Optimal Spatial Strategy of the Fishing Efforts for Heterogeneous Fishing Grounds

Gaku Ishimura
Ren Odaira
Faculty of Agriculture
Iwate University

Keita Abe
Department of Economics
University of Washington

Resource Policy + Economics
+ Quantitative Managament Lab
FISHERY SYSTEMS
AT MORIOKA, IWATE UNIVERSITY

Motivation

Kesennuma
気仙沼

- The 9th largest fishery landig values in Japan.
- A base port for distant water tuna fisheries.

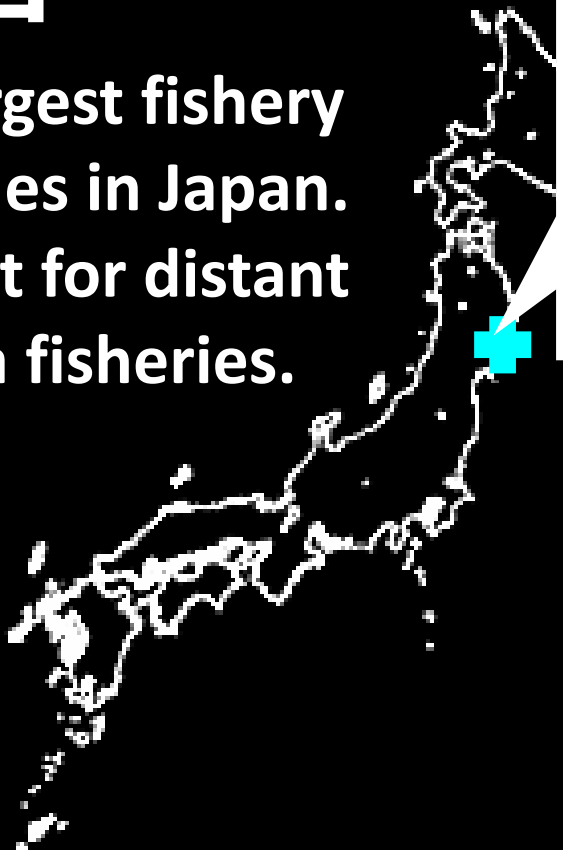
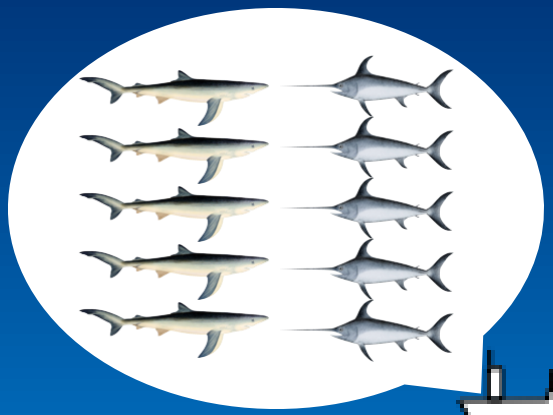
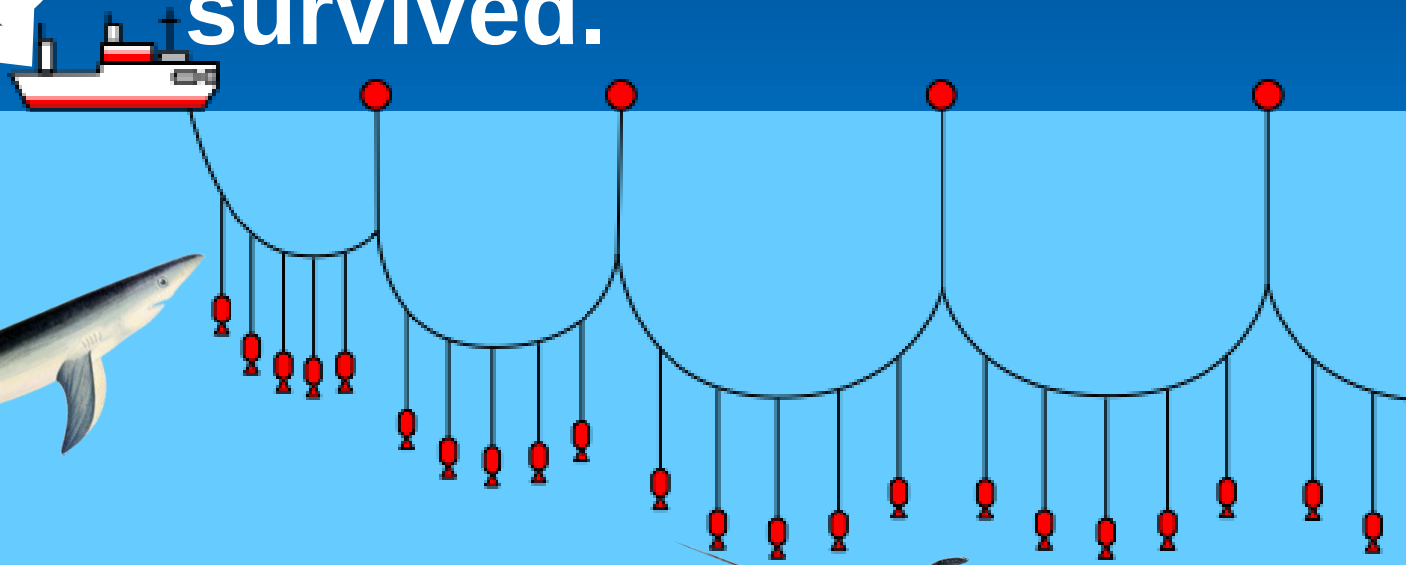


Photo: Yuma Sugawara

March 11
2011
東北大震災
East Japan Earthquake Picture Proje

In Kesennuma.
16 119MT-distant water longline fishing vessels survived.





