The relationship between cetacean distributions and oceanographic conditions in the western North Pacific

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Outline

1. Background
2. Objectives
3. Data and methods
4. Result and discussion
5. Conclusion
6. Future work

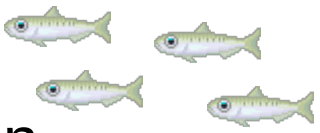
1.Background

Why should we investigate whales ??

- The important species for “Top down control” as higher trophic level species
- Forage commercial fish species

Why these 2 species ??

- They use pelagic creature
- Closely related
- Habitat Segregation



Sei whale (*Balaenoptrera borealis*)

Bryde’s whale *(Balaenoptrera edeni*)

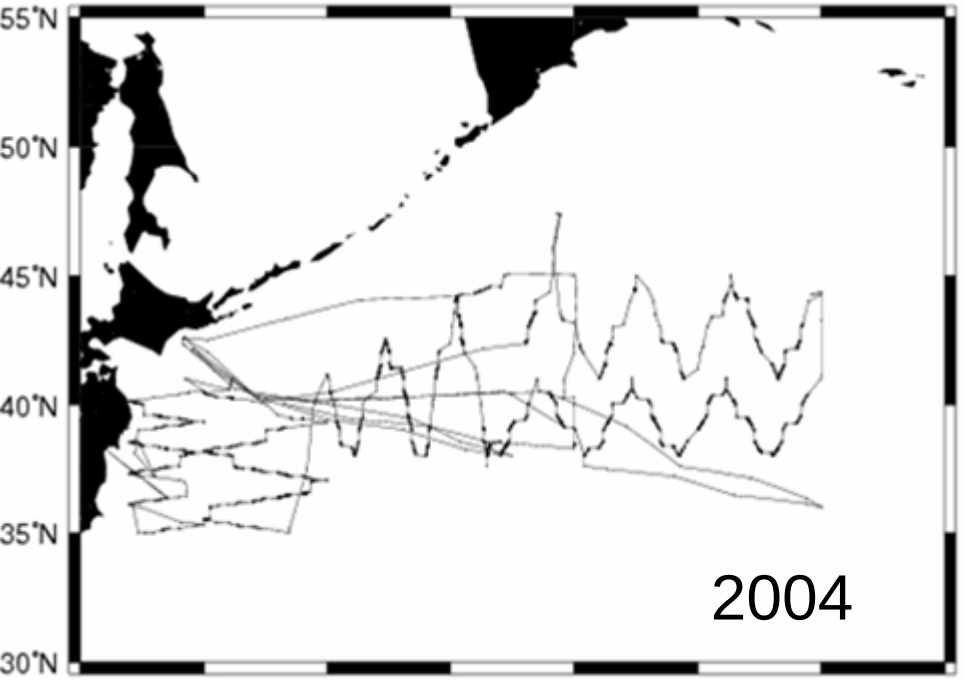
Little is known about the preferences of the two species for different habitats and marine environments.

1.Background

Sighting Research in western North Pacific

The Japanese Whale Research program under Special Permit in the Western North Pacific

(JARPN/JARPN II)



JARPN II (2000 ~ now) only monitoring by ship

- Cost much money
- Hasn't obtained temporal oceanographic condition
- Can't grasp the

