



Lipid Content of Immature Chum Salmon in the North Pacific Ocean and the Bering Sea

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Introduction

Ocean Climate Index.
Aleutian Low Pressure Index, North Pacific Index, etc.

Zooplankton biomass

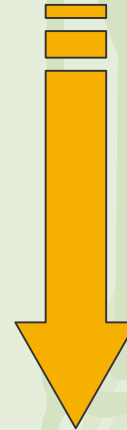
Sugimoto et al. 1997, etc.

Salmon's Trophic status

Lipid Content

Pacific salmon abundance

Beamish et al. 1999, etc.



Materials and Methods



**Immature
Chum salmon**

Lipid Analysis

Kept at -30°C until analysis



**Chemical analysis
according to
the Folch method**

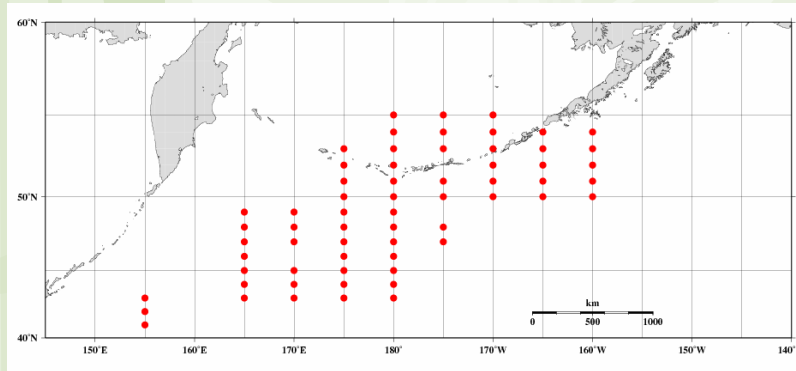
where they were caught in the
spring of 2006
summer of 1998-2007
fall of 2000, 2002-2003
winter of 1998, 2006

Measured on ship

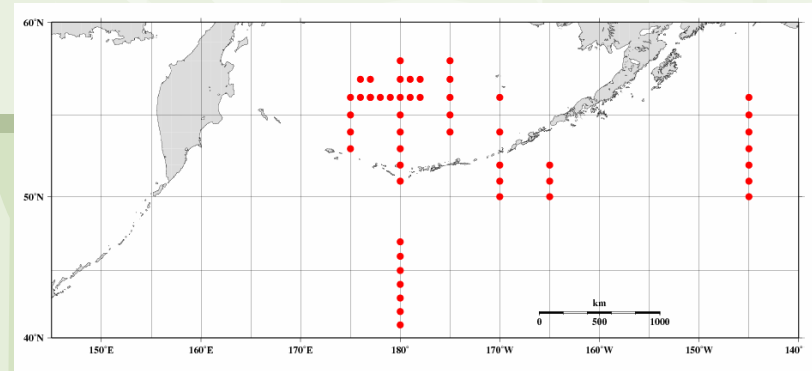


**Quick estimation by
microwave transmission
using fish fat meter**

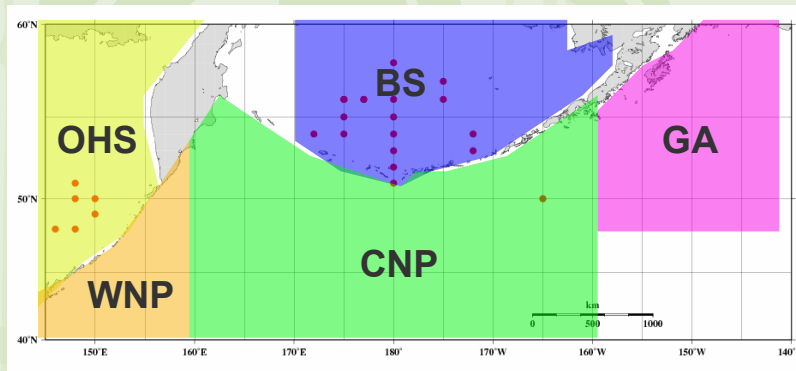
Spring (2006)



Summer(1998-2007)



Fall(2000, 2002-2003)



Winter(1998, 2006)

