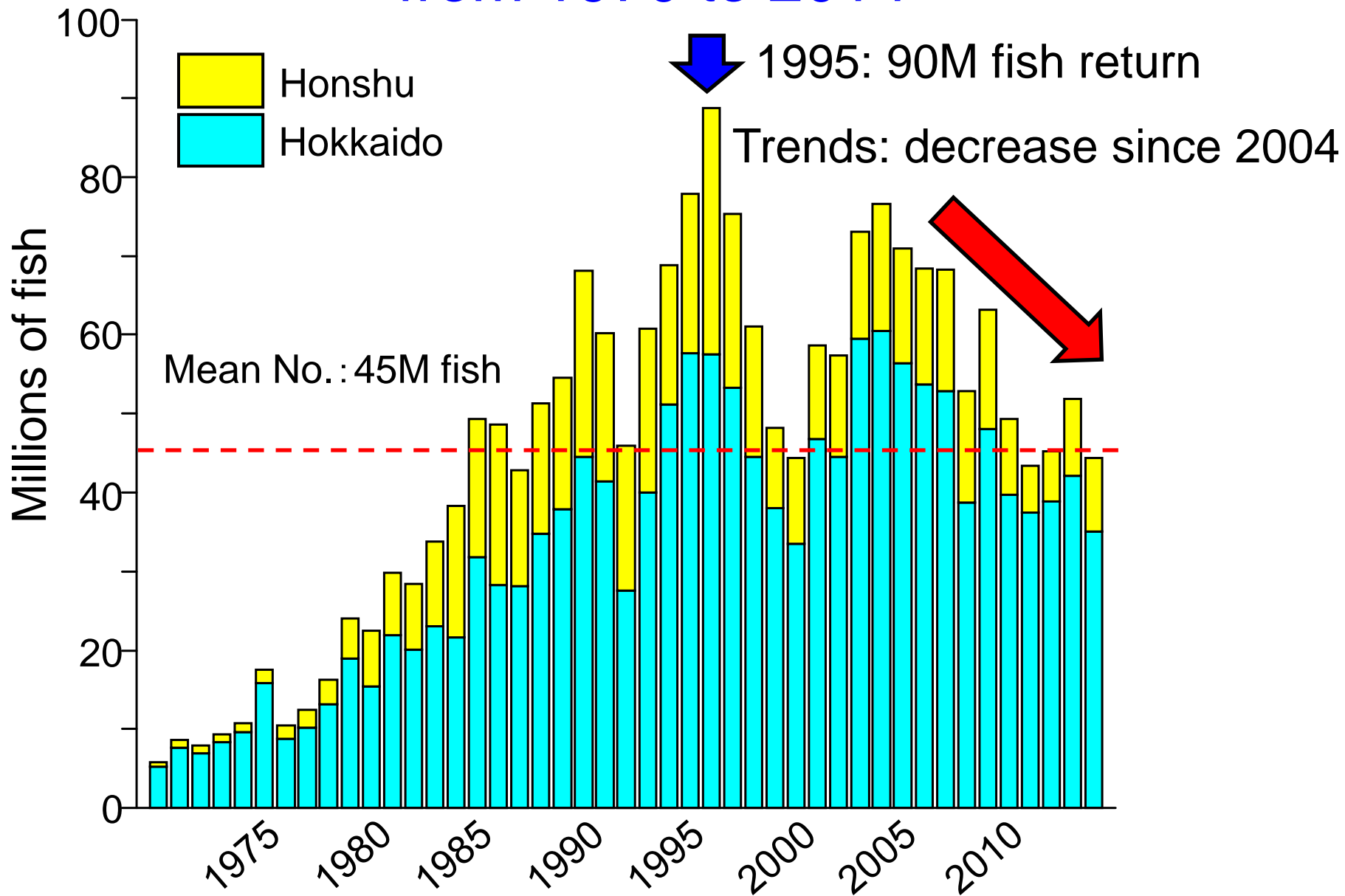


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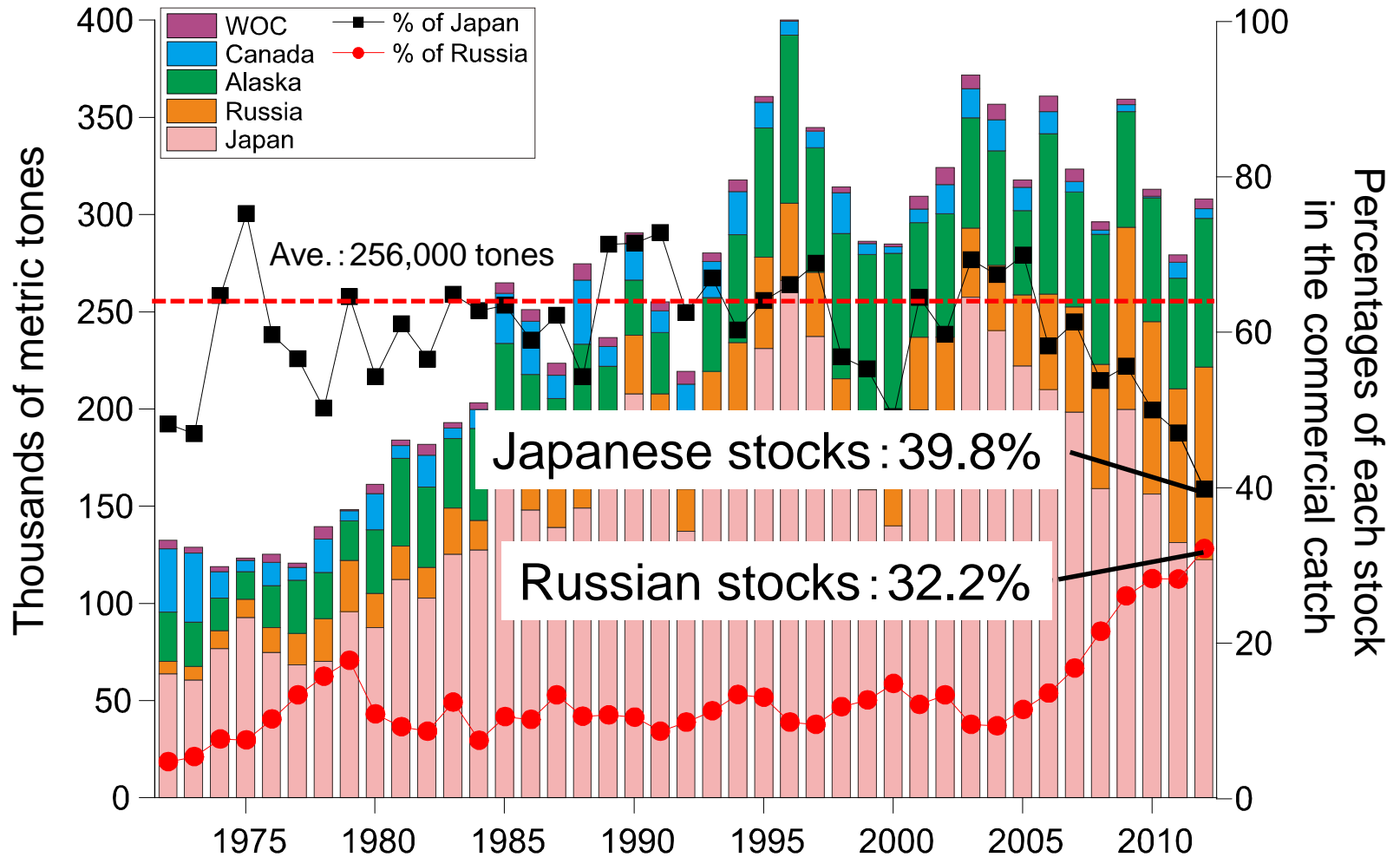
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Commercial catch of Japanese chum salmon from 1970 to 2014



Commercial catch of chum salmon in the North Pacific from 1972 to 2012

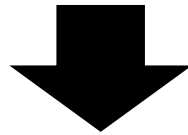


Trends:

- Russian stocks: 10% in early-2000s and increase since 2004
- Japanese stocks: 50-70% in early-2000s and reduce since 2004

Why reduce the return numbers of Japanese chum salmon?

- Several possible reasons:
 - Low survival rate in ocean
 - Competition among other stocks in ocean
 - Affect by climate change etc...