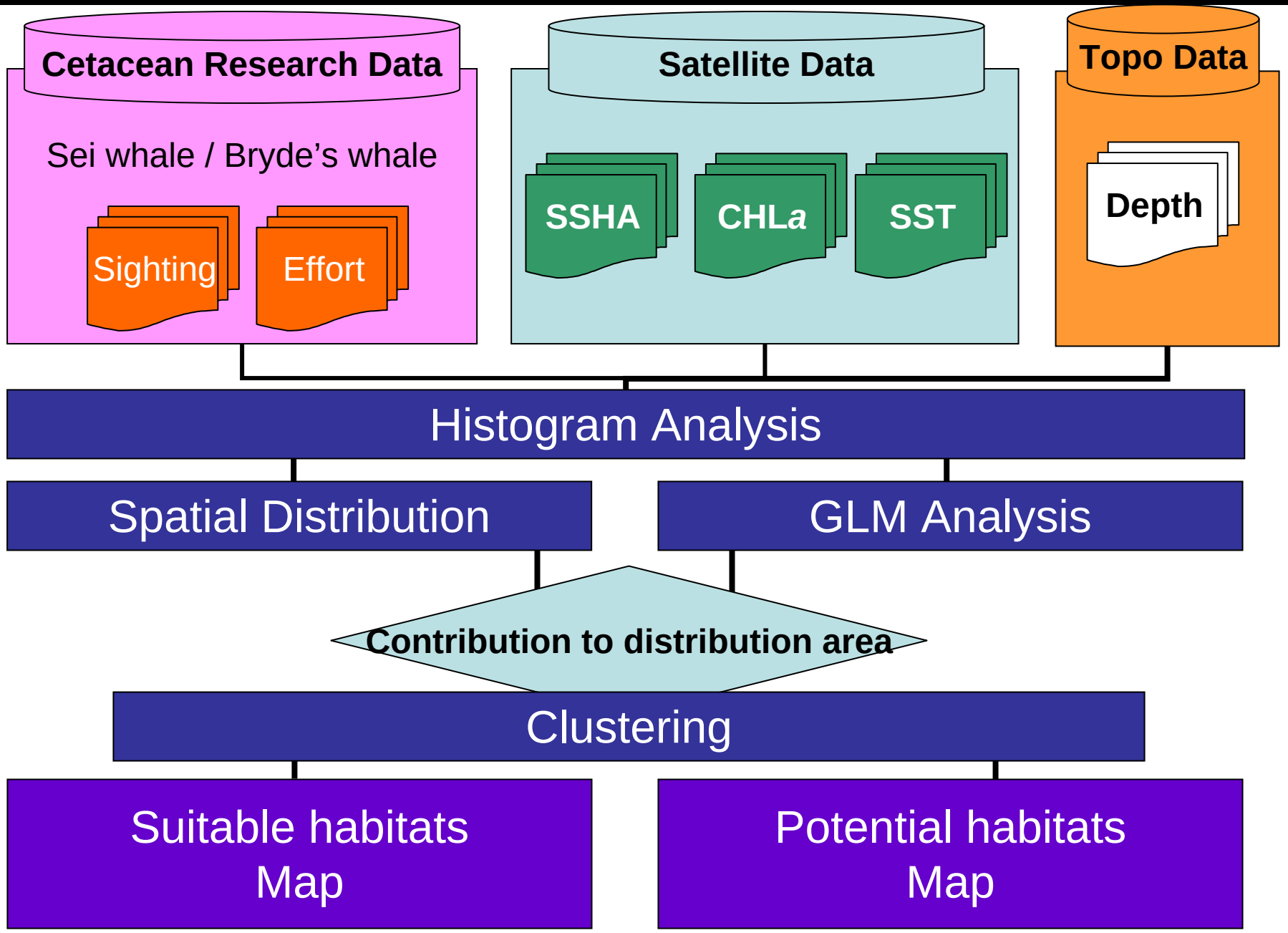
There was monitoring limitation for ocean environmental change in vast area simultaneously