Blue shark

Swordfish

After the 2011 Earthquake/Tsunami

Ex-vessel Price ↓

Fuel Price ↑

Kesennnuma Longline Fisheries

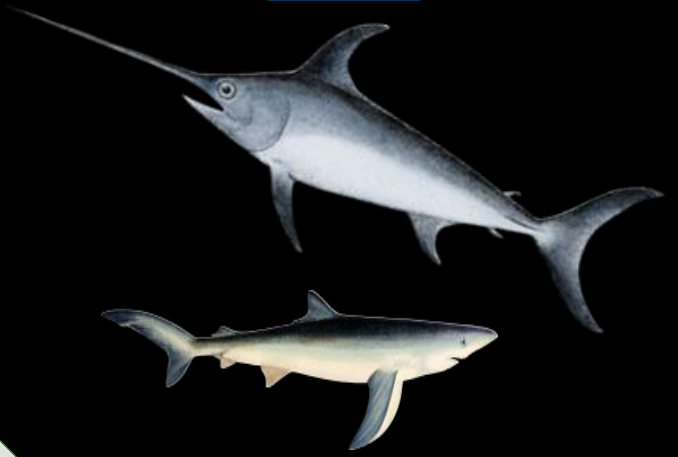
Society
社会

Fishery
漁業

Fish
魚

Employment generated by the processing industries

Economic Motivations



North Pacific swordfish & blue shark resources

Approach

Approach
to bring economic incentives

Explore **optimum fishing strategies** to maximize economic benefits from Swordfish fisheries .

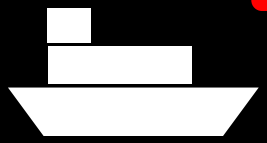
Two decision variables for optimum fishing trip strategies

① **Fishing Efforts**
(= days per trip)
How many days per trip?

② **Fishing Locations**
Where shall we fish?

① Combine Catch, Cost, Revenue from the 2005-2010 trip-based data under the competitive individual operation to explore optimum fishing efforts to maximize economic benefits from Swordfish fisheries .

Move/Search Days Operation Days Move/Search Days



Fishing Efforts (Days per Trip)

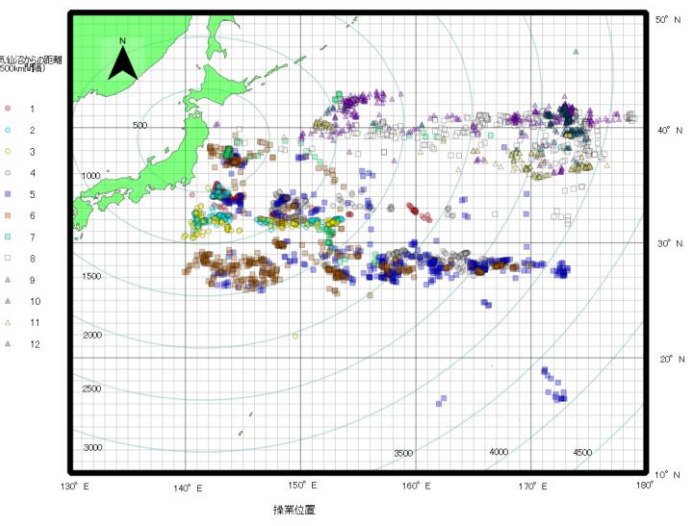
= Move/Search Day + (longline) Operation Days

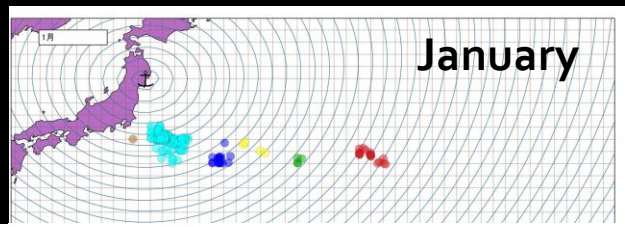
Harvest model + Price model + Cost model

