Fishery income fluctuation due to changing vessel speed from the harbor to the fishing ground, in the Japanese squid jigging fishery

“Moving at high vessel speed” causes to

1. be able to operate their jigging operation for longer time
2. be able to operate their jigging operation at better fishing grounds
3. increase the catch of squid
4. increase the fuel cost at the moving process

Does it maximize fishery income?

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Japanese coastal squid jigging fishery

Mainly catch Japanese common squid (*Todarodes pacificus*)

Vessel size: 5 – 19 GT

2 – 3 fishermen / ship

Automatic jigger machines

High powered fish lamps

Fishing ground is so far from a harbor (20 – 40 km)

High fuel consumption in comparison to other fishery
Many fishermen have been in financial trouble because of rising fuel price and falling fish prices (Baba, 2008).

People make a risky choice when they are in bad situations (Kahneman and Lovallo, 1993).
**The Prospect Theory 1**

Daniel Kahneman  (Winner of the Nobel Prize in Economics)

- people make a choice which they only think that is optimal
- they make a risky choice when they are in bad situations

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**Question 1**

A. Regardless of color, you get 10,000$

B. Only Blue, you get 20,000 $

Expected value = 10,000$

Almost of all people chosed “A”
Almost of all who choosed “A” in the question 1, choosed “B”

People don’t make a choice as only high expected value

Many Japanese coastal squid jigging fishermen might make a risky choice at their own fisheries management

- Moving to far fishing ground
- Using high power fishing lamps
- Moving at high speed
Introduction – Vessel speed at moving processes

High speed
Fuel cost ↑

Low speed
Fuel cost ↓

They think they can chose good fishing ground

Good F.G.

Poor F.G.
their catch may be decreased

If they lose 1 knot at vessel speed, fuel consumption decrease about 15%.

Which is better for increasing their economic return? Is economical speed same as ecological speed?
Why use simulation model?

Fishing condition change from hour to hour
Social situation also changes
Surveying real income in all social situations and operating conditions is not feasible

We used the Fishery Income Simulation Model (Tamaru et al., in press)

Purposes of this study

To clarify fishery income fluctuation due to changing vessel speed from the harbor to the fishing ground, in the Japanese coastal squid jigging fishery

To clarify economical vessel speed, when fuel price changes
Fishery Income Simulation Model

\[ E = P - O \]

- **E**: Income (JPY)
- **P**: Price of catch (JPY)
- **O**: Total cost (JPY)

**P = C \cdot r**

- **C**: Amount of catch (case)
- **r**: Unit price of squid (JPY/case)

**O = F + M + W**

- **F**: Fuel cost (JPY)
- **M**: Employment cost (JPY)
- **W**: Maintenance cost (JPY)

**F = f \cdot R**

- **f**: Total fuel consumption (L)
- **R**: Unit price of fuel (JPY/L)

\[ f = m_m \cdot d + h_o \cdot m_o \]

- **m_m**: Mileage of vessel (km/L)

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**Graphs**

**Graph 1**
- Unit price of fresh squid (JPY/case)
- **Very Poor Catch**: 1,500 (¥/case)
- **Poor Catch**: 2,000 (¥/case)
- **Regular Catch**: 2,333 (¥/case)
- **Good Catch**: 2,500 (¥/case)

**Graph 2**
- Fuel consumption (Liter/h)
- **Vessel speed (kt)**
- **Fuel consumption**: \[ y = 0.0131x^{3.658} \]
- **R²**: 0.9952
Fishing Ground

Distance: 40km
Duration: 14 hours
Vessel speed: 8 – 13 kt

Catch condition: Very poor (50 cases)
Poor (100 cases)
Regular (200 cases)
Good (350 cases)

We estimated fishery income in each catch condition.
Economical vessel speed in each catch condition

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<thead>
<tr>
<th>Catch condition</th>
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<th>10</th>
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(Unit: 1,000 JPY)

Bad catch condition

Moving at **lower** vessel speed cause to increase fishery income.

Good catch condition

Moving at **higher** vessel speed cause to increase fishery income.
Discussion

1. Do fishermen select economical speed in each fuel price level?
   
   Before the 3rd oil crisis (80 JPY/L) ……moved at 12 – 13 kt
   
   At the 3rd oil crisis (120 JPY/L) ……………decreased to 10 kt
   
   After the 3rd oil crisis (80 JPY/L) ……… keep moving at 10 kt

2. Fishermen can’t predict expected catch of squid before they depart from a harbor.
   
   Does estimating the economical vessel speed in each catch condition have meaninglessness?

3. Economical vessel speed is the same as ecological vessel speed?

4. What should we do for constructing efficient system of coastal squid jigging fishery?
Decreasing their vessel speed to 10 kt at the 3rd oil crisis is the economical choice.

Keeping their vessel speed at 10 kt now is not economical choice.
2. Estimating economical speed is meaninglessness?

By selecting vessel speed in each season, fishermen will increase their fishery income.
If fishermen increase vessel speed from 10 kt to 13 kt, fuel consumption and emission of exhausted CO$_2$ gas increase 40%.

From the view of sustainable fishery, increasing speed is not better way.

By extending the duration of the operation, fishermen might increase their fishery income, and might decrease fuel consumption and emission of exhausted CO$_2$ gas.
3. Moving at 10kt and extend duration 1 hour

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At almost of all situations, by extending duration of operation 1 hour for moving at 10 kt, fishermen will increase their fishery income.
4. What should we do?

Now, few fishing port have departure time restriction

Fishermen tend to move at high vessel speed

We should to change from departure time restriction to start jigging operation time restriction

Fishermen will increase their fishery income and will decrease fuel consumption and emission of exhausted CO$_2$ gas.
Summary

To decreasing their vessel speed from 13 kt to 10 kt in the 3rd oil crisis
- Economical choice

To keep moving at 10 kt now
- Not economical choice

- Moving at 12 kt is an economical choice

Low season
- Moving at about 10 kt is an economical choice

At almost of all situations, by extending duration of operation for moving at 10 kt, fishermen will increase their fishery income and will decrease fuel consumption and emission of exhausted CO\textsubscript{2} gas.

Departure time restriction  \rightarrow  Start jigging operation time restriction
Thank you for your attention

Todarodes pacificus