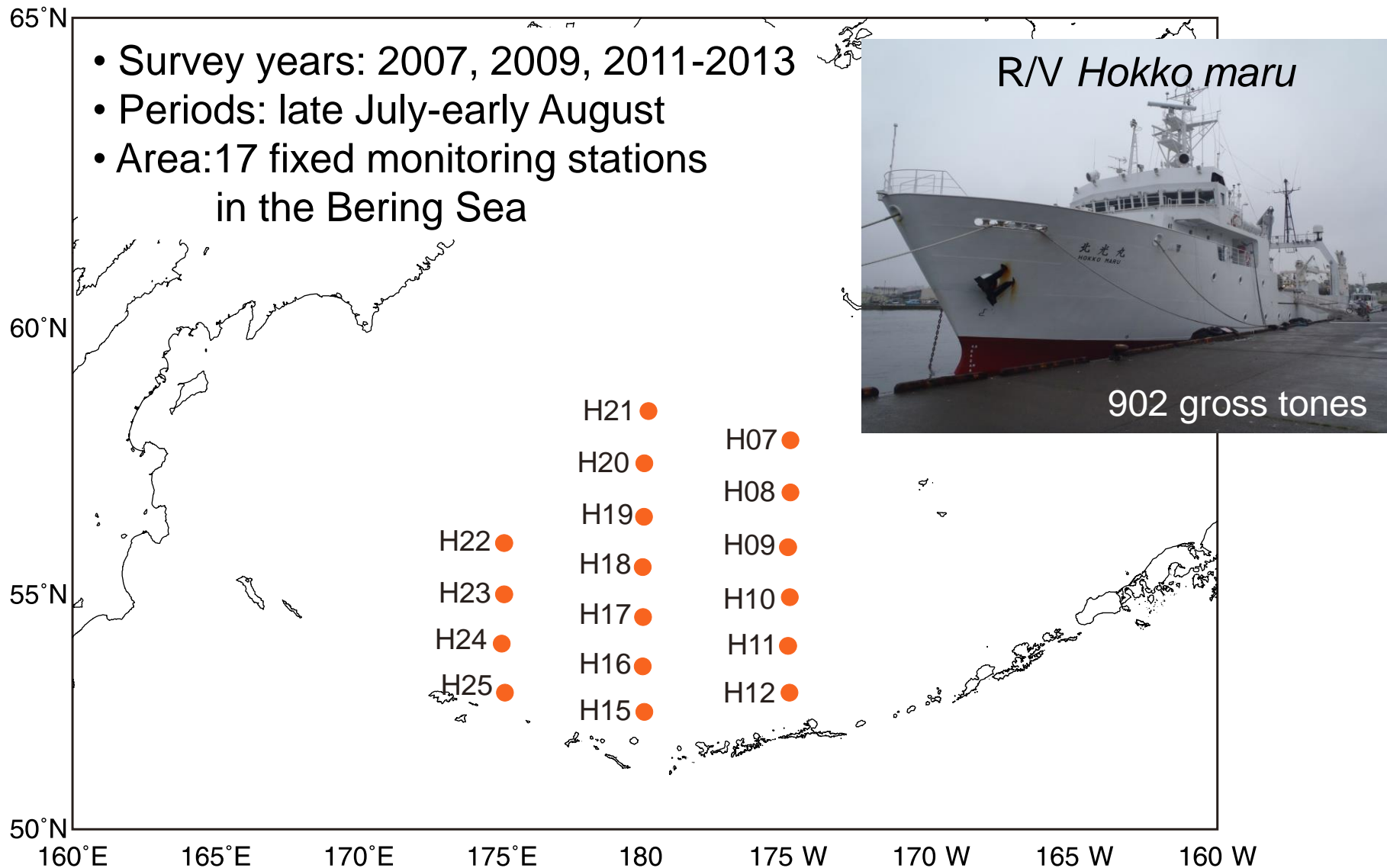


- These reasons may influence to ocean life stage of Japanese stocks
- Biological data in the ocean life stage
 - Provide important information to clarify factors of abundance fluctuation and to management of chum salmon

Objectives

Estimation of the stock-specific ocean distribution and abundance of chum salmon in the summer Bering Sea during five survey years

Sampling locations of R/V *Hokko maru* during summer of 2007, 2009, and 2011-2013



Materials and Methods

1. Sampling gear

- Surface trawl net
- A speed of approximately 5 knots at the surface layer (0-30 m depth) for one hour during daytime

2. Sample collection and DNA extraction

- Total of 14,608 adipose fin samples were collected
- DNA extraction: Purgene DNA extraction kit (QIAGEN)

<Surface trawl>



<Cod-end>



<Collected adipose fin>



Materials and Methods

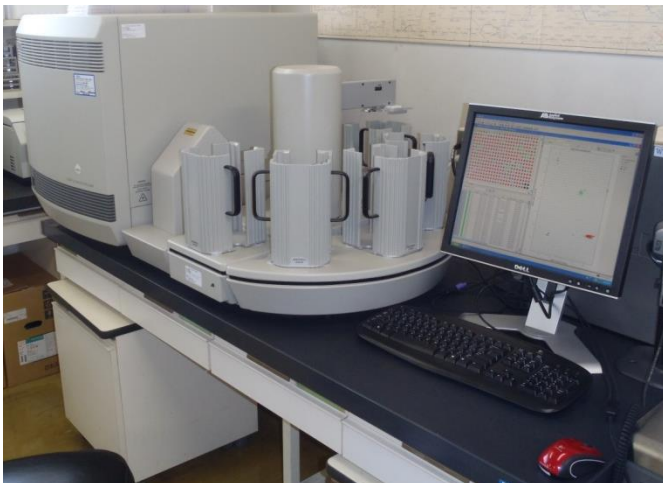
3. Genotyping assays

- Using 42 SNP markers (TaqMan chemistry)
- Genotyping data were pooled from 2 or 3 stations

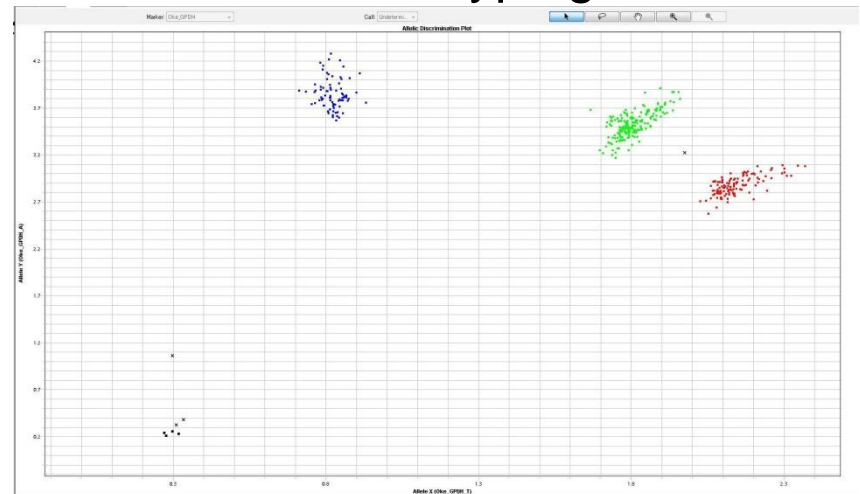
4. Genetic stock identification analysis

- SNP baseline: About 15,000 individuals from 158 populations around the Pacific Rim (data from Seeb et al. (2011) and Sato et al.2014)
- Estimation methods: Conditional maximum likelihood

