2ND REVIEW OF THE STOCK ASSESSMENT OF YELLOWFIN TUNA IN THE EASTERN PACIFIC OCEAN
La Jolla, California (USA) 02-06 December 2019

Longline data – Japanese size-composition data

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Outline

1. Review of size composition data
   - availability and representativeness -
2. Future work

Review size composition data – availability –

Data fields for the size composition data.

- ✓ Species code,
- ✓ Date (year, month, day) (monthly, daily)
- ✓ Position (latitude , longitude)
- ✓ Spatial resolution (10x20 degrees, 5x10, 5x5, 1x1)
- ✓ Vessel type (commercial vessel and training vessel)
- ✓ Sex
- ✓ Size unit (weight, length)
- ✓ Size
- ✓ Vessel identifier and associated logbook data fields including date, position, catch, effort and gear configurations)

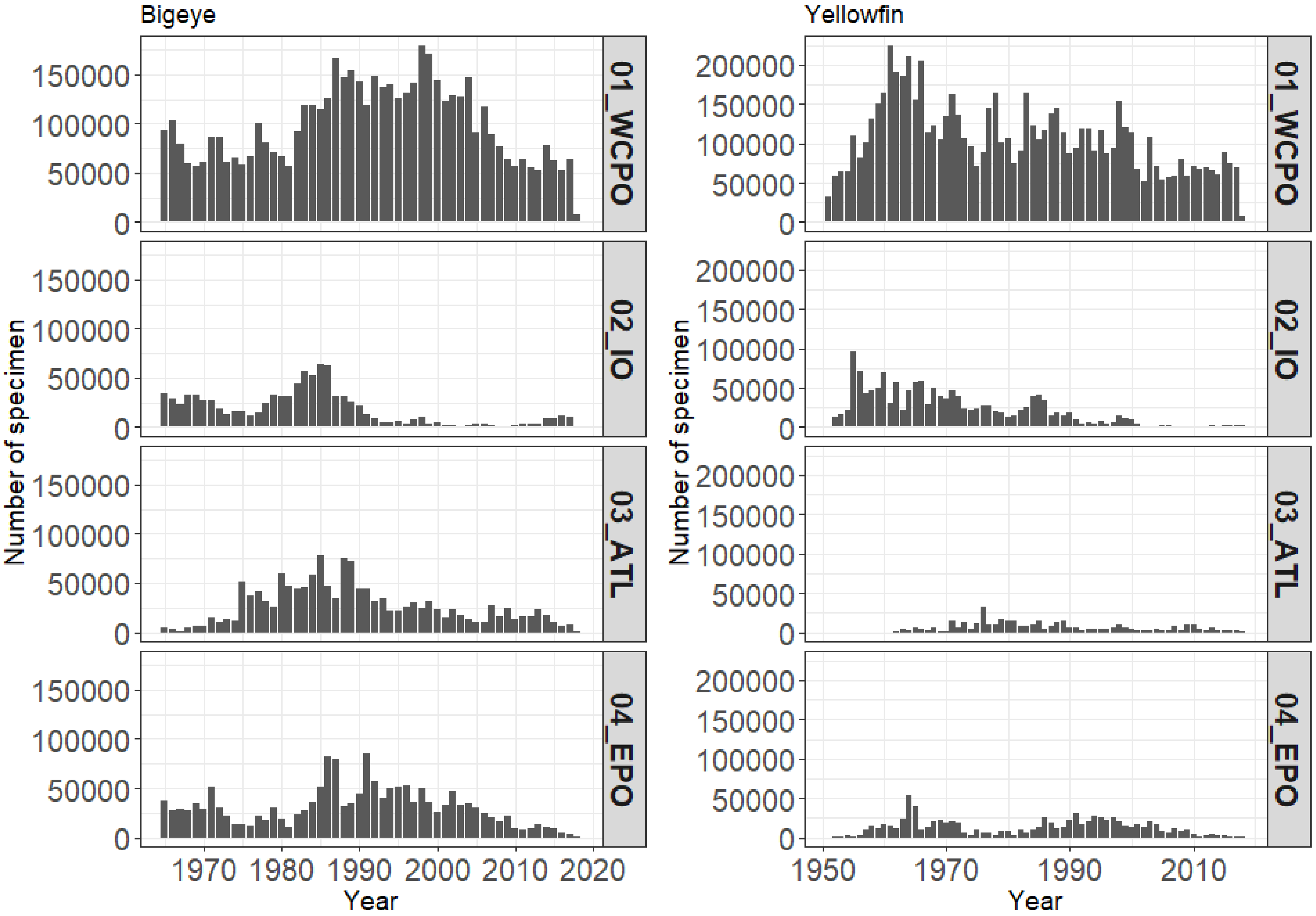
* temporarily shared with IATTC and Japan under a MOU

- Values in 2018 is preliminarily.
- ➢ Availability of each data field
- ➢ Progress of matching size composition data and logbook, which enable us to analyze relationship between gear configuration and fish size.

Table 4. Data fields of Japanese longline fishery size composition data.

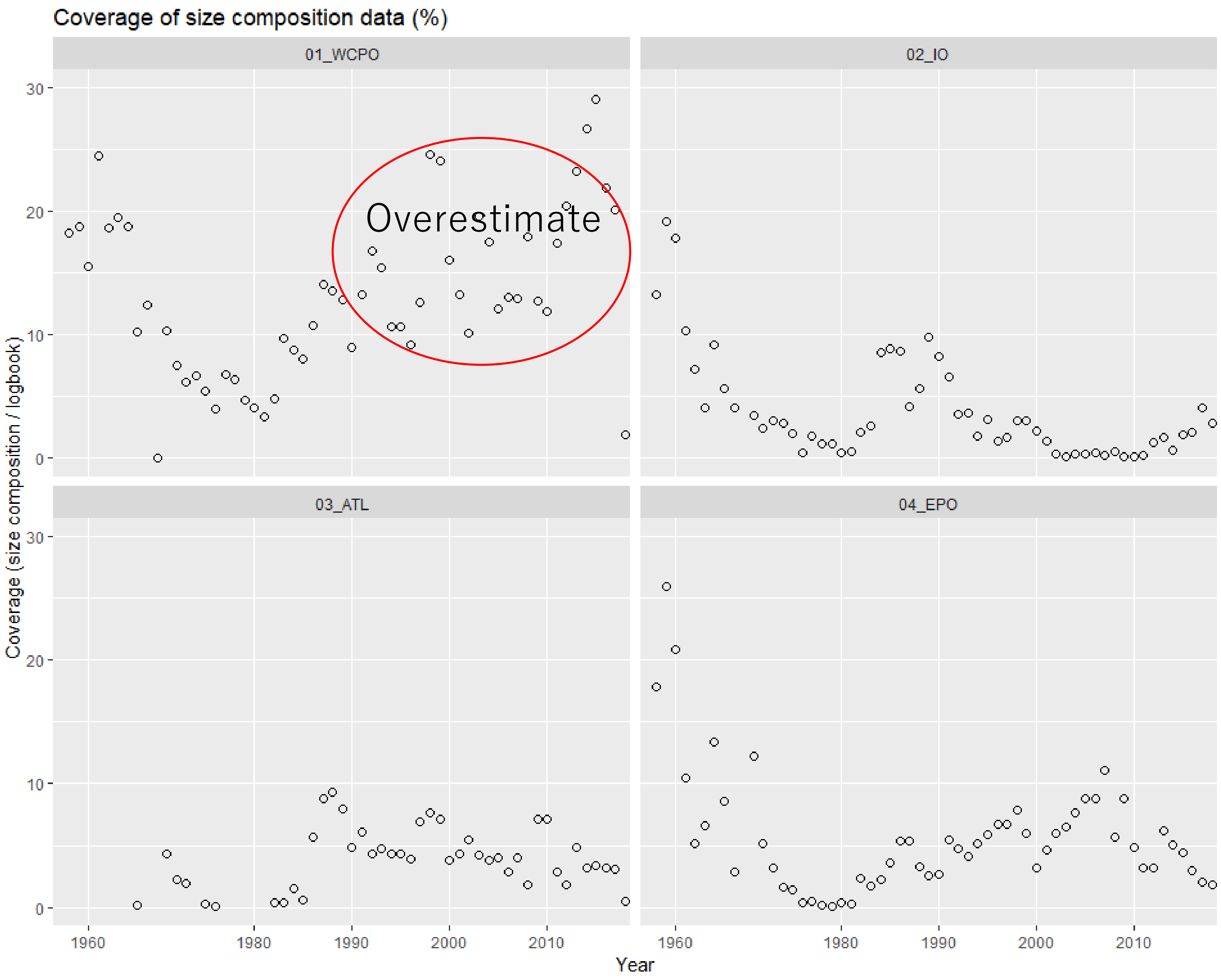
Data.field	Remarks
Species	4: bigeye, 5: yellowfin
YY	Catch year
MM	Catch month
DD	Catch day
Spatial resolution	1: 10x20 degree, 2: 5x10, 3: 5x5, 4: 1x1
X	same as Table 1 but record in size composition data
Y	same as Table 1 but record in size composition data
Size unit	3: weight 1 kg, 6: length 1 cm, 7: length 2 cm, 8: length 5 cm
Vessel type	1: commercial vessel, 2: training vessel
Sex	1: female, 2: male
Fish Size	
Ocean code	1: the western and central Pacific Ocean, 2: the Indian Ocean, 3: the Atlantic Ocean, 4: the eastern Pacific Ocean
Location for measurement	1: On board (fisherman), 2 - 12, >=14: Port sampling, 13: On board (observer)
Number of fish	It is always 1
Data availability	1: No vessel identifier, 2: Vessel identifier is available but the spatial resolution is not 1 x 1 degree and/or the temporal resolution is not daily basis, 3: Vessel identifier is available and its spatio-temporal resolution is 1x1 degree and daily basis
VID	same as Table 1
tonnage	same as Table 1
ves_ton	same as Table 1
hooks	same as Table 1
Catch number of bigeye	same as Table 1
Catch number of yellowfin	same as Table 1
Catch weight (kg) of bigeye	same as Table 1
Catch weight (kg) of yellowfin	same as Table 1
nhbf	same as Table 1
float_len	same as Table 1
branch_len	same as Table 1
dist_branch	same as Table 1
n_main_type	same as Table 1
main_type	same as Table 1
bran_type	same as Table 1
num_light	same as Table 1
n_bait_type	same as Table 1
start_hh	same as Table 1
start_mm	same as Table 1
set_type	same as Table 1
active_code	same as Table 1
logbookid_9	same as Table 1
SEQ	same as Table 1
dif_day	same as Table 1
distance	same as Table 1
X	same as Table 1 (recorded in the logbook)
Y	same as Table 1 (recorded in the logbook)

Review size composition data – availability –



In the EPO, since 1965 for BET, 1951 for YFT.

Figure 1. Number of size composition data by the ocean and species including both vessel type (commercial vessel and training vessel).