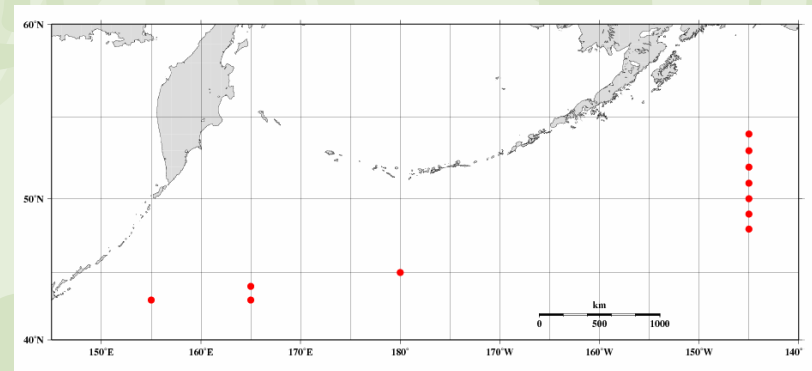


Fig. 1. Location where lipid samples of immature chum salmon were caught in each seasons (year).

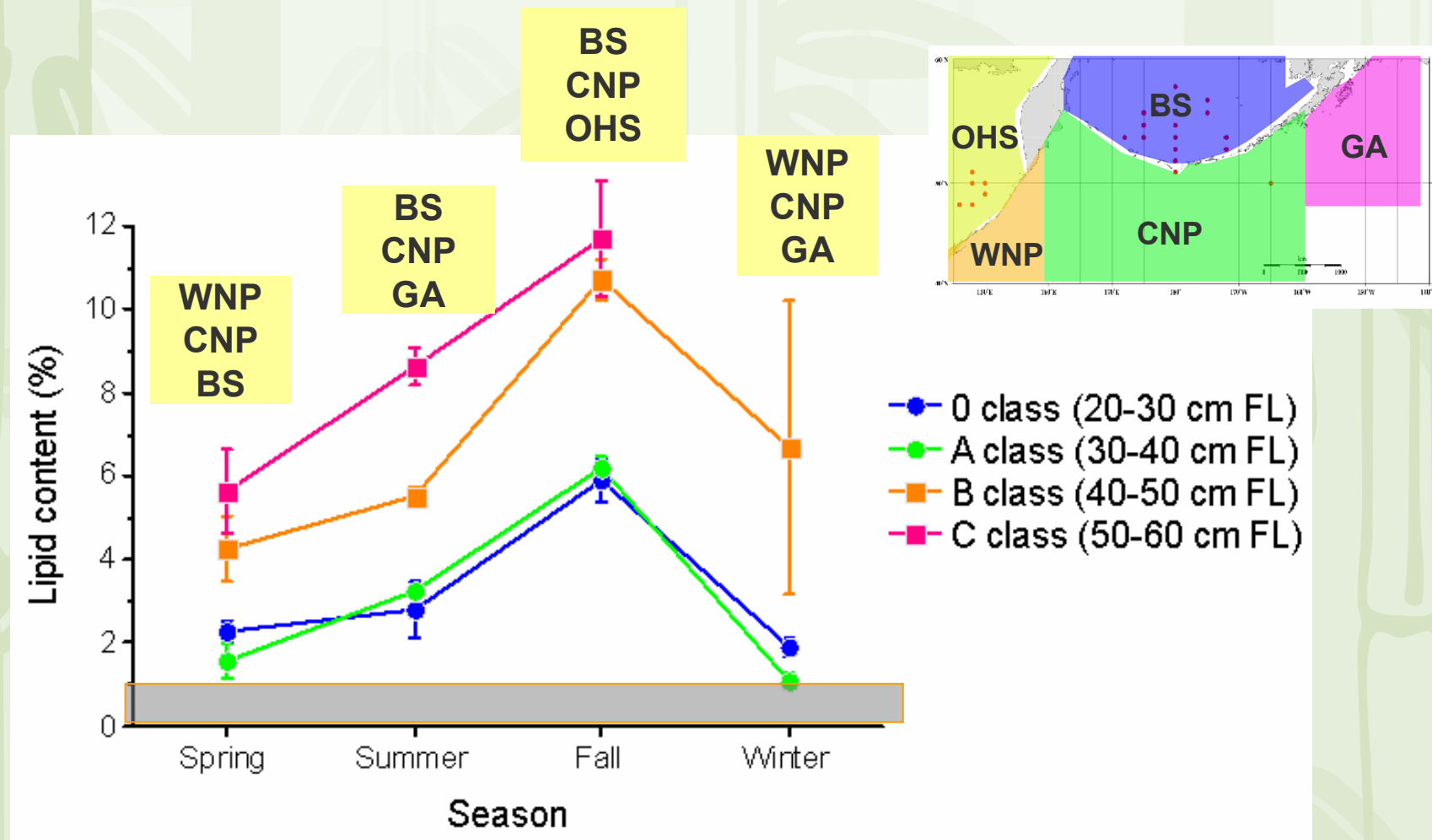