2. Objectives

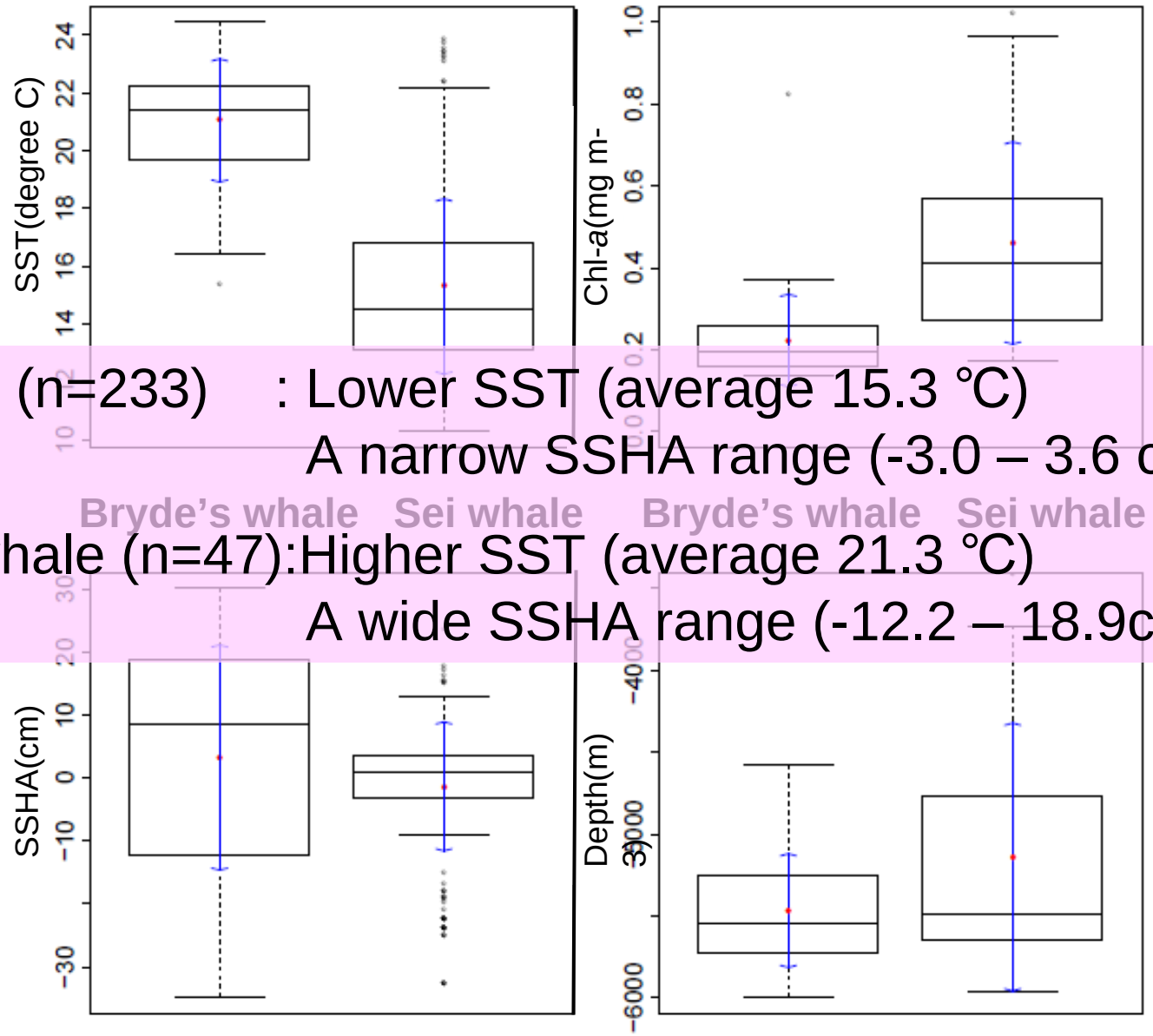
- **To investigate the distribution patterns of Sei whale and Bryde's whale with regard to oceanographic conditions in the western North Pacific.**

- **To estimate areas of suitable (occupied) habitat using satellite remote sensing.**

3. Data and Analysis flow



4. Result and Discussion -1



Sei whale (n=233) : Lower SST (average 15.3 ℃)
A narrow SSHA range (-3.0 – 3.6 cm)

Bryde's whale (n=47):Higher SST (average 21.3 ℃)
A wide SSHA range (-12.2 – 18.9cm)

Method : Generalized Linear Model

To clarify which variables are significant to define the area of potential habitat for these whales

Sei Whale presence : 1
Bryde's whale presence : 0

→ Categorical binary variables

Probability of Sei whale presence $P(Y=1)$

$$\log\left[\frac{P(Y=1)}{1-P(Y=1)}\right]=\beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3+\beta_4x_4=y$$

$x_1 \sim x_4$; Environmental variables

Probability of Sei whale presence $P(Y=1)=\frac{e^y}{1+e^y}$

4. Result and discussion -2

Expression	Variables	AIC
1	SST,CHL*a*,SSHA,DEPTH	111.66
2	SST,CHL*a*,SSHA	109.88
3	SST,CHLa,DEPTH	120.38
4	SST,SSHA,DEPTH	125.6

