

Archival tag deployments by NRIFS FRL with tropical tunas around Japan

By

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Outline

- Summary of archival tagging for BET and YFT
- Summary of archival tagging for SKJ
- Future outlook

Summary of archival tagging for BET and YFT



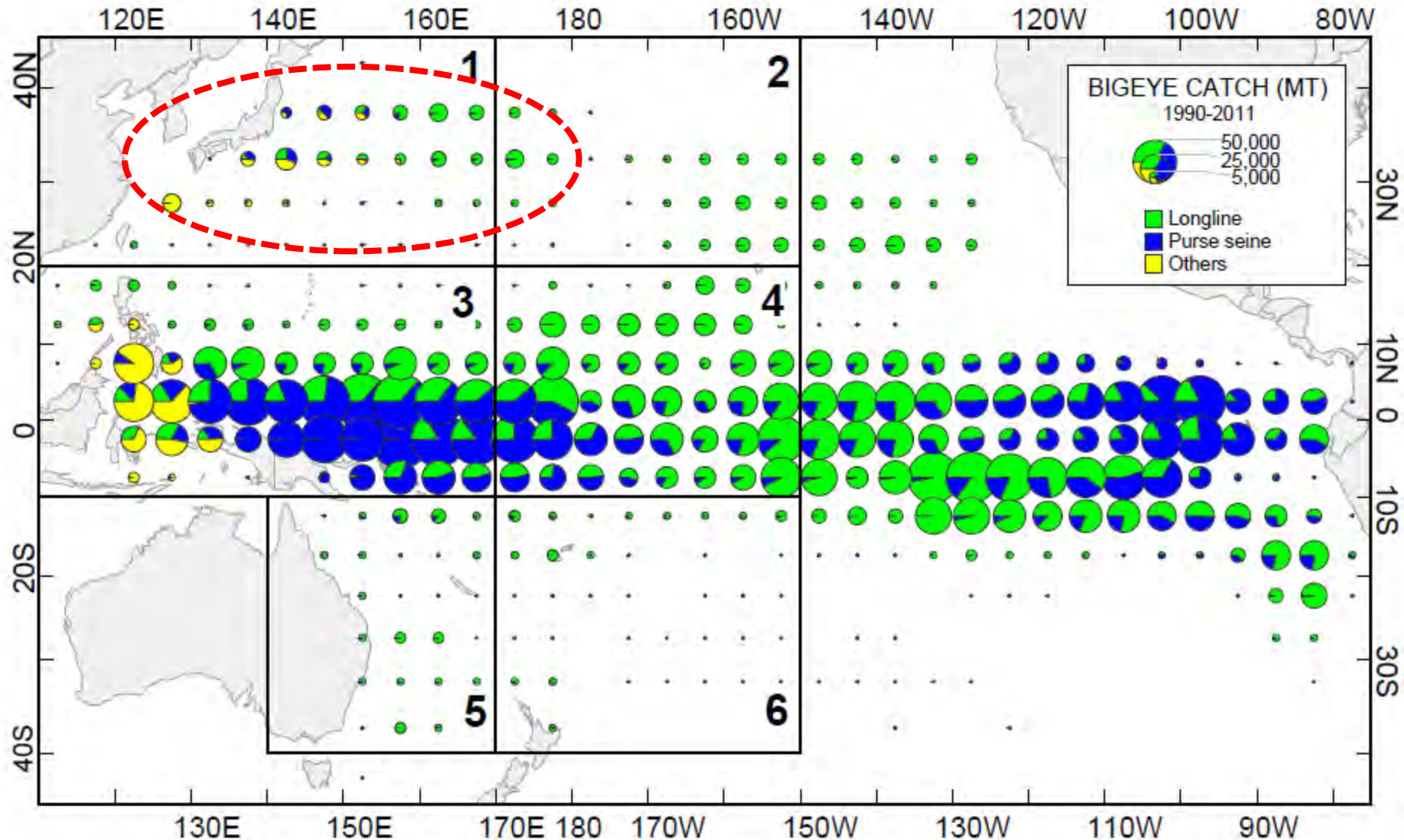
Literatures

- Matsumoto et al. (2013) Considerations on diving patterns of bigeye tuna *Thunnus obesus* based on archival tag data. Fisheries Science. Vol.79, No.1, pp39–46
- Matsumoto et al. (2013) Vertical behavior of bigeye tuna (*Thunnus obesus*) in the northwestern Pacific Ocean based on archival tag data. Fisheries Oceanography. Vol.22, No.3, pp234–246
- Matsumoto et al. (2013) Vertical behavior of juvenile yellowfin tuna *Thunnus albacares* in the southwestern part of Japan based on archival tagging. Fisheries Science. Vol.79, No.3, pp417–424
- Hino et al. (in press) Changes to vertical thermoregulatory movements of juvenile bigeye tuna (*Thunnus obesus*) in the northwestern Pacific Ocean with time of day, seasonal ocean vertical thermal structure, and body size. Fisheries Oceanography.

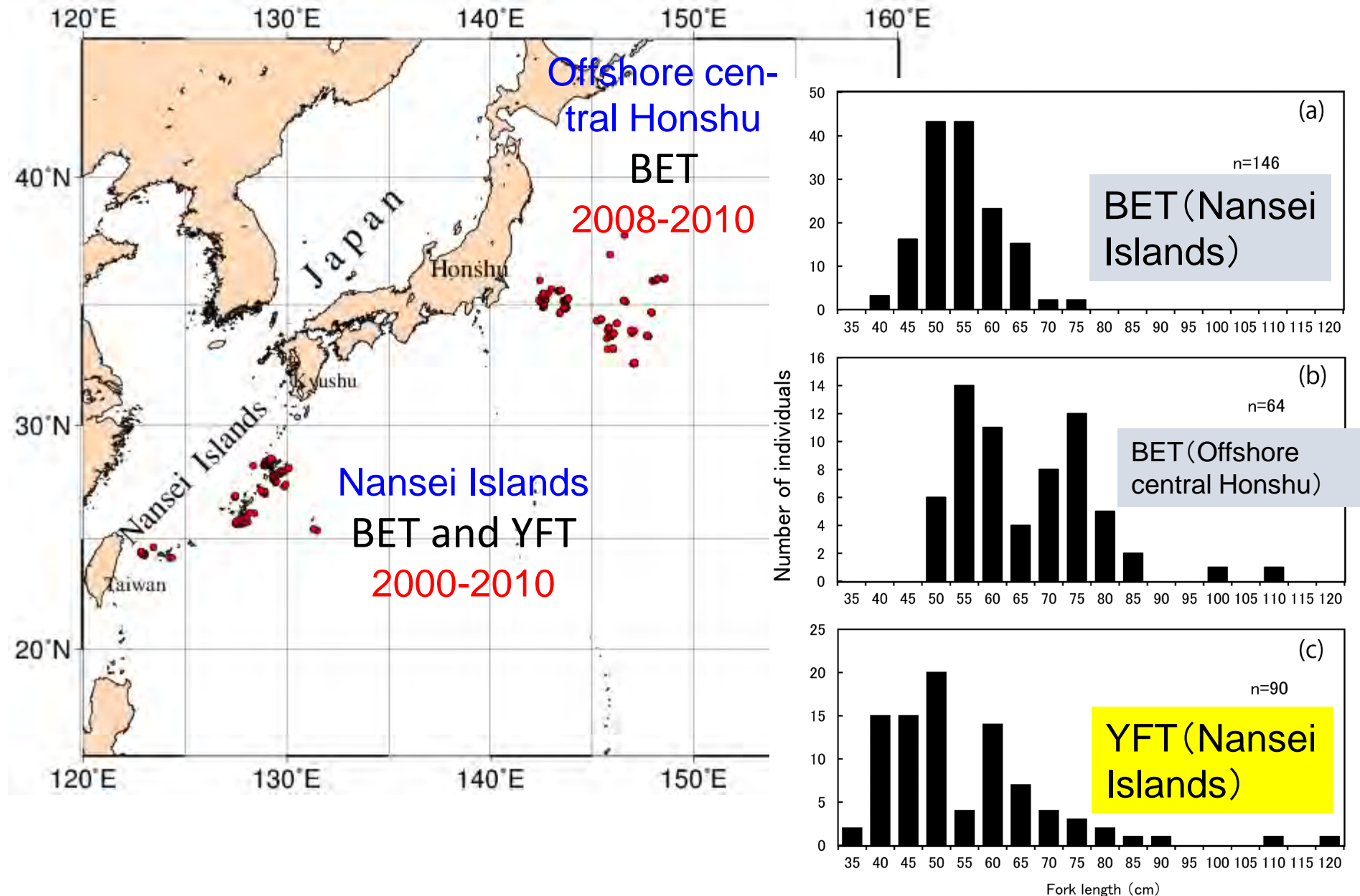
Backgrounds

- **Northwestern Pacific Ocean** including Japanese water is one of fishing grounds for **tropical tunas** (LL, PS, PL, etc).
- In the past (until 1990s), there was almost no report for the migration and behavior of BET and YFT in this area.
- In the tropical tuna tagging projects by Fisheries Agency of Japan in cooperation with NRIFSF during 2000-2010 (presentation on the 1st day), both **conventional** and **archival** tagging were conducted.

Distribution of bigeye catch

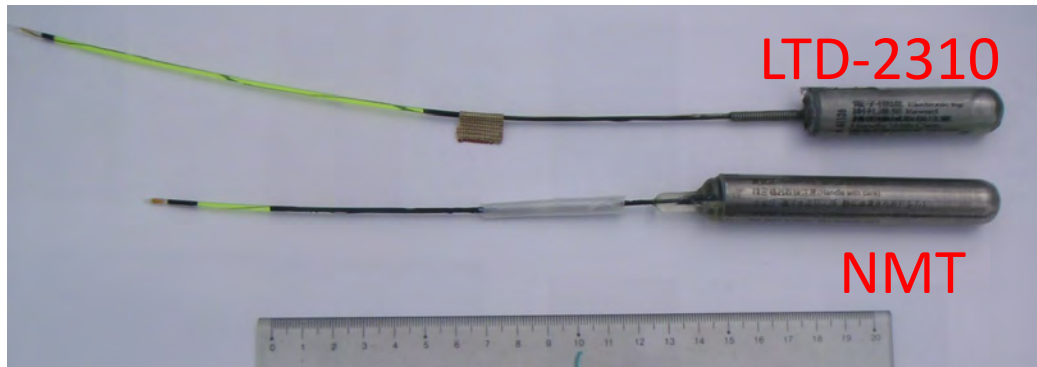


Location of release, period of study and fish size



Archival tags used for BET and YFT

- ◆ NMT (US) Ver. 1.0, Ver. 1.1(2000-2004), Lotek (Canada) LTD-2310 (2003-)
- ◆ Tags were inserted in the peritoneal cavity

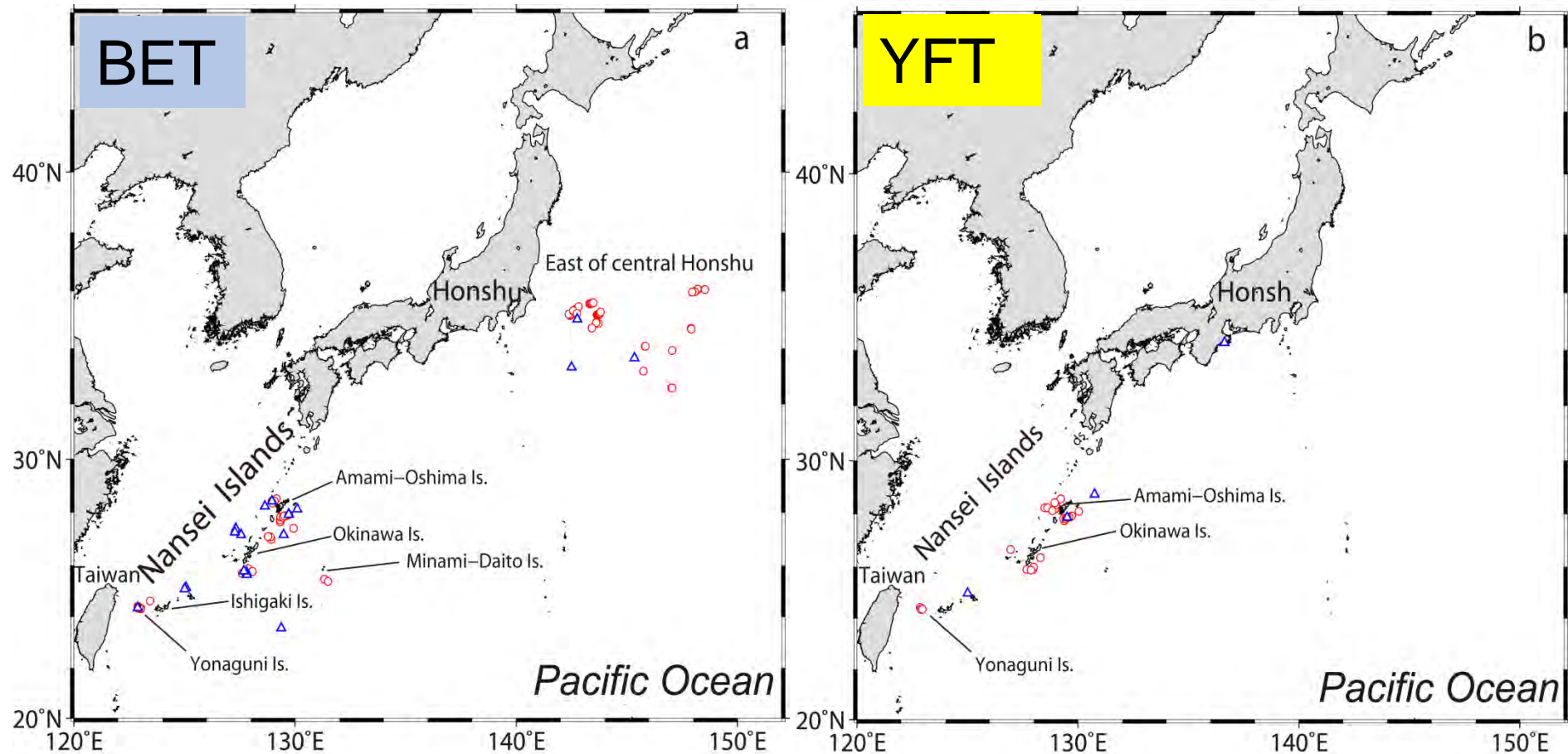


		NMT Ver.1.0, 1.1	LTD-2310 (8MB)	LTD-2310 (16MB)
Memory size		256 KB	8 MB	16 MB
Length(cm)		10	7	7
Diameter (cm)		1.6	1.6	1.6
Weight in air (g)		52	40	40
Logging interval (sec)		256	60	60
Data logging period (days)	Fixed part	40	500	500
	B part (changeable)	122	480	1460

