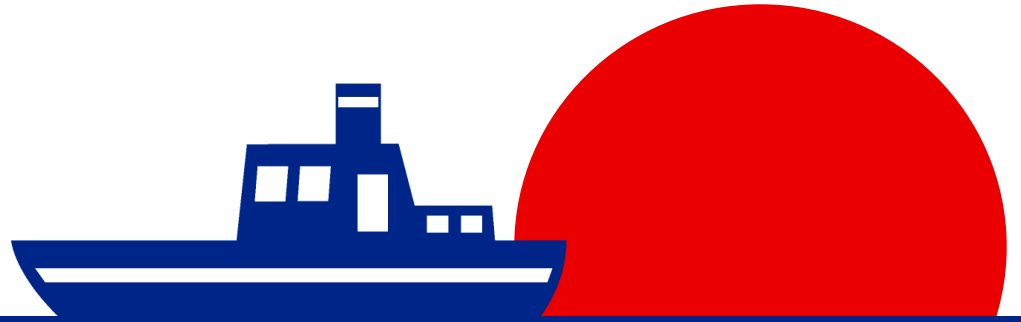
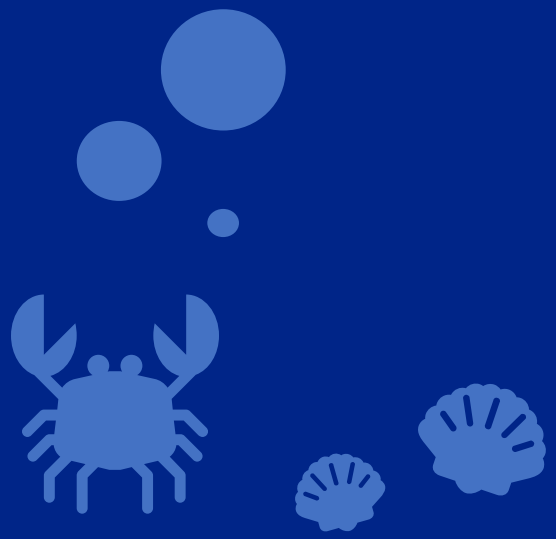
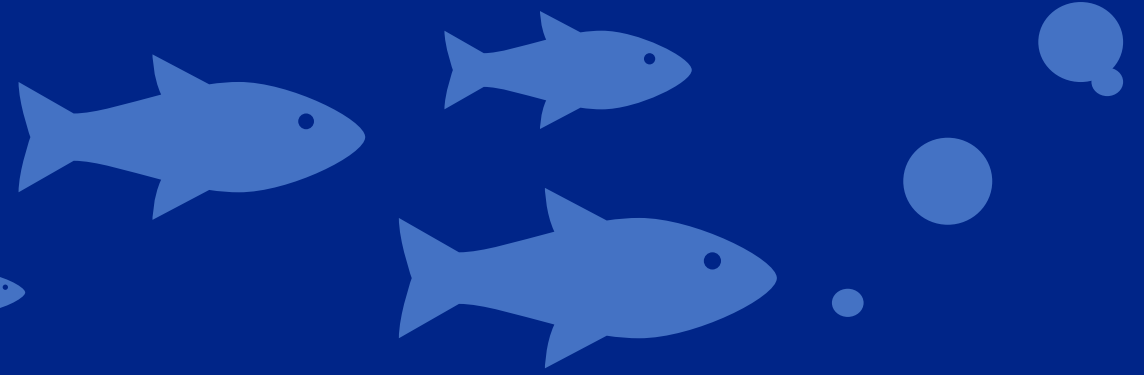
Infrastructuring big data of multi-species fishery catch for agile-up fishery strategy

Hiroaki Sugino, Nobuyuki Yagi
The University of Tokyo

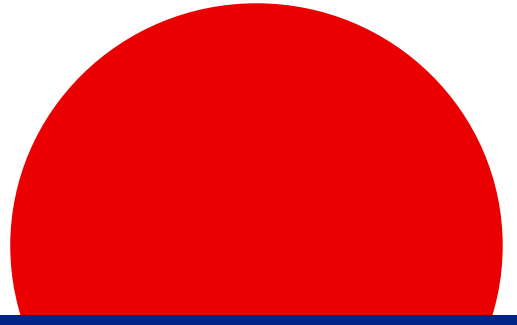


This story is about one psychologist who straggles with exploring practical solutions for the demands of fishers in Iwate, Japan.





Introduction



Introduction

Background Story...

#Computer Geek

#Environmental Psychology

#CPTED

#Arson

#Bicycle Theft

Introduction

Background Story…

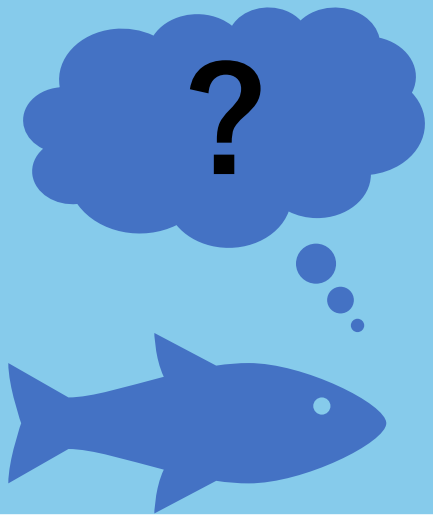
#The UT since 2015
#MSP
#Consensus Building
#Tohoku region
#Iwate
#Miyagi

Introduction

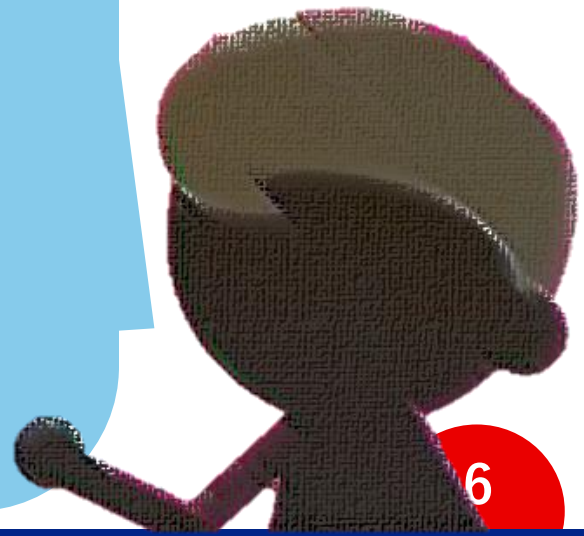
One day...

"The temper of the sea, I can see/know.

But, the temper of fish, how can I know?"



Fishermen
In
Iwate Pref.

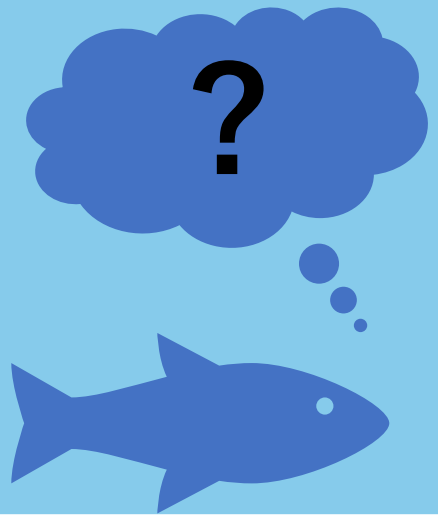


Introduction

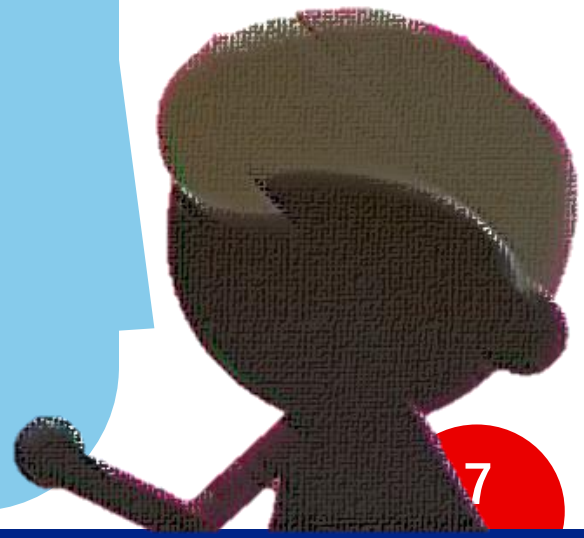
One day...