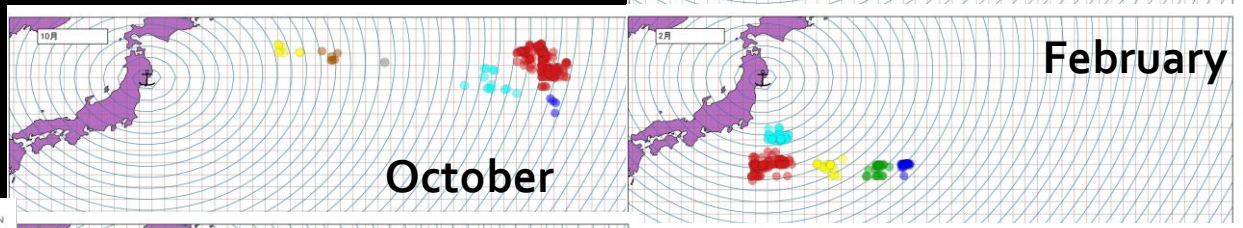
(Production) (Demand)

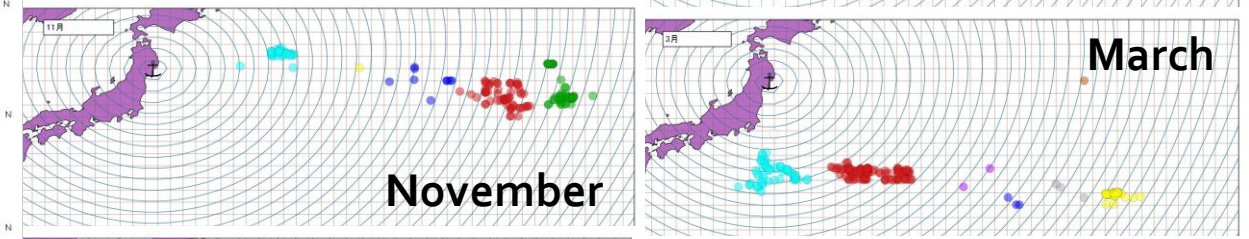
② Cluster Analysis to identify the location/profile of the fishing grounds from 2012-2014 log-book data

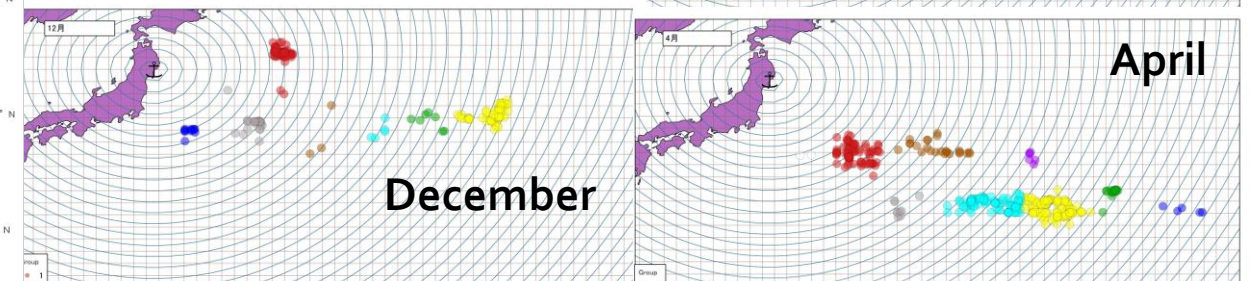
Clustered by distances of operation points