Summary of release and recapture (BET and YFT)

	BET			YFT
Release area	Nansei Islands	Offshore central Honshu	Total	Nansei Islands
Release	146	64	210	90
FL at release (cm)	42–75 (mean 56.7)	53–111 (mean 68.4)	42–111 (mean 60.3)	38–120 (mean 56.8)
Recapture	34	2	36	7
Recapture rate	23%	3%	17%	7.8%
Number of tags whose data are available	26	2	28	5
Number of days of time series data (range, total)	3–503 (2681)	34–175 (209)	3–503 (2890)	27–280 (541)

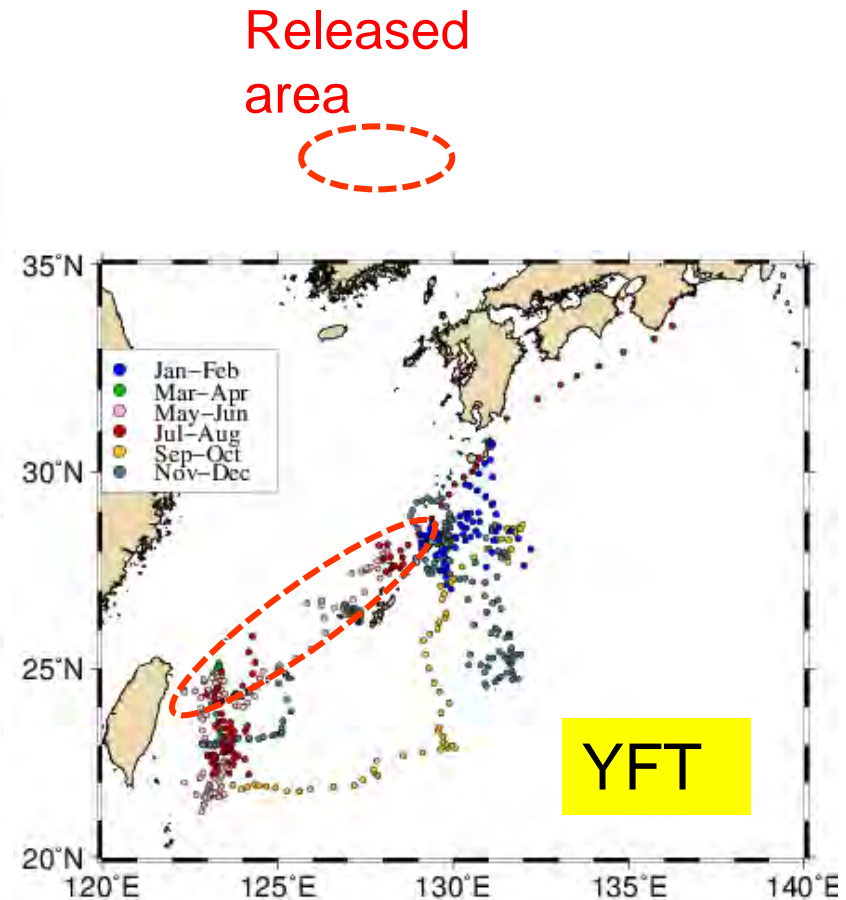
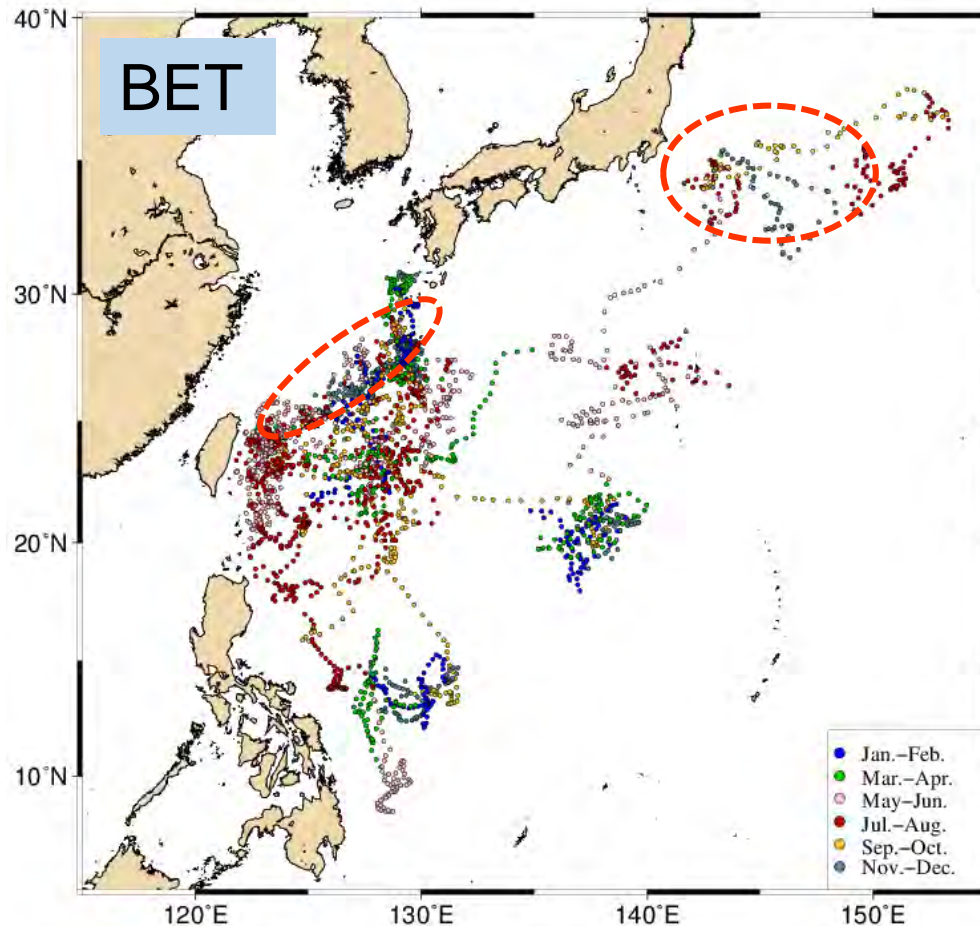
Release and recapture location



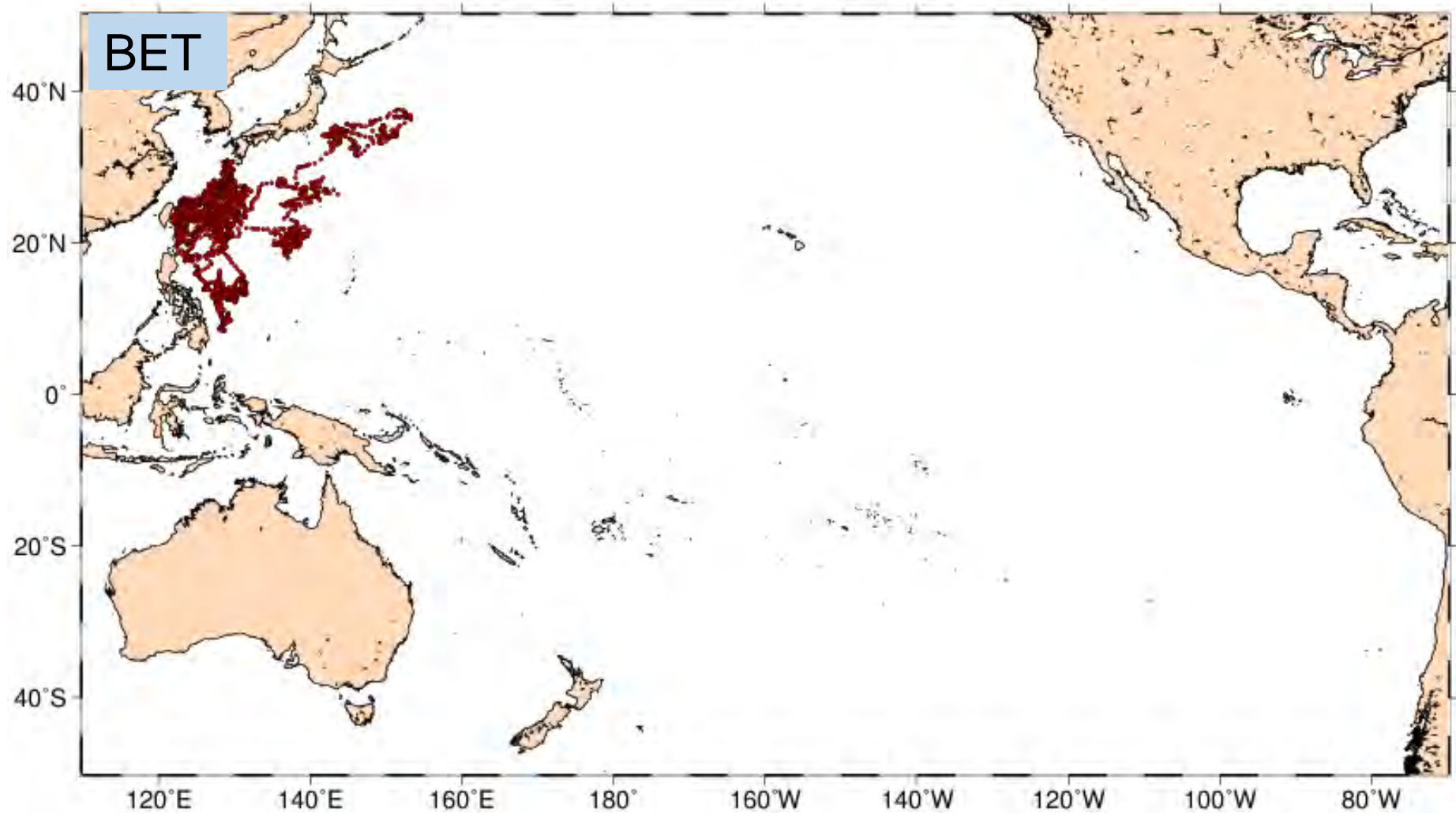
One BET was recaptured
at 8° N, 151° E (estimated)

○: Release
△: Recapture

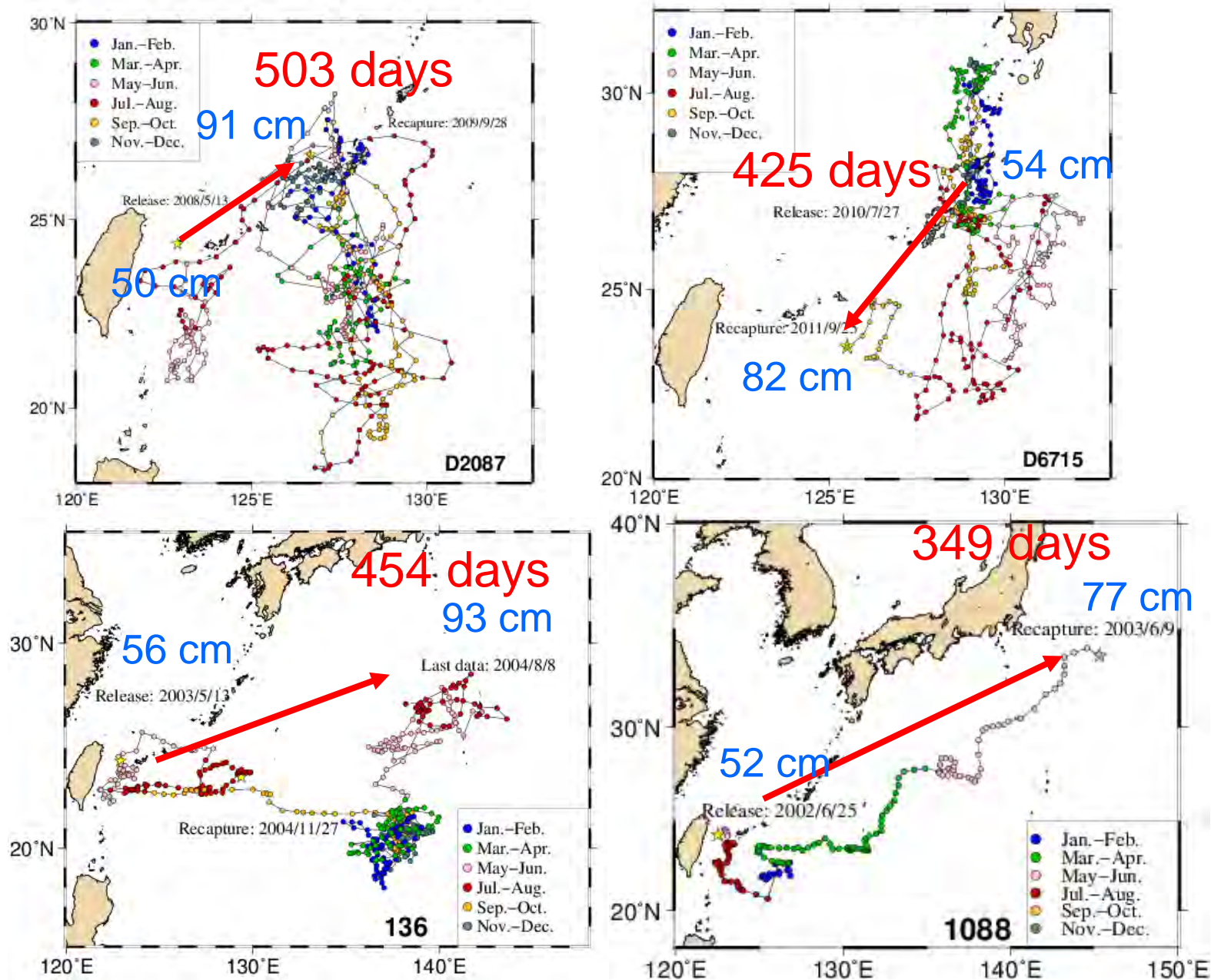
Daily horizontal distribution by archival tags (by month)