"Hey, you are a psychologist.

Can you tell me the temper of fish?



Fishermen
In
Iwate Pref.



Introduction

By the way…

■What's Psychology

psychology /sʌɪˈkɒlədʒi/

1. **The scientific study of the human mind and its functions, especially those affecting behavior in a given context**
2. **The mental characteristics or attitude of a person or group**

Reference: Oxford Dictionary

Introduction

By the way…

■What's Psychology

psychology /sʌɪˈkɒlədʒi/

1. The efforts to explain our behaviors or actions that everyone knows in "complicated" words

Reference: Devil's Dictionary

Introduction

By the way…

■What's Psychology

psychology /sʌɪˈkɒlədʒi/

1. **The efforts to understand or explain tacit knowledge, system, mechanism or functions from something observable**

Introduction

By the way…

■What's Psychology

psychology /sʌɪˈkɒlədʒi/

1. **The efforts to understand or explain tacit knowledge, system, mechanism or functions from something observable**

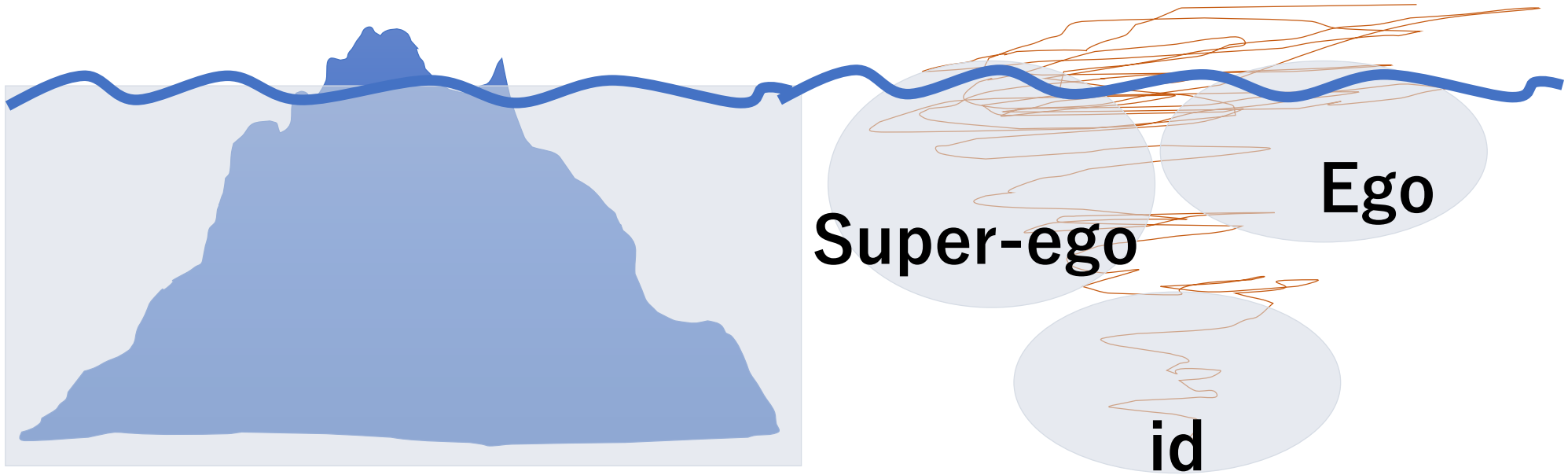
- Hiroaki Sugino

Introduction

By the way…

■What's Psychology

Tip of Iceberg = Behavior & Action

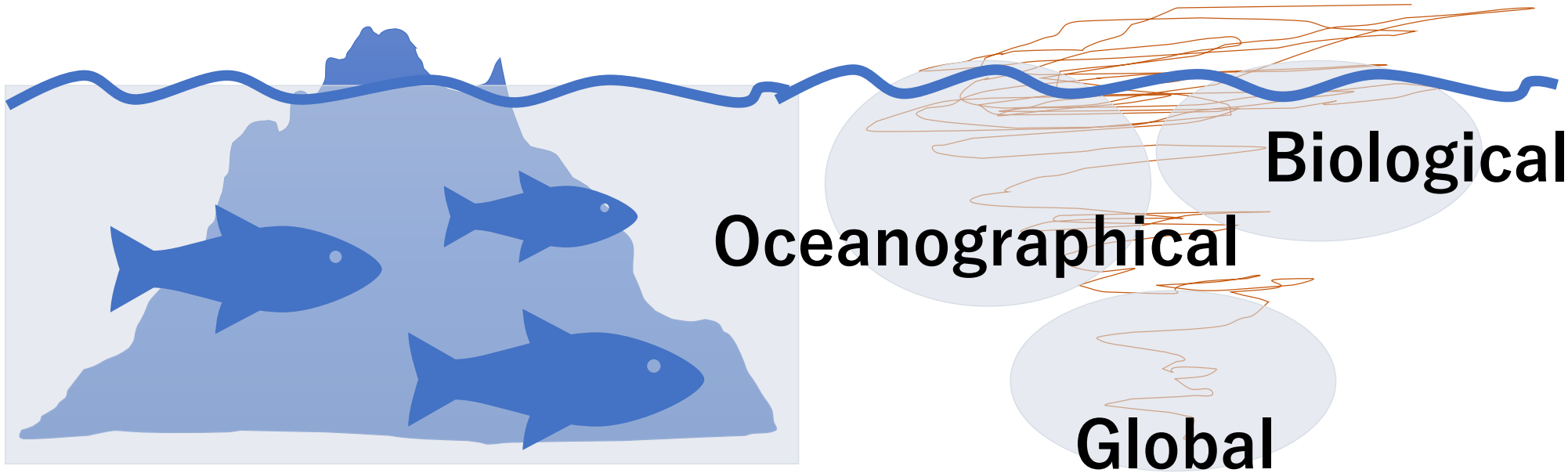


Introduction

By the way…

■How I thought

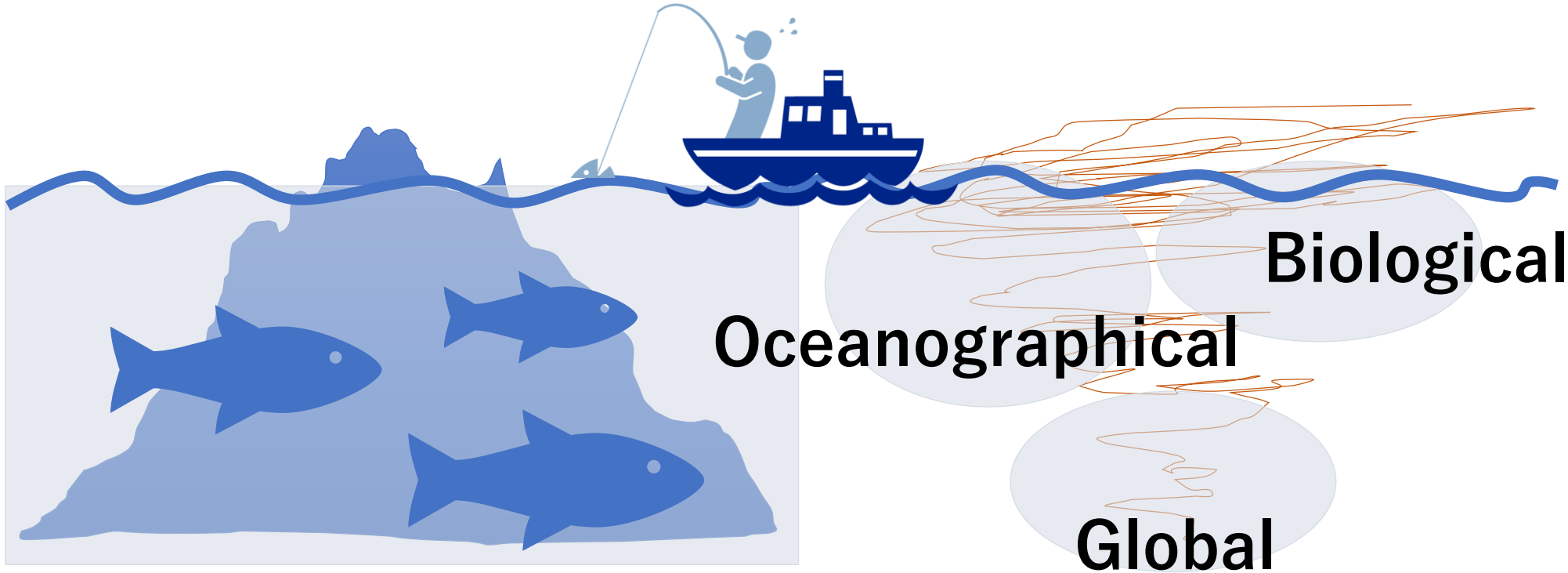
Tip of Iceberg = ?????????????