Whale distribution areas were characterized by these 3 parameters

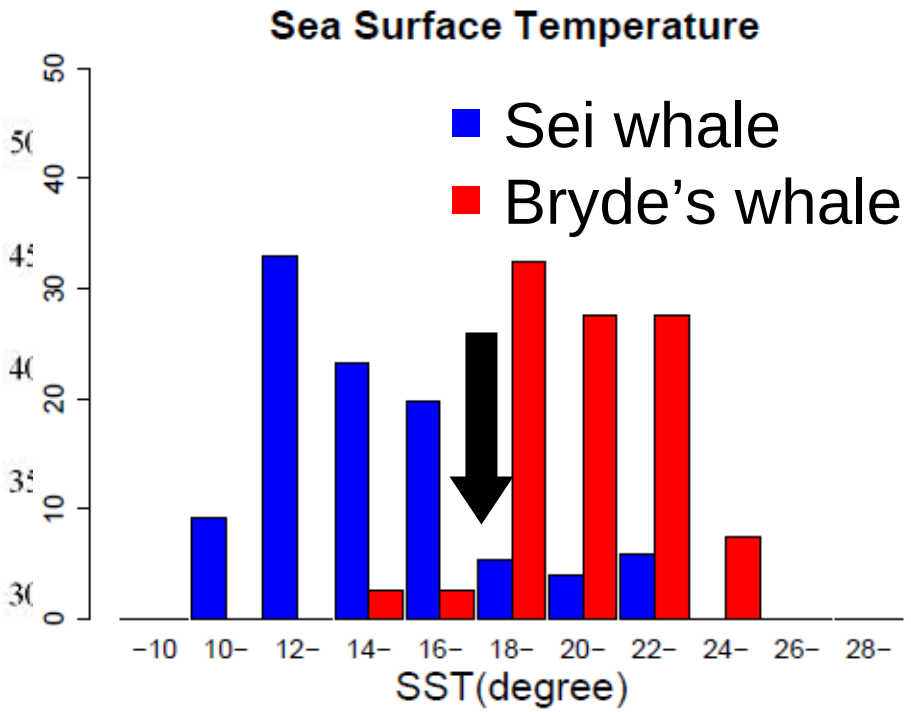
$$P(Y=1)=\frac{\exp(8.82-0.47\times SST-0.07\times SSHA+4.25\times CHLa)}{1-\exp(8.82-0.47\times SST-0.07\times SSHA+4.25\times CHLa)}$$