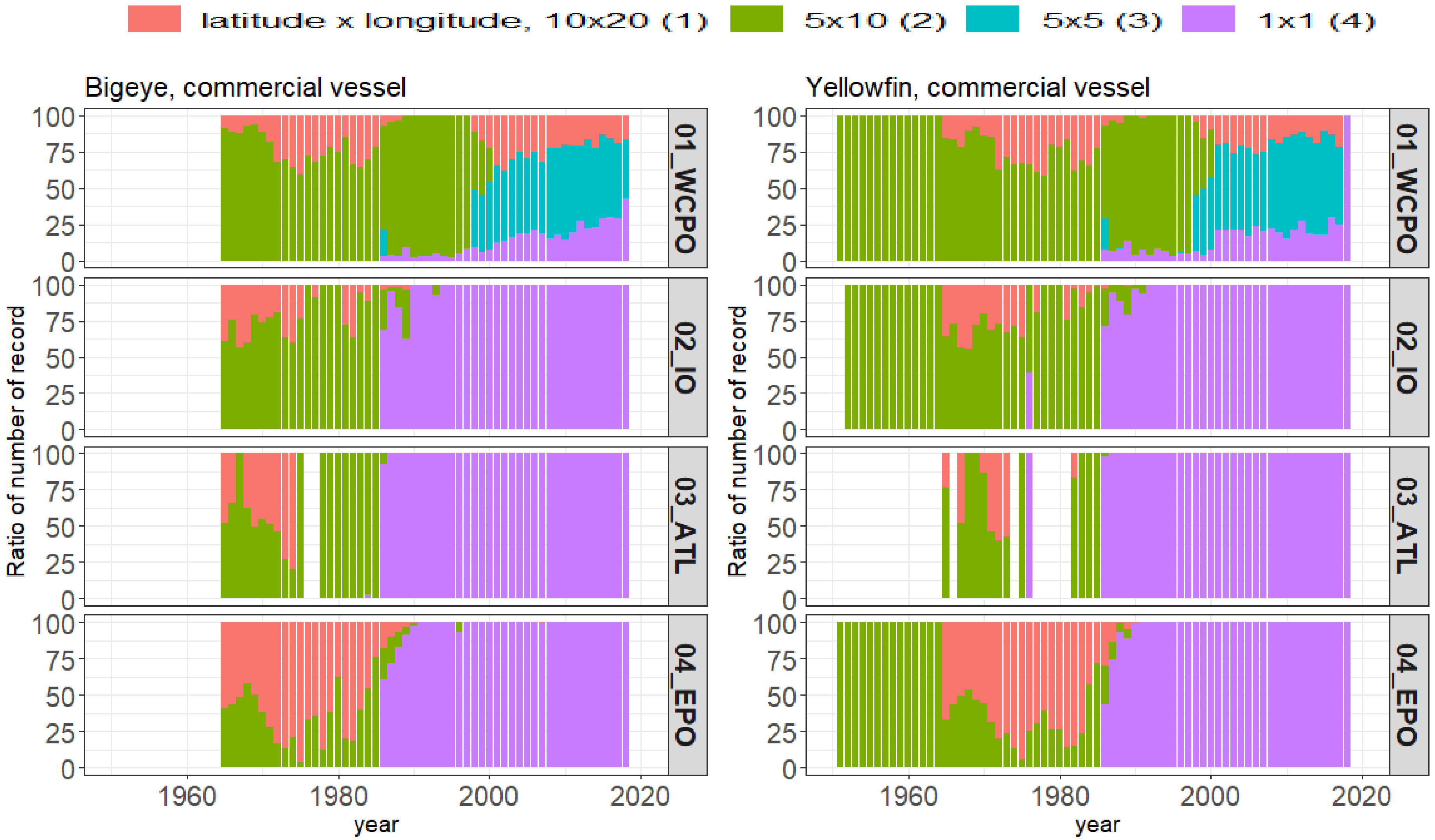
The size composition data included information on vessels less than 10 GRT, while the logbook data recorded information about vessels more than 10 GRT after 1993. Also, the size composition data base doesn‘t record vessel size.
Thus, it is difficult to calculate the coverage by vessel size especially in the WCPO area where there are the smaller vessel (< 10GRT) fishing activity.

In the other three oceans after 1960s only the larger vessels operated, thus the coverages are for the larger vessel’s one.

Figure 2. Inter annual changes of coverage (number of size composition data / number of total catch) of yellowfin tuna.

Figure 3. Inter annual changes of coverage (number of size composition data / number of total catch) of bigeye tuna by the ocean.

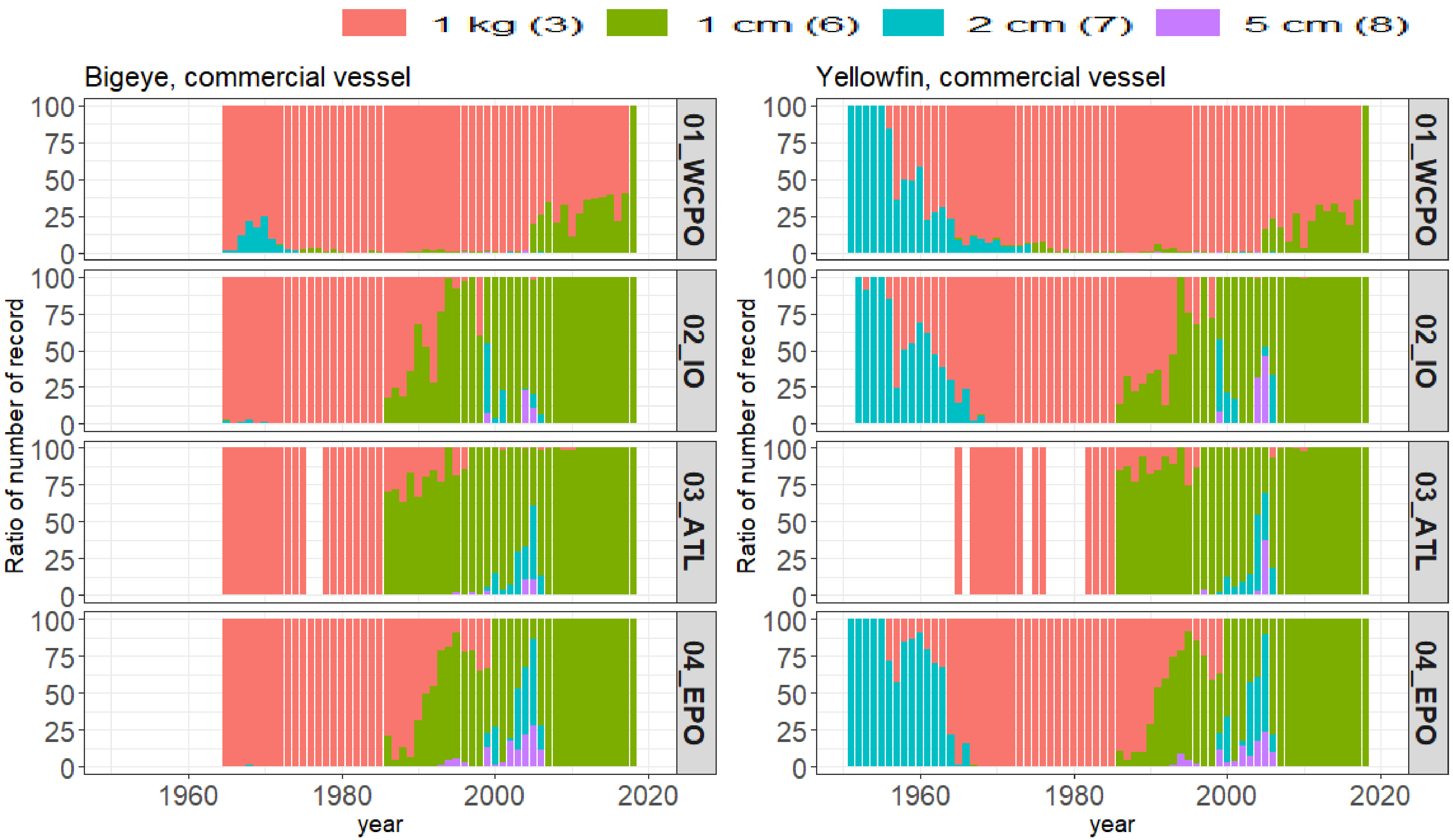
Review size composition data – spatial resolution –



- ✓ Except for the WCPO, after 1986 fine spatial scale (1x1) is dominant.

Figure 4. Availability of spatial resolution (latitude x longitude. 1; 10x20, 2; 5x10, 3; 5x5, 4; 1x1) of size composition data of commercial vessel by the ocean and by species (left; bigeye, right; yellowfin).

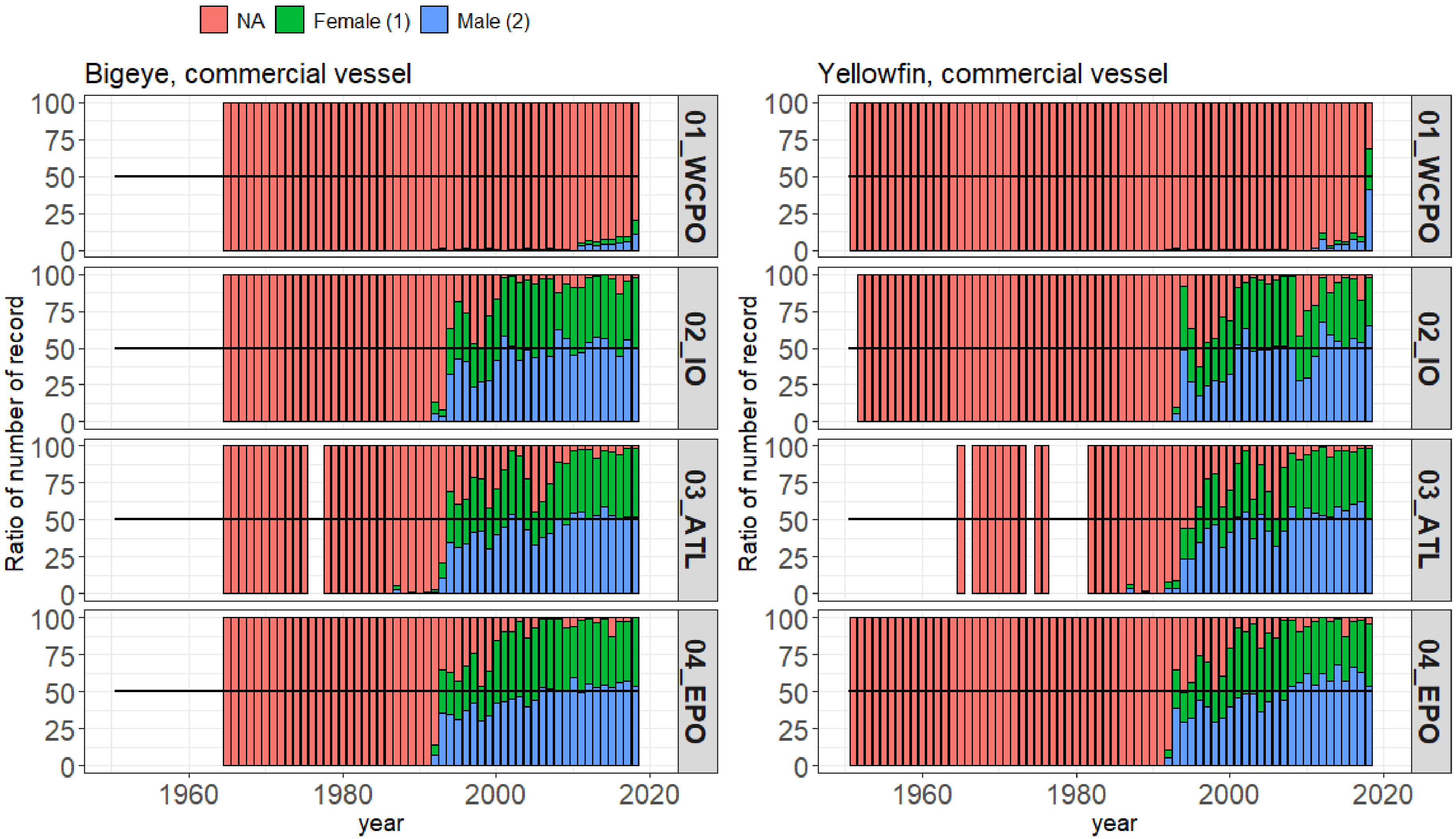
Review size composition data – Size unit (weight, length) –



- ✓ Except for the WCPO, after 1986 proportion of length data.
- ✓ For 10 years around 2000 measurement unit became coarse (1 cm to 2 or 5 cm)

Figure 5. Availability of measurement unit (3; 1 kg, 6; 1 cm, 7; 2 cm and 8; 5 cm) of size composition data of commercial vessel by the ocean and by species (left; bigeye, right; yellowfin).