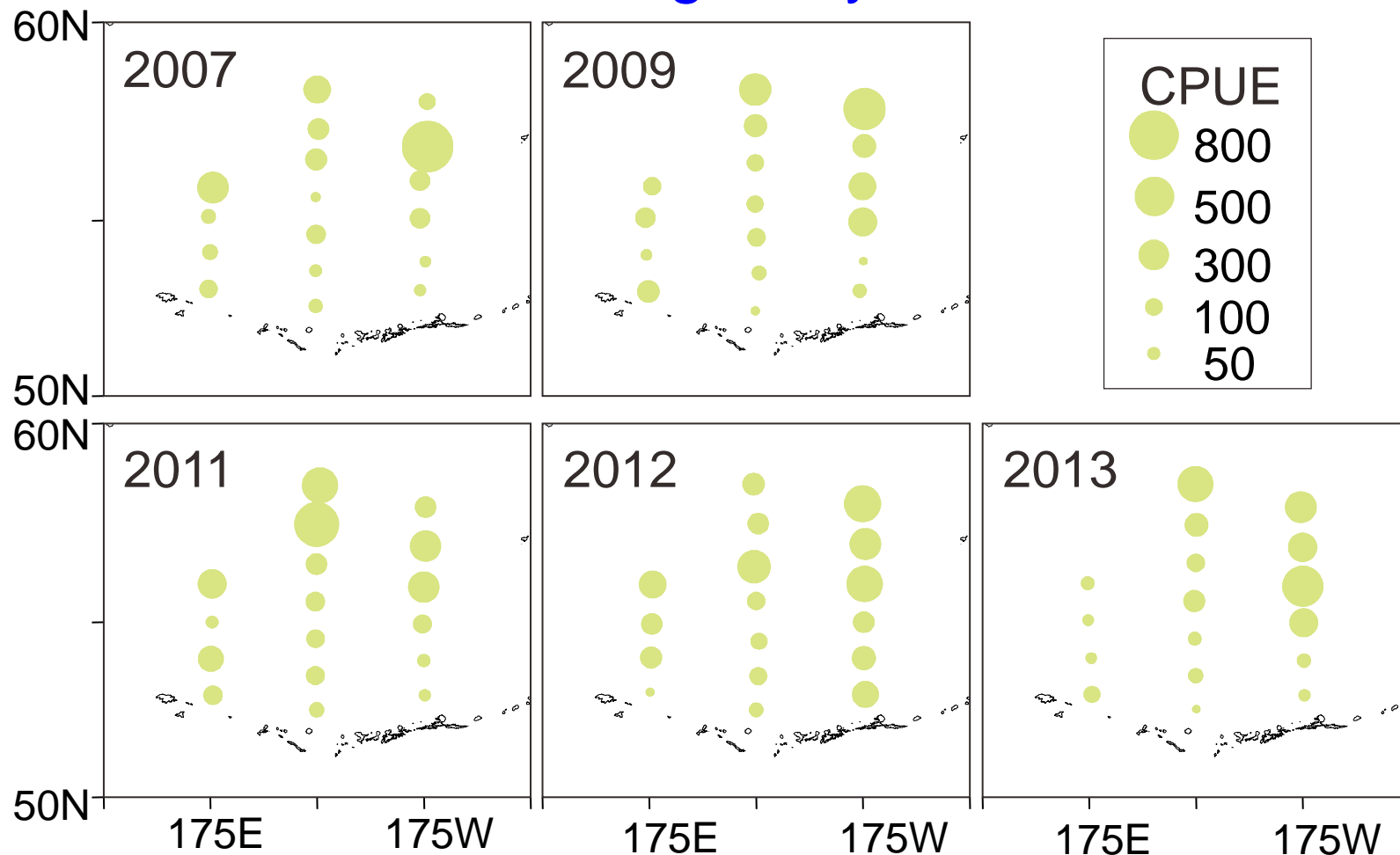
<AB 7900HT real-time PCR>



<Genotyping>

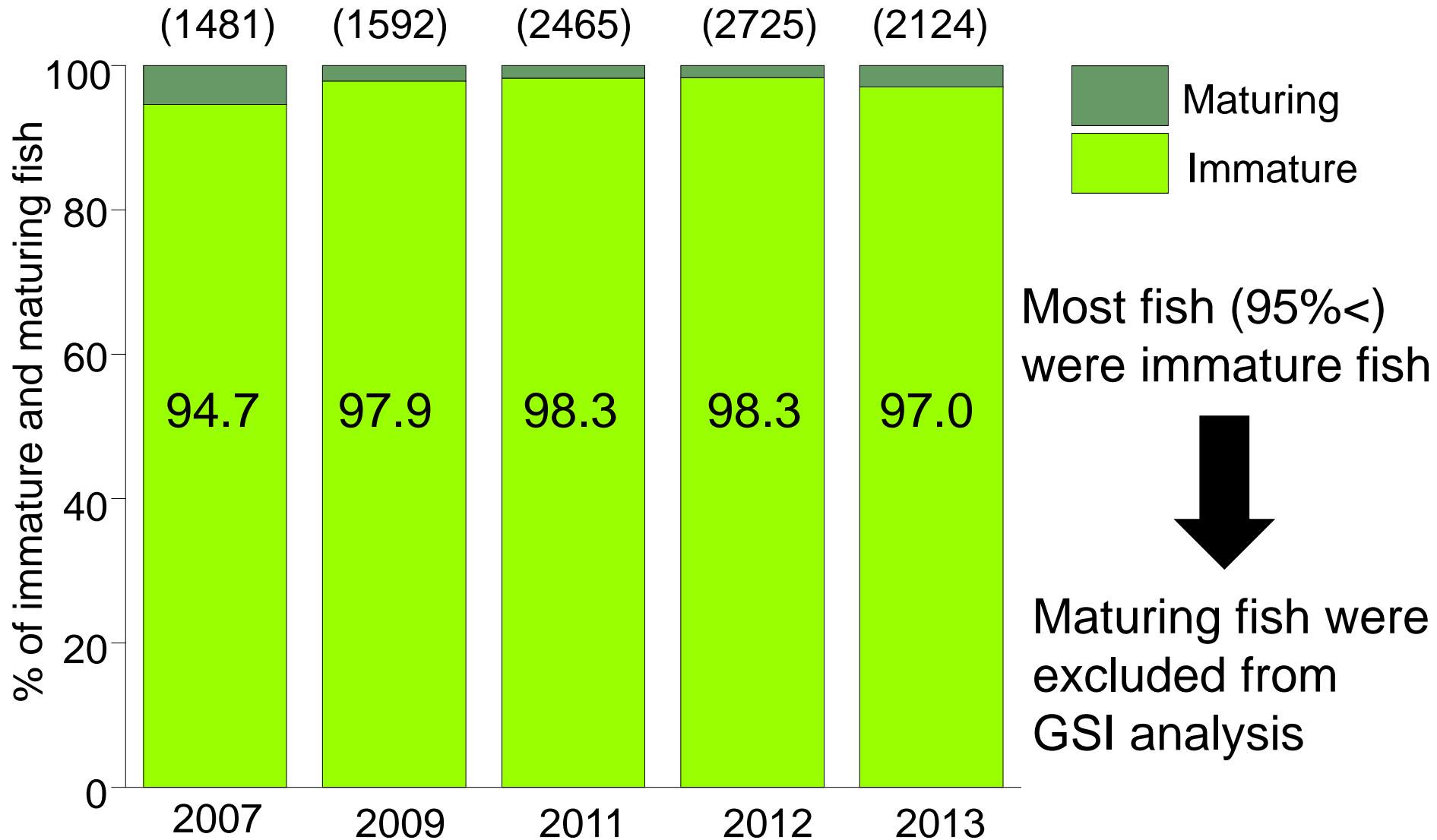


CPUE distribution of chum salmon in the survey areas during five years



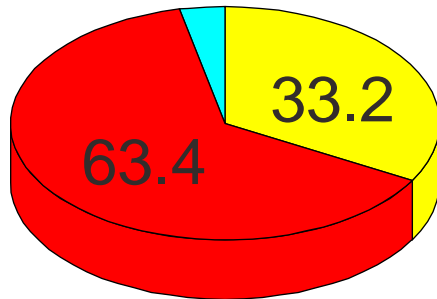
- Collected from all stations every year
 - widely distribution in the summer Bering Sea
- Main distribution areas: Northern areas on 180° and 175°W lines