- Geolocation for all the fish
- Estimation of geolocation: UKFSST (Lam et al., 2008)
- Site fidelity
- No clear seasonality

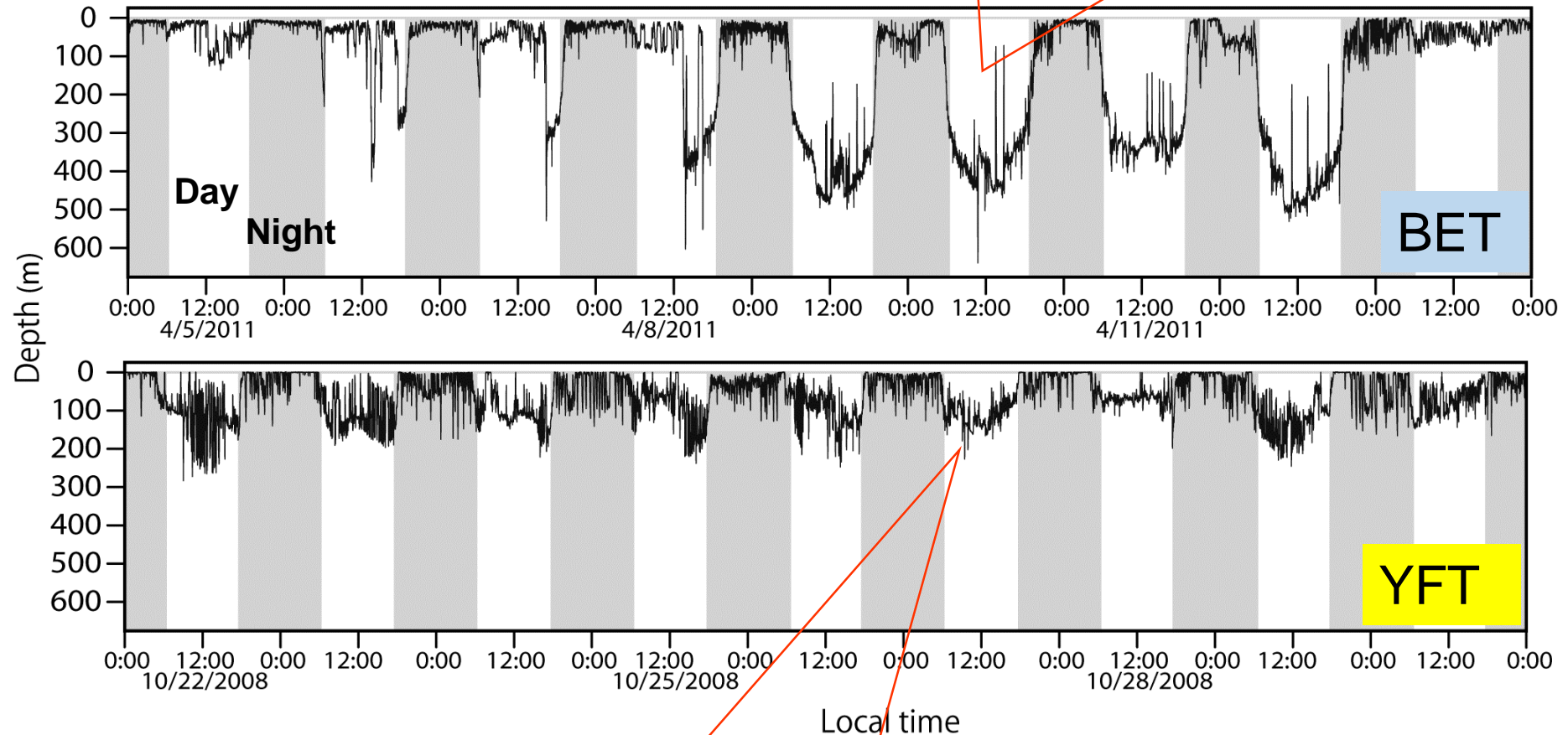


Examples of BET movement for long term recovery



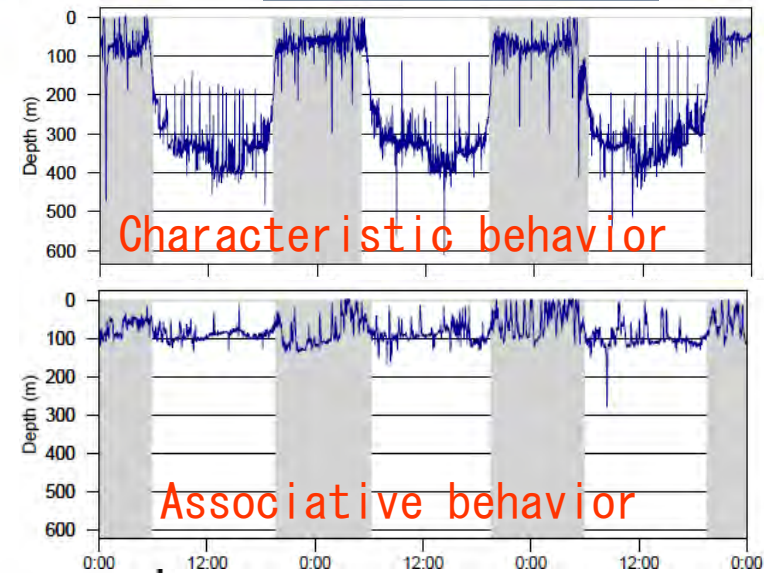
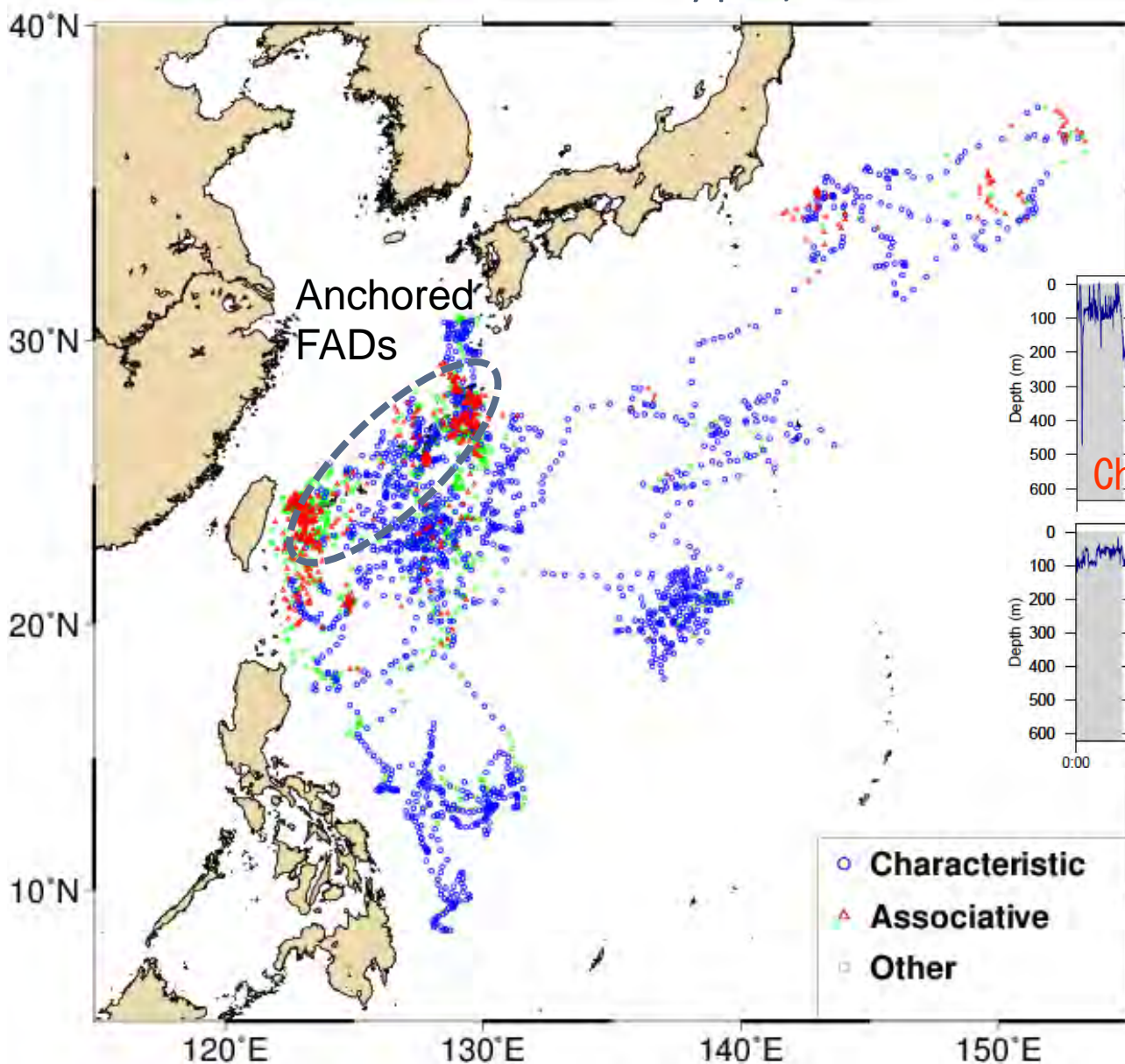
‘Typical’ vertical behavior

- Diurnal change in swimming depth
- Up to 400-500m during daytime



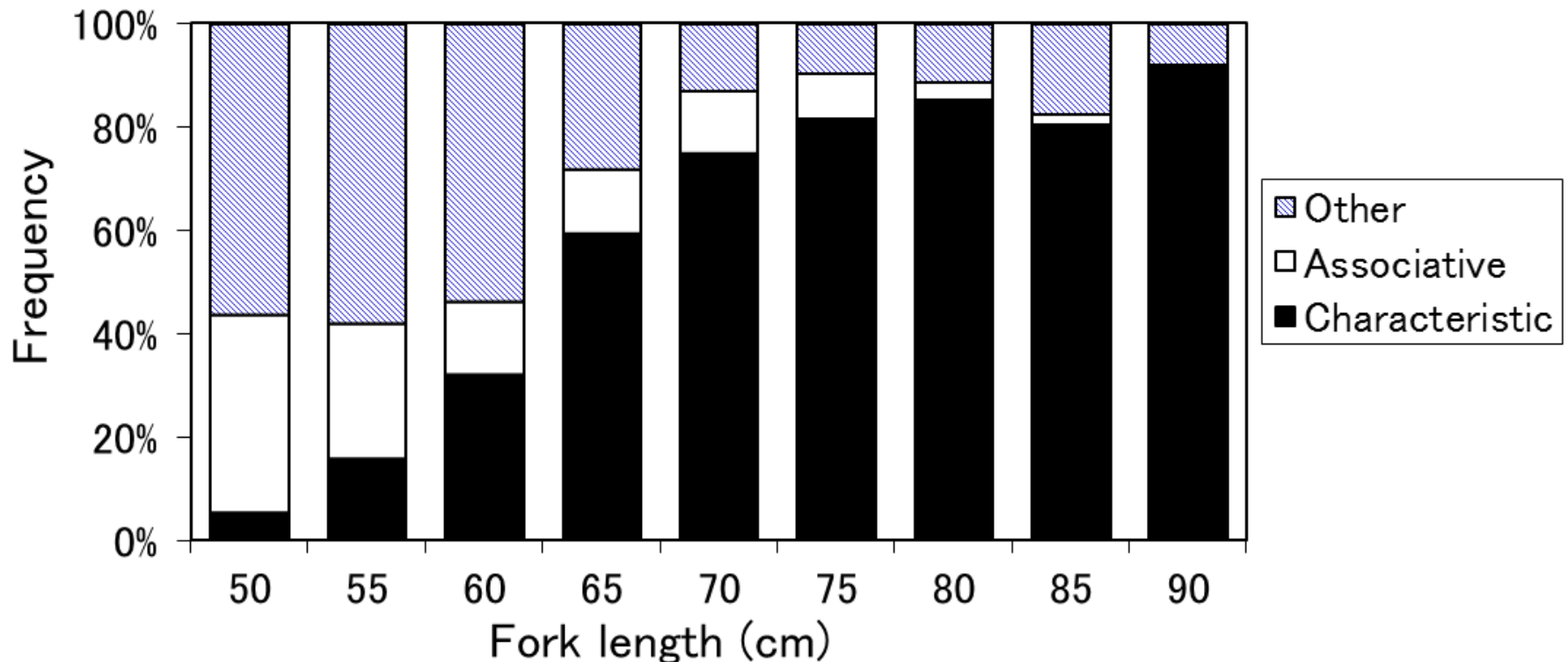
- Diurnal change in swimming depth is not clear
- Usually shallower than 400-500m