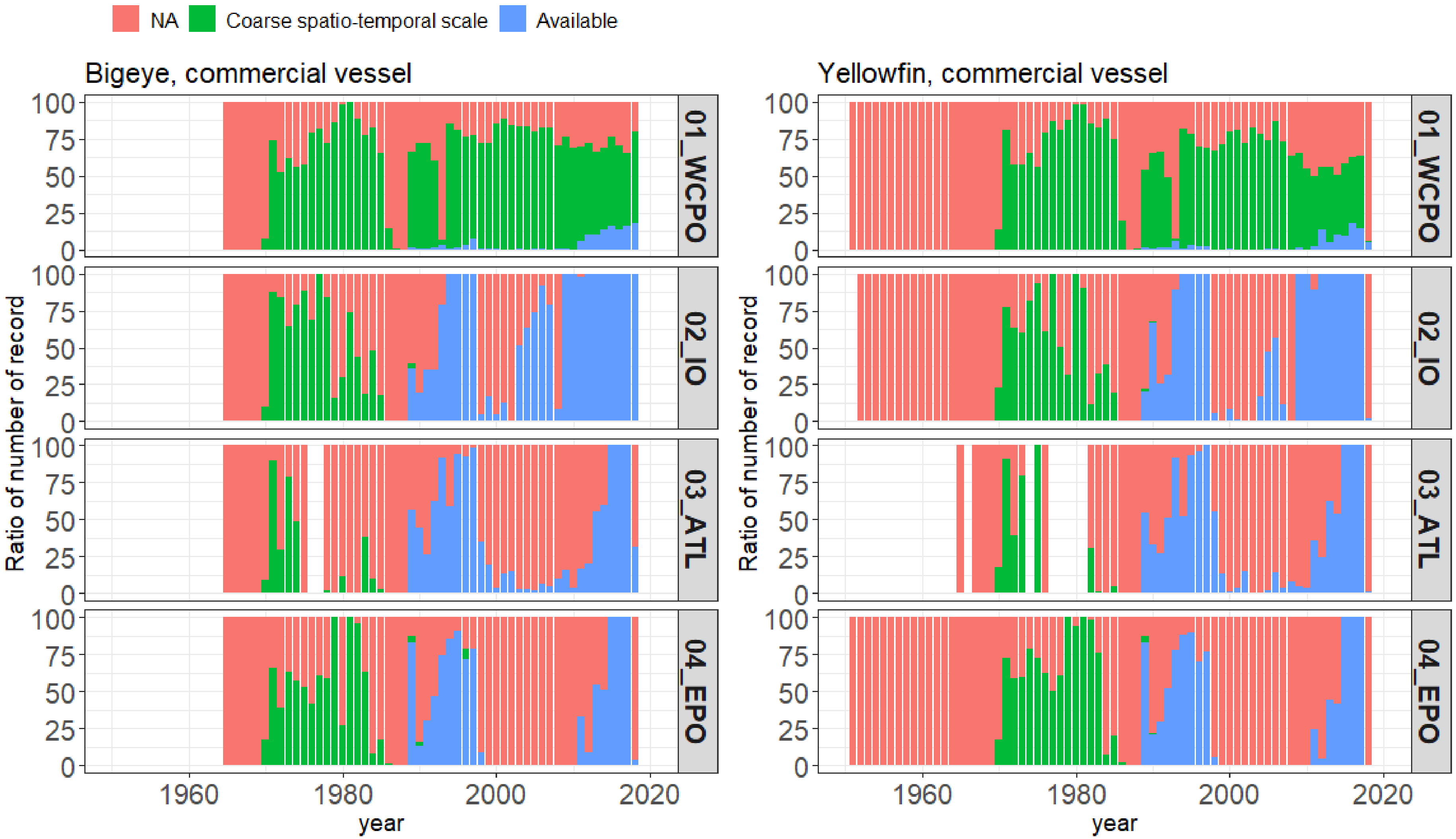
Review size composition data – Sex –



✓ Except for the WCPO, after 1986 size data is basically recorded by its sex.

Figure 6. Availability of sex (1; female, 2; male, NA; not available) of the size composition data of commercial vessel by the ocean and by species (left; bigeye, right; yellowfin).

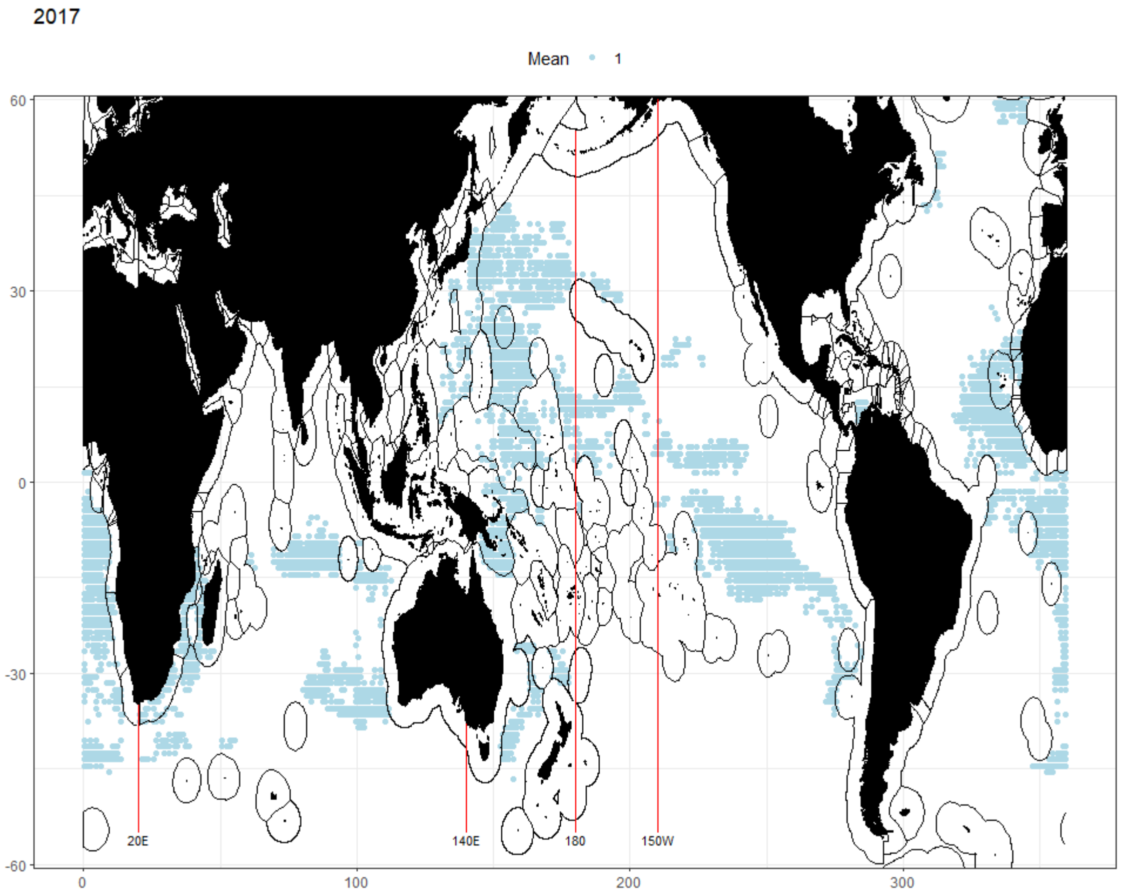
Review size composition data – Vessel id and spatio-temporal resolution –



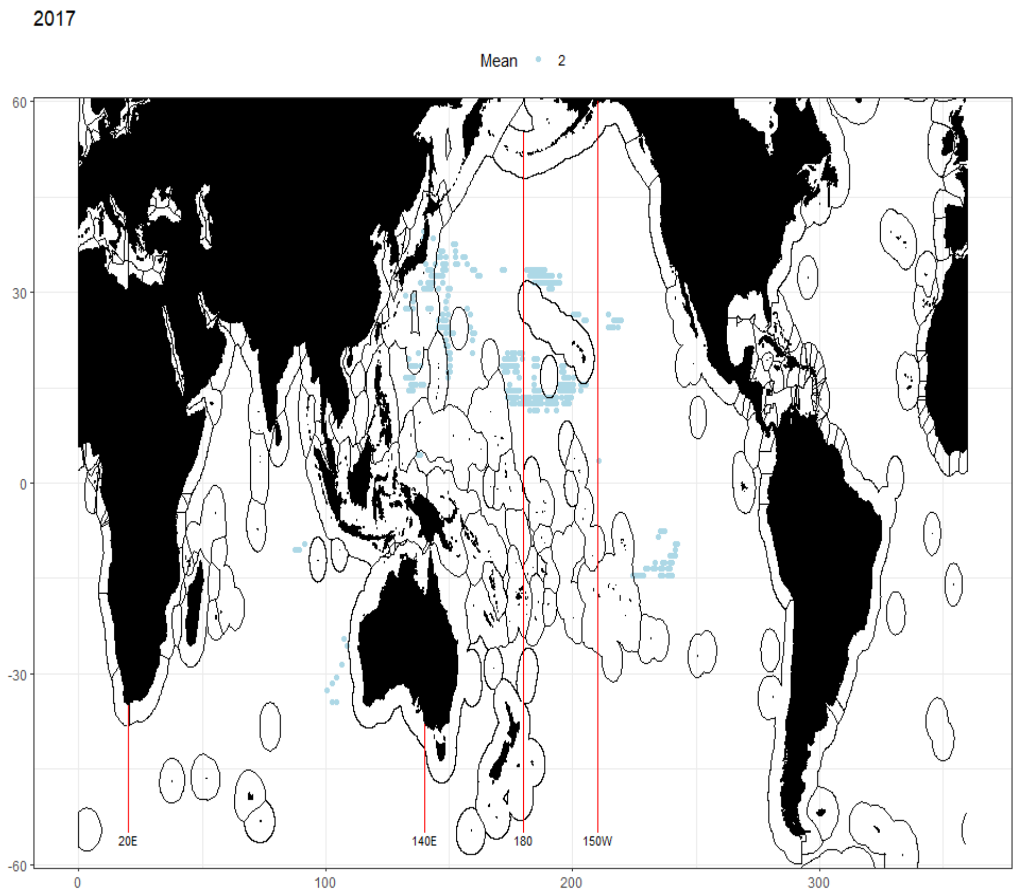
Except for the WCPO, 1990s and recent years the fine resolution (1x1, daily) and vessel identifier is available.

Figure 7. Availability of fine spatio-temporal scale (daily and 1 x 1 degree) size composition data with vessel identifier by the ocean and species (left; bigeye, right; yellowfin) for commercial vessel

Commercial vessel



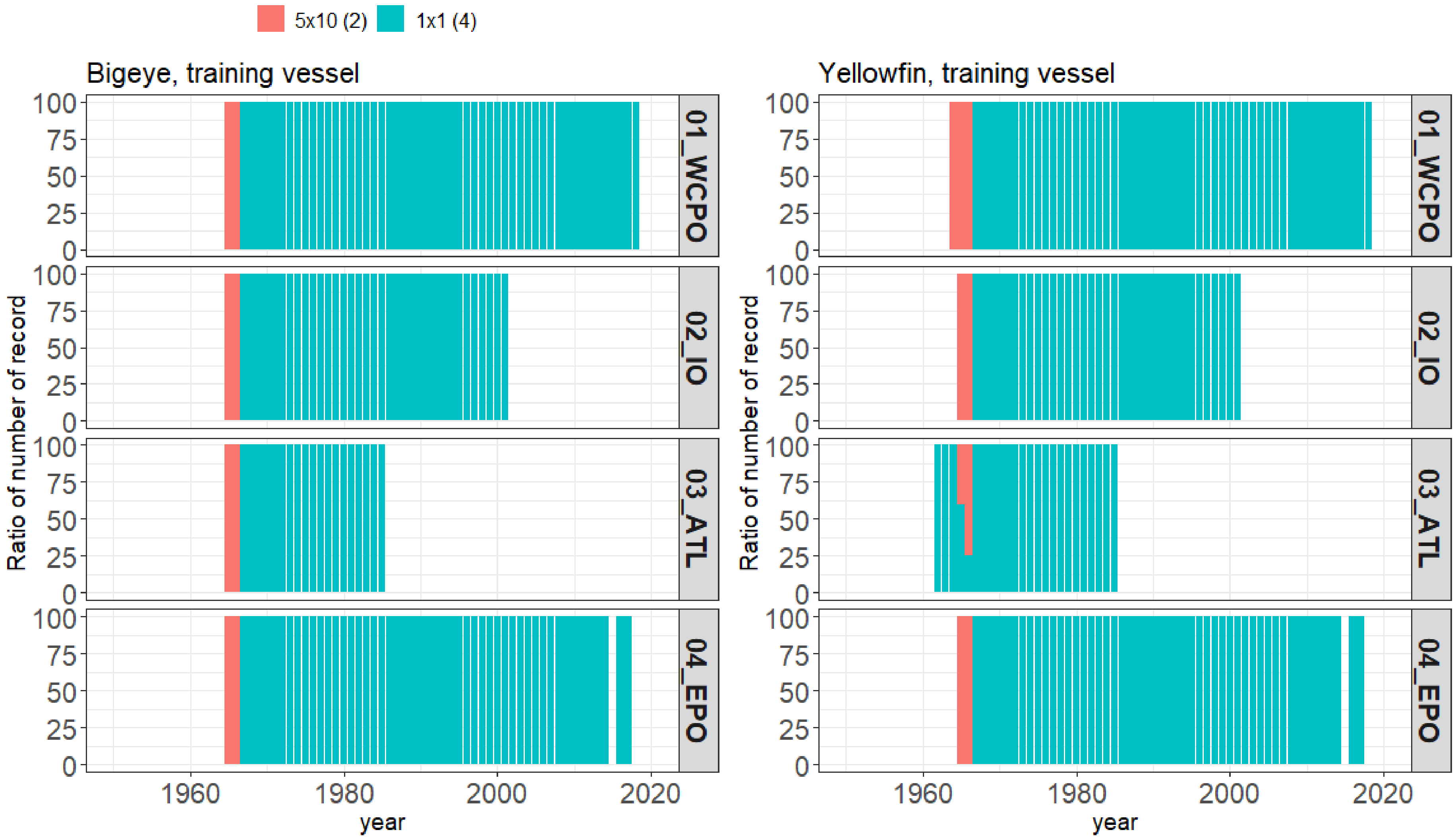
training vessel



- ✓ The fishing ground of commercial vessel and training vessel is comparable only in certain areas (vicinity of Japan, off Hawaii, off Johnston and western part of south EPO.