Introduction

Target

■How about **Fishery Catch**?



Introduction

Target

■How about **Fishery Catch**?

Tip of Iceberg = Fishery Catch

Roughly let's think >>> Fishery catch is always expressed based on…

Fishery Catch = f(Human Dimension・Natural Dimension)

What I need: Less biased, ecologically validate, and something let me obtain much data for quantitative analysis

Introduction

Target

■How about **Fishery Catch**?

Tip of Iceberg = Fishery Catch

Roughly let's think >>> Fishery catch is always expressed based on…

Fishery Catch = f(Human Dimension・Natural Dimension)

What I need: Less biased, ecologically validate, and something let me obtain much data for quantitative analysis

Questionnaire?

Introduction

Target

■How about **Fishery Catch**?

Tip of Iceberg = Fishery Catch

Roughly let's think >>> Fishery catch is always expressed based on…

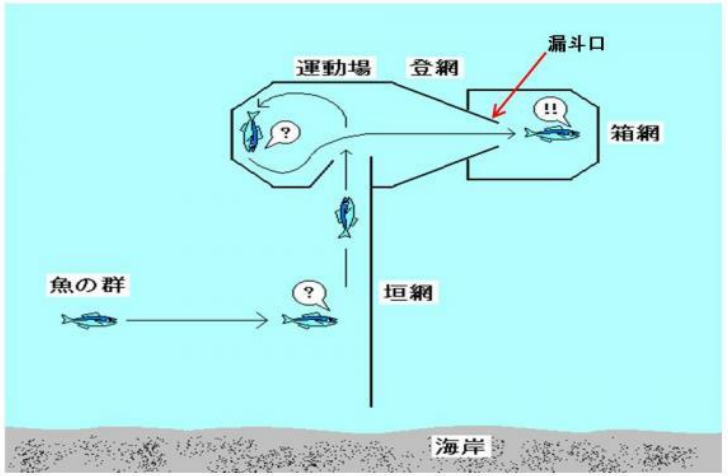
Fishery Catch = f(Human Dimension・Natural Dimension)

What I need: Less biased, ecologically validate, and something let me obtain much data for quantitative analysis

Set-net

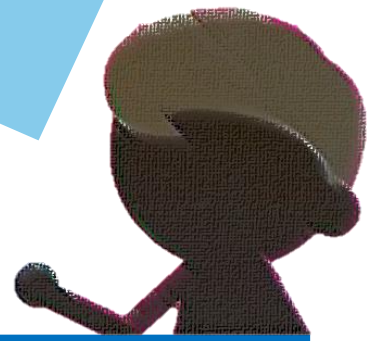
Introduction

Set-net Fishery in Japan



OK, boy, here is the basic procedure to fish by set-net
1)Set a net, 2)Wait, and 3)Go getting fish in the net if the sea is NOT rough

Fishery catch by set-net can be used as a sensor



What I need: Less biased, ecologically validate, and something let me obtain much data for quantitative analysis

Set-net

Introduction

To do list for me to start

1. Obtain much data of set-net fishery catch

2. Find something informative for the fishery people

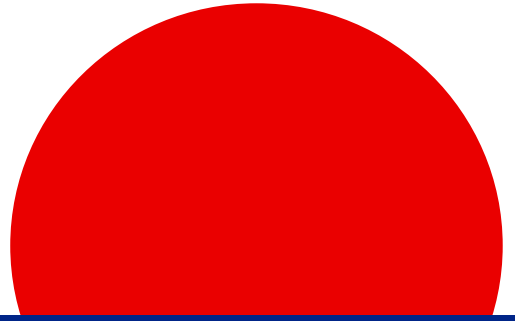
1. By fully taking advantage of my geeky skill

>>> Web scraping

2. By slightly taking advantage of my psychological skill

>>> Mechanism analysis by time series data analysis

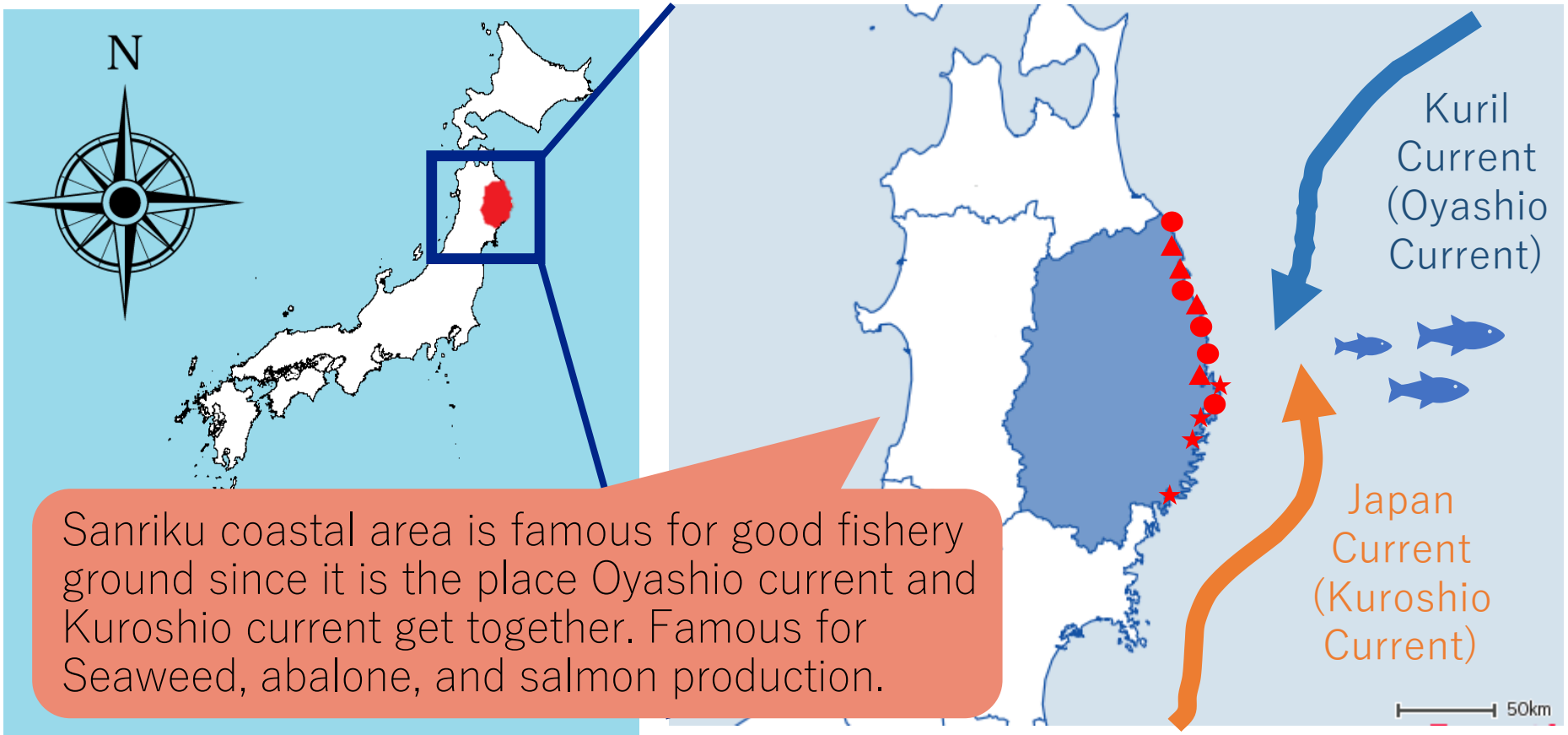
Method



Introduction

Target Area

▲ = locally, ● = regionally, ★ = nationally important



Sanriku coastal area is famous for good fishery ground since it is the place Oyashio current and Kuroshio current get together. Famous for Seaweed, abalone, and salmon production.