Daily horizontal distribution by archival tags (by behavior type) for BET



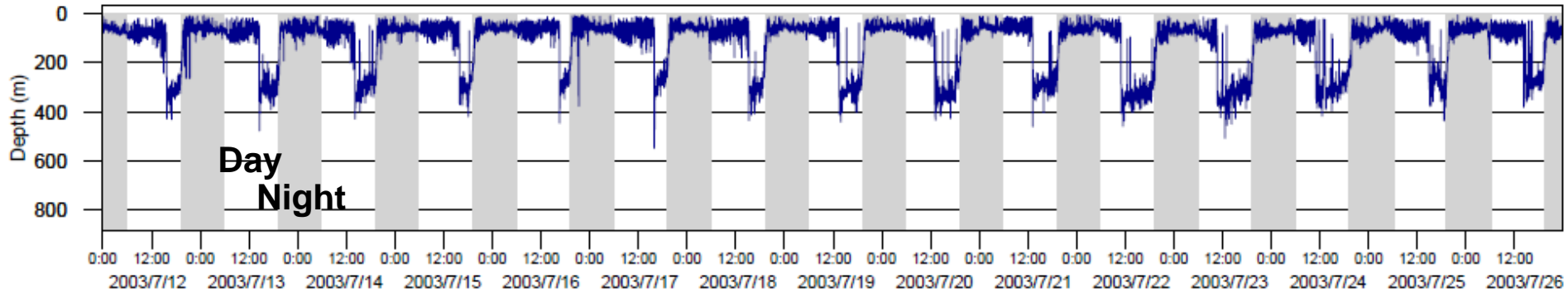
Classification of vertical behavior:
Schaefer and Fuller, 2010;
Matsumoto et al., 2013

Behavior type of BET by fish size

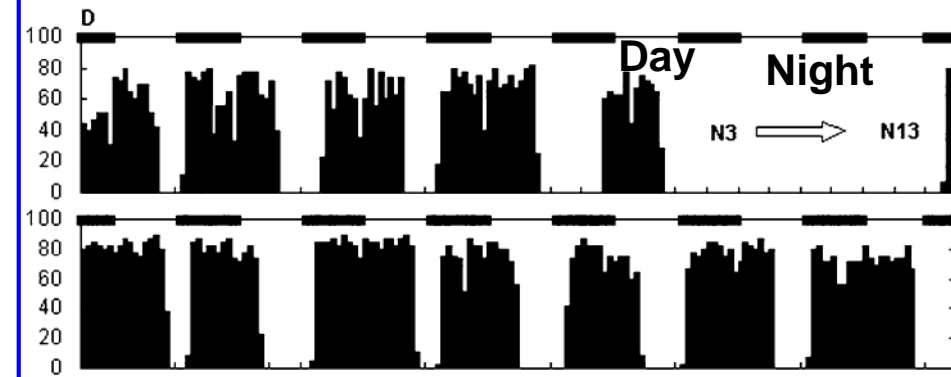


(Matsumoto et al., 2013)

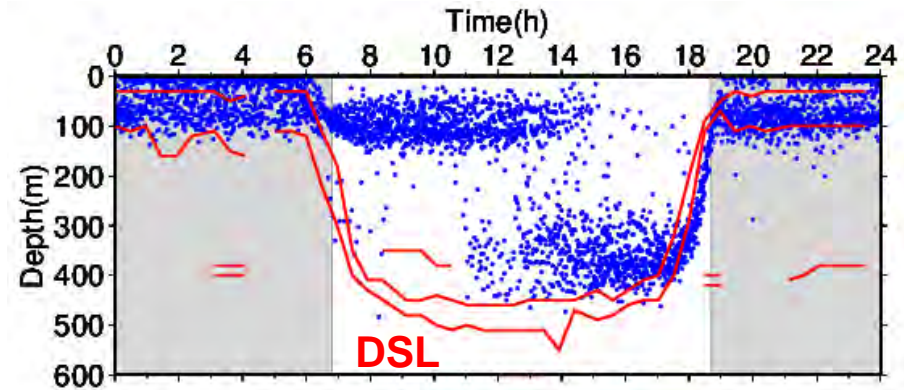
'Afternoon dive' (characteristic + associative) for BET



BET association with anchored FADs by time of day (Ohta and Kakuma, 2005)



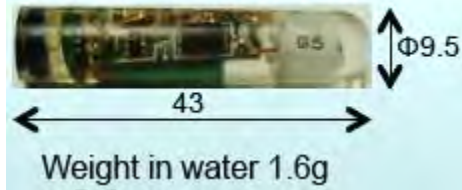
Afternoon dive and DSL



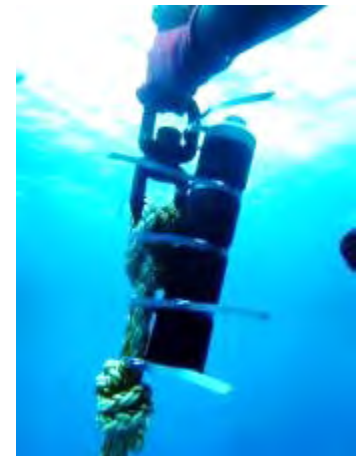
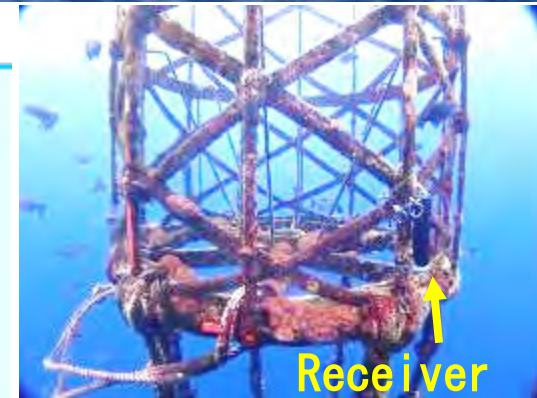
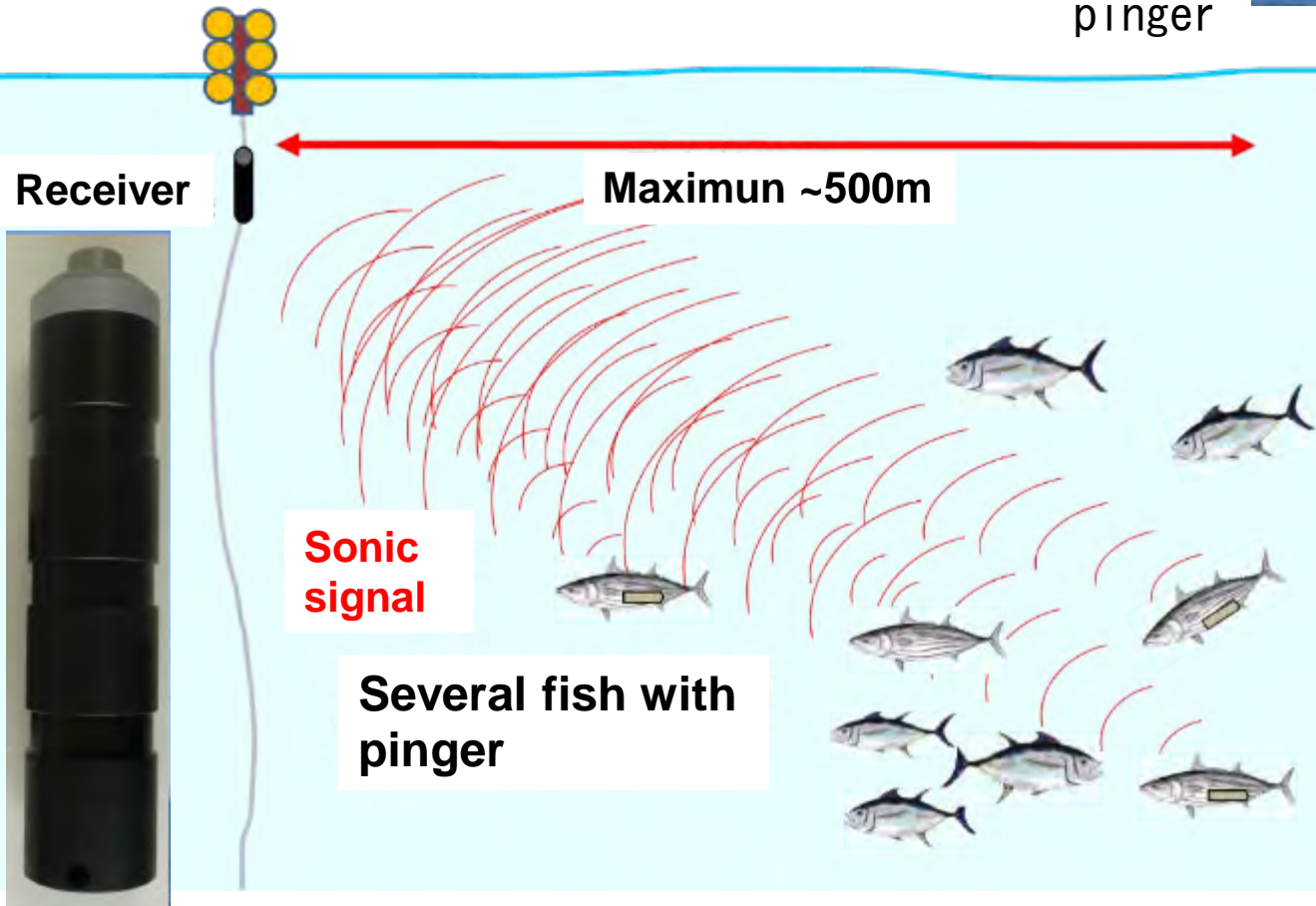
- 16% of days for BET behavior type.
- Ohta and Kakuma (2005) reported that sonic tagging of BET indicated that over half of days the fish left the FADs during afternoon to night.
- Depth for 'afternoon dive' agrees with DSL depth.
- Hypothesis: bait is not enough around the FAD, and so BET temporarily leave the FAD for feeding.

Monitoring behavior by pinger around anchored FAD

FPXG-1040-60PxxxT30



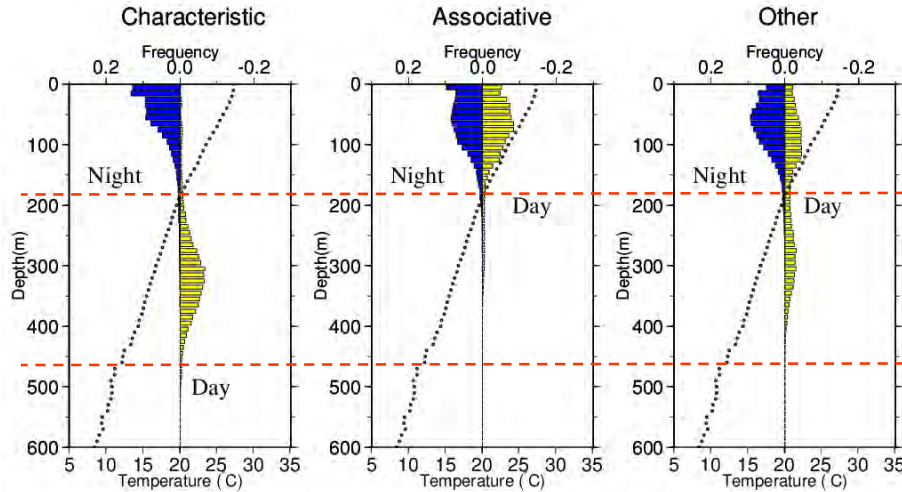
Pinger
FAD



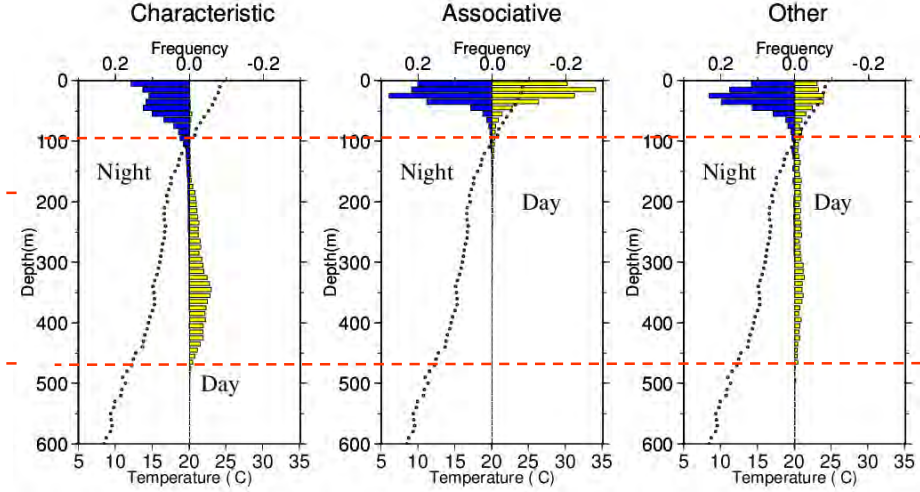
Swimming depth and ambient temperature by behavior type (BET and YFT)

BET

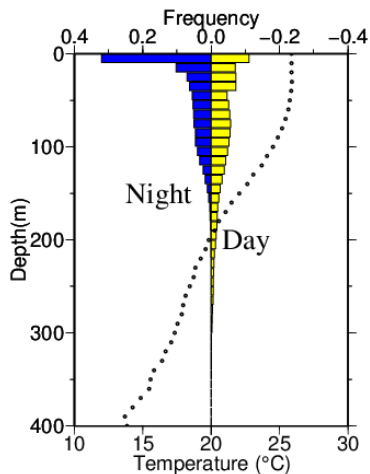
Nansei Islands



Offshore central Honshu



YFT



- BET: $>20^{\circ}\text{C}$ at night (all behavior) and at daytime for associative behavior. Lower limit is around 10°C .
- YFT: $>20^{\circ}\text{C}$ at night and lower limit is around 15°C .

Summary of archival tagging for SKJ

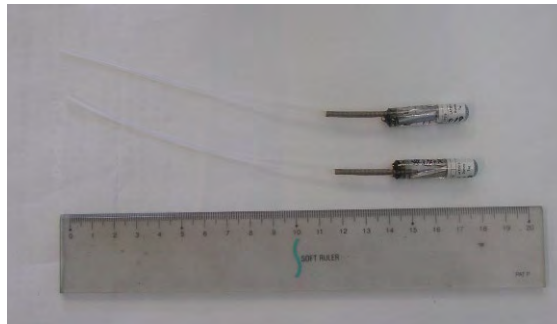


Background and objectives

- Since 2009, **SKJ** tagging has been conducted in the subtropical area mainly to focus on elucidating migration (route and mechanism) to Japanese waters.
- In addition to conventional tagging, **archival tagging** is conducted.
- To investigate **migration route**, especially from subtropical to temperate area (Japanese water).
- To investigate **vertical behavior** and relationship with oceanographic environment.