Figure 8. Comparison of fishing ground between commercial vessel and training vessel in 2017.

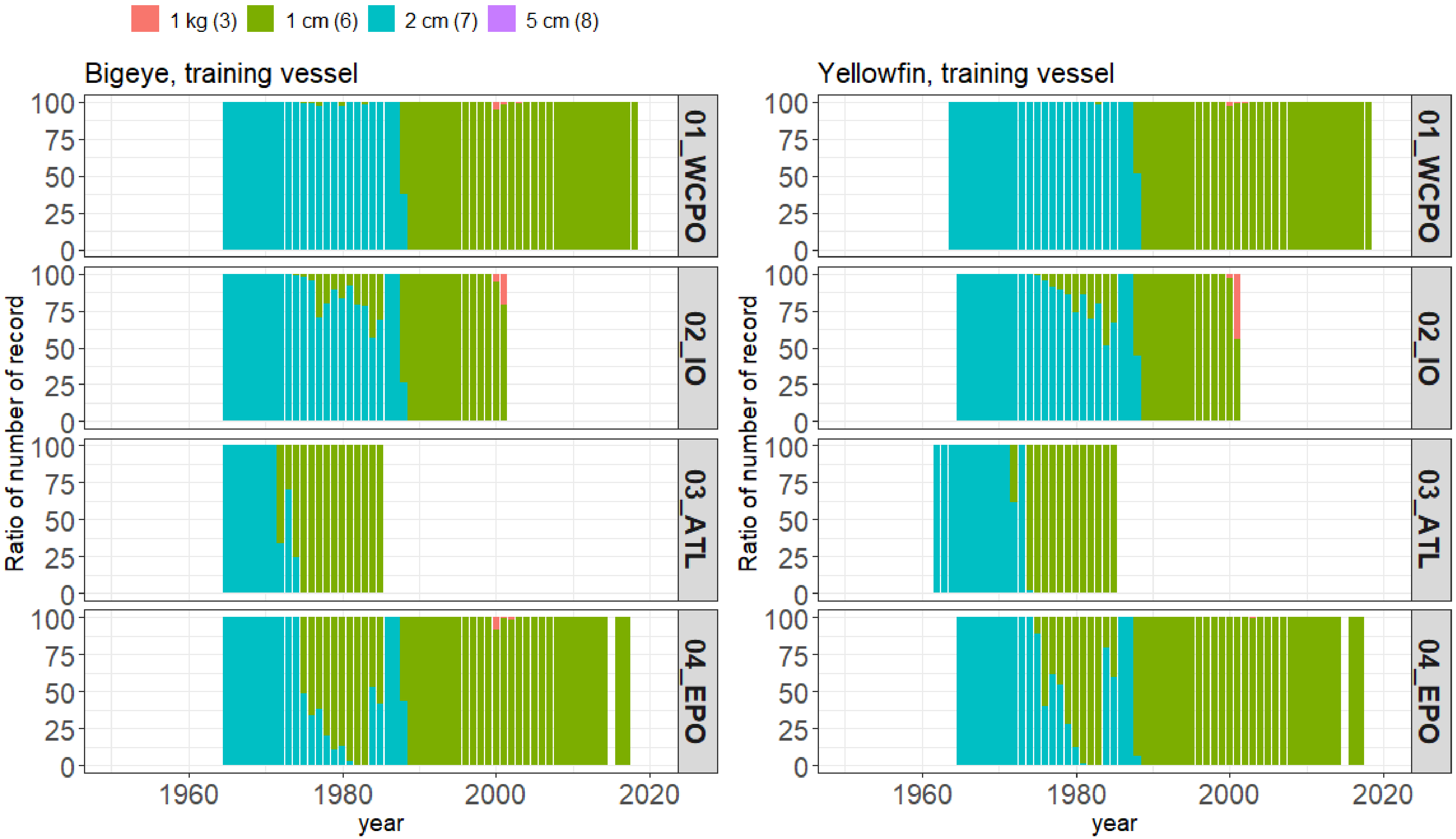
Review size composition data – spatial resolution (training vessel) –



✓ Fine spatial-temporal resolution (1x1, daily) is available for almost data period.

Figure 10. Availability of spatial resolution (latitude x longitude. 1; 10x20, 2; 5x10, 3; 5x5, 4; 1x1) of size composition data of training vessel by the ocean and by species (left; bigeye, right; yellowfin).

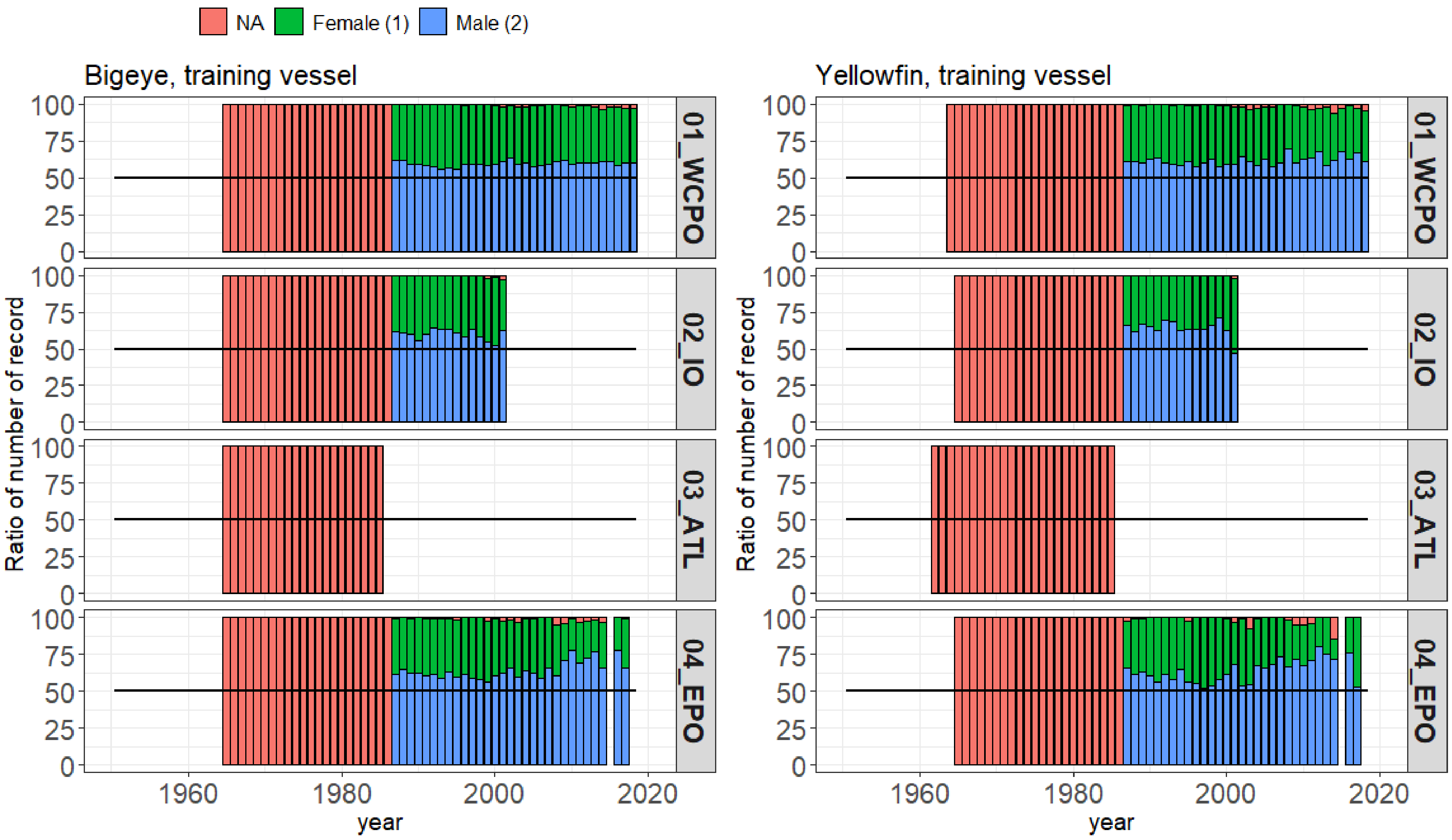
Review size composition data – Size unit (weight, length) (training vessel) –



- ✓ Length data is dominant for almost period.
- ✓ After 1986 fine scale (1 cm) is available.

Figure 11. Availability of measurement unit (3; 1 kg, 6; 1 cm, 7; 2 cm and 8; 5 cm) of size composition data of training vessel by the ocean and by species (left; bigeye, right; yellowfin).

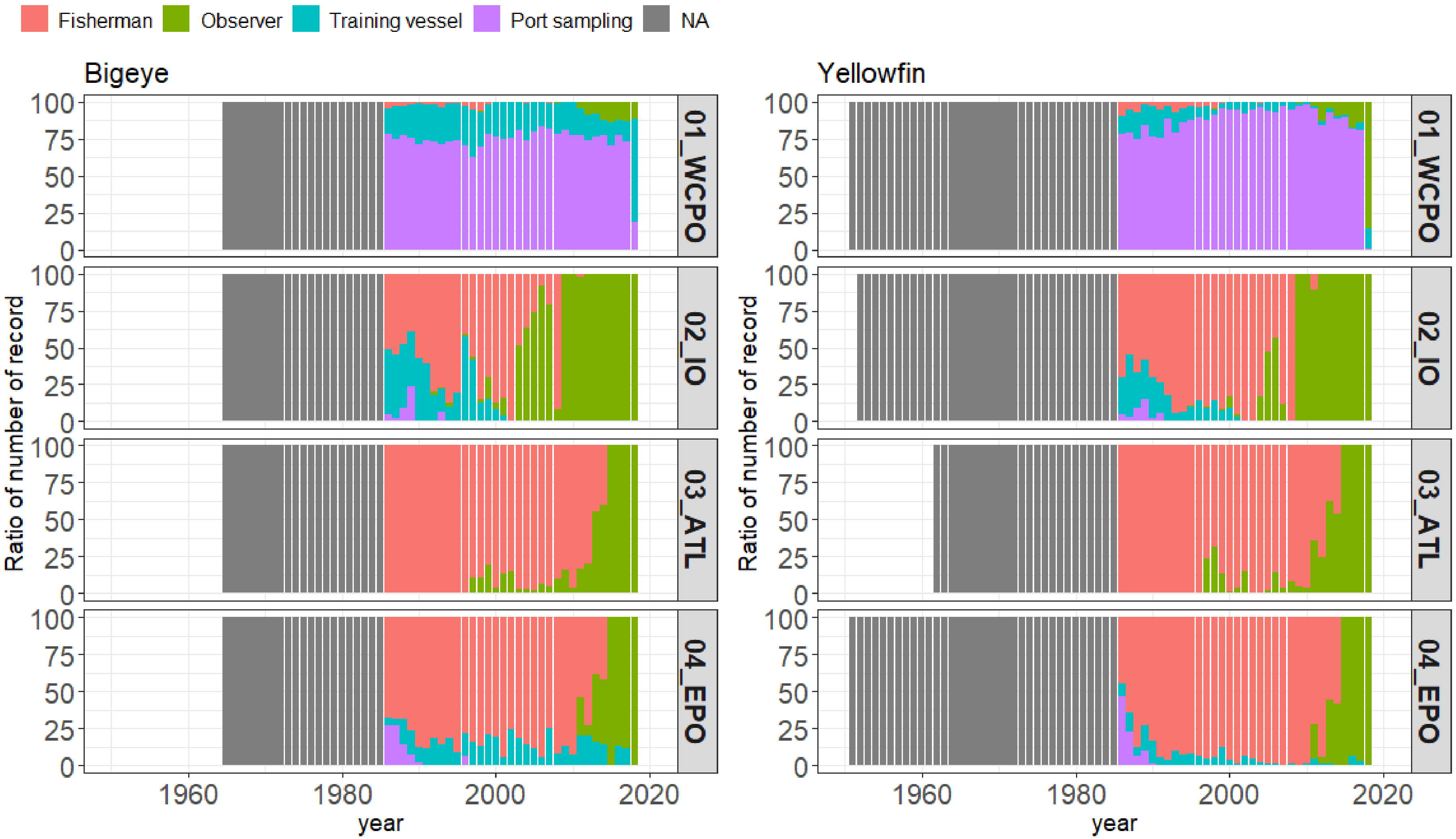
Review size composition data – Sex (training vessel) –



- ✓ After 1986 size data is basically recorded by its sex.
- ✓ Proportion of male is larger than female.