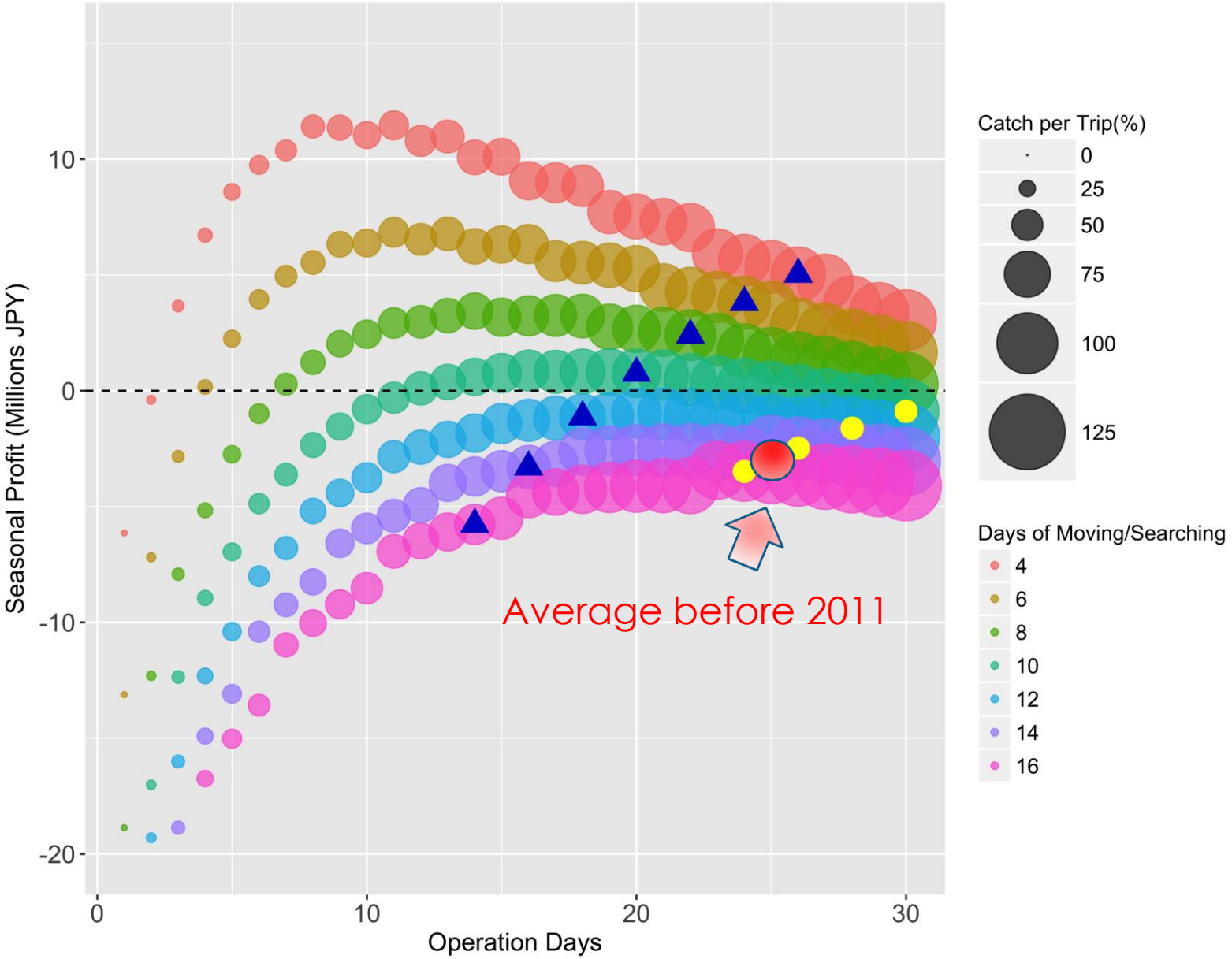






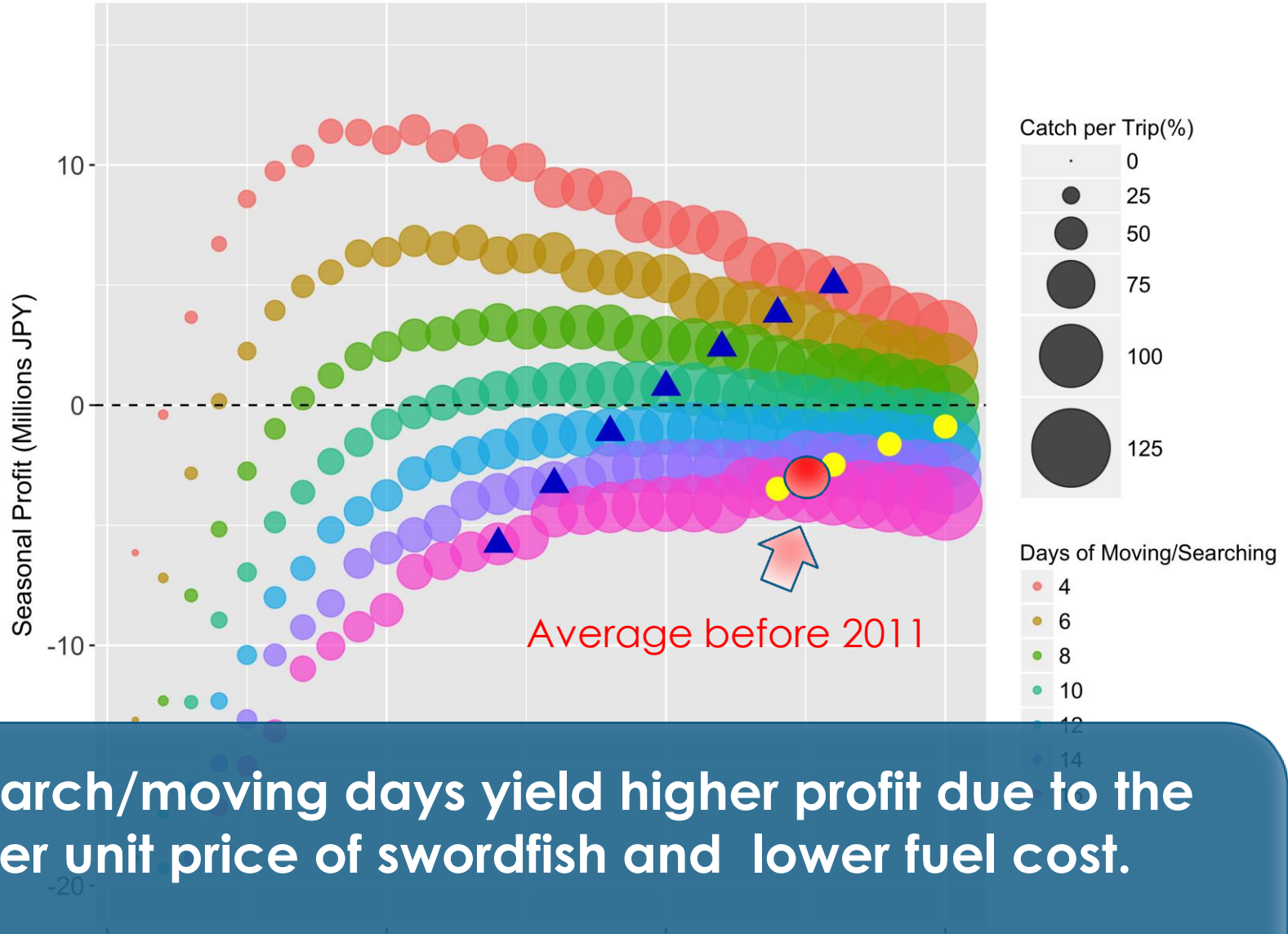


Result



The seasonal profit and harvest per trip on operation days when search/move days are 4, 6, 8, 10, 12,14 and 16 days.

Ishimura,G., Abe, K. & Goto, T. Rivision submitted to the ICES Journal of Marine Science