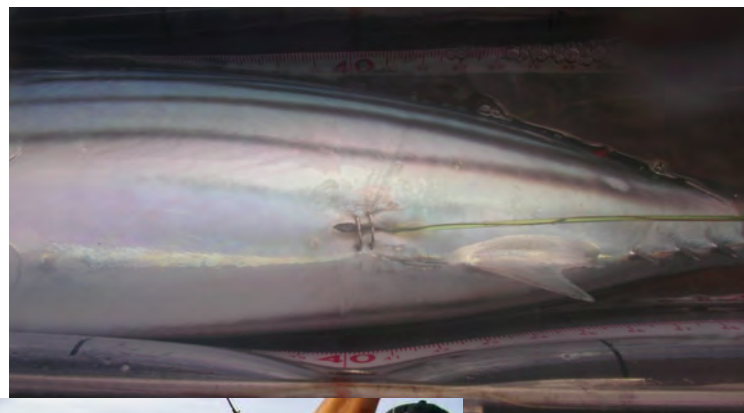
Challenge to archival tag deployment on SKJ

- Before current projects, there was almost no archival tagging of SKJ by Japan (NRIFS).
- The scientists had experience of only other species(BET, YFT, using needles).
- Feasibility study was conducted in 2009 (at the beginning of current projects) by using dummy archival tags.
- At first needles were used, and it was not successful.
- Then skin staplers were introduced, and it worked well.
- As a result of dummy tag deployment,we got several recovery, and recovery rate was not so much different from that for conventional tags.



Archival tags used for SKJ

- ◆ Lotek (Canada) **LAT2510** (2010-2011) and **LAT2910** (2012-)
- ◆ Tags were inserted in the peritoneal cavity, and skin stapler was used to close the incision.

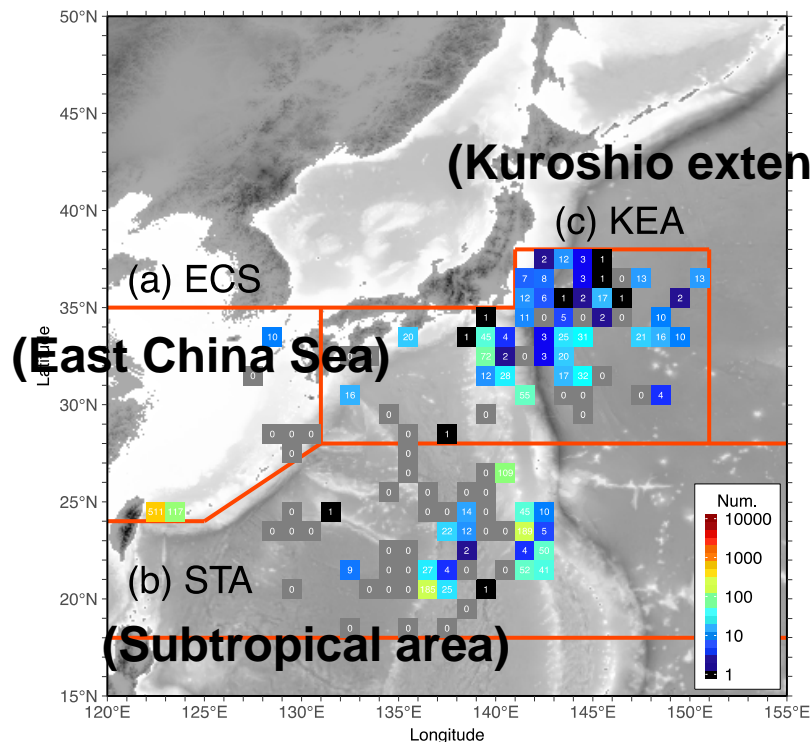


Tag deployment



Summary results of archival tagging for SKJ

Archival SKJ tags released in 2009–2016

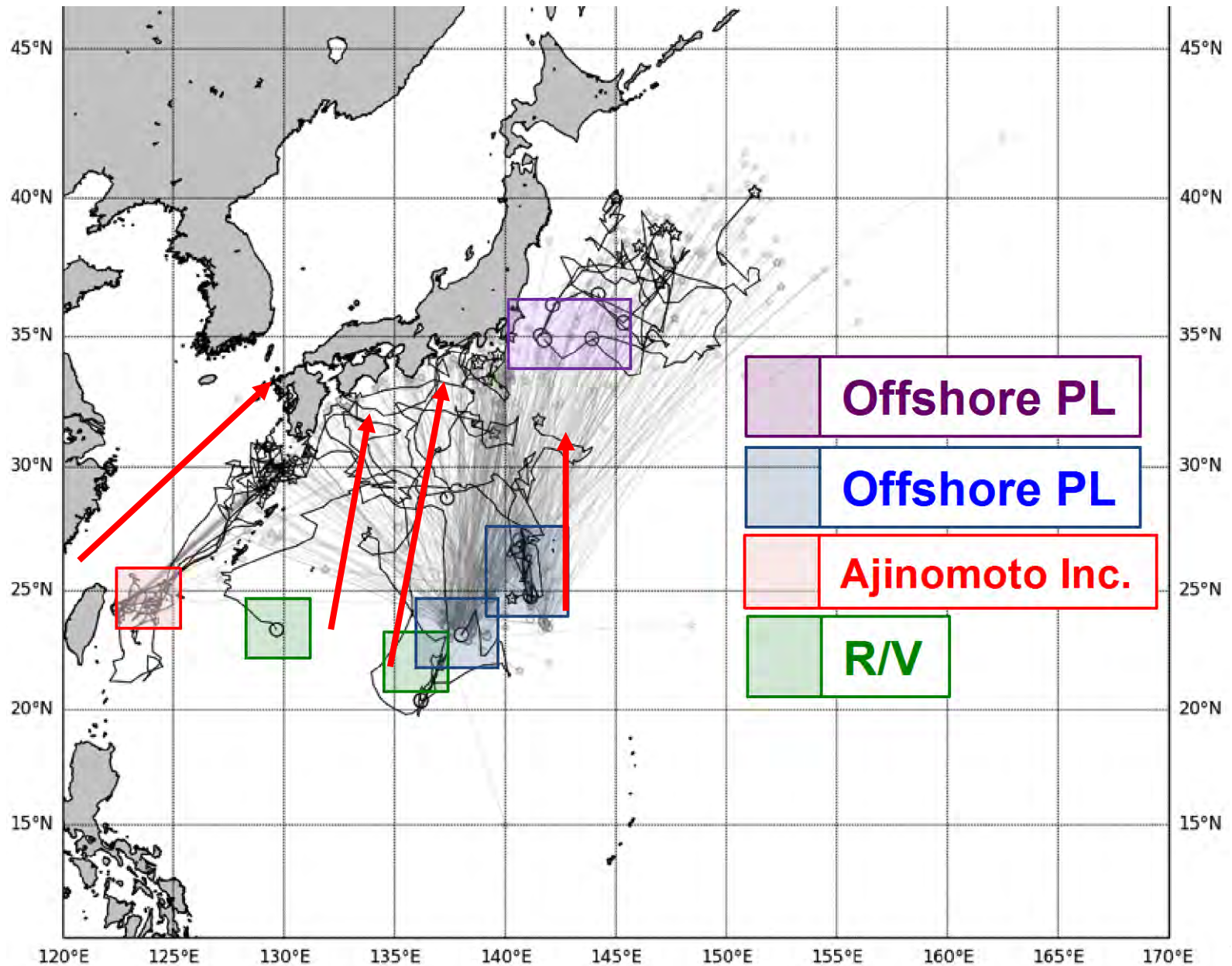


[Season and area]
Jan.-Mar (Subtropical)
May-Jun (Temperate)

[Size at release]
35cm – 48cm

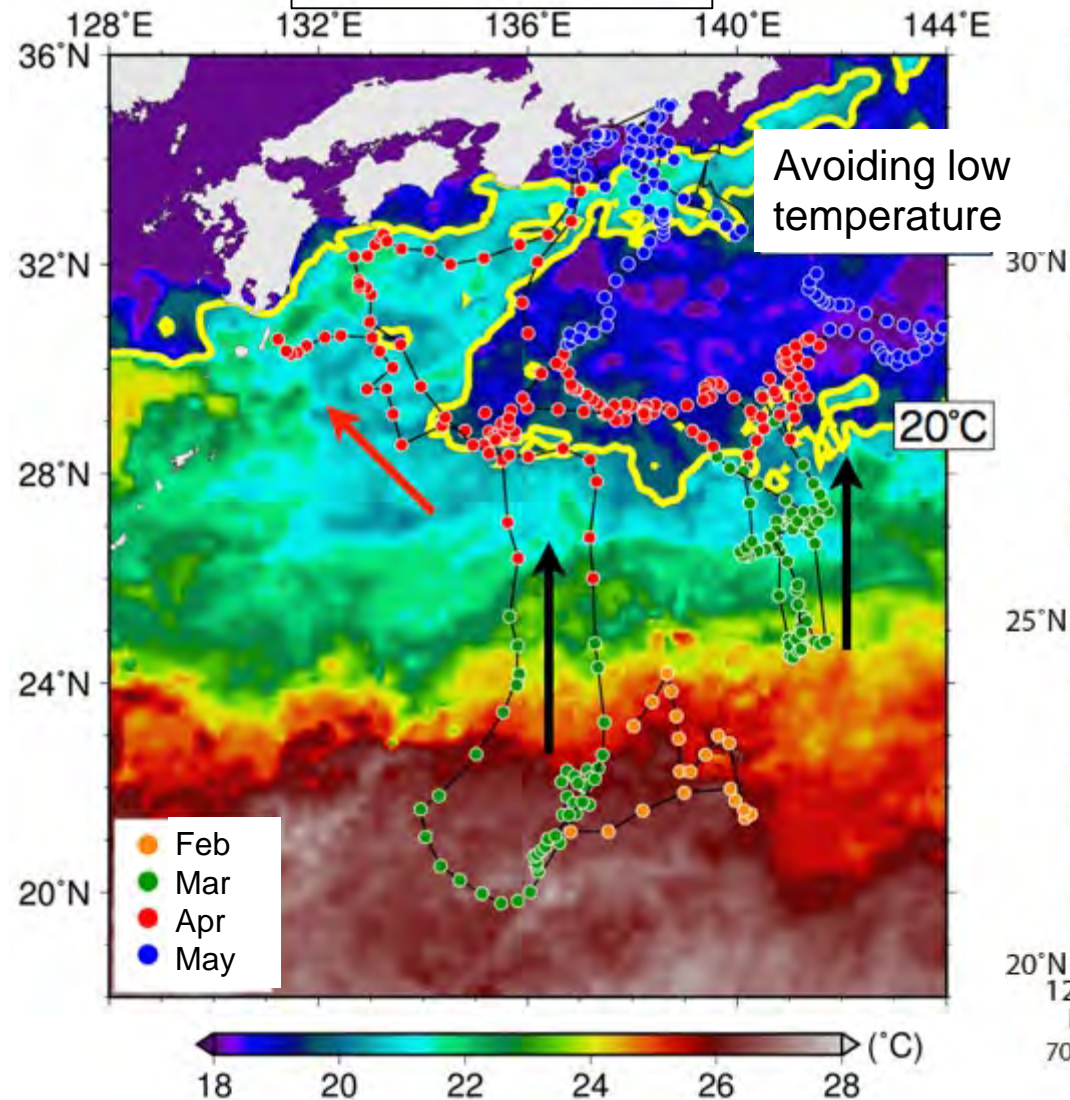
Release Year	Number of release								Number of recapture	
	ECS		STA		KEA		Total		Dart	Archival
	Feb.-Jun.		Jan.-Jun.		May-Jul.					
	Dart	Archival	Dart	Archival	Dart	Archival	Dart	Archival		
2009	1,293	-	367	-	314	-	1,319	-	97	-
2010	2,854	44	110	-	892	-	3,361	-	147	-
2011	77	-	229	83	157	-	677	83	35	2
2012	2,995	169	3,167	109	196	-	6,628	278	227	14
2013	715	43	3,995	180	215	80	4,950	320	452	23
2014	730	94	369	104	350	212	1,451	410	52	33
2015	292	139	1,990	149	979	127	2,647	415	468	21
2016	678	183	3,687	180	732	67	5,254	510	156	17
Total	9,634	672	13,914	805	3,835	486	27,383	1,963	1,634 (6.0%)	106 (5.4%)