Figure 12. Availability of sex (1; female, 2; male, NA; not available) of the size composition data of training vessel by the ocean and by species (left; bigeye, right; yellowfin).

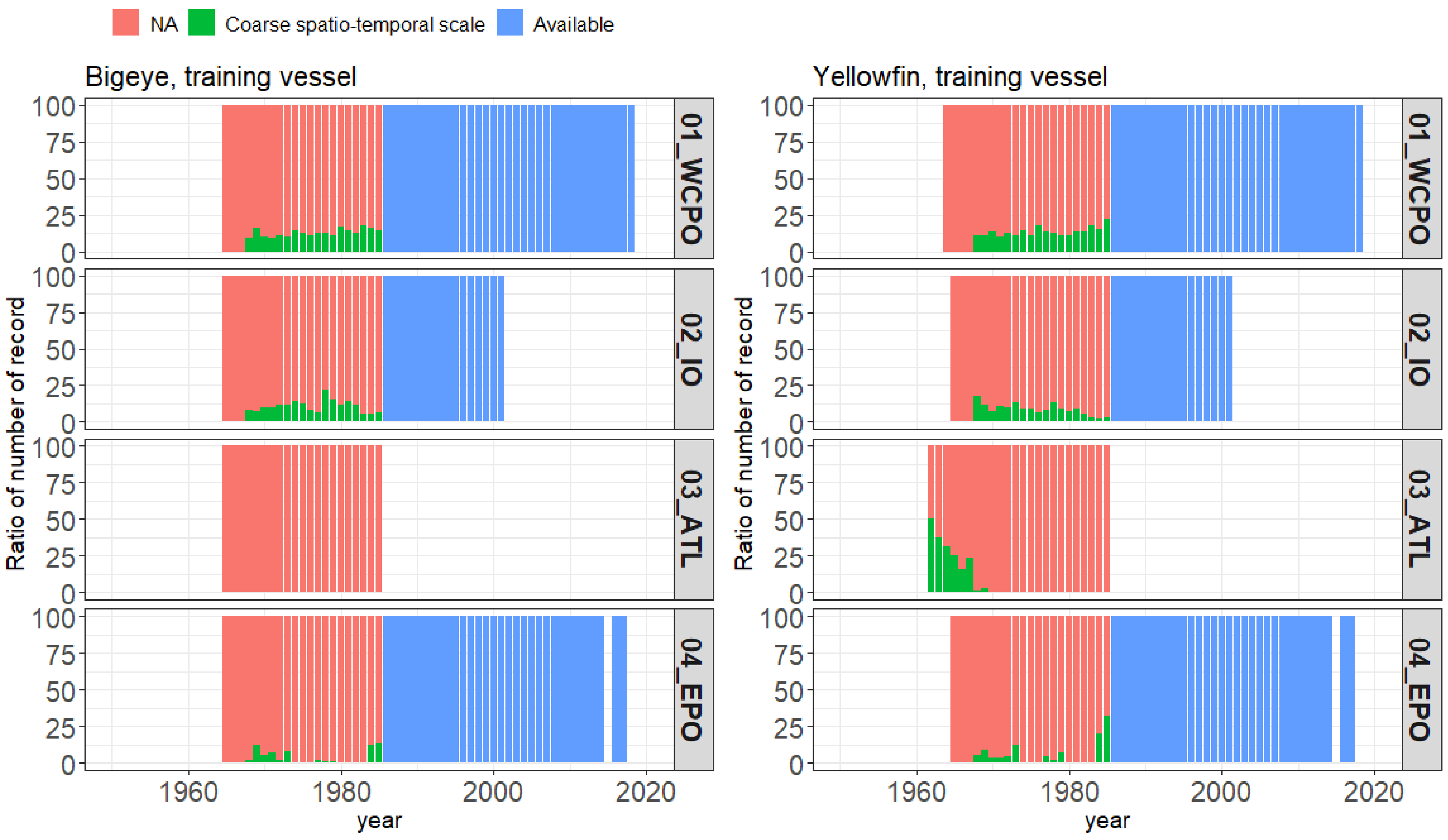
Review size composition data – Data source –



- ✓ Except for the WCPO, observer data is dominant in recent years, since 2011 in the EPO.
- ✓ In the WCPO, port sampling is dominant.
- ✓ Before 1986 data source isn’t available.

Figure 13. Data source of size data by the ocean and species (upper; bigeye, bottom; yellowfin). NA means that size composition data exists, but its data source is unknown.

Review size composition data – availability –



After 1986 the fine resolution (1x1, daily) and vessel identifier is available.

Figure 14. Availability of fine spatio-temporal scale (daily and 1 x 1 degree) size composition data with vessel identifier by the ocean and species (left; bigeye, right; yellowfin) for training vessel.

Summary of data availability

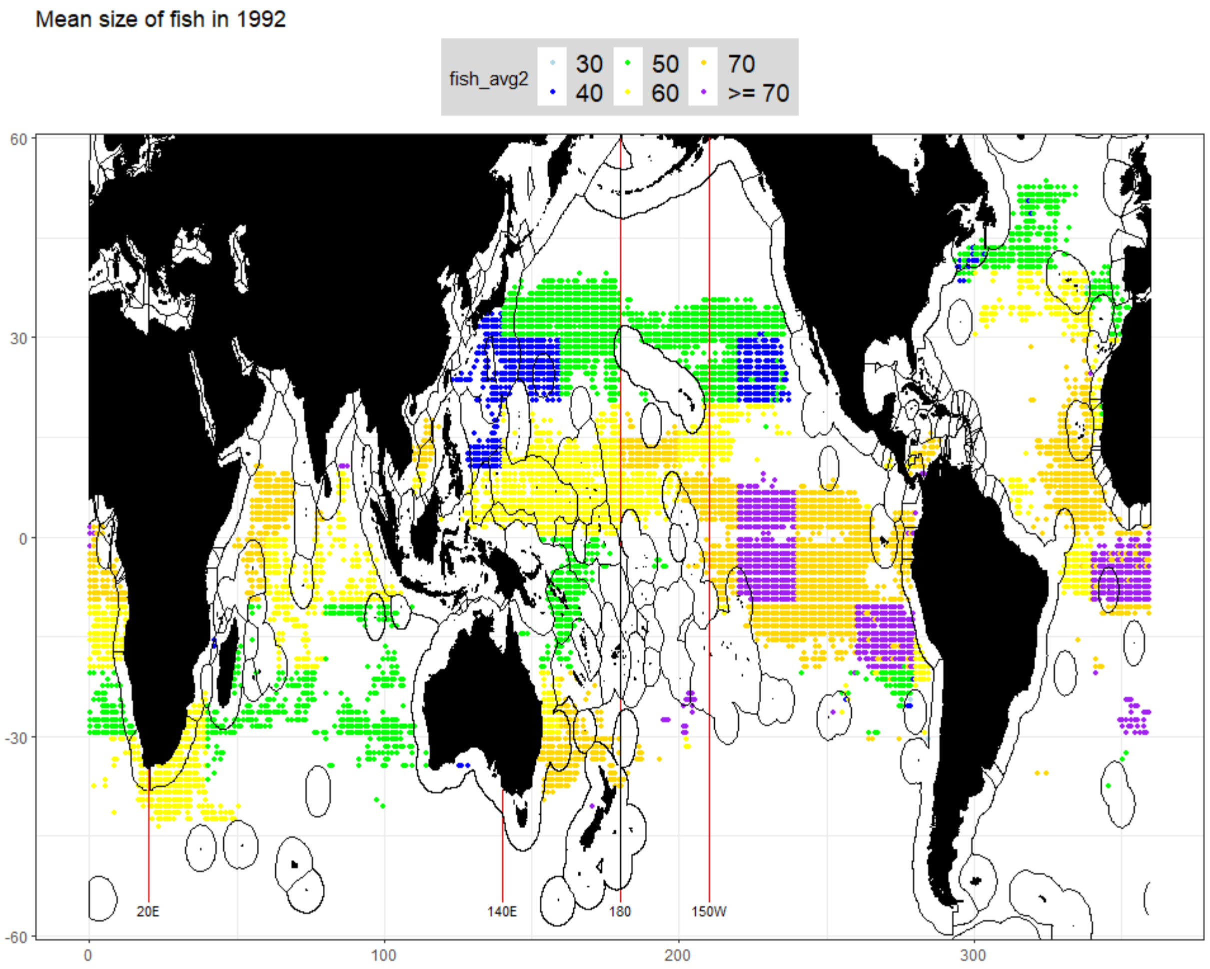
- ✓ The size composition data after 1986 are informative in the EPO, which include sex information and recorded by fine spatio-temporal resolution (1x1 degree and daily).
- ✓ Some size composition data in 1990s and after 2011 in the EPO had vessel identifier, which is associated with gear configurations in the logbook for the training vessels, while training vessels had the fine resolution (1x1, daily) and vessel identifier after 1986.
- ✓ Fine spatio-temporal resolution of training vessels are available since 1960s, which is longer period than commercial vessels.
- ✓ Overlap of fishing ground between the vessel type was limited.