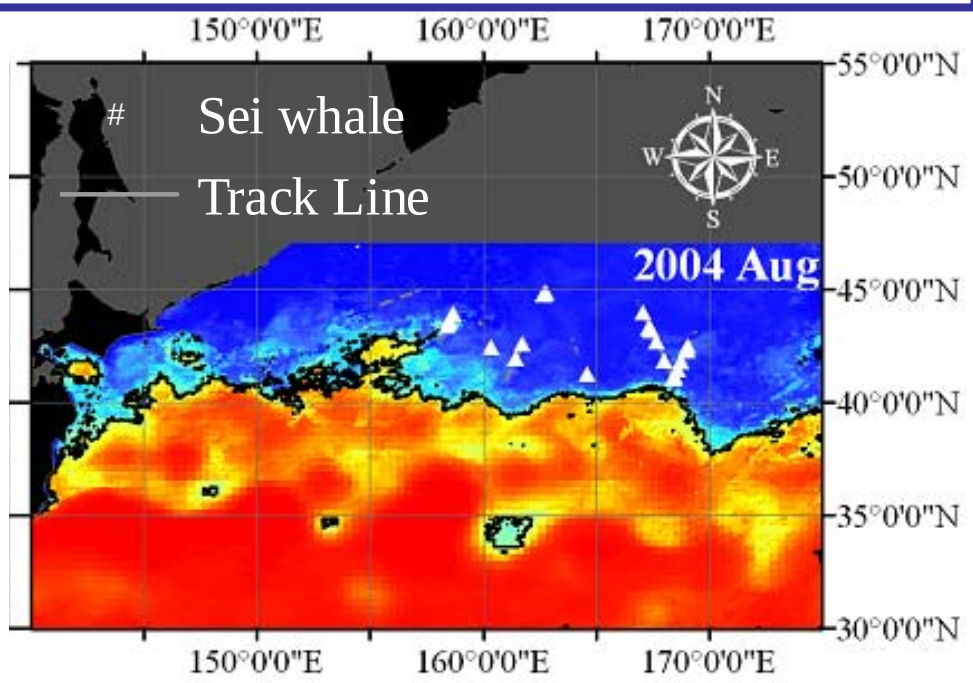
The relative importance of variables

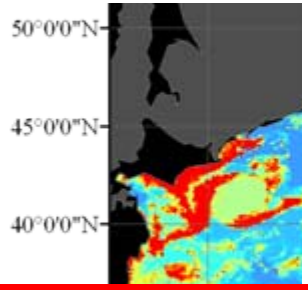
→ SST > CHL-*a* > SSHA

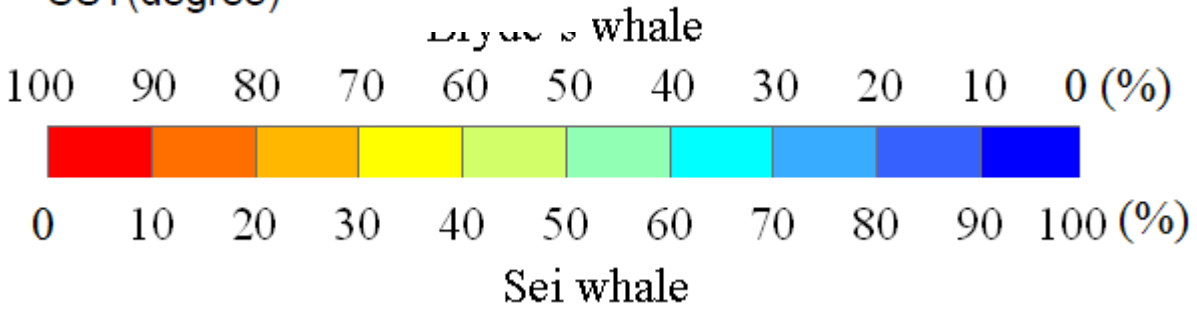
4. Result and Discussion -3

GLM(SST, Chl-a, SSHA) → Potential Habitat Area





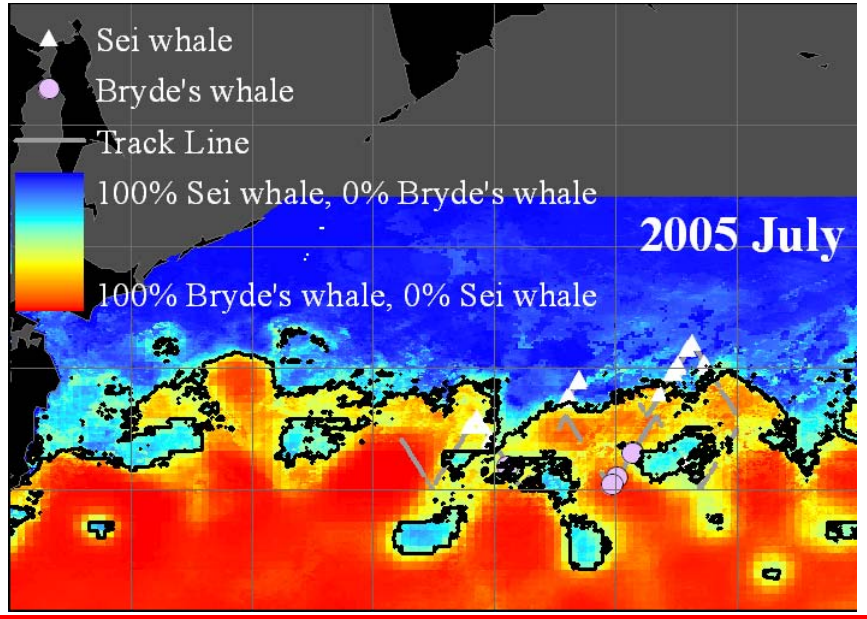




There was a distinct boundary which divided
→ Sei whales and Bryde' s whales (model and sightings)