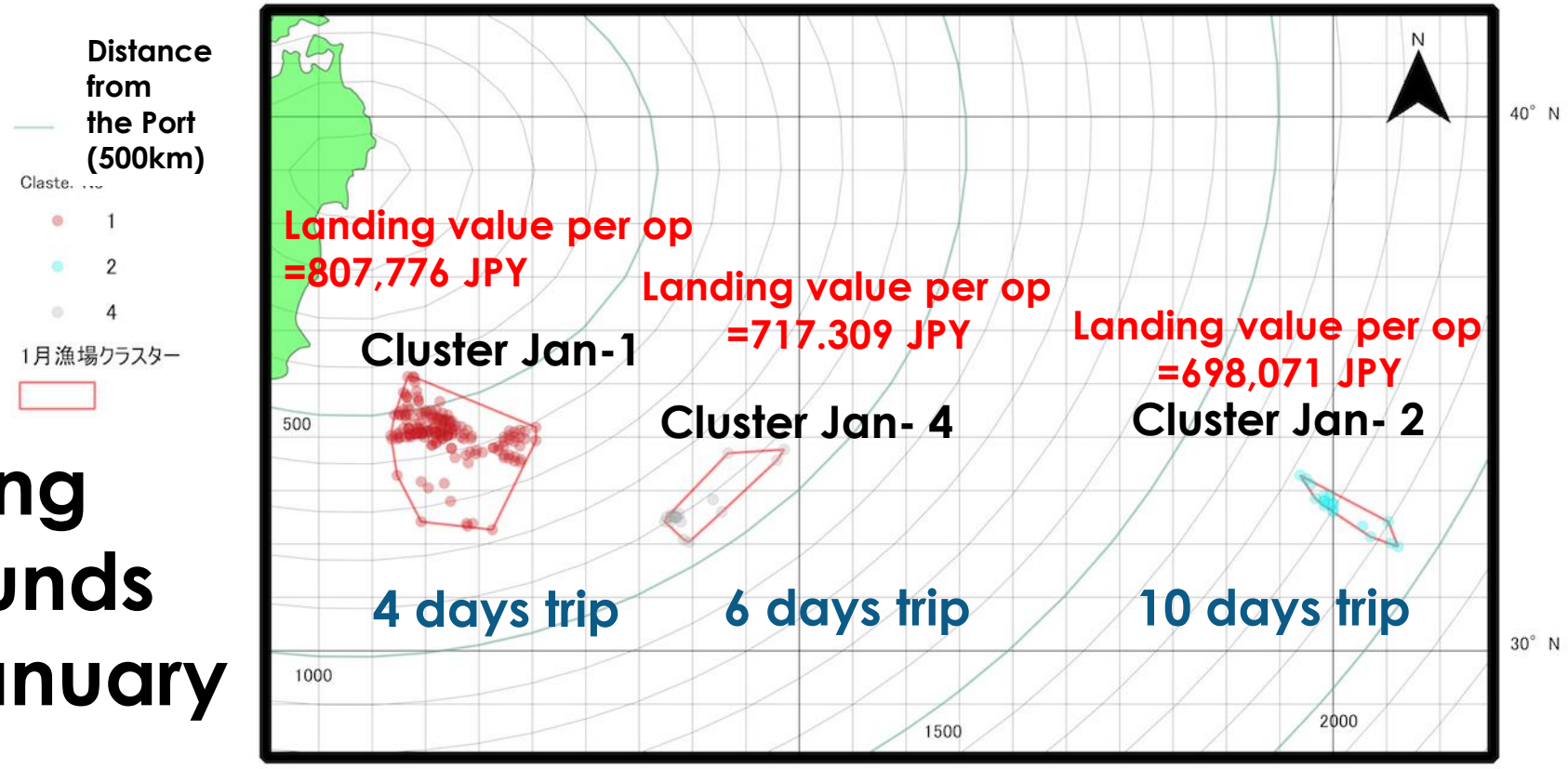


Less search/moving days yield higher profit due to the higher unit price of swordfish and lower fuel cost.

Average trip before 2011 (M/S days 14 + Op days 26 =total 40 days) is not profitable.