Review of size composition data - representativeness - BET

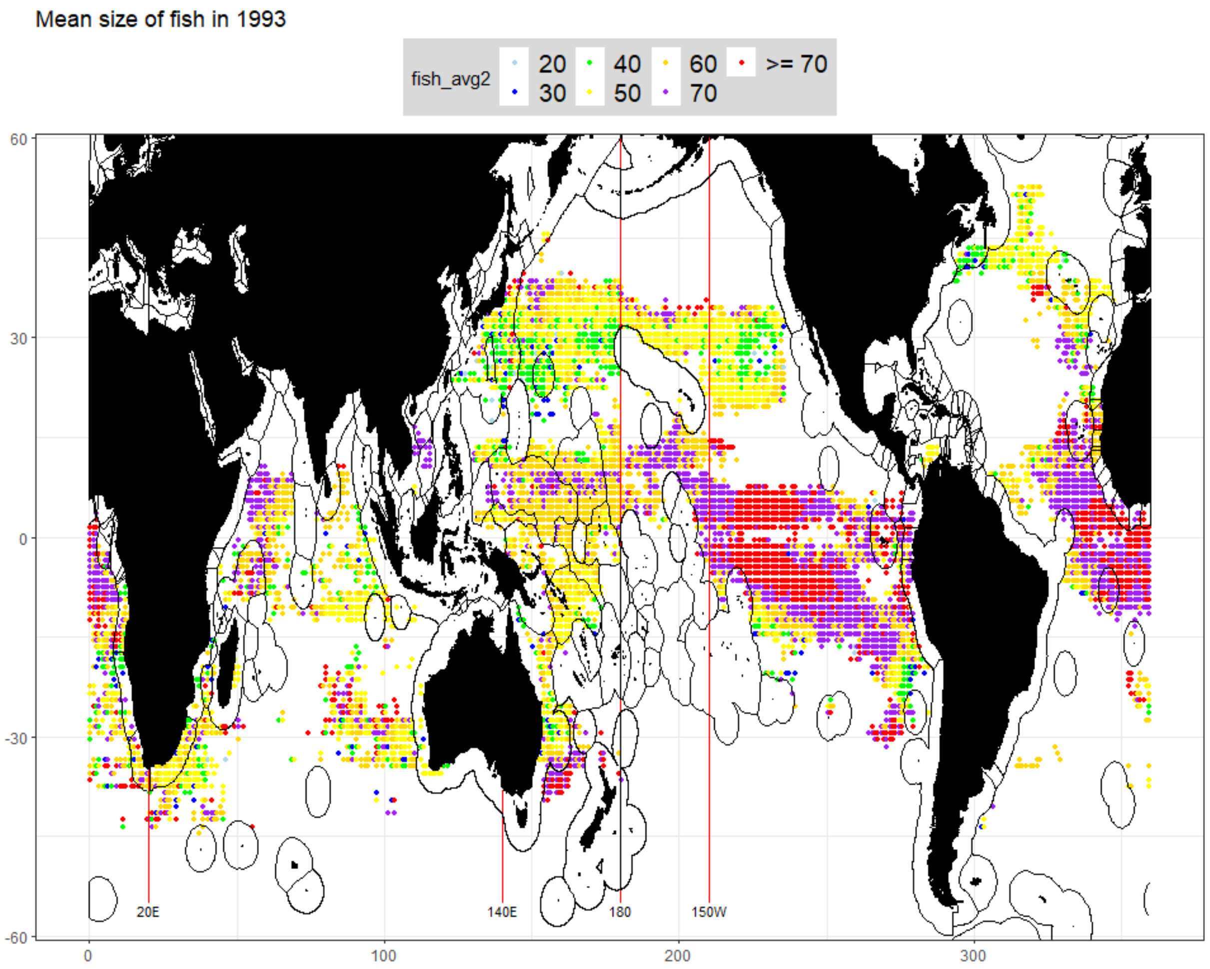
- ✓ There were three data sources, 1) average fish weight by a longline set from logbook (weight / number caught by a set), 2) measured fish body weight and 3) measured fish length.
- ✓ Data quality for the 1st data is different prior- and post-1993. In the earlier period the fish size was predicted value using mean fish size in a certain area. In later part, the caught fish weight per set were observed by fisherman and reported in the logbook. Thus, the 1st data set is used only after 1993 for further analysis.
- ✓ Fish weight is presented as live weight from originally recorded GG (gilled-and-gutted weight).

BET

1992

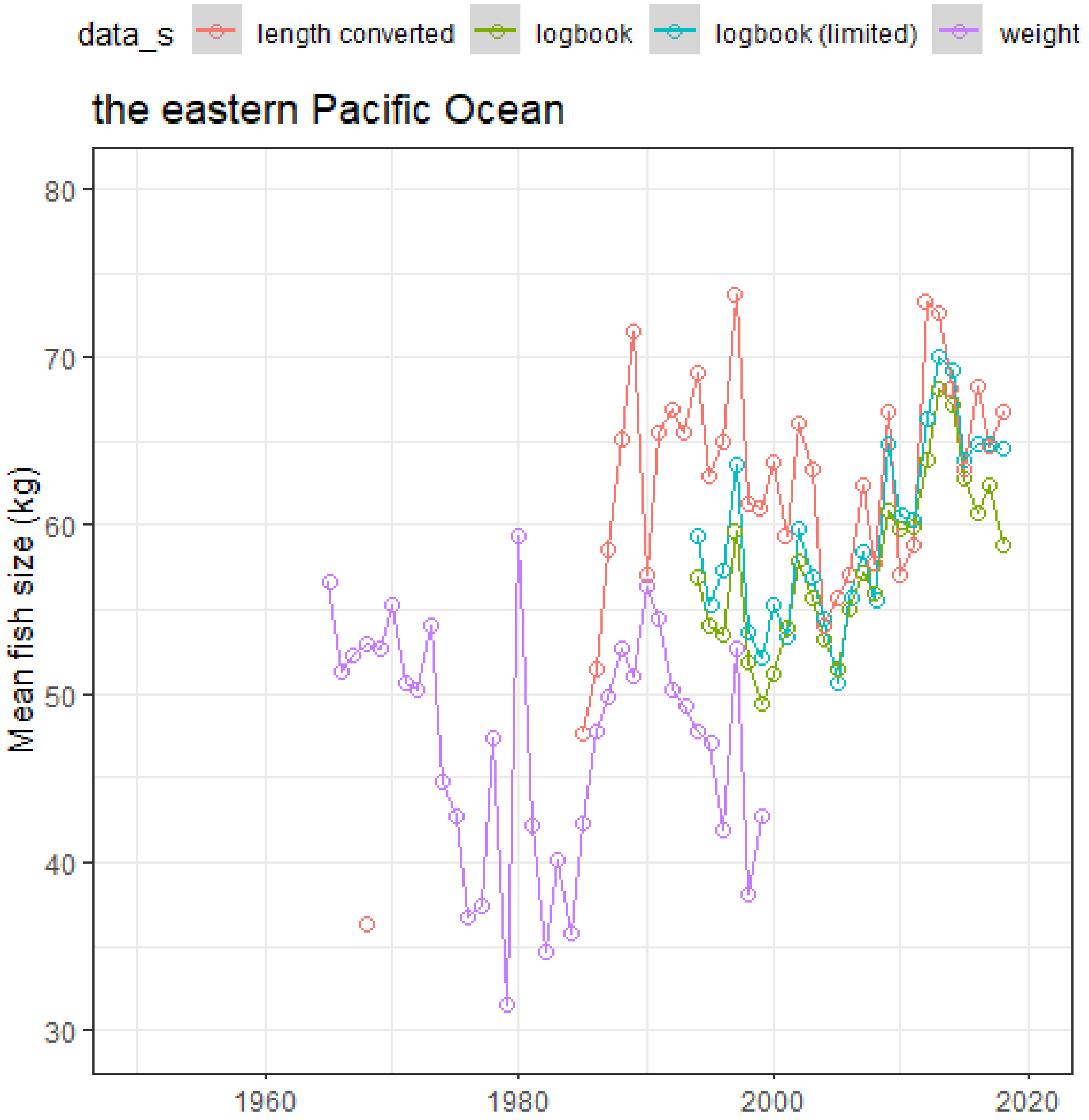


1993

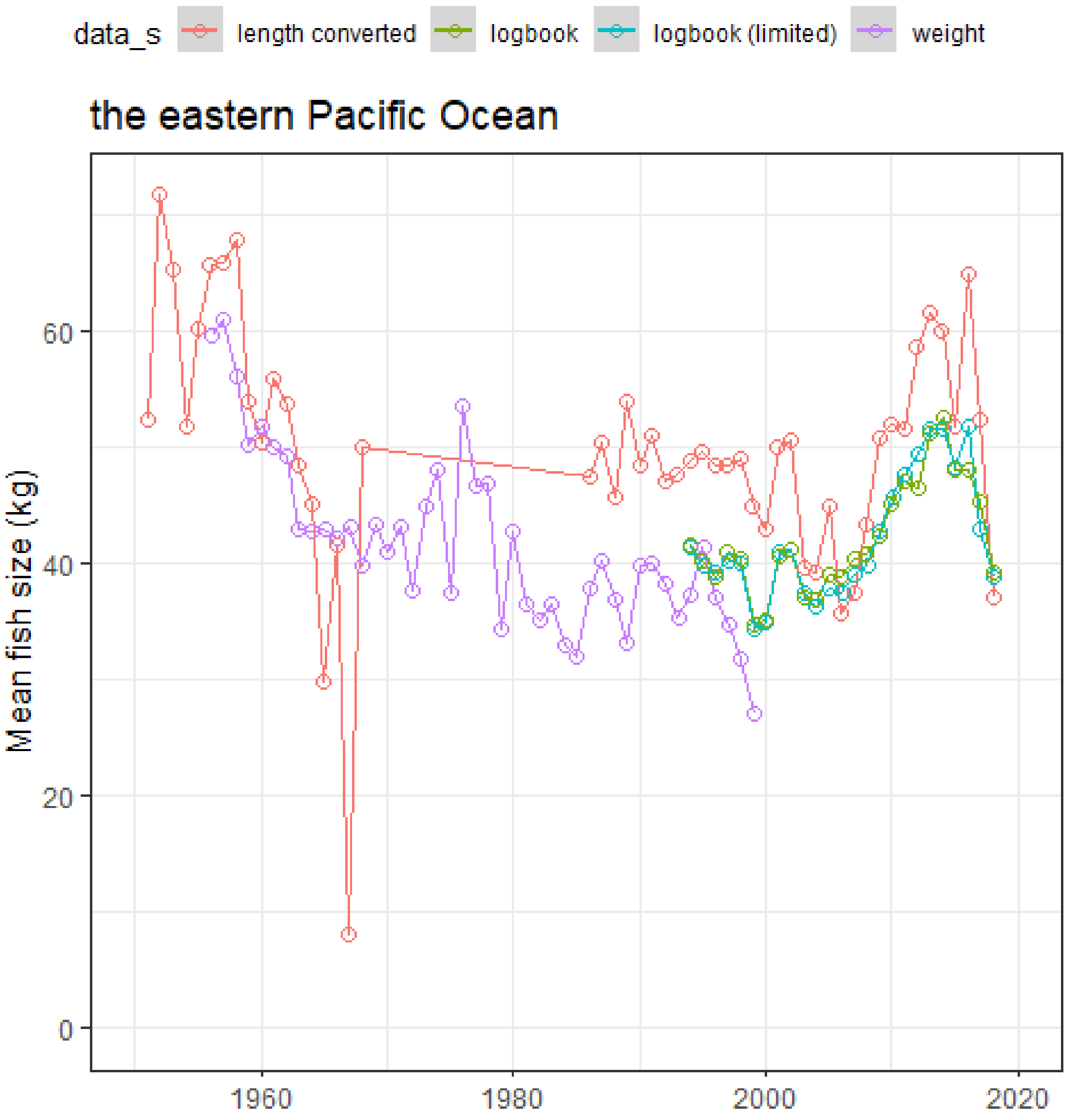


Comparison of average fish weight by a longline set from logbook (weight / number caught by a set), between 1992 and 1993

BET



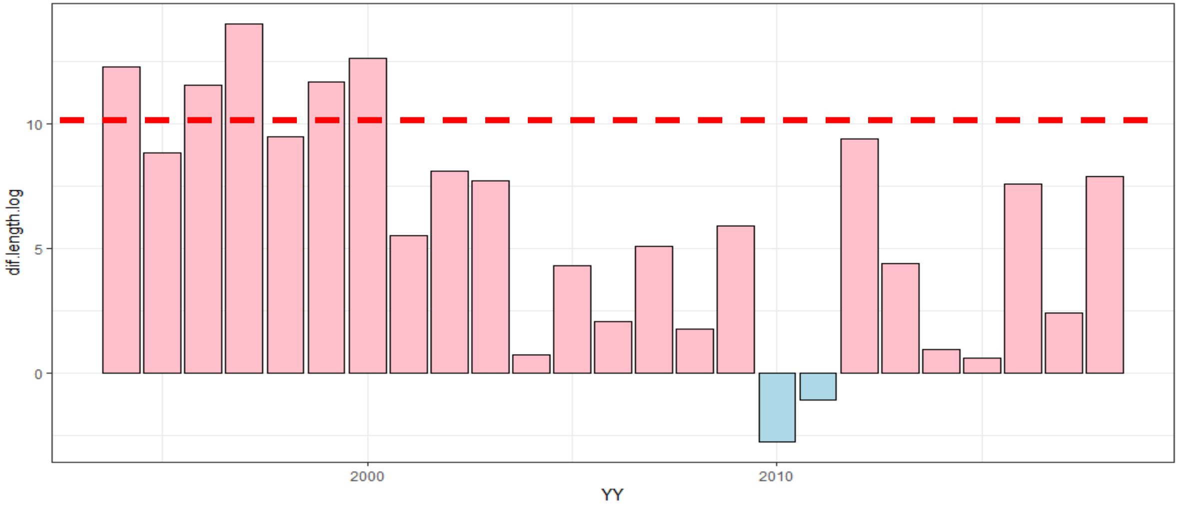
- ✓ Fish weight is presented as live weight from originally recorded GG (gilled-and-gutted weight) using this equation; Whole weight (kg) = 1.3264 * GG (kg) ^ 0.969 (Langley et al. 2006). Length data is converted to whole weight (kg) using this equation, whole weight (kg) = 3.661 * 10 ^ -5 * FL (cm) ^ 2.90182 (Nakamura and Uchiyama 1966).
- ✓ In the EPO, weight data was lower than others. The trend of the logbook and length converted data were similar, but there was differences before around 2000.