Movement of SKJ by archival tags

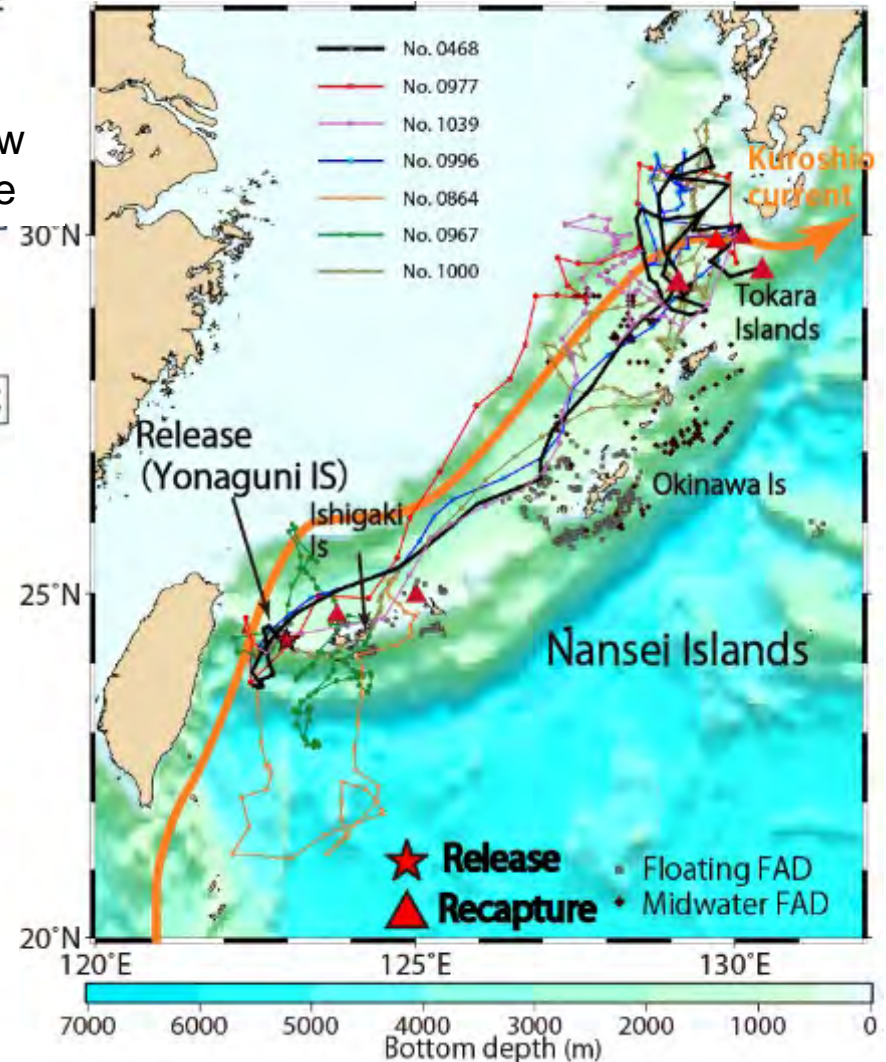


Examples of horizontal movement based on archival tags

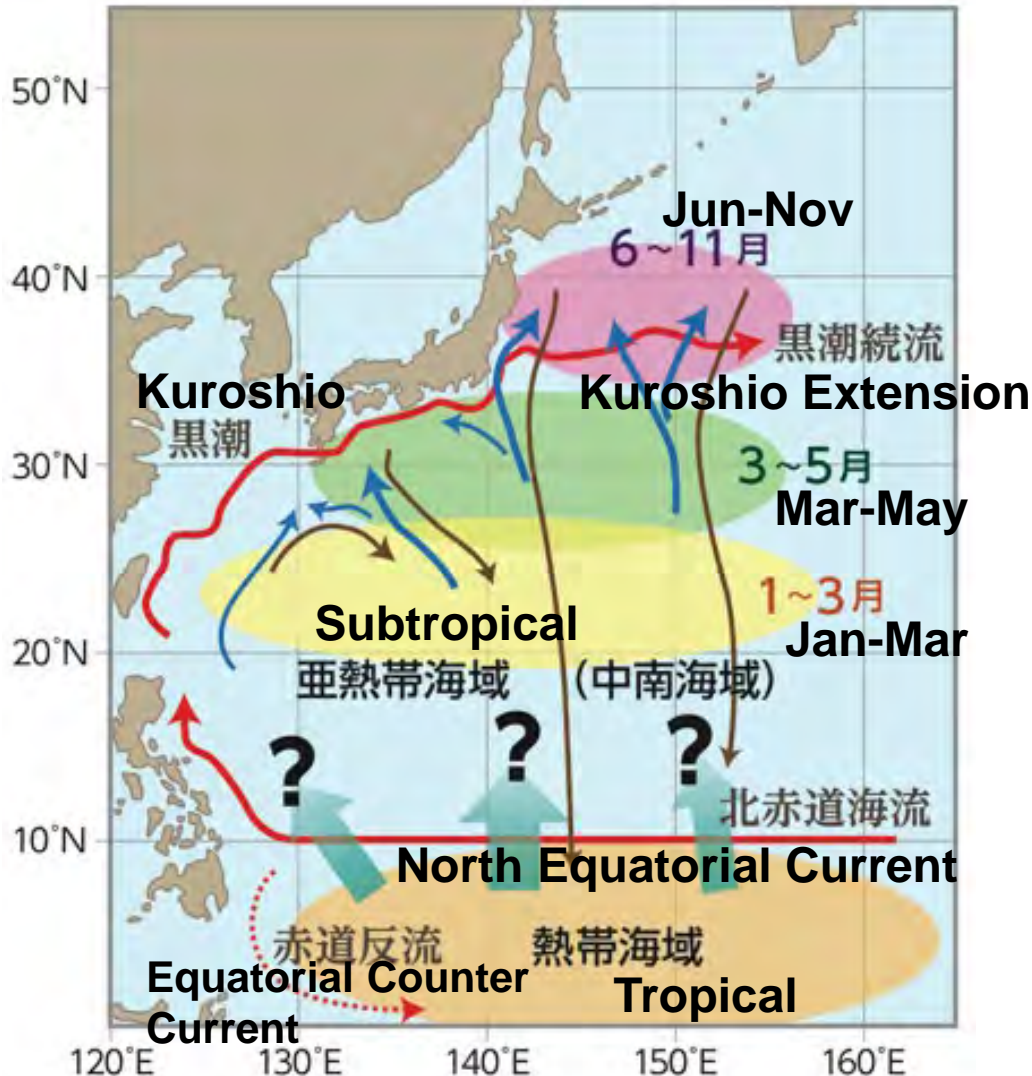
Offshore area



Coastal area

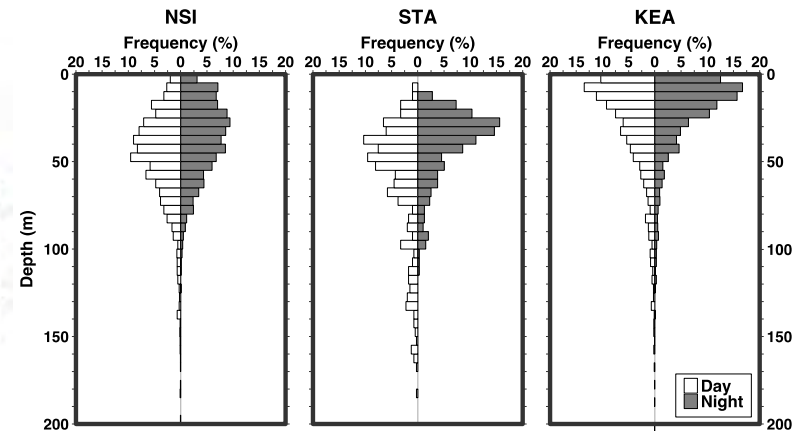
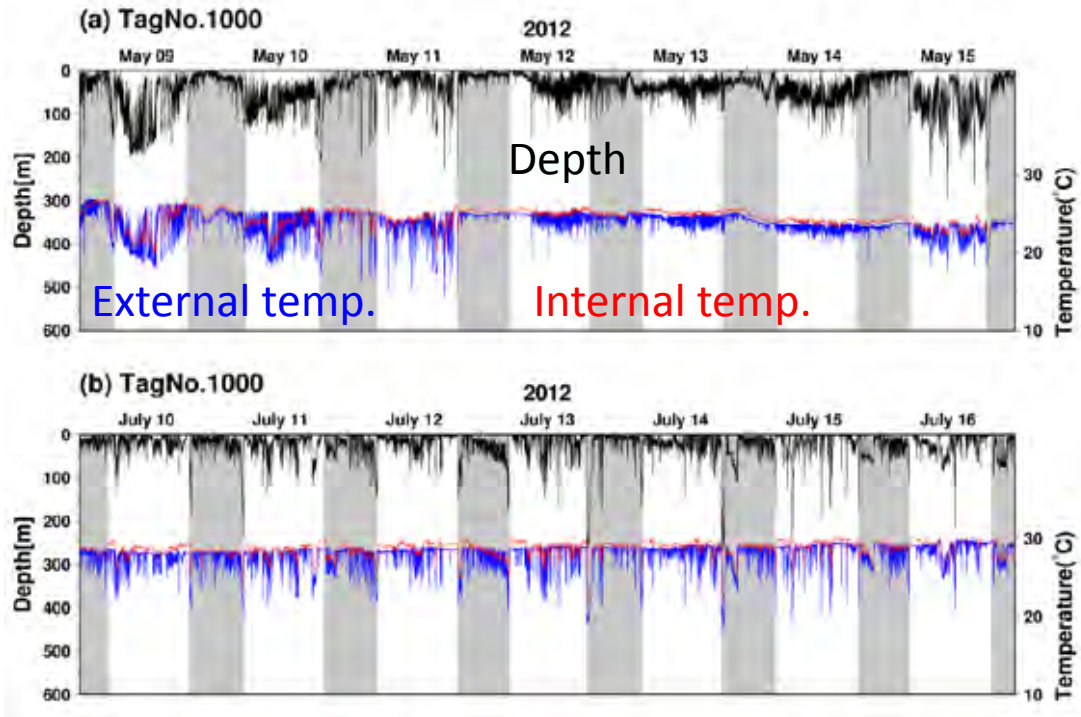


Estimated migration route based on tagging

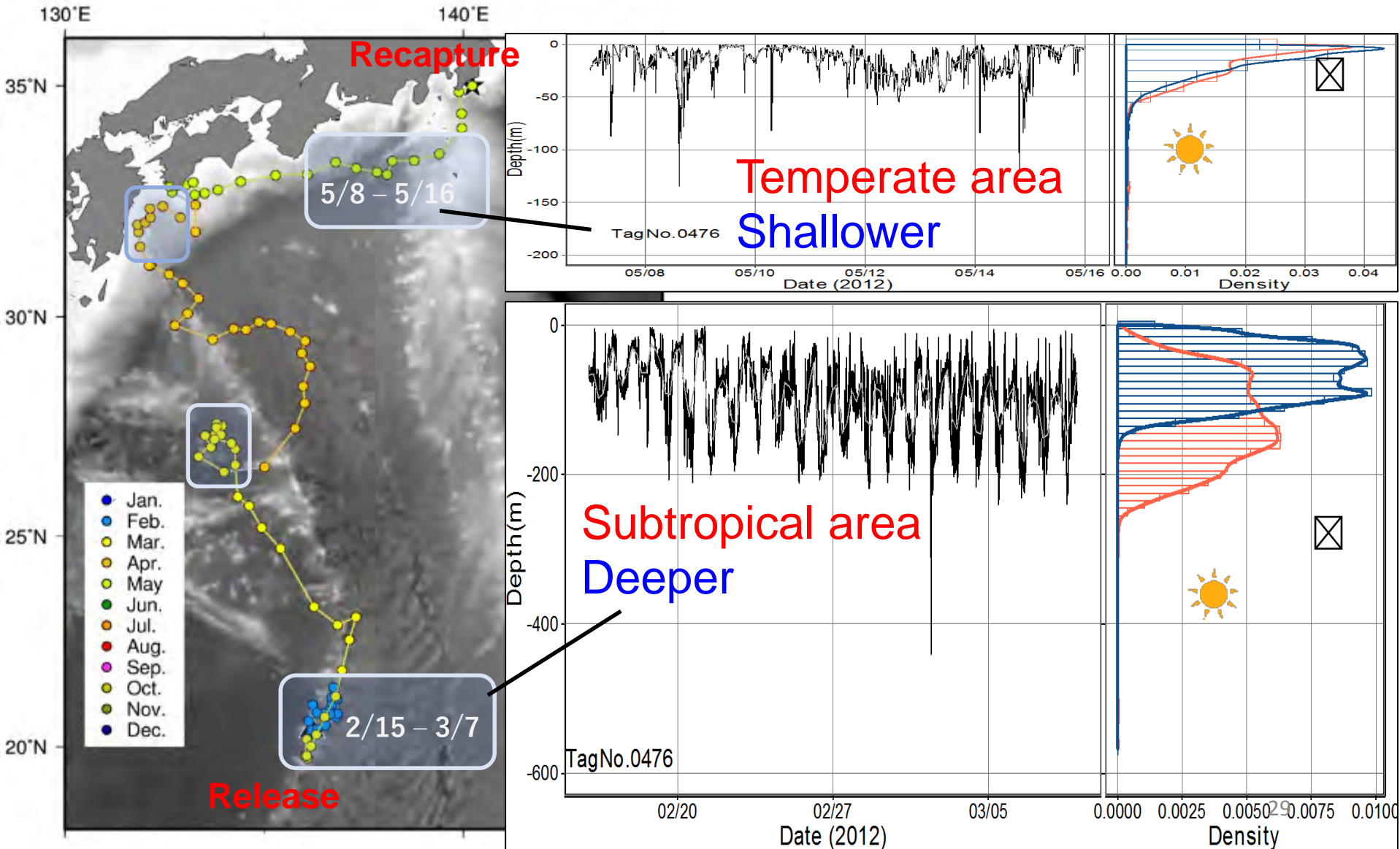


- **Northward** movement from winter to autumn.
- **Southward** movement around late autumn.
- Several migration routes seem to exist.
- Detail of connection between tropical and subtropical areas is unclear.