4. Result and discussion -3

GLM(SST, Chl-a, SSHA) validation



Sei whale → 97%

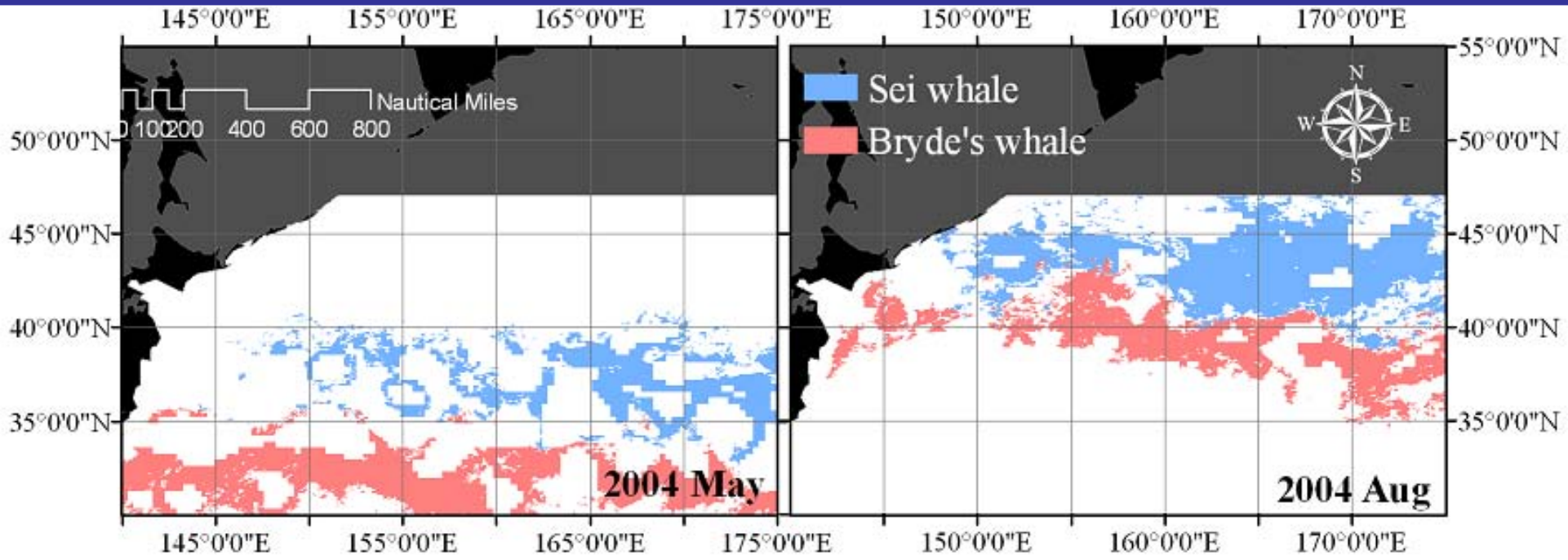
Bryde's whale → 48%

Western North Pacific Oceanographic Condition

→ Suitable for Sei whale than Bryde's whale ??