YFT

- ✓ For yellowfin tuna, there are similar differences among data sets.

BET



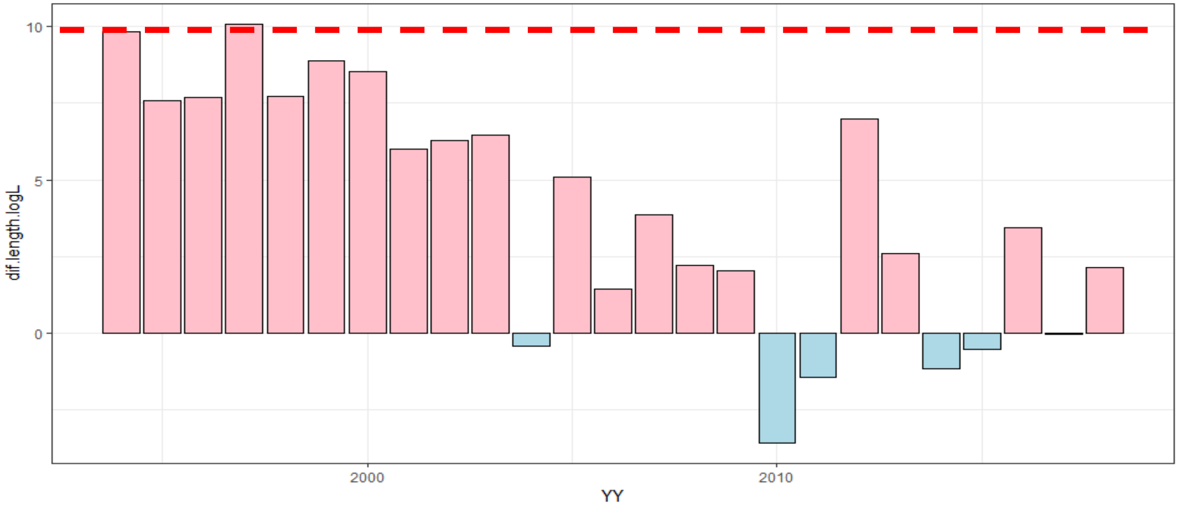


Figure 14. Differences of fish weight between length converted weight and average weight from logbook (upper), average weight from logbook whose data was limited to the place where the size composition data exist (bottom).

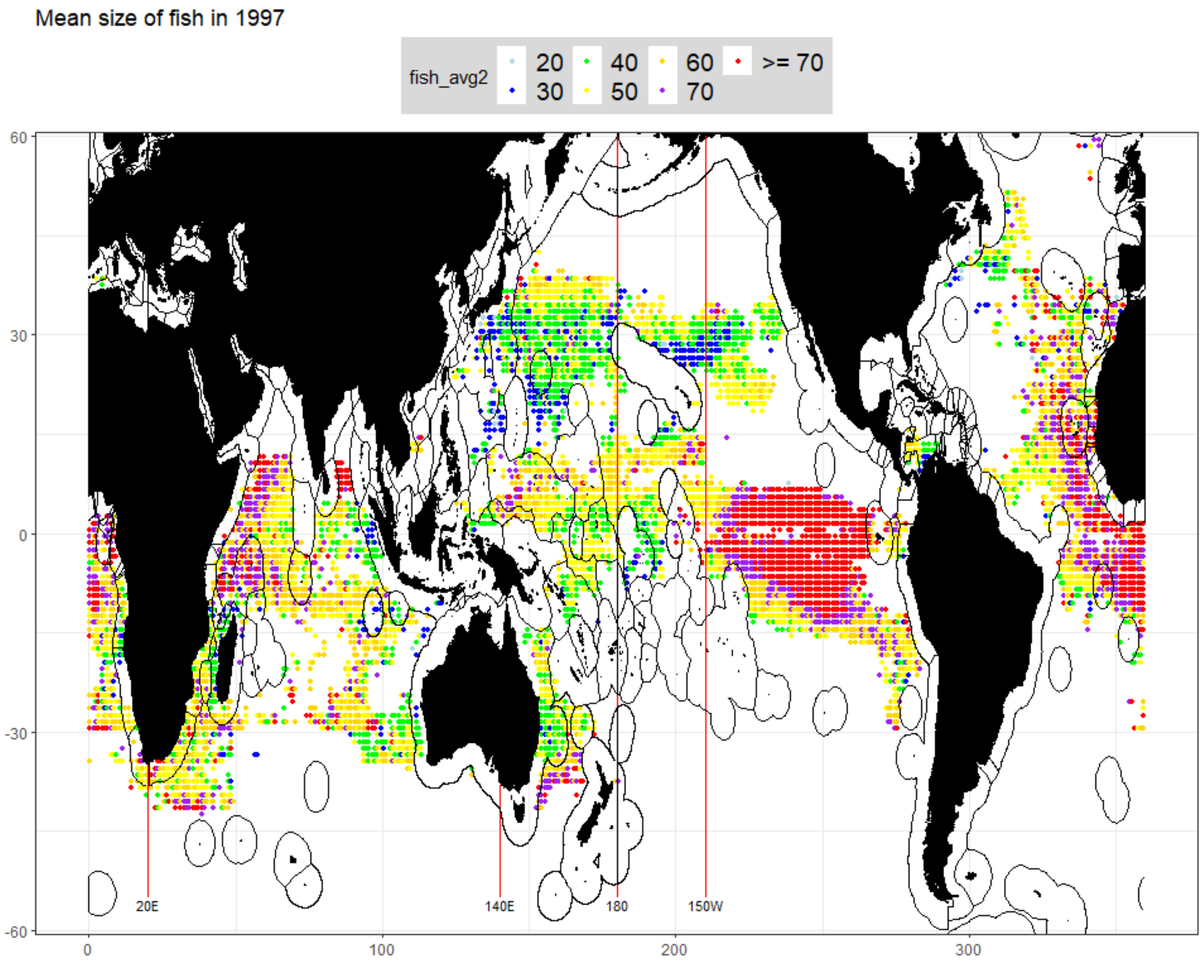
- ✓ Possible causes

1. Spatial effect; Data coverage (number of size composition / number of catch) is around 5%, thus spatial representative of size composition data isn't enough.
2. Fisherman tend to measure larger fish; In recent years observer measured fish, while fisherman mainly measured fish before 2010.
3. Wrong conversion

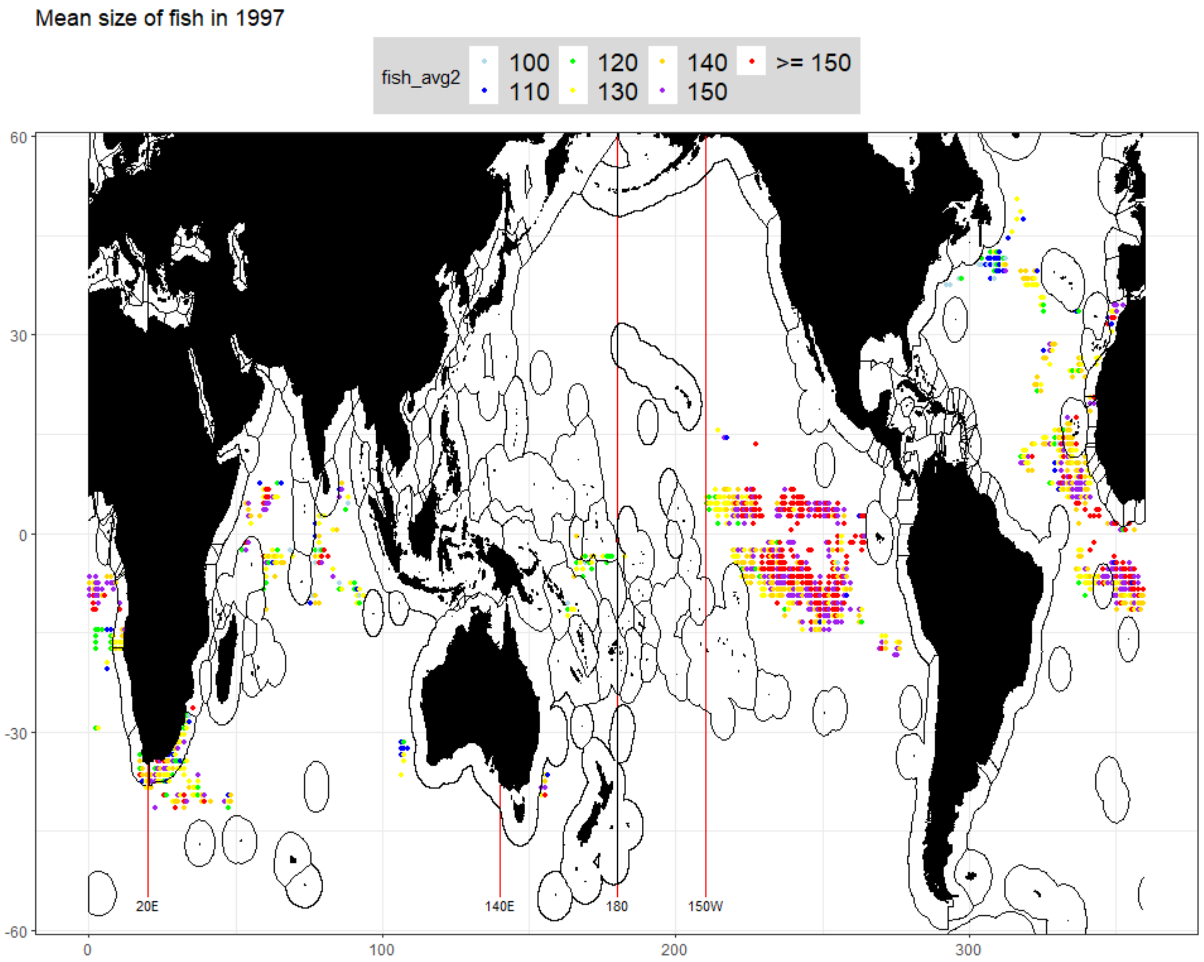
- ✓ The first hypothesis is confirmed by calculating average weight from logbook was limited to the location where the size composition data exist, and then compare these weight. The left figures showed that the spatial effect may exist to a certain degree. The difference between length converted weight and average weight from logbook was smaller if the data was limited where the size composition data exist. However it does'nt explain all the differences.