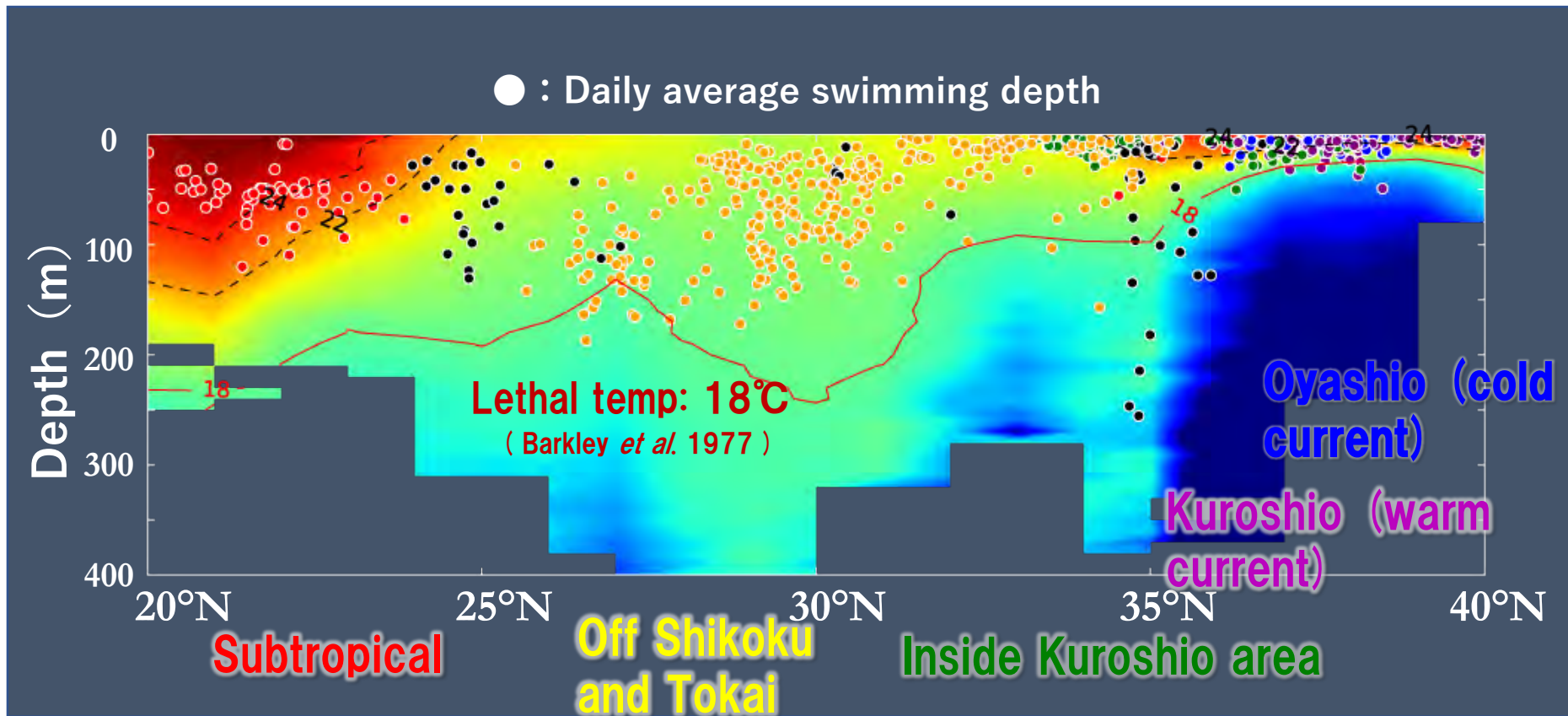
Vertical behavior



Examples of vertical movement based on archival tagging



Change in the swimming depth during northward movement



- Swimming depth of skipjack was usually shallower than the depth of lethal temperature (18°C)
- When the fish moved to the north and 18°C isotherm became shallower, swimming depth got shallower.

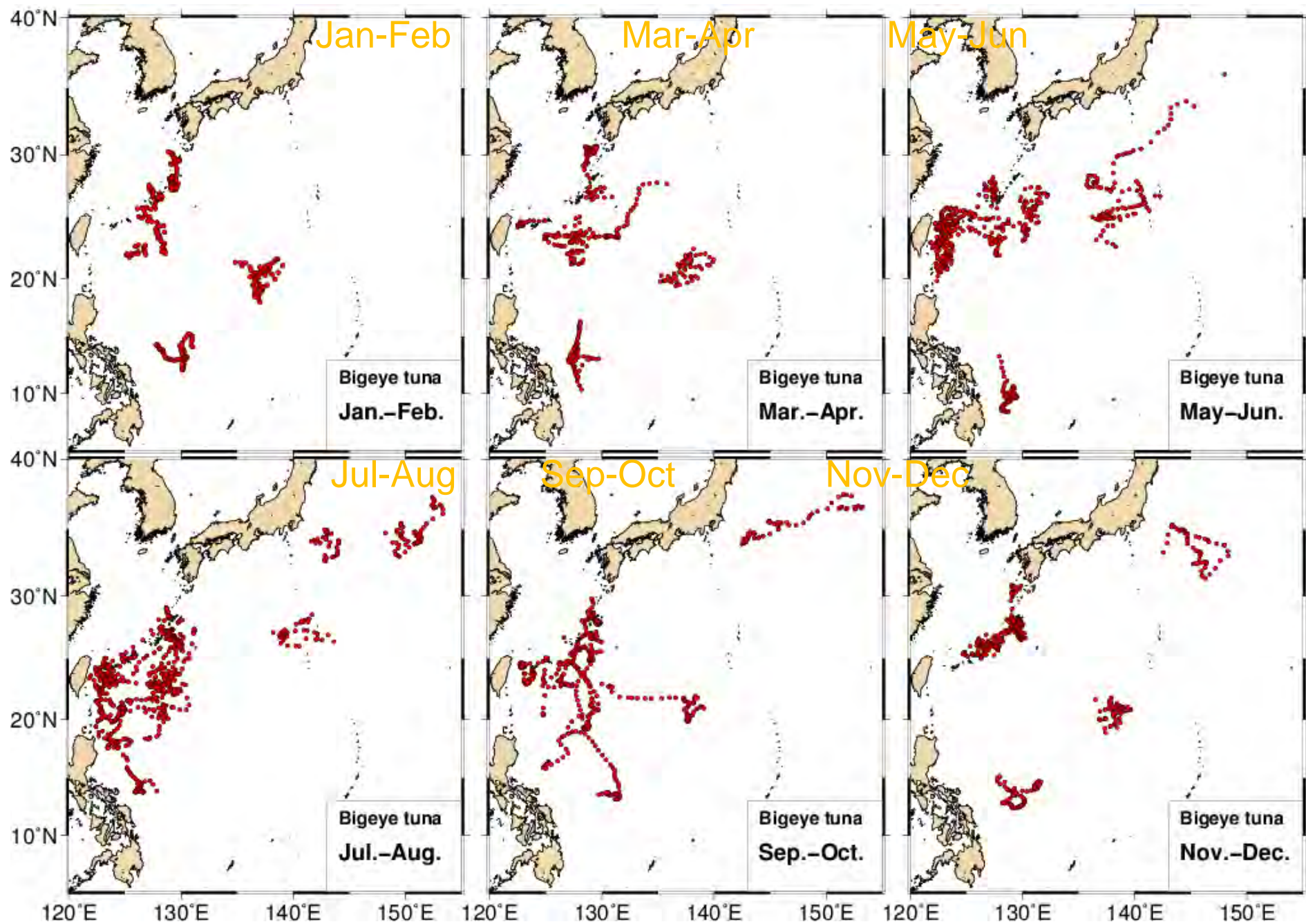
Future outlook for tropical tuna archival tagging by NRIFSF

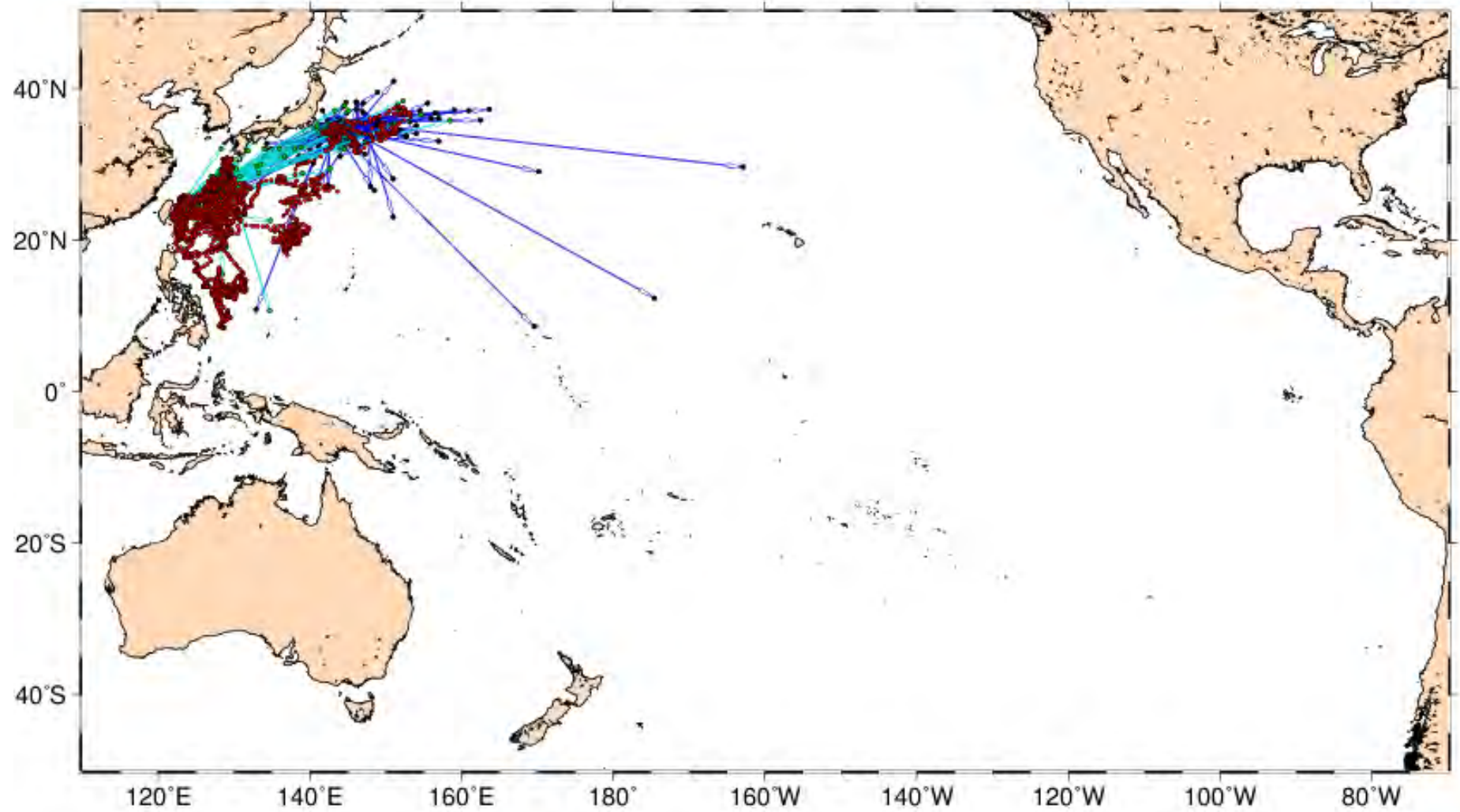
- We will continue archival tagging for SKJ (including tropical and Taiwan area).
- No plan for archival tagging of BET and YFT.
- More detailed analysis of the data.

Additional slides

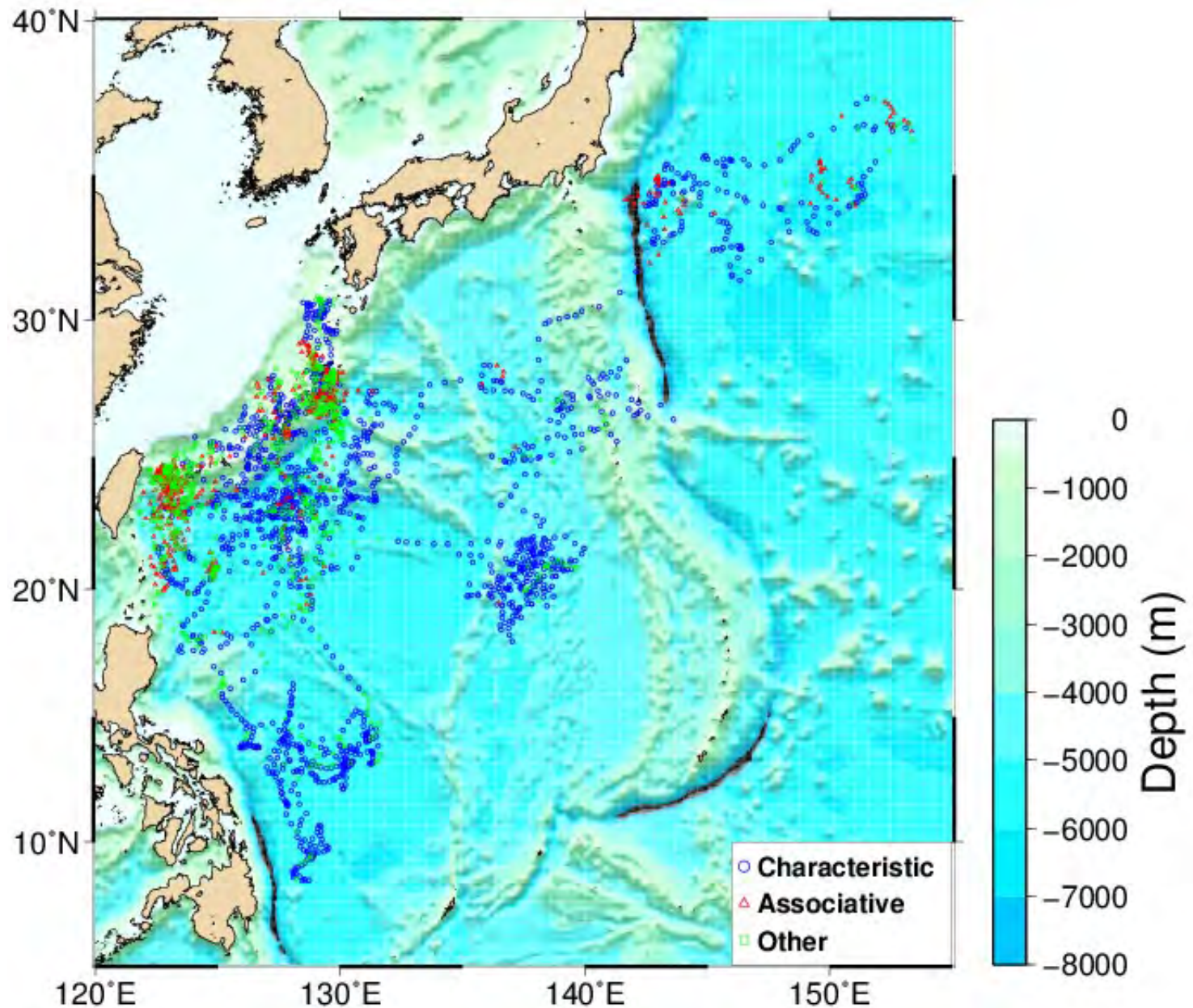
Summary of archival tagging

Area released	Nansei Islands (southwestern Japan)	Offshore central Honshu
Species for archival tagging	BET and YFT	BET
Location	24-29°N, 123-130°E	32-36°N, 142-148°E
Period	Mar. 2000- Oct. 2010	Jun. 2006- Jul. 2010
Season of release	All year (mainly spring to autumn)	Summer
Fishing method	PL, troll, HL, etc.	PL
Fork length at release (cm)	24-90	48-115