Ishimura,G., Abe, K. & Goto, T. Revision submitted to the ICES Journal of Marine Science

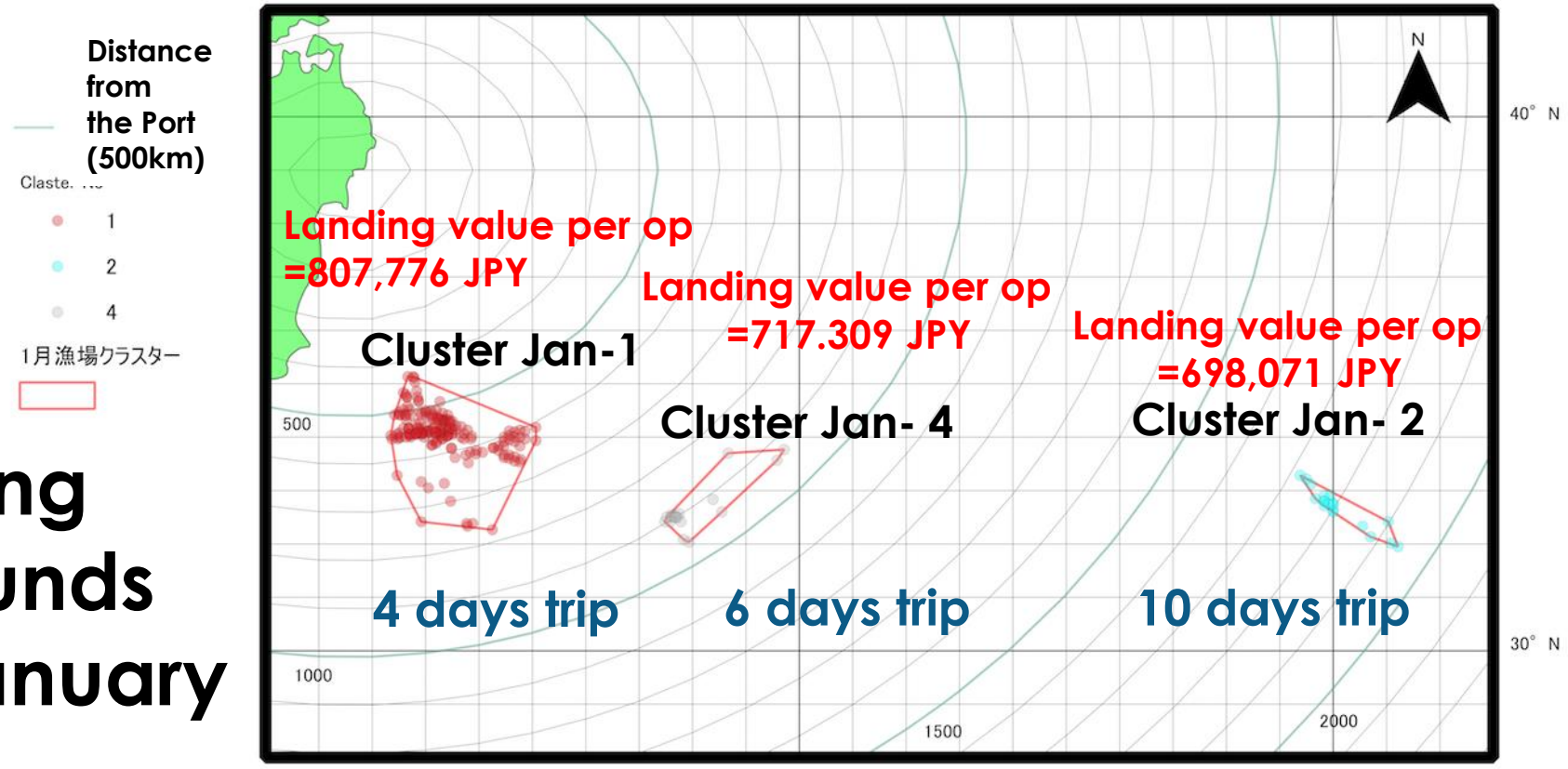
Fishing Grounds in January



Cluster Number	1	2	4
n	172	19	19
Data Share within Month	79%	9%	9%
Average Landing Values per Operation (JPY)	807,776	698,071	717,309
Share of Swordfish Landing	86%	79%	78%
Distancece from Port (km)	561	1806	907
Search/Moving Days	4	10	6
Operation Days for Maximized Profit per Trip	15	16	18
Total Days for Maximized Profit per Trip	19	26	22
Operation Days for Maximized Profit per Season	11	16	13
Total Days for Maximized Profit per Season	15	26	17
Total Days for Break-Even Points	10 & 41	21 & 36	9 & 41