1. Taneichi ●
2. Yagi ▲
3. Kuji ▲
4. Noda ●
5. Fudai ▲
6. Tanohata ●
7. Tarou ●
8. Miyako ▲
9. Yamada ★
10. Funakoshi ●
11. Otsuchi ★
12. Kamaishi ★
13. Ofunato ★

Introduction

Wonderful Data Resource

岩手県内市場市況日報

2018年10月22日　大船渡市場　　2019年10月22日作成　岩手県水産技術センター

漁業種類	隻数	魚種（銘柄）	水揚量(kg)	高値(円/kg)	平均値(円/kg)	安値(円/kg)
定置網	6	アキサケ（オス）	57	450	357	150
	4	アキサケ（メス）	22	1,200	1,094	1,000
	13	サバ類	8,600	830	149	20
		マイワシ				
		カタクチイワシ				
	10	マアジ	260	630	334	30
		クロマグロ				
		サンマ				
	16	ブリ	21,659	500	158	50
	6	スルメイカ	53	1,300	756	200
	9	ヤリイカ	395	1,900	780	110
磯建網	21	アキサケ（オス）	467	250	228	219
	22	アキサケ（メス）	407	993	992	991
さけ・ます延縄		アキサケ（オス）				
		アキサケ（メス）				
突き棒		マカジキ				
		メカジキ				
かつお一本釣り		カツオ				
まき網		サバ類				
		マイワシ				
		カタクチイワシ				
さんま棒受網	2	サンマ	140,604	400	341	261
いか釣		スルメイカ				
		アカイカ				
船凍いか		アカイカ				
底刺網	5	ヒラメ	21	3,500	1,705	616
	2	マコガレイ・マガレイ	2	865	1,720	865
	1	ナメタガレイ	2	895	895	895
	1	マダラ	189	657	453	336
		スケトウダラ				
	3	アイナメ	12	2,600	1,152	150
		アンコウ類				
	1	タコ類	1	870	870	870
		アナゴ類				
小延縄		マコガレイ・マガレイ				
		ナメタガレイ				
		その他のカレイ類				
		マダラ				
		スケトウダラ				
		エゾイソアイナメ				
		アイナメ				
かご	3	タコ類	65	1,800	1,706	1,500
	4	アナゴ類	45	1,710	1,497	720
底びき網		マダラ				
		スケトウダラ				
		スルメイカ				
		ヤリイカ				
		タコ類				
		ナメタガレイ				
		キチジ				
その他		ヒラメ				
	1	マコガレイ・マガレイ	89	1,500	1,315	1,000
		アイナメ				
	1	タコ類	142	900	858	400
		アナゴ類				

※高値及び安値については、箱・山計算、傷もの、規格外を含む場合があります。
※この日報は朝夕の合計値です。

Developed and run by the Iwate Prefecture Fishery Technology Center

Introduction

Wonderful Data Resource

岩手県内市場市況日報

2018年10月22日　大船渡市場　　2019年10月22日作成 岩手県水産技術センター

漁業種類	隻数	魚種（銘柄）	水揚量(kg)	高値(円/kg)	平均値(円/kg)	安値(円/kg)
定置網	6	アキサケ（オス）	57	450	357	150
	4	アキサケ（メス）	22	1,200	1,094	1,000
	13	サバ類	8,600	830	149	20
		マイワシ				
		カタクチイワシ				
	10	マアジ	260	630	334	30
		クロマグロ				
		サンマ				
	16	ブリ	21,659	500	158	50
	6	スルメイカ	53	1,300	756	200
	9	ヤリイカ	395	1,900	780	110
磯建網	21	アキサケ（オス）	467	250	228	219
	22	アキサケ（メス）	407	993	992	991
さけ・ます延縄		アキサケ（オス）				
		アキサケ（メス）				
突き棒		マカジキ				
		メカジキ				
かつお一本釣り		カツオ				
まき網		サバ類				
		マイワシ				
		カタクチイワシ				
さんま棒受網	2	サンマ	140,604	400	341	261
いか釣		スルメイカ				
		アカイカ				
船凍いか		アカイカ				
底刺網	5	ヒラメ	21	3,500	1,705	616
	2	マコガレイ・マガレイ	2	865	1,720	865
	1	ナメタガレイ	2	895	895	895
	1	マダラ	189	657	453	336
		スケトウダラ				
	3	アイナメ	12	2,600	1,152	150
		アンコウ類				
	1	タコ類	1	870	870	870
		アナゴ類				
小延縄		マコガレイ・マガレイ				
		ナメタガレイ				
		その他のカレイ類				
		マダラ				
		スケトウダラ				
		エゾイソアイナメ				
		アイナメ				
かご	3	タコ類	65	1,800	1,706	1,500
	4	アナゴ類	45	1,710	1,497	720
底びき網		マダラ				
		スケトウダラ				
		スルメイカ				
		ヤリイカ				
		タコ類				
		ナメタガレイ				
		キチジ				
その他		ヒラメ				
	1	マコガレイ・マガレイ	89	1,500	1,315	1,000
		アイナメ				
	1	タコ類	142	900	858	400
		アナゴ類				

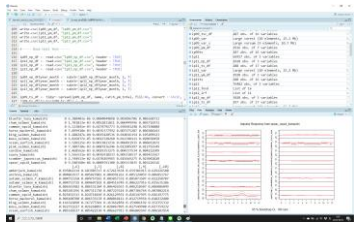
※高値及び安値については、箱・山計算、傷もの、規格外を含む場合があります。
※この日報は朝夕の合計値です。

Good to see detailed landing report

But not appropriate to download

Method

Data Obtaining Process



Program

Each page of the Website

Download the data by R

- Write a program to go and connect to each daily report to download by R
- Download each daily report and contain the data to csv file. (Repeat from 1994-01-01 to 2018-12-31)
- Extract only set-net fishery catch, convert and sum-up from day-level to month-level

Method

Data Analysis Flow

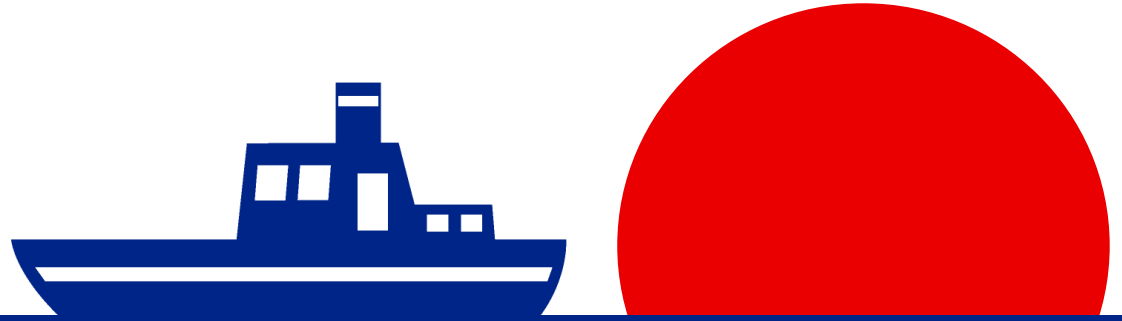
- **Unit Root Test** >>> To check the data has stationarity
  - ＊The following analysis requires data with stationarity
  - Phillips-Perron unit root test is utilized. Lagged by Bartlett Kernel

- **Time-series Hierarchical Clustering** >>> To know interrelationship between time-series multi-variables
  - Distance was calculated by DTW(dynamic time warping) method