Percent of immature and maturing fish of chum salmon in the summer Bering Sea during five survey years

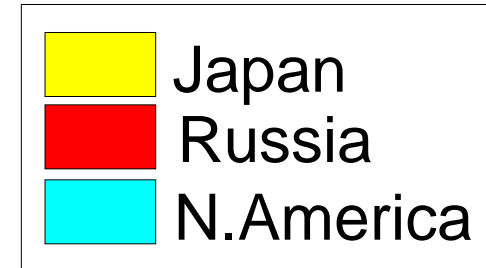
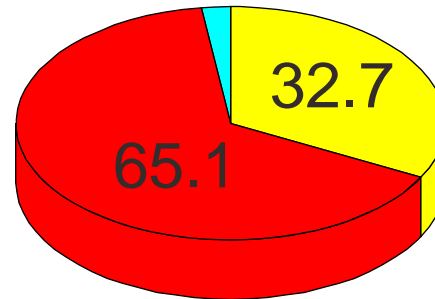


GSI-estimated composition of immature chum salmon in the Bering Sea during five survey years

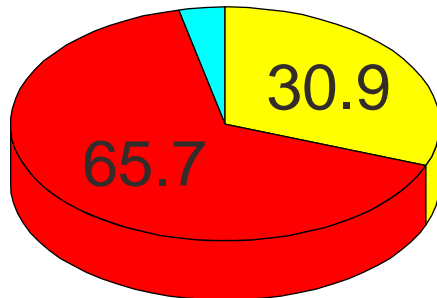
2007
(N=1366)



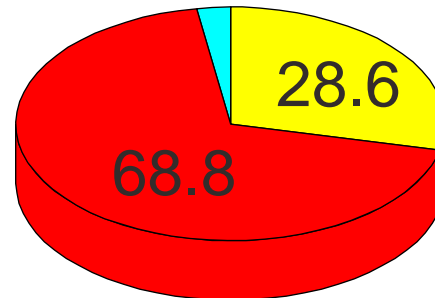
2009
(N=1460)



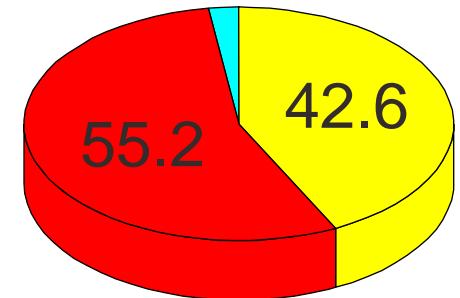
2011
(N=2419)



2012
(N=2654)