Calculated from optimal efforts

Fishing Grounds in January

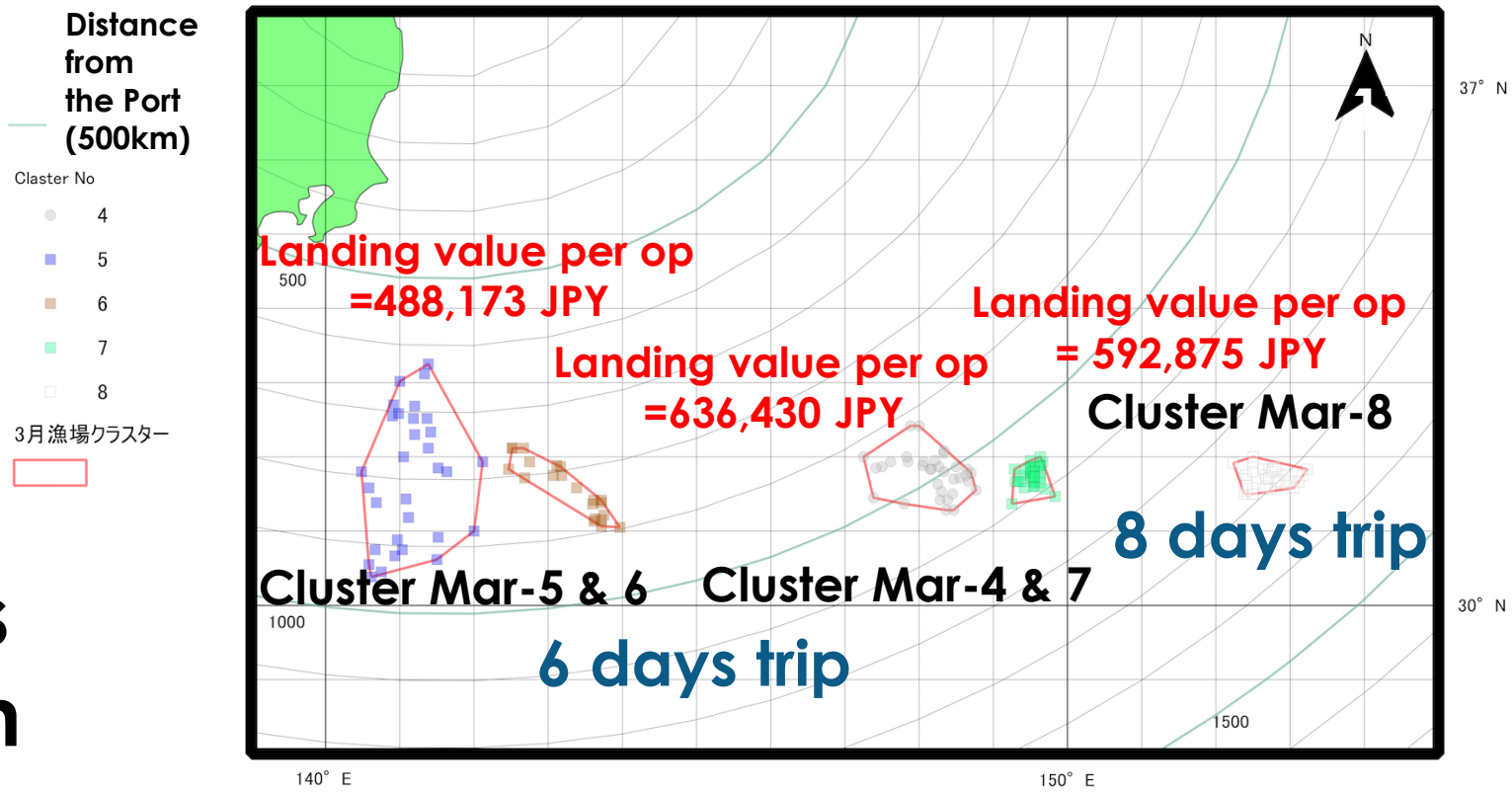


Calculated from optimal efforts

Cluster Number	1	2	4
n	172	19	19
Data Share within Month	79%	9%	9%
Average Landing Values per Operation (JPY)	807,776	698,071	717,309
Share of Swordfish Catch	88%	79%	78%
Distancece from Port (km)	561	1806	907
Operation Days for Maximized Profit per Trip	4	6	6
Operation Days for Maximized Profit per Trip	15	16	18
Total Days for Maximized Profit per Trip	19	26	22
Operation Days for Maximized Profit per Season	11	16	13
Total Days for Maximized Profit per Season	15	26	17
Total Days for Break-Even Points	10 & 41	21 & 36	9 & 41