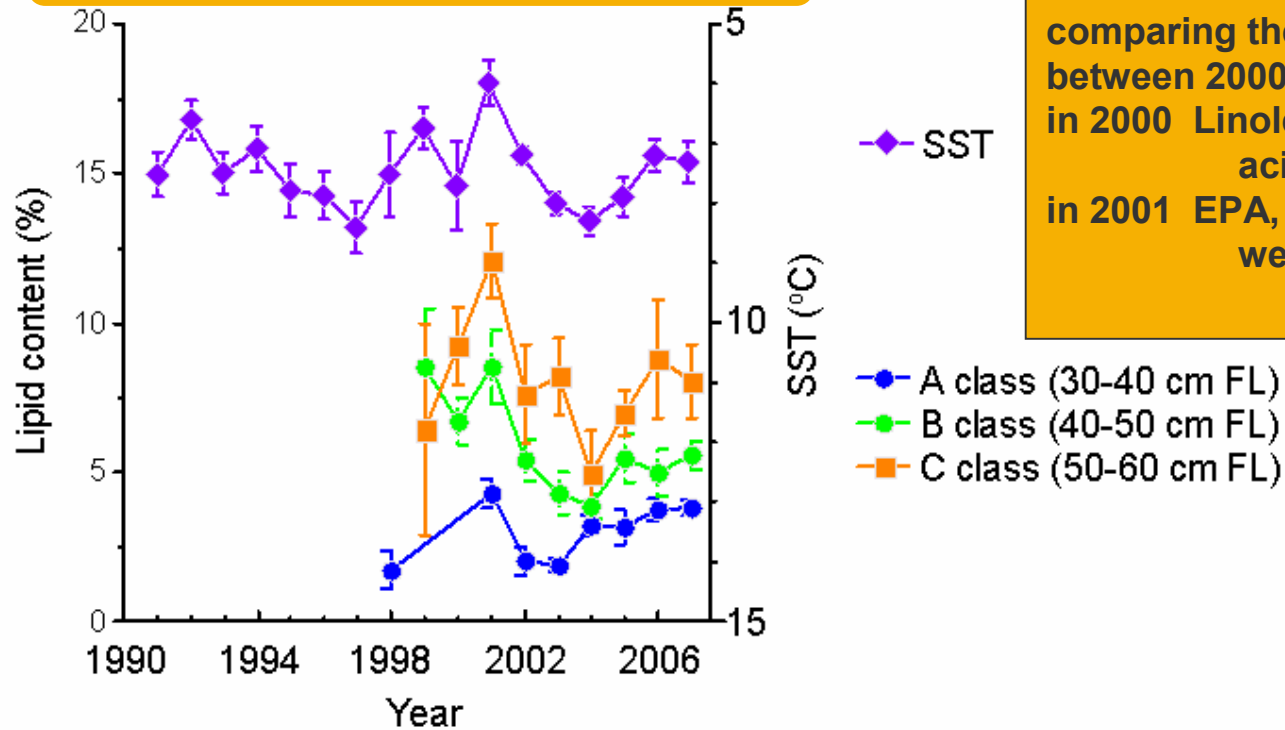


Fig. 2. Seasonal changes of mean lipid content (%) in the white muscle of 0, A, B, and C classes immature chum salmon. The error bars represent the standard error for the means.