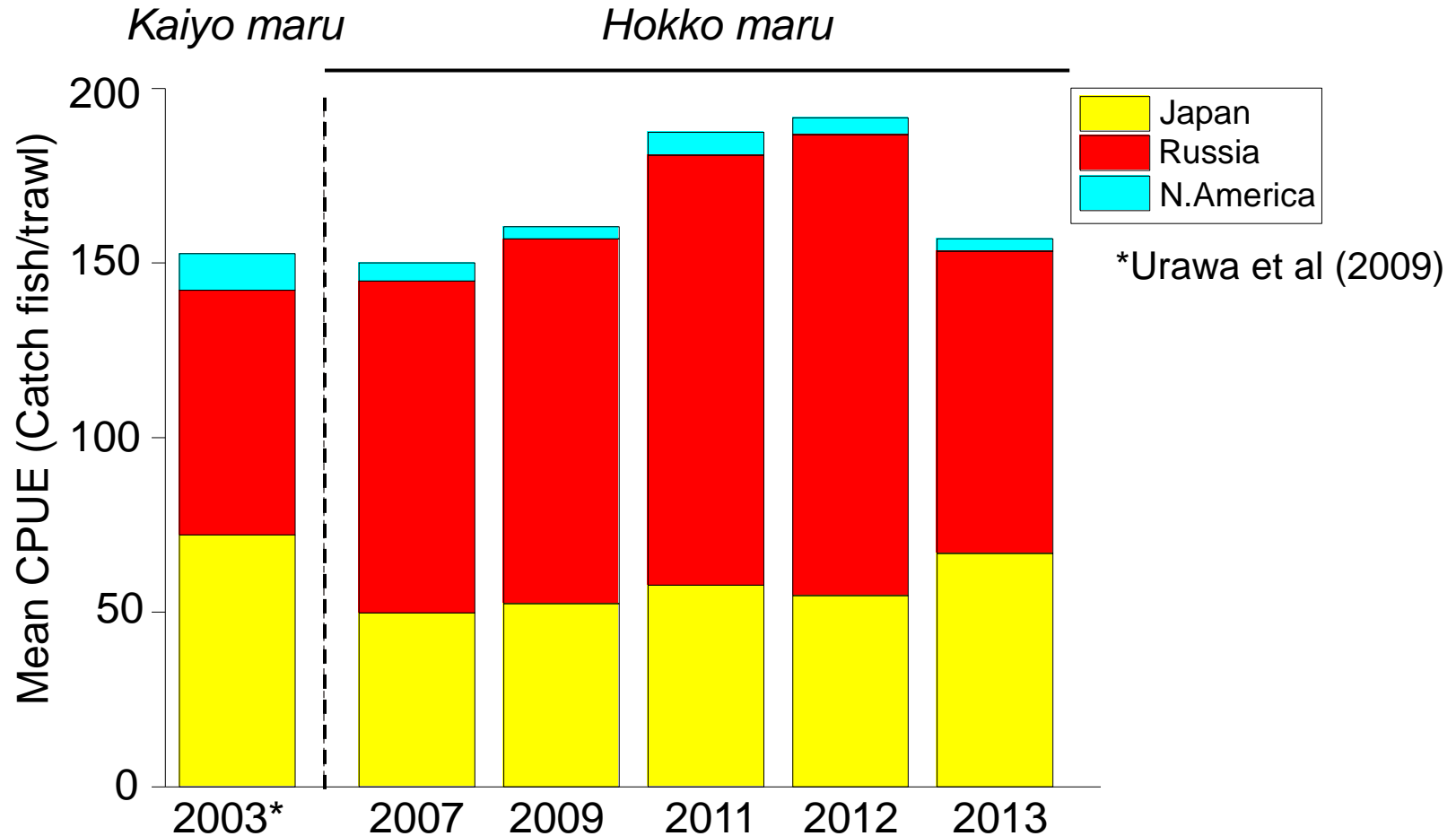


2013
(N=2028)



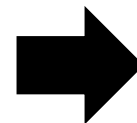
- In 2007-2012: Russian chum salmon was highest (63.4-68.8%)
- In 2013: Proportion of Japanese chum salmon increased

Estimation of stock-specific CPUE of immature chum salmon in the Bering Sea during five survey years





Trend of stock abundance in the summer BS

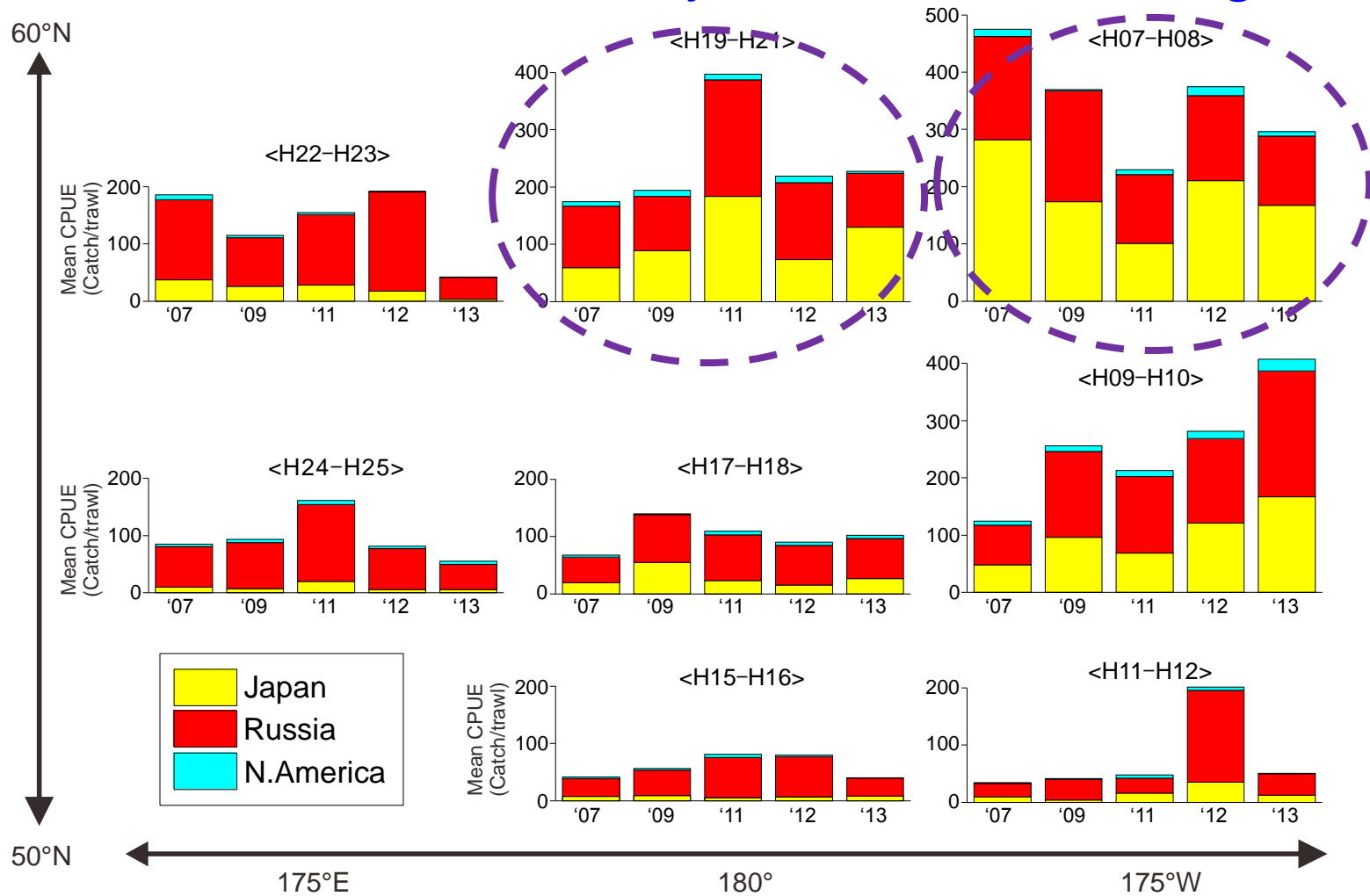
- Present results : Japan < Russia
- Past result (2003): Japan = Russia