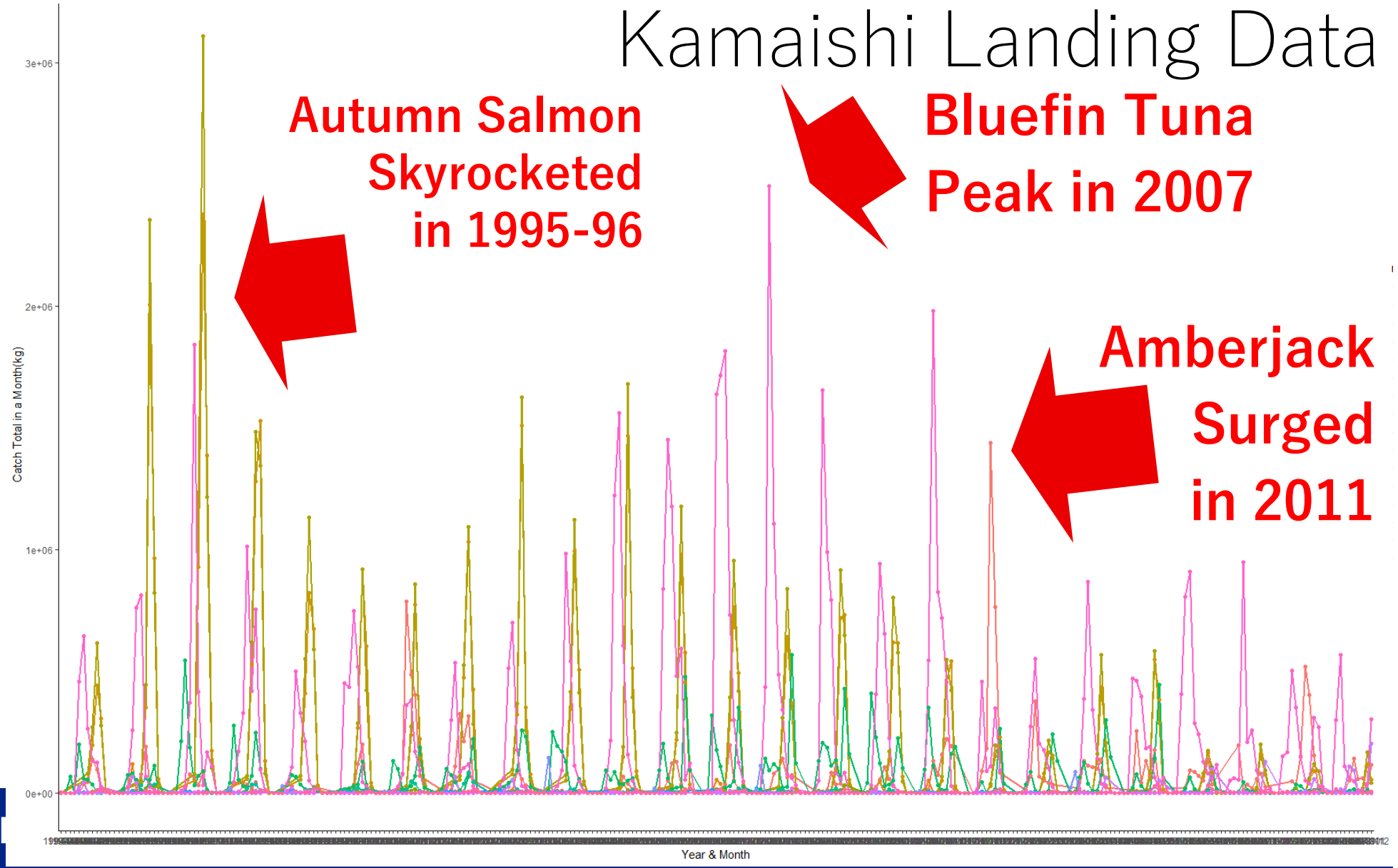
- **Impulse Response Function** >>> To understand the influence that one fish has to the other fish
  - Non-vertical impulse responses were calculated for CI 95%