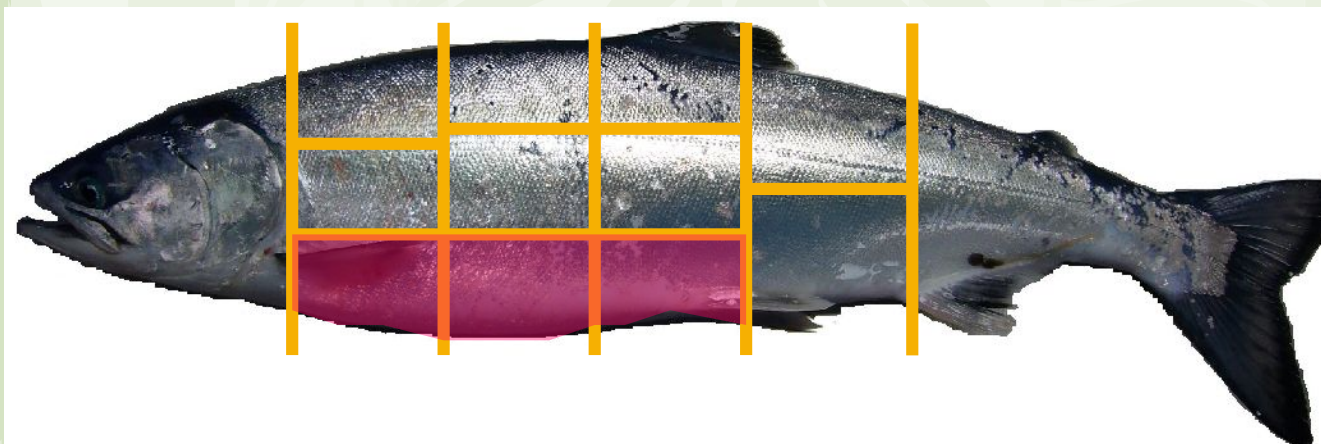
Significant negative correlation was observed between SST and Lipid content



comparing the fatty acids between 2000 and 2001 in 2000 Linoleic, Arachidonic acid were higher in 2001 EPA, Docosen acid were higher

Fig. 3. Annual changes of mean lipid content in the white muscle of immature chum salmon which were caught in the central Bering Sea and mean Surface Sea Temperature during the summer of 1998-2007. Chum Salmons were classified into 3 categories: open circle=A class (FL 30-40 cm), closed circle=B class (FL 40-50 cm), closed square=C class (FL 50-60 cm). The error bars represent the standard error for the means. (1998-2004 data was cited from Nomura et al. 2001, 2005)

Some of the fish which had different size and lipid level were selected...



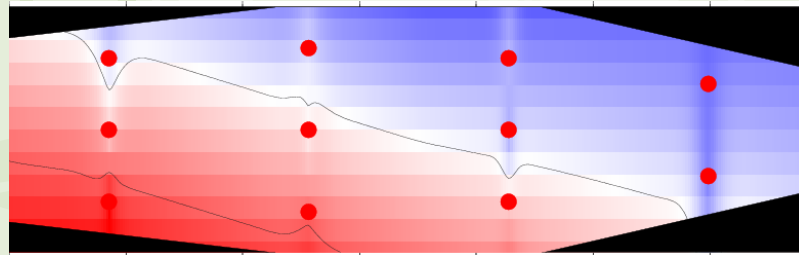
Lipid content of each muscle parts were determined by Folch method.