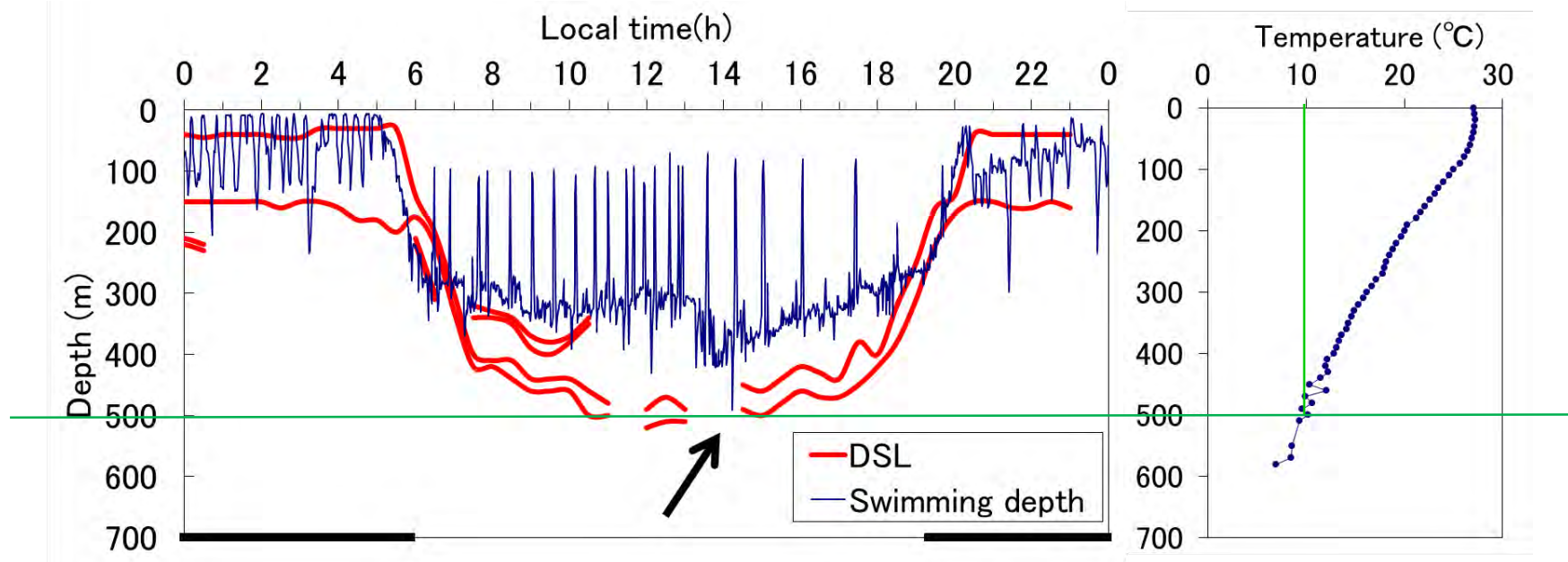




Daily horizontal distribution by archival tags with topography

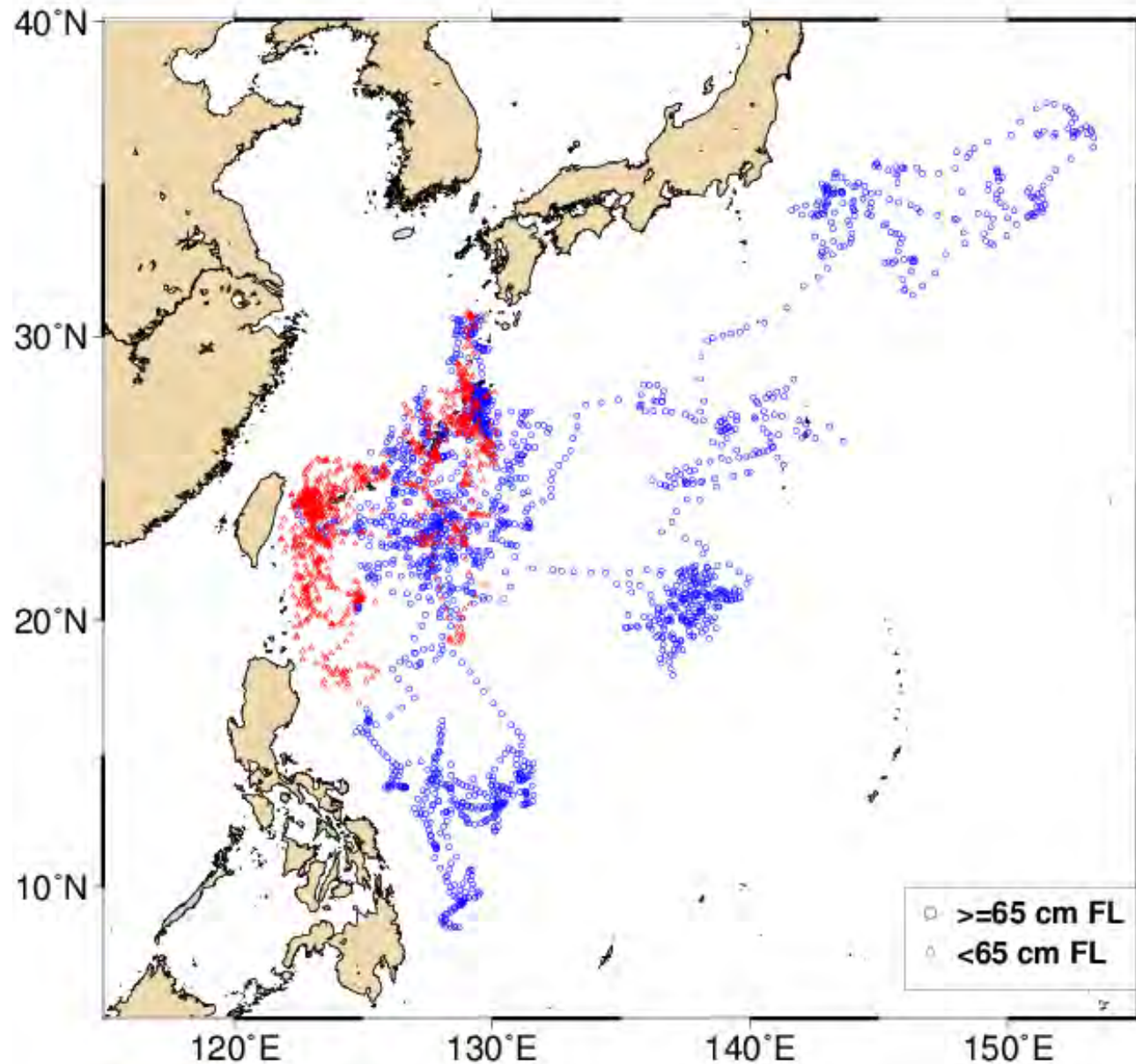


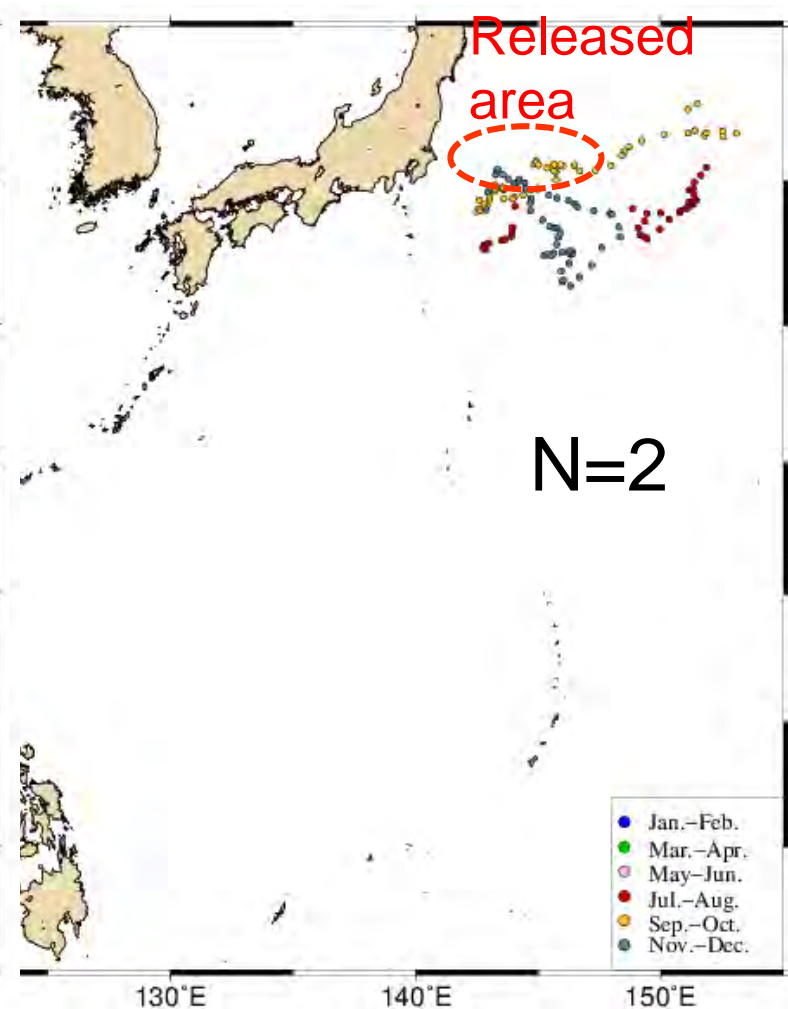
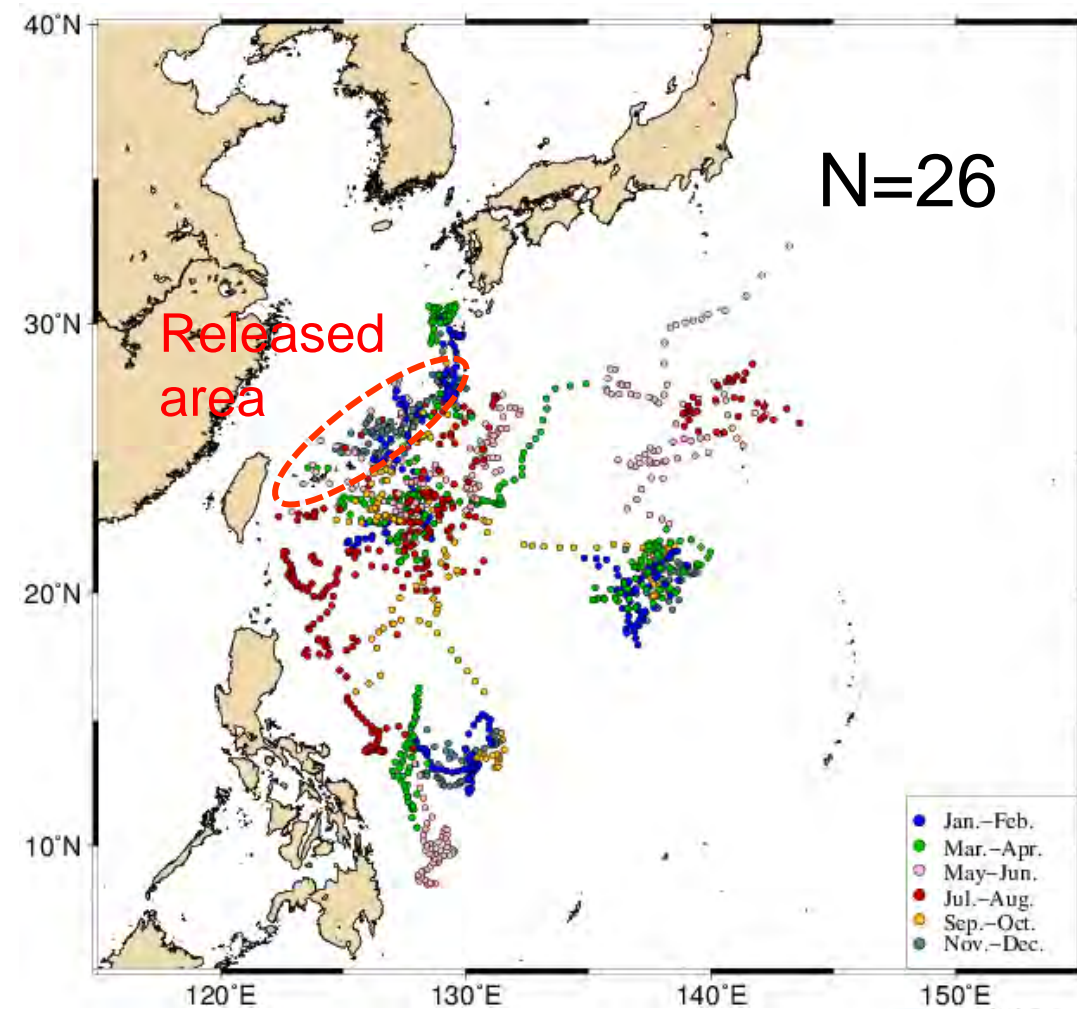
BET comparison between DSL (deep scattering layer) and swimming depth



- DSL (Kondo, 2007) and BET swimming depth were not observed simultaneously but in the same season and area.
- Agreement between DSL and BET swimming depth.
- Diurnal movement of BET may be for foraging.
- Disagreement of the two during midday is probably because of low temperature ($\approx 10^{\circ}\text{C}$) at DSL layer.

Daily horizontal distribution by archival tags (by fish size)







Catch by pole and line



Catch by troll