4. Result and Discussion -3

Empirical data (SST, Chl-a, SSHA) → Suitable Habitat Area



Habitat **R**ange (**HR**) ⇒ average ± standard deviation

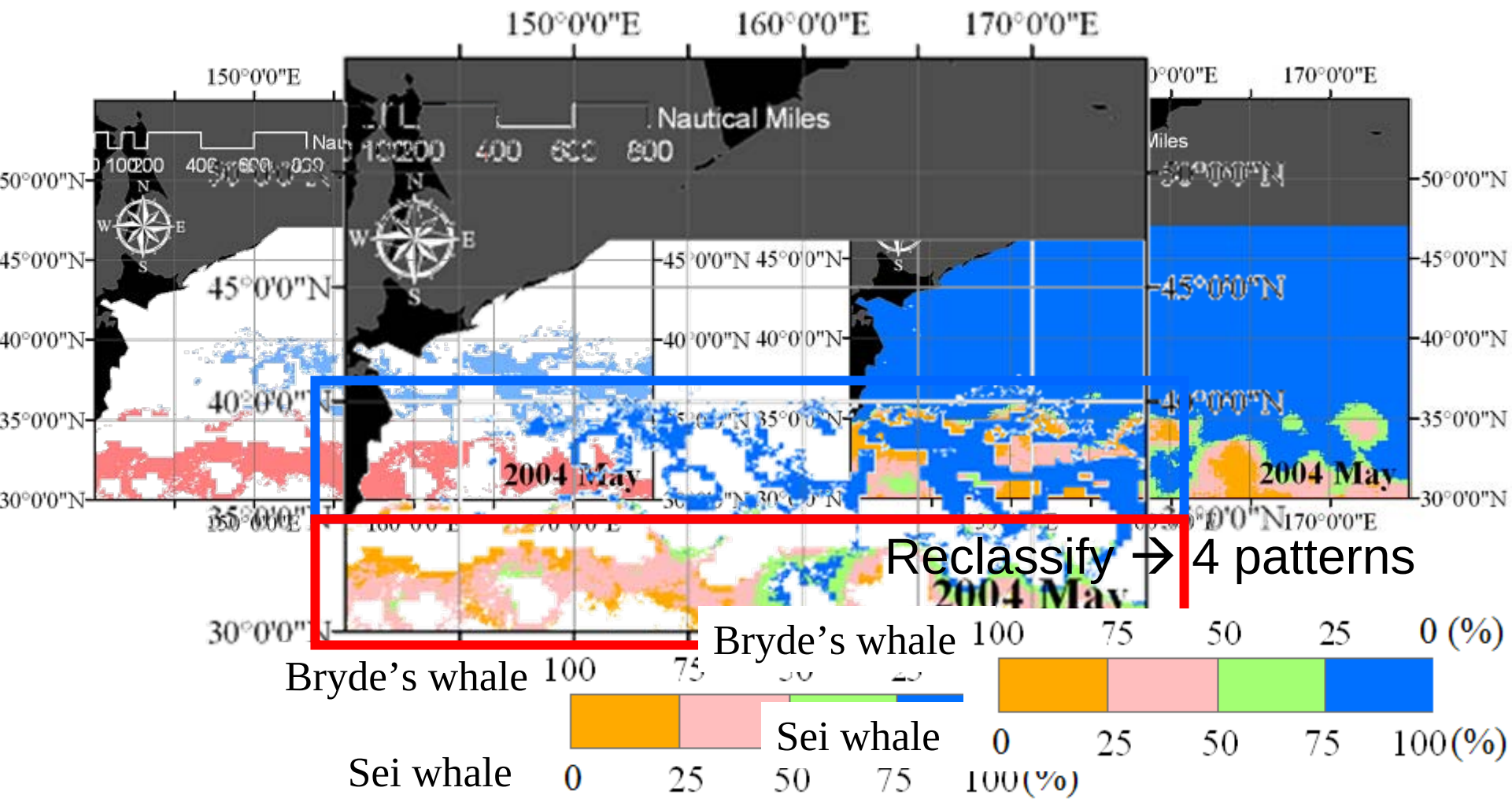
The two suitable habitat areas were clearly separated

North : Sei Whale South : Bryde's whale

The same pattern was observed in all months

4. Result and Discussion -3

Suitable Habitat Area (Empirical) & Potential Habitat Area (GLM)

