Development of Information Service for Set Net fisheries using Satellite and numerical data

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Acknowledgment

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Contents

• Introduction: Set Net Fisheries
• Motivation
• Development of prediction model
• Experimental activities
• Effect of information service
• Future aspects
• Summary
Set Net Fisheries

Operation scenery of the Set net

Harvesting scenery of the Set net

Concept of Set Net

Play ground

Lead net

Bag net
- Set net fisheries management entities: Hokkaido 34%
- Fisheries landing of Hokkaido: Set net fisheries 18%

Set net fisheries management entities

<table>
<thead>
<tr>
<th></th>
<th>Japan</th>
<th>Hokkaido</th>
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<tbody>
<tr>
<td>Large Set Net</td>
<td>431</td>
<td>34</td>
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<tr>
<td>Salmon Set Net</td>
<td>821</td>
<td>821</td>
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<td>Small Set Net</td>
<td>2,867</td>
<td>552</td>
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<td>Total</td>
<td>4,119</td>
<td>1,407</td>
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Fisheries Census 2013 in Japan

Fisheries landing of Hokkaido (2016)

Trawl (47%)
Set Net (18%) Gill net (18%)
Fisheries Landing in Hakodate: Set Net Fisheries 50%

- Management stabilization of Set Net Fisheries => contribute to activation of regional economy

- Fisheries Landing in Hakodate (2016)
  - Set Net 50%
  - Zigging 18%
  - Gill Net 12%
  - Shell 9%
  - Others 11%

- It can also be used for resource management of bluefin tune, a local issue.

- Horizontal deployment is possible not only in Hokkaido but also in areas that operate set net throughout Japan.

Reference: CeisNet (Japanese Coast Guard)
Features and challenges

• This is an **environmentally friendly** fishing method
• “Passive” fishing method waiting for fish to enter the net
• The **amount and type of fish is not known** until it is actually confirmed on site
• **Understanding the current situation and forecasting the future** are **key** to the operation and management of set net fisheries

Support using satellite and numerical data
Motivation

• Under changing climate, it is necessary for fisher to manage the sustainable set net fisheries and one of solutions is to develop the information service including prediction of when and what kind of fish will be trapped in the set net.

• We challenge to have co-working and co-designing with a set net fisheries company to develop of information service in southern Hokkaido coast, along Cape Esan.
Study Area
Development of prediction model

• 10 years catch data
• 10 years satellite and numerical data

• Machine Learning method (Decision Tree)

• Target species: Yellow tail, Tune, Salmon and Squid
Development of prediction model

1. Prepare Data Set
   - Ten years Catch Data
   - Ten years Marine Environment Data

2. Model Development
   - Good Catch Marine Environmental Parameters

3. Model Evaluation

4. Prediction
   - Use numerical data
   - Up to 30 days

5. Visualization
   - Map
     - Calendar
     - Index
Satellite Data
SST level 4 Map （October 20, 2008-2017）

衛星に観測よる表面水温10年分比較

GHRSSST Level 4 MUR Global Foundation
Sea Surface Temperature Analysis (v4.1)

October_20
Numerical Re-analysis Data (10 Km)
Unify the type of fish: Salmon = Male + Female
Remove abnormal years from learning data (Salmon)

Yearly total catch was about 50 ton

Big Catch in 2009 (unusual year)
## Make subjective class expression (Salmon)

<table>
<thead>
<tr>
<th>Class</th>
<th>Amount of catch</th>
<th>Categorization</th>
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<tbody>
<tr>
<td>#0</td>
<td>0</td>
<td>No catch</td>
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<td>#1</td>
<td>$0 &lt; \text{Catch} &lt; 100$kg</td>
<td>A little catch</td>
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<td>#2</td>
<td>$100 \text{kg} \leq \text{Catch} &lt; 1,000$kg</td>
<td>Can be a business</td>
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<tr>
<td>#3</td>
<td>$1,000 \text{kg} \leq \text{Catch} &lt; 10,000$kg</td>
<td>Good catch</td>
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<tr>
<td>#4</td>
<td>Over 10 ton</td>
<td>Big catch</td>
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</tbody>
</table>
値
数量（★さけの場合）
肌感覚・感情

#0
いない

#1
0 <水揚量<100kg
ちょろちょろ

#2
100kg ≦水揚量<1,000kg
商売になる

#3
1,000kg ≦水揚量
10,000kg
豊漁

#4
10トン以上
（ちなみに4回だけ）
大漁

それに応じて商売になるかどうかを予測する。
Evaluation Results

Catch

Prediction

Yellow tail: 60%
Bulefin tuna: 60%
Salmon: 90%
Squid: 60%
Experimental activities
Experimental activities

Overview of service system

• Based on the Japan Meteorological Agency’s sea temperature and current data released every day at around 22:30, a **prediction calendar and map up to 30 days ahead** is being created.

• **Signage** can be used to easily access the predicted information using fisherman’s workshop (Banya) **TV monitor**.
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### 最近漁火画像

![最近漁火画像](image1.png)

### 予測根拠の可視化

![予測根拠の可視化](image2.png)

### カラーコード

- **赤**: 漁火あり（10トン以上）
- **黄**: 大漁
- **緑**: 中漁
- **青**: 小漁
- **黒**: 不漁

**説明**

- 漁火の実績を基に、水揚げ量を示す。
- 漁火の位置を可視化し、実績を示す。
- 近年の漁火のデータを基に、今後の予測を示す。

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**注**

- カラーコードは、実績データを基に作成されたものです。
- 今後の渔火予測は、実績データを基に作成される予定です。
Mid-term meeting
Effect of information service

- Lost prevention and **maximization** of the profit of fish catch and chance
- Contribution to voluntary action of the *resource conservation*
- Improvement of the **labor productivity**
  - Decision on fishing gear choice, frequency of renewal, installation and withdrawal time
  - Contribution to the way of working reform by the busy prediction
  - Labor-saving of maintenance of facilities
    - etc.
Future aspects

• In the case of feeding migration fish (Bluefin tuna and Yellow tail), if we add habitat information on forage fish (Sardine and Mackerel), the prediction match rate will be improved.

• The spatial resolution of numerical model will be improved from 10km to 2km in next year 2020, then apply to this service.

• Horizontal deployment is possible not only in Hokkaido but also in areas that operate set net throughout Japan.
Summary

• We challenge to have co-working and co-designing with a set net fisheries company to develop of information service for set net fisheries in southern Hokkaido coast, along Cape Esan.

• The novel machine learning method was employed for developing of prediction model using satellite and numerical data.
Thank you for your attention!