Result

Focusing on Kamaishi

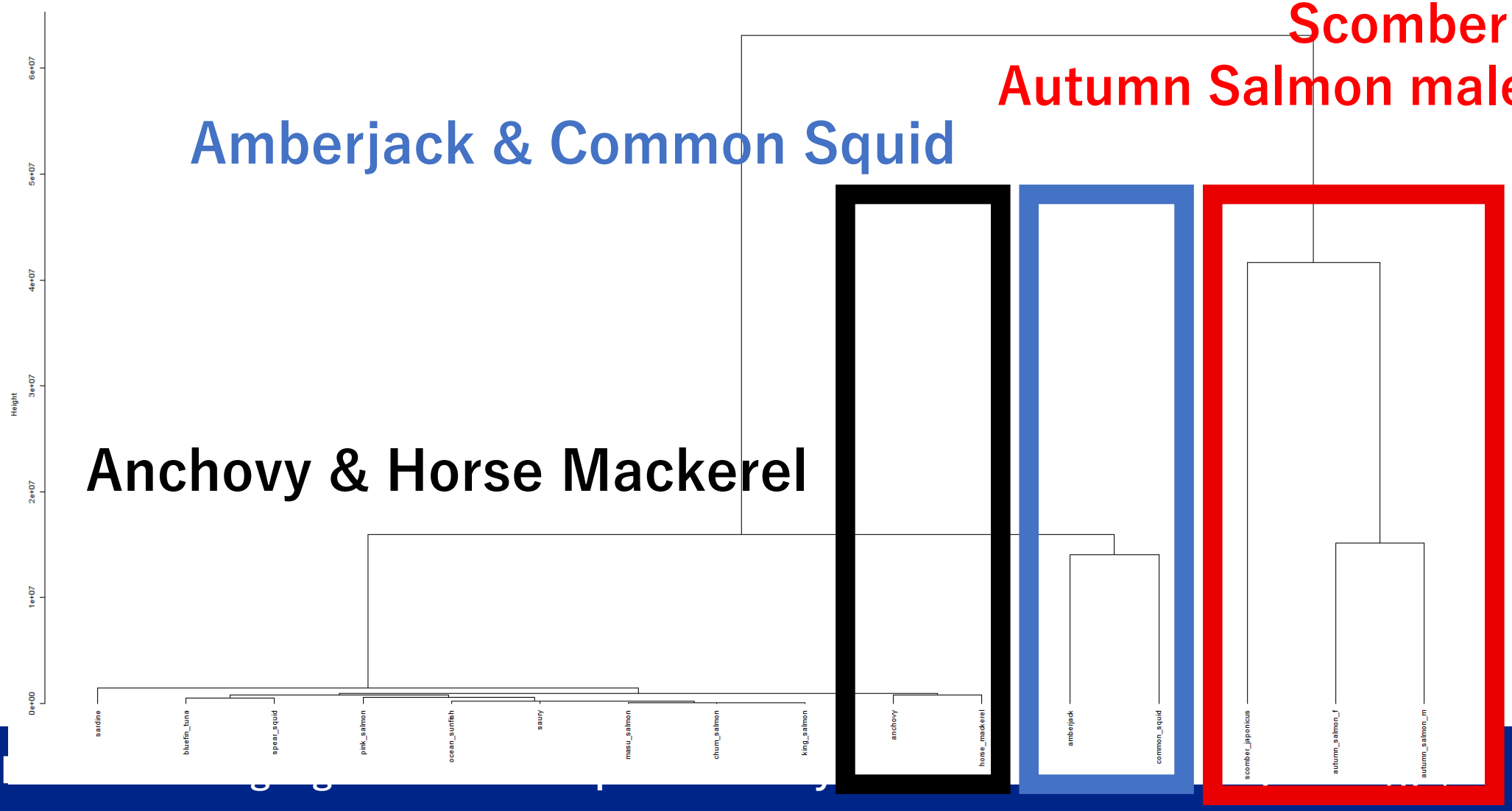


Result

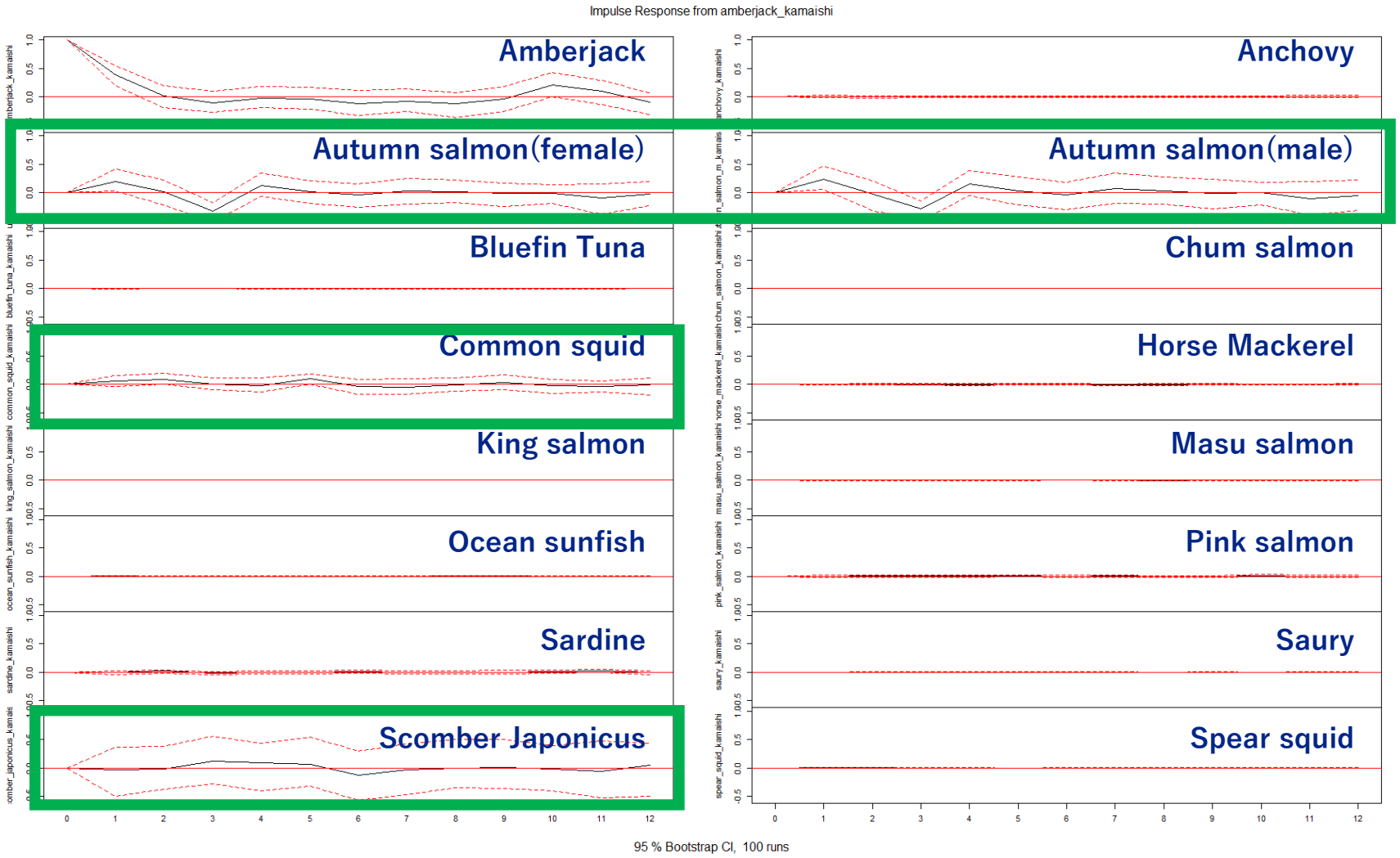

Kamaishi Landing Data
Autumn Salmon
Skyrocketed
in 1995-96
Bluefin Tuna
Peak in 2007
Amberjack
Surged
in 2011
3e+06
2e+06
1e+06
0e+00
Catch Total in a Month(kg)
Year & Month
name
amberjack
anchovy
autumn_salmon_f
autumn_salmon_m
bluefin_tuna
chum_salmon
common_squid
horse_mackerel
king_salmon
masu_salmon
ocean_sunfish
pink_salmon
sardine
saury
scomber_japonicus
spear_squid