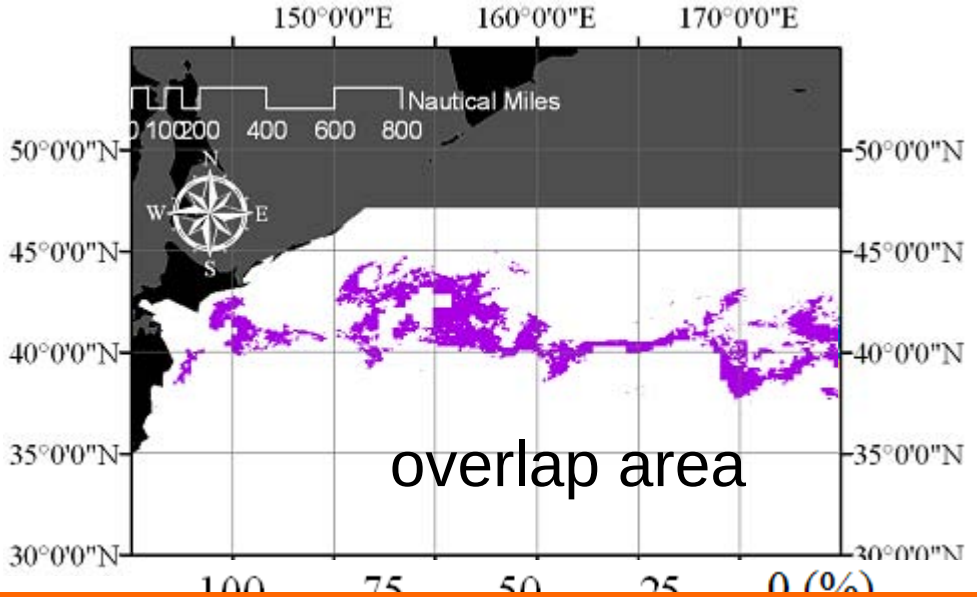


Sei whale habitat area = High probability (75 - 100%)

Bryde's whale habitat area = Not High probability (25 – 75%)

4. Result and discussion -3

Whale presence probability inside overlap area



Overlap area

Average probability → 65%

(Probability leans slightly toward Sei whales)

SST range → overlap range (15.9 – 22.2℃)

Chl-a → large overlap range (0.12 - 1.77 mg m-3)

SSHA range → overlap(-9.02 – 12.93)

5. Conclusion

- Distribution areas were clearly differentiated based on oceanographic conditions, with sei whales having a more northern distribution compared to Bryde's whales.

- Habitat segregation clearly revealed a distinct boundary (~18℃) between these two whale species in the Western North Pacific.

- Sei whale habitat more clearly defined than Bryde's whale.

6. Future Work

- Clarify the relationship between their distribution in each potential habitat area and spatial signature like as oceanic fronts

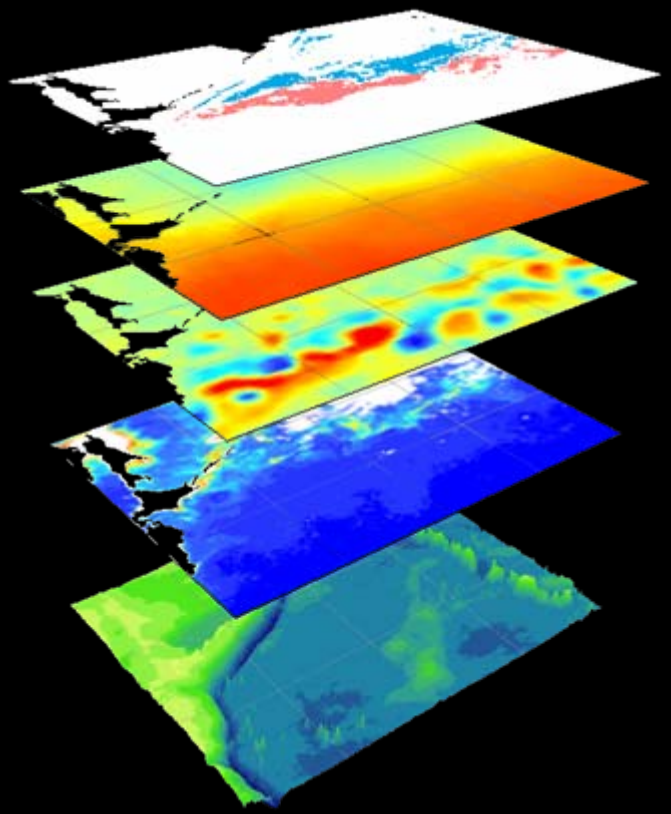
ex…

Temporal resolution

Monthly resolution ⇒ Weekly resolution

- Use more parameters (Weekly Scale)

→ eddy , ΔSST, Δchl-*a*



Thank you
for your attention