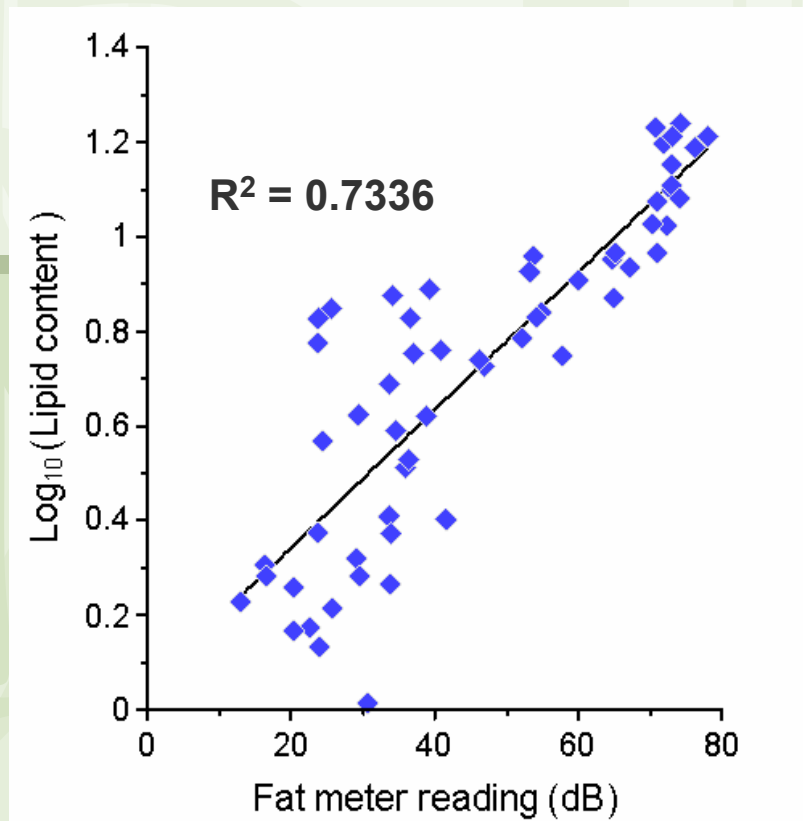
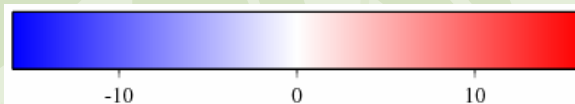
Similarly, each muscle parts except pink shaded parts were measured using fish fat meter.

Horizontal lipid distribution

Head Tail



Difference from the mean value



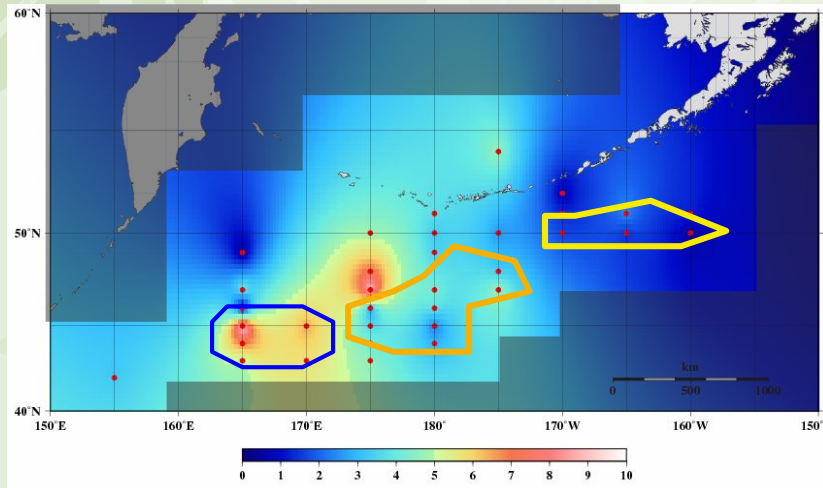
Formulae

$$\text{Log}_{10}(y) = 0.05 + 0.0144 \times x$$

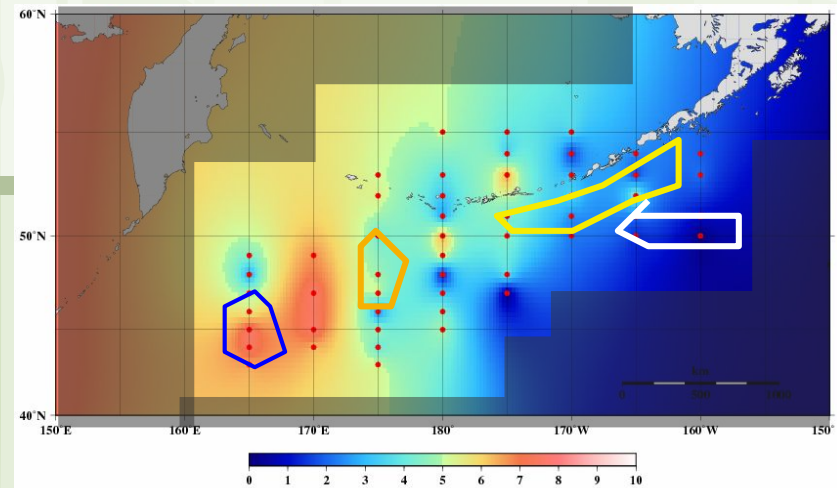
where y: Lipid content (%), x: fat meter reading (dB)

Fig. 4. Horizontal lipid distribution in the chum salmon (Left) and lipid content versus fat meter readings in dB (Right). Lipid distribution means the difference from the mean value.