Result

Time-series Hierarchical Cluster Analysis



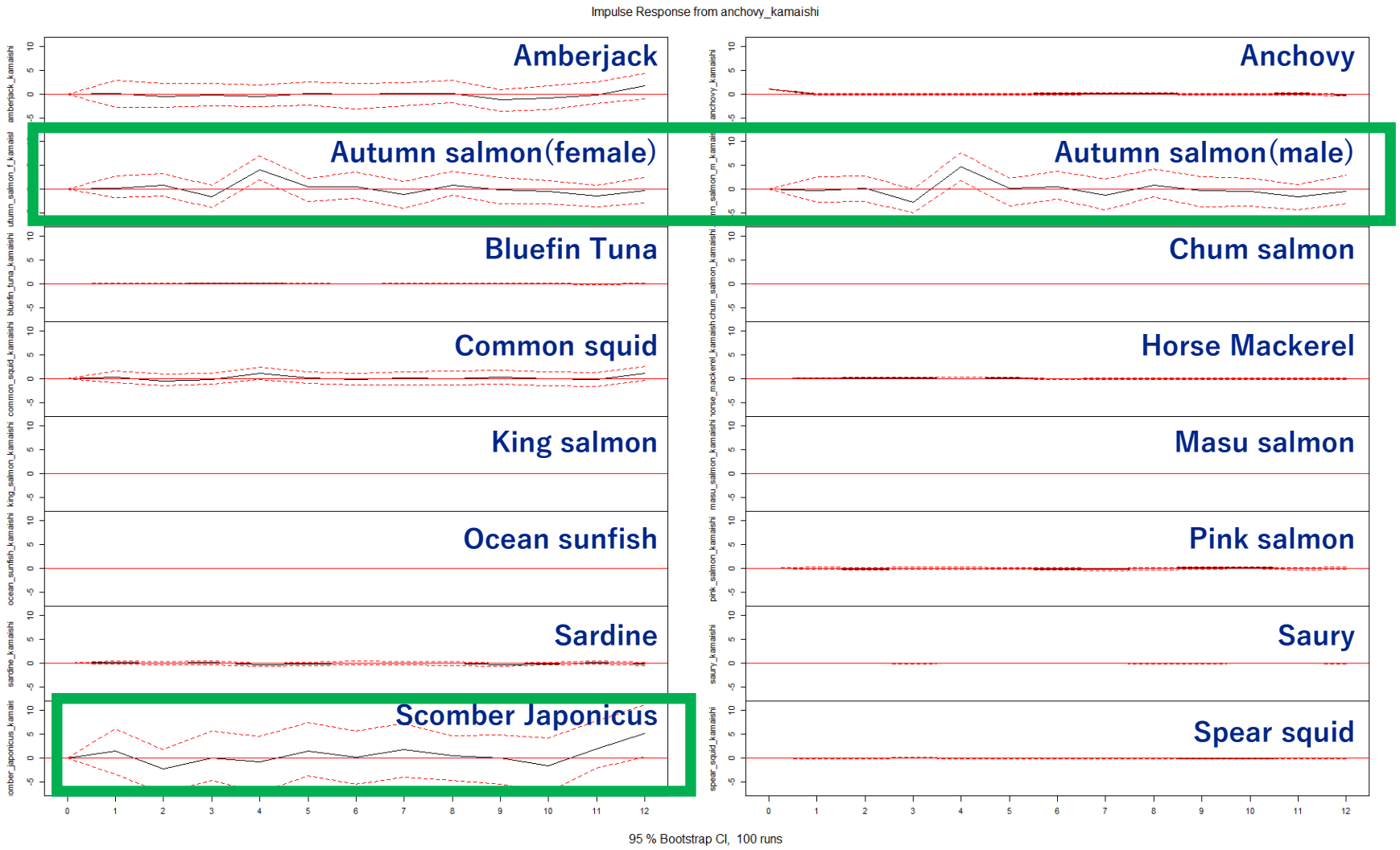
Impulse Response Analysis - Amberjack



Amberjack

- Autumn salmons
- Scomber japonicus
- Common squid

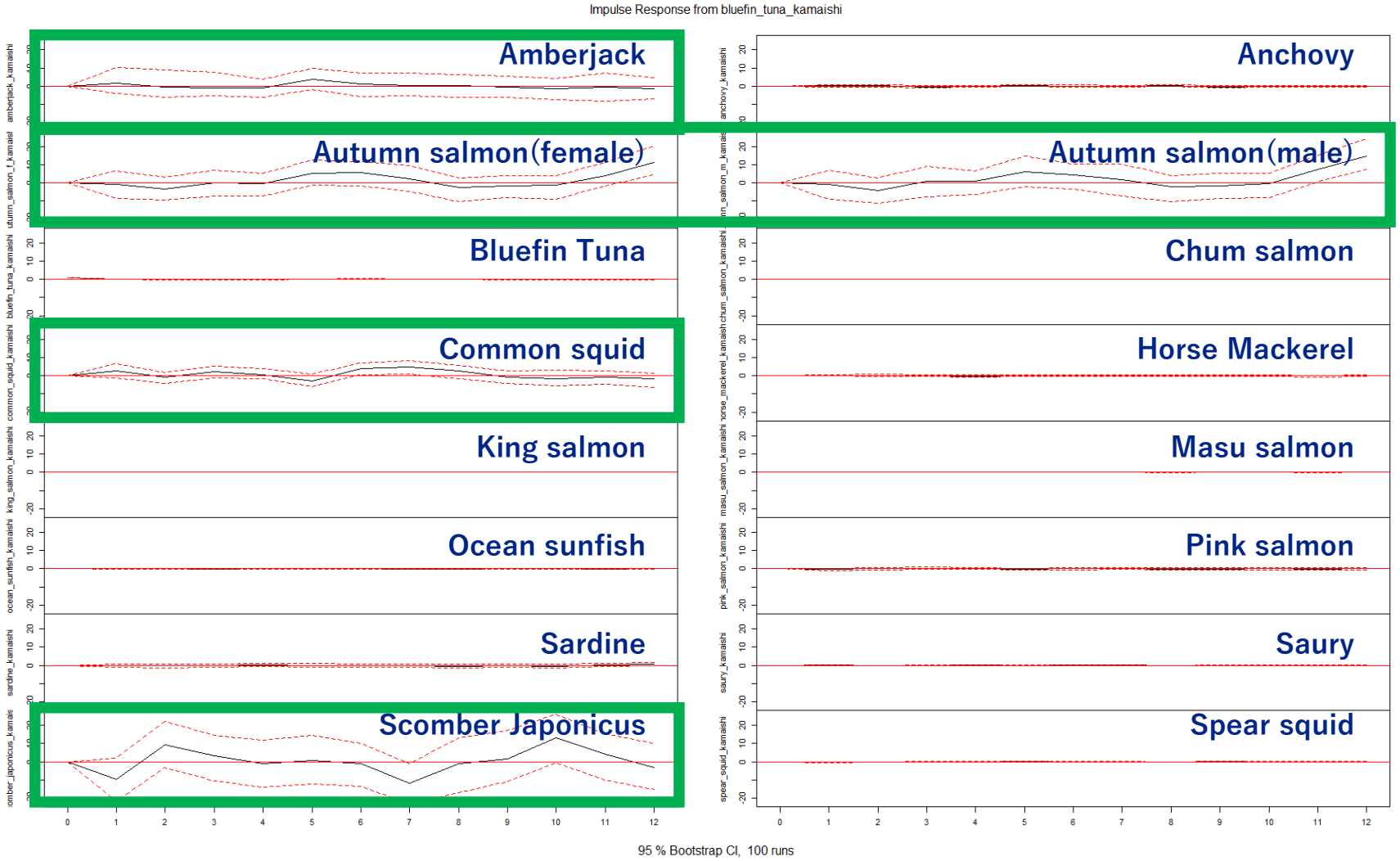
Impulse Response Analysis - Anchovy



Anchovy

- Autumn salmons
- Scomber japonicus

Impulse Response Analysis – Bluefin Tuna

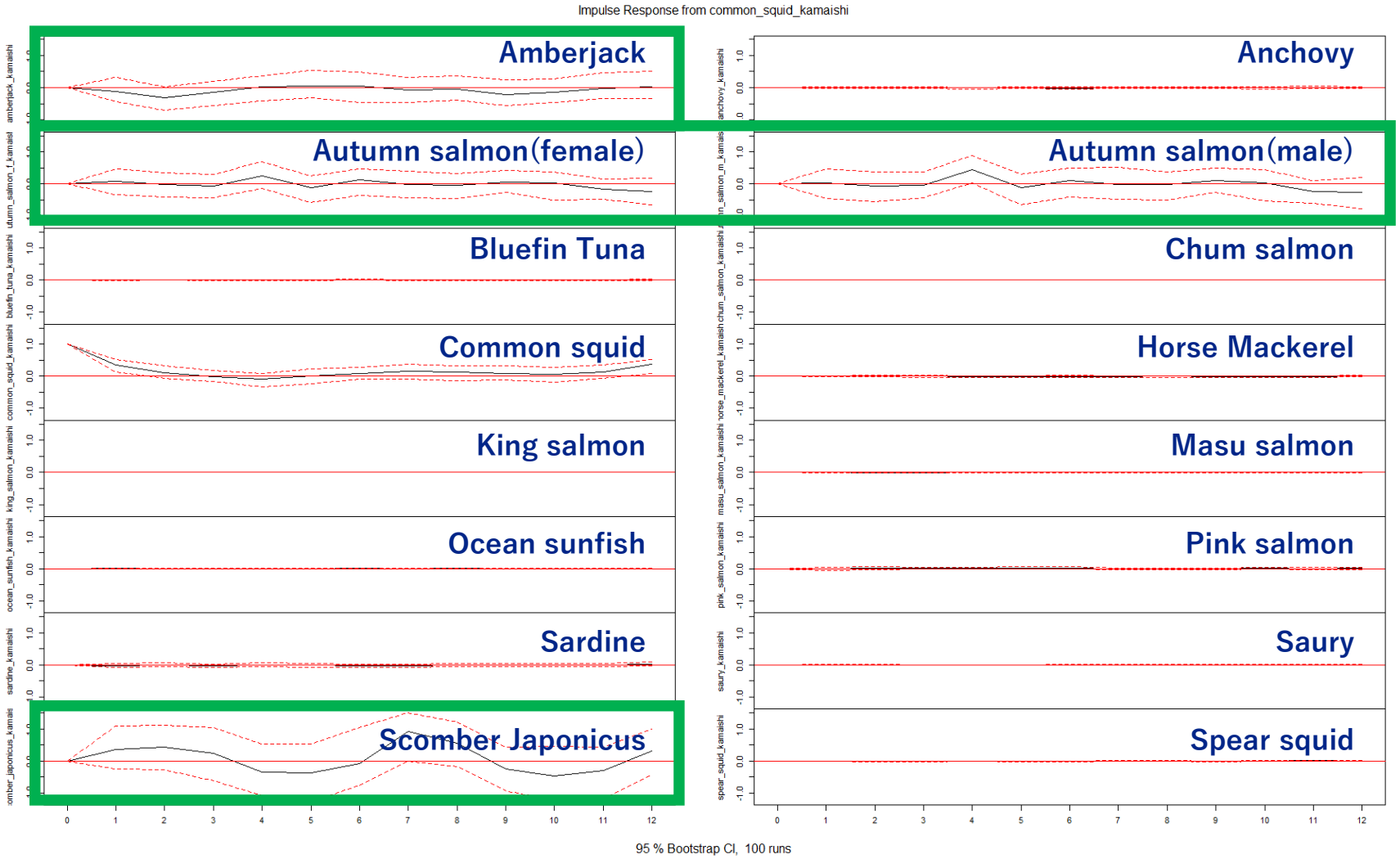


Bluefin Tuna

- Amberjack
- Autumn salmons
- Scomber japonicus
- Common squid

Result

Impulse Response Analysis – Common Squid

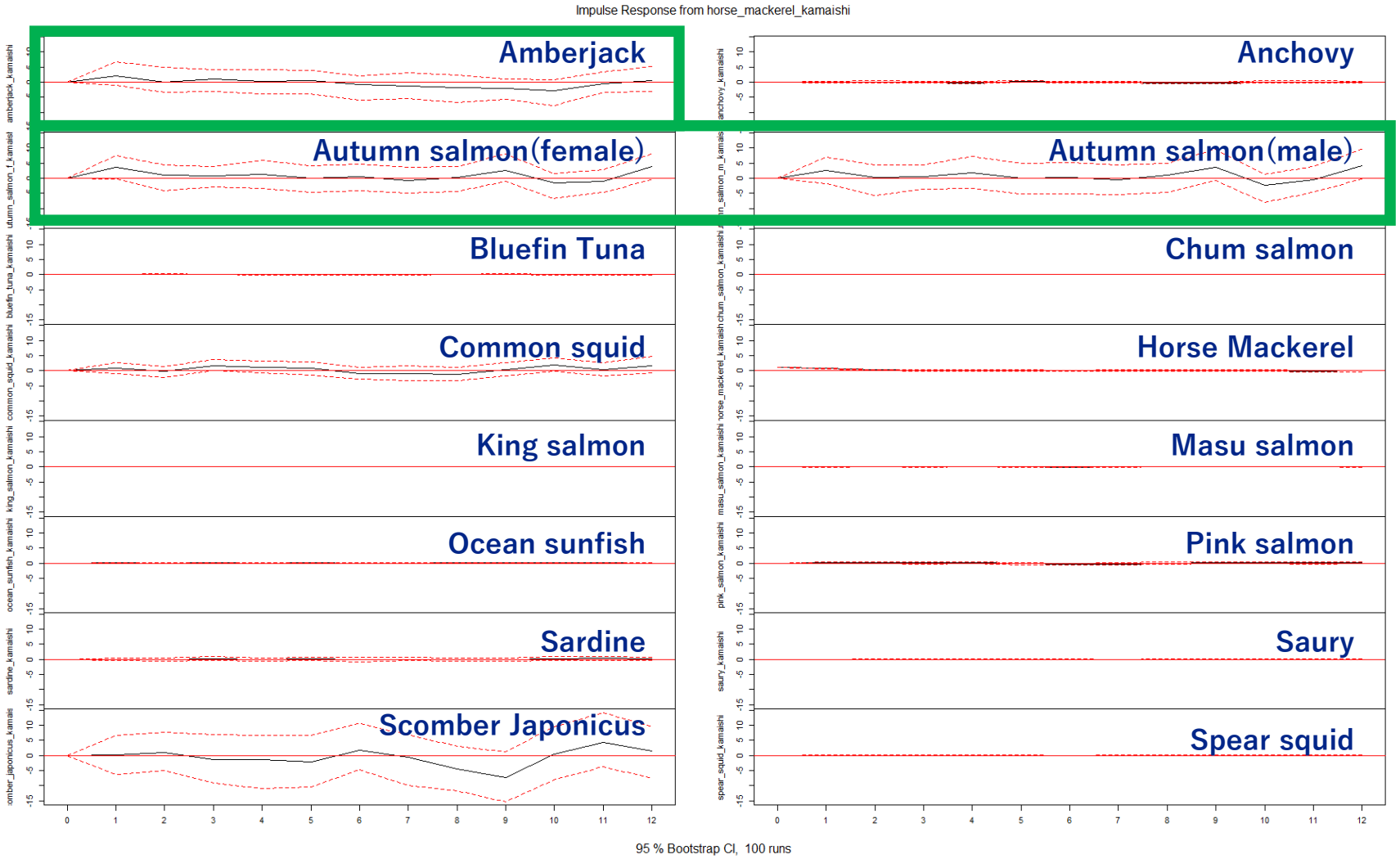


Common Squid

- Scomber japonicus
- Amberjack
- Autumn salmons

Result

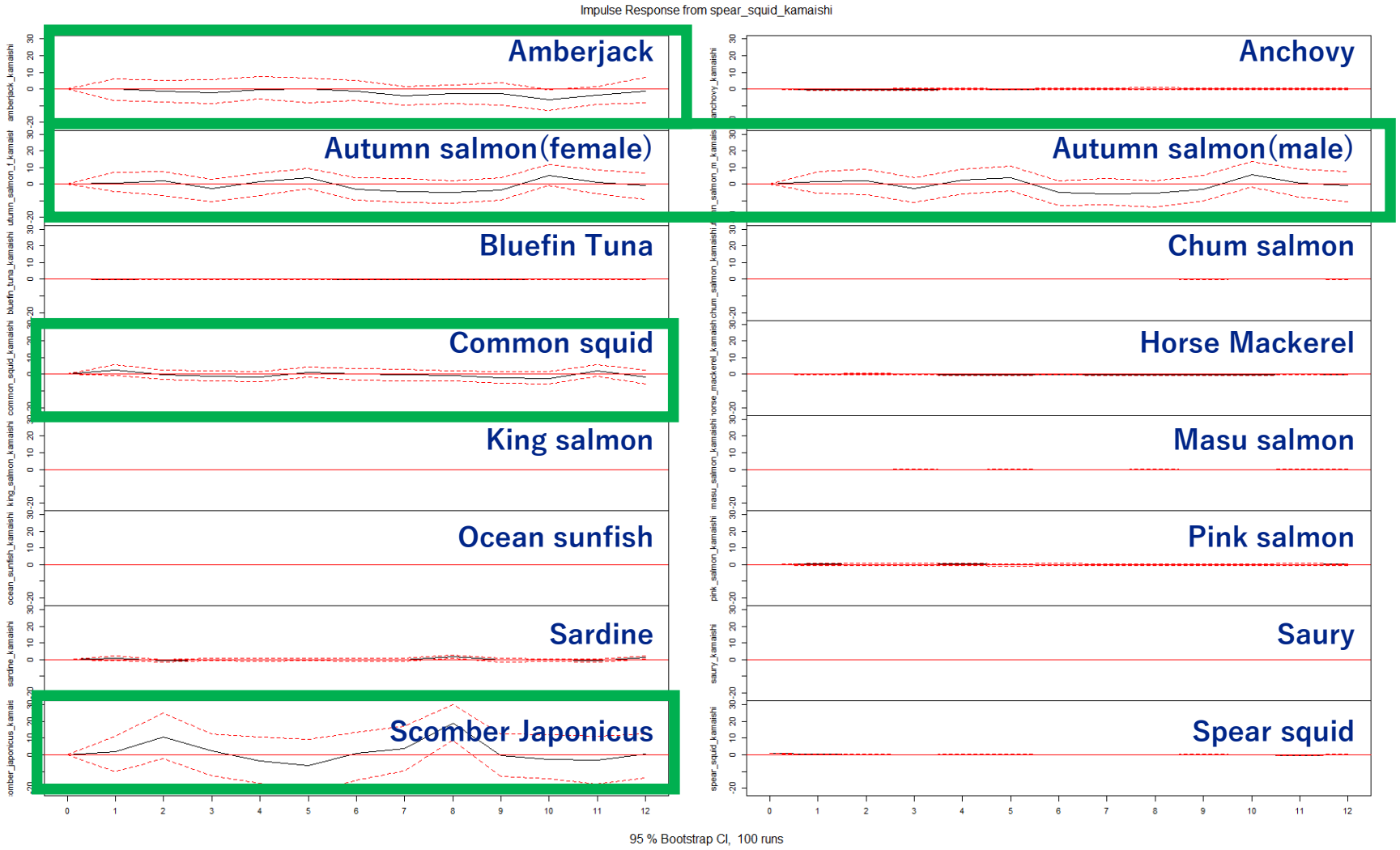
Impulse Response Analysis – Horse Mackerel



Horse Mackerel

- Amberjack
- Autumn salmons

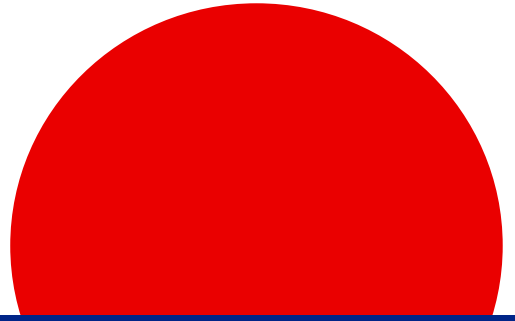
Impulse Response Analysis – Spear Squid



Spear Squid

- Amberjack
- Autumn salmons
- Scomber japonicus
- Common squid