Recent summer BS

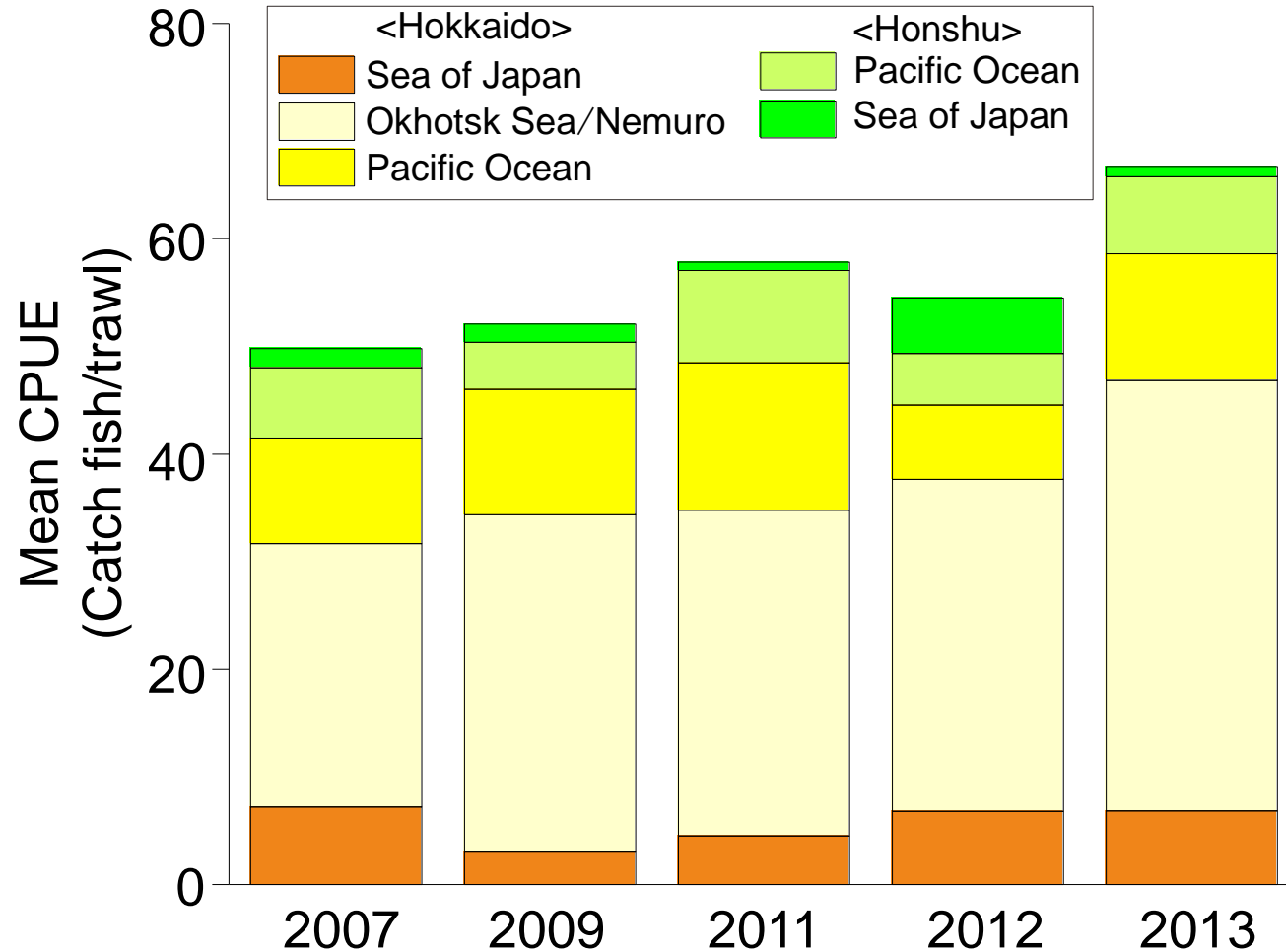
- Japanese stocks 
- Russian stocks 

Stock-specific CPUE distributions of immature chum salmon in each survey area of the Bering Sea



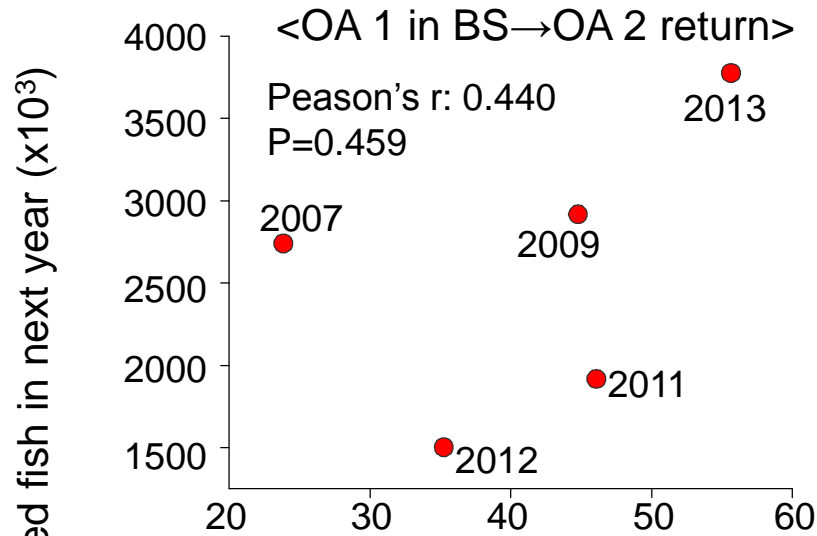
- Russian stocks: Widely distributed in the all survey areas of BS
- Japanese stocks: Predominant in northern areas of the BS on 180° and 175°W line