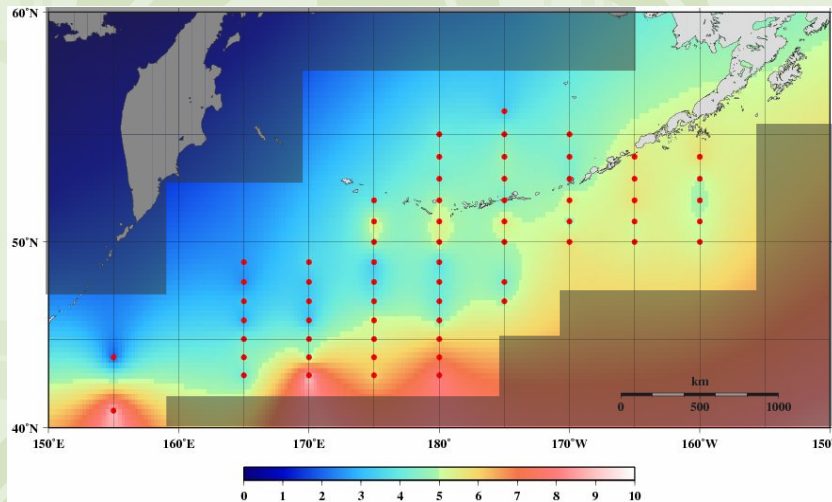
B class (FL 40-50 cm)



C class (FL 50-60 cm)



Sea Surface Temperature



Sea Surface Salinity

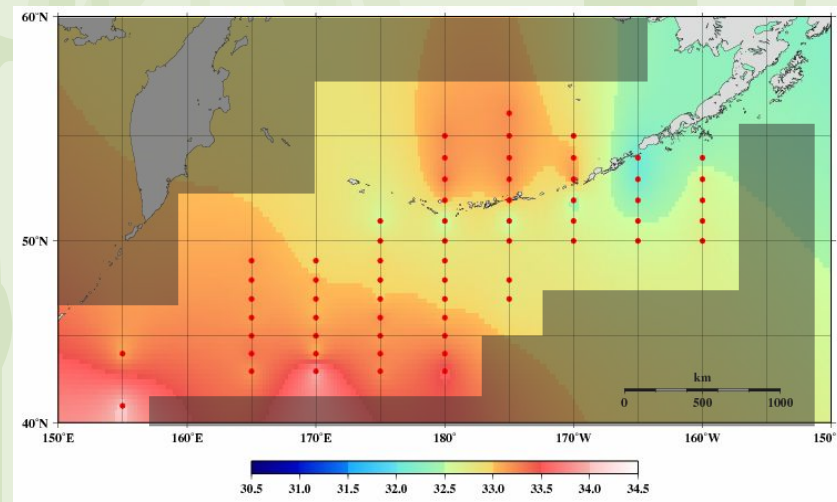
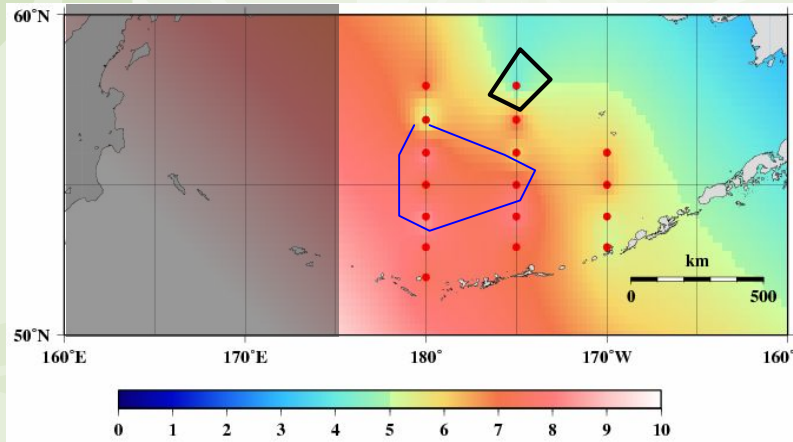
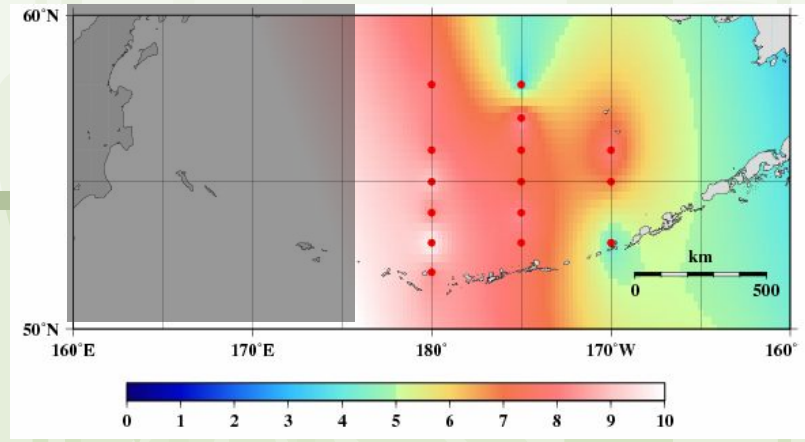