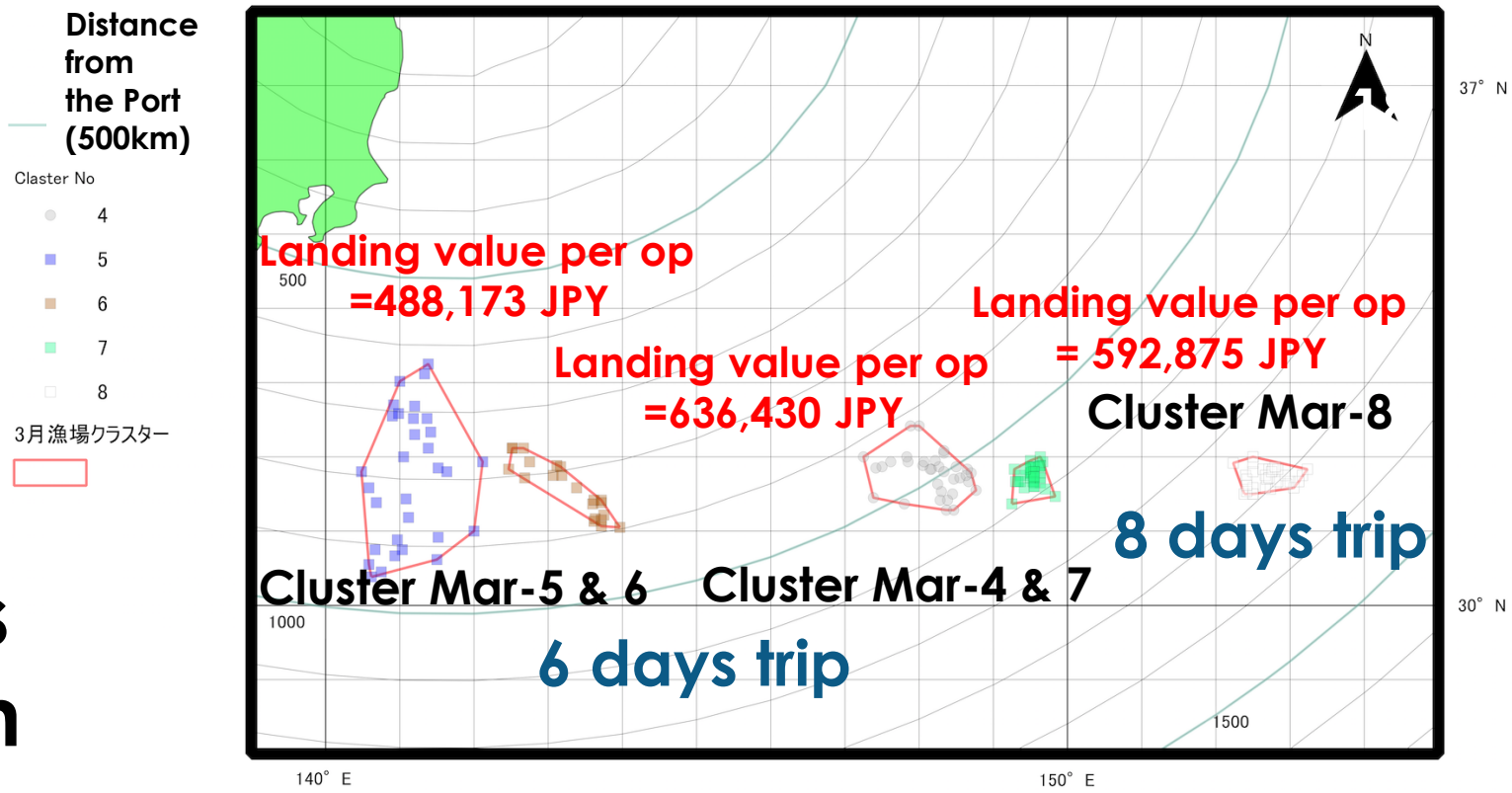
Support the result from ① optimal fishing efforts - Less search/moving days yield higher profit due to the higher unit price of swordfish and lower fuel cost..

Fishing Grounds in March



Cluster Number	4	5	6	7	8
n	34	31	21	39	31
Data Share within Month	20%	18%	12%	23%	18%
Average Landing Values per Operation (JPY)	450,362	488,173	578,924	636,430	592,875
Share of Swordfish Landing	61%	65%	75%	79%	68%
Distancece from Port (km)	991	797	828	1072	1285
Search/Moving Days	6	6	6	6	8
Operation Days for Maximized Profit per Trip	18	18	18	18	17
Total Days for Maximized Profit per Trip	22	22	22	22	25
Operation Days for Maximized Profit per Season	13	13	13	13	14
Total Days for Maximized Profit per Season	17	17	17	17	22
Total Days for Break-Even Points	9 & 41	9 & 41	9 & 41	9 & 41	14 & 39

Fishing Grounds in March



Cluster Number	4	5	6	7	8
n	34	31	21	39	31
Data Share within Month	20%	18%	12%	23%	18%
Average Landing Values per Operation (JPY)	450,362	488,173	578,924	636,430	592,875
Share of Swordfish Landing	61%	65%	75%	79%	68%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Search/Moving Days	6	6	6	6	8
Operation Days for Maximized [illegible]	[illegible]	[illegible]	18	18	17
Total Days for Maximized Profit per Trip	22	22	22	22	25
Operation Days for Maximized Profit per Season	13	13	13	13	14
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Days for Break-Even Points	9 & 41	9 & 41	9 & 41	9 & 41	14 & 39

As the season reach to the end, the fishing grounds have homogeneous profiles.

Next Step

Extend analysis for blue shark and the joint production function.

Explore optimum choice of fishing grounds and fishing efforts under uncertainties.

As all vessels will join the new company, develop the group-vessel schedule to make this fishery sustainable .

Next Steps

Thanks!