Ending



Ending

So far…

- Data collection for all 13 landing markets is done for 25 years
- Classic time-series data analysis has been done on the data
- Some interesting things the data is talking to me, but I need interpreter to understand that…

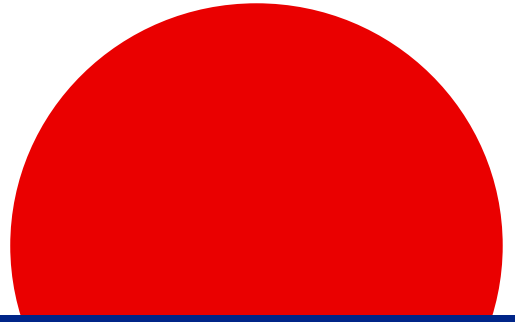
OK, boy, I understand squid is the one to check to know what's the temper of amberjack. …but why?

(OK, other research questions coming up…)

Here is the end of my presentation,
but this story may continue with great help from you.

Any question? Or kind offer for cooperation?

Thank you very much ;-)



Acknowledgement:

This research was funded by JSPS KAKENHI Grant Number 19K15894 “Elucidation of the Actual Condition of Balanced Harvesting Performed by Small-scale Fisheries in Japan and its Application to Sustainable Fisheries,” and supported by Iwate Prefecture Fishery Technology Research Center and fishery people in Iwate prefecture, Japan.