Fig. 5. Distribution of the lipid content (%) of B and C classes immature chum salmon, SST, and SSS in the North Pacific Ocean and the Bering Sea during the spring of 2006.

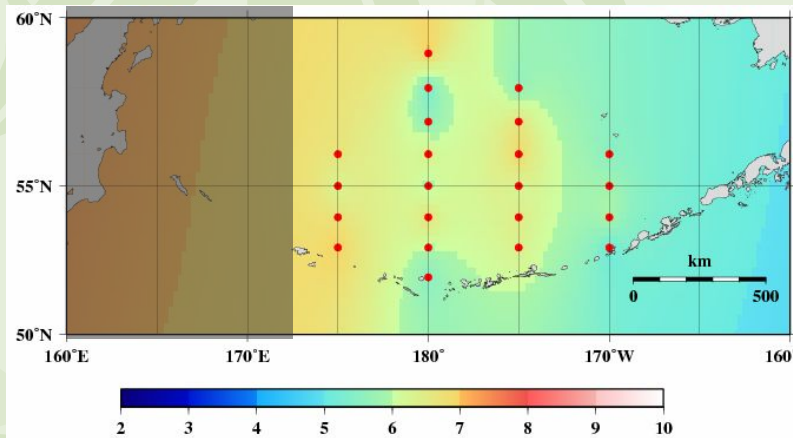
B class (FL 40-50 cm)



C class (FL 50-60 cm)



Sea Surface Temperature



Topography

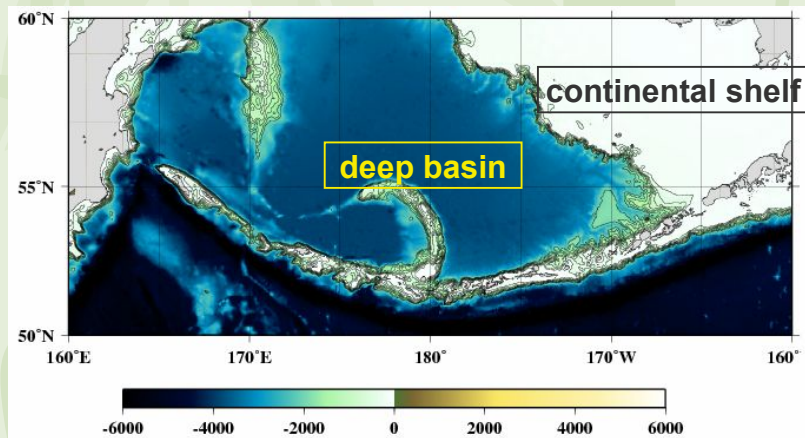


Fig. 6. Distribution of the lipid content of B, and C classes immature chum salmon, SST, and Topography in the Bering Sea during the summer of 2007.

Bering Climate Change

Temperature

Change ?

Biological production
Diet Composition

Key season
for survival

Bering Sea

Okhotsk Sea

Low

High Survival
in winter ?

Low Survival
in winter ?

Temperature
High

Lipid Content in summer



spring winter winter winter

Season

$$\text{Log}_{10}(\text{Lipid}) = 0.05 + 0.0144 \times \text{fm}$$



**This research program was funded
by Japanese Fisheries Agency.**

Thank you for your kind attention !