Estimation of stock-specific CPUE of regional stocks of Japanese chum salmon in the Bering Sea

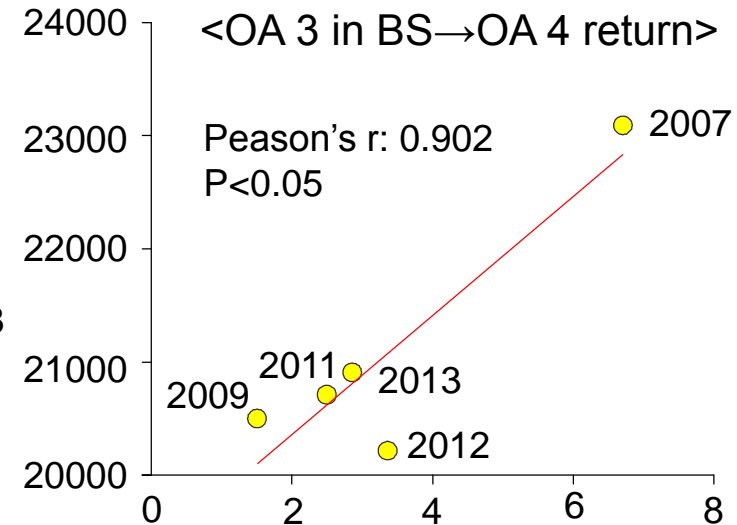
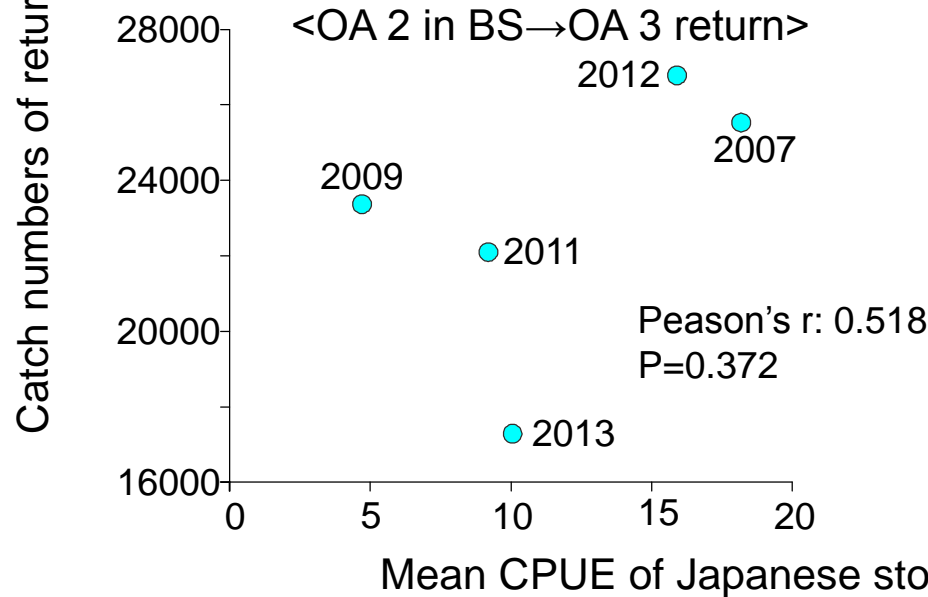


- Abundance of Okhotsk Sea/Nemuro stocks were much dominant in all survey years

Relationships between Japanese stocks abundance in the Bering Sea and return fish numbers in next year



- OA 1 in BS-OA 2 return
- OA 2 in BS-OA 3 return
- No significant correlations
- OA 3 in BS-OA 4 return
- Strong Significant correlation (Peason's r: 0.902, P<0.05)



Summary

1. CPUE distribution

- Widely distributed in the survey areas in the Bering Sea
- Main distribution: northern areas of Bering Sea on 180° and 175°W lines

2. GSI estimation

- In 2007-2012: Russian chum was highest
- In 2013: Japanese chum salmon was increased

3. Stock-specific CPUE

- Trend of stock abundance
 - Russian stocks > Japanese stocks
 - Present results different from recent result (e.g. 2003 result)

Summary

3. Stock-specific CPUE (Continued)

- Distribution patterns
 - Russian stocks: Widely distribution in the Bering Sea
 - Japanese stocks: Predominant in northern areas
- Abundance in five Japanese stocks
 - Okhotsk Sea/Nemuro stocks were much dominant

4. Relationships between Japanese stocks abundance in the Bering Sea and adult returns

- Significant relationships between OA3 in BS and OA 4 return
- No significant correlations between OA1/2 in BS and OA2/3 return

Summary

- Stock distribution patterns in the summer Bering Sea are different between Japanese and Russian chum salmon.
- Recent stock abundance of Japanese and Russian chum salmon in the summer Bering Sea may reflect the regional abundance levels in each regions.
- It is difficult to accurate forecast for return numbers of ocean age 2 and 3 of Japanese chum salmon using CPUE data of Japanese stocks in the summer Bering Sea.

Acknowledgements

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