BET

logbook



Length composition



Comparison of average fish weight by a longline set from logbook (left; weight / number caught by a set) and from length composition data in 1997

BET

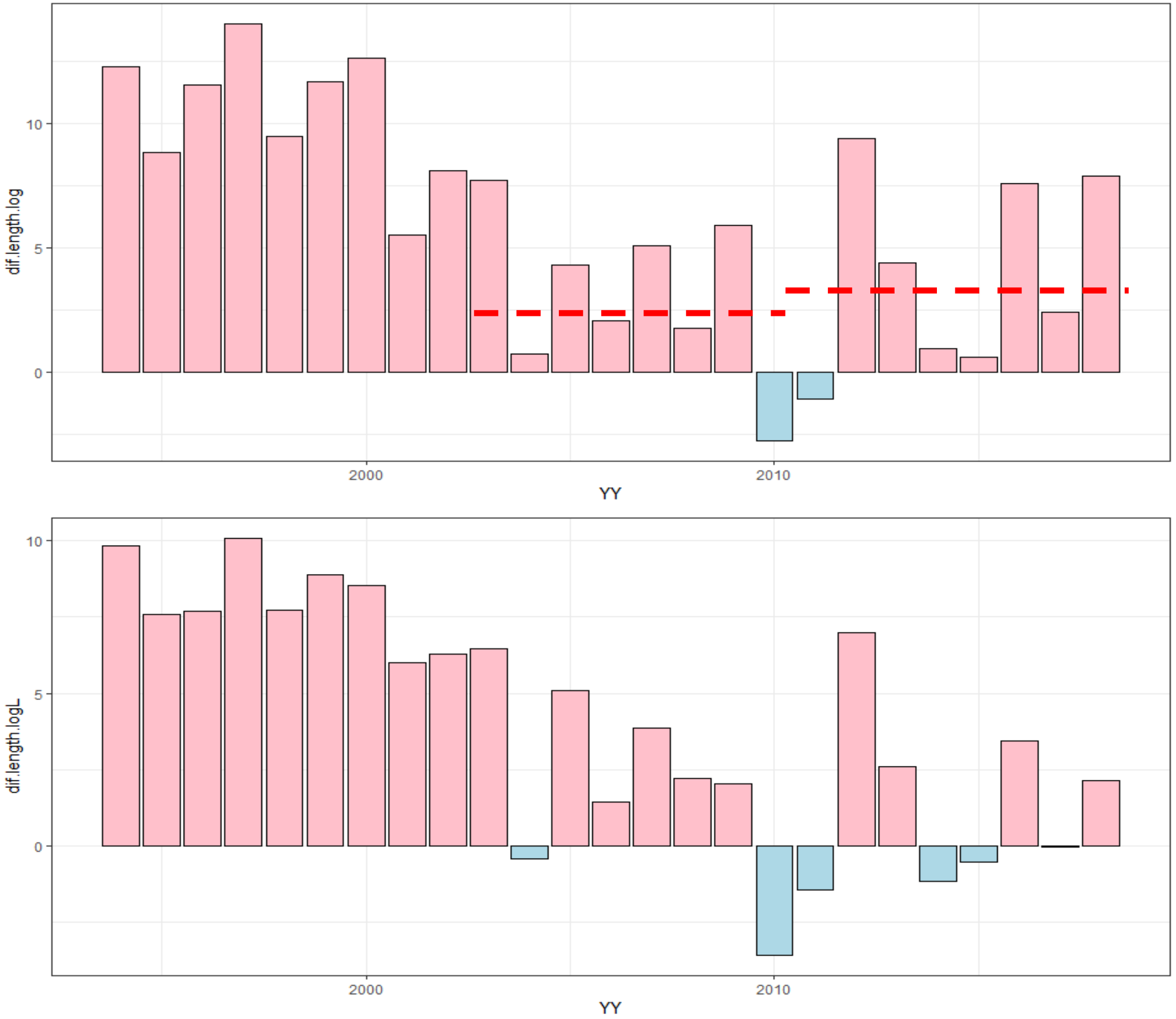


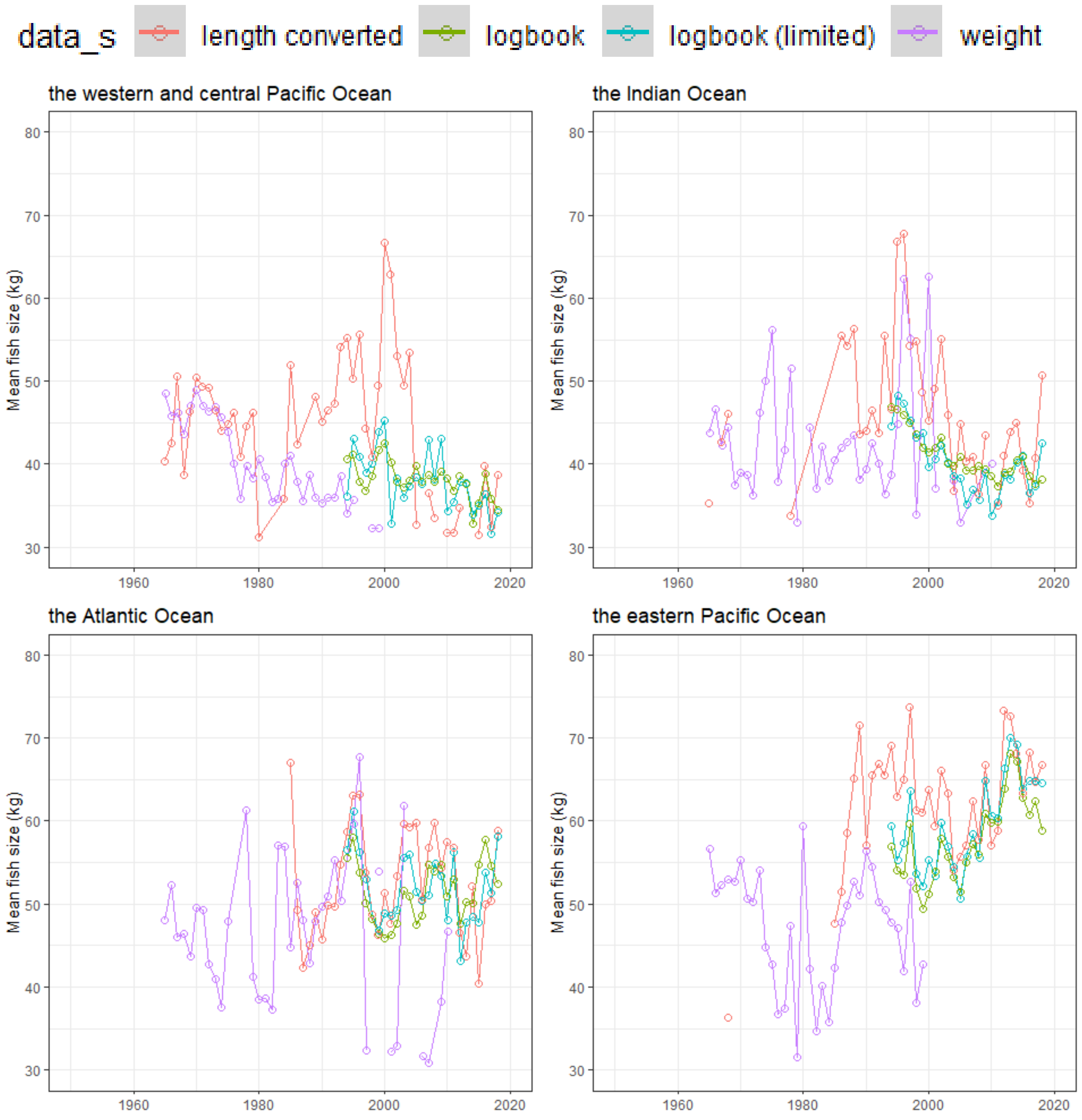
Figure 15. Differences of fish weight between length converted weight and average weight from logbook (upper), average weight from logbook whose data was limited to the place where the size composition data exist (bottom).

- ✓ Possible causes

2. Fisherman tend to measure larger fish than observer; In recent years observer measured fish, while fisherman mainly measured fish before 2010.

- ✓ The second hypothesis is confirmed by calculating differences average weight pre-, and post-2011 there is no substantial differences between fisherman and observer during overlap from 2011 to 2014 (1^{st} IATTC LL CPUE workshop).
- ✓ Also, the average difference from 2003 to 2010 (8 years) and from 2011 to 2018 was 3.11 and 4.02, respectively. The hypothesis seems to be wrong.

BET



✓ Possible causes

3. Wrong conversion

Same analysis applied to other oceans using different equation, which is used for stock assessments.

round weight - GG weight (BET)

WCPO; round weight (kg) = 1.3264 * GG (kg) ^ 0.969 (Langley et al. 2006)

IO; round weight (kg) = W (GG) * 1.16 (Morita 1973, ICCAT Manual)

ATL; round weight (kg) = W (GG) * 1.16 (Morita 1973, ICCAT Manual)

EPO; round weight (kg) = 1.3264 * GG (kg) ^ 0.969 (Langley et al. 2006)

round weight - Fork length

WCPO; round weight (kg) = 2.0417 * 10 ^ -5 * FL (cm) ^ 3.0214 (McKechnie et al. 2017)

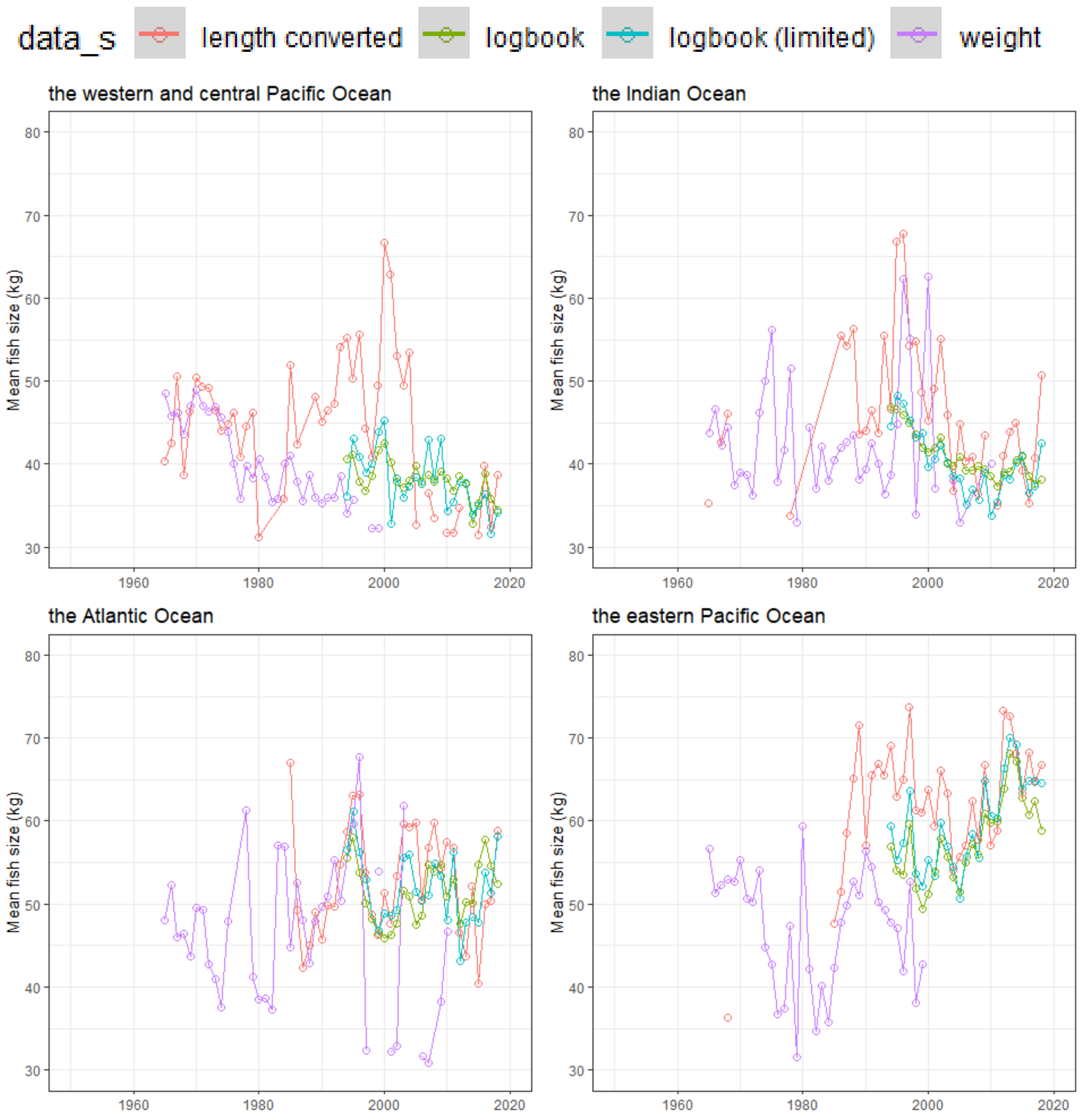
IO; round weight (kg) = 2.74 * 10 ^ -5 * FL (cm) ^ 2.908 (Poreeyanond, D. 1994; FL <= 80 cm)

IO; round weight (kg) = 3.661 * 10 ^ -5 * FL (cm) ^ 2.90182 (Poreeyanond, D. 1994; FL > 80 cm)

ATL; round weight (kg) = 2.396 * 10 ^ -5 * FL (cm) ^ 2.9774 (Parks et al. 1982)

EPO; whole weight (kg) = 3.661 * 10 ^ -5 * FL (cm) ^ 2.90182 (Nakamura and Uchiyama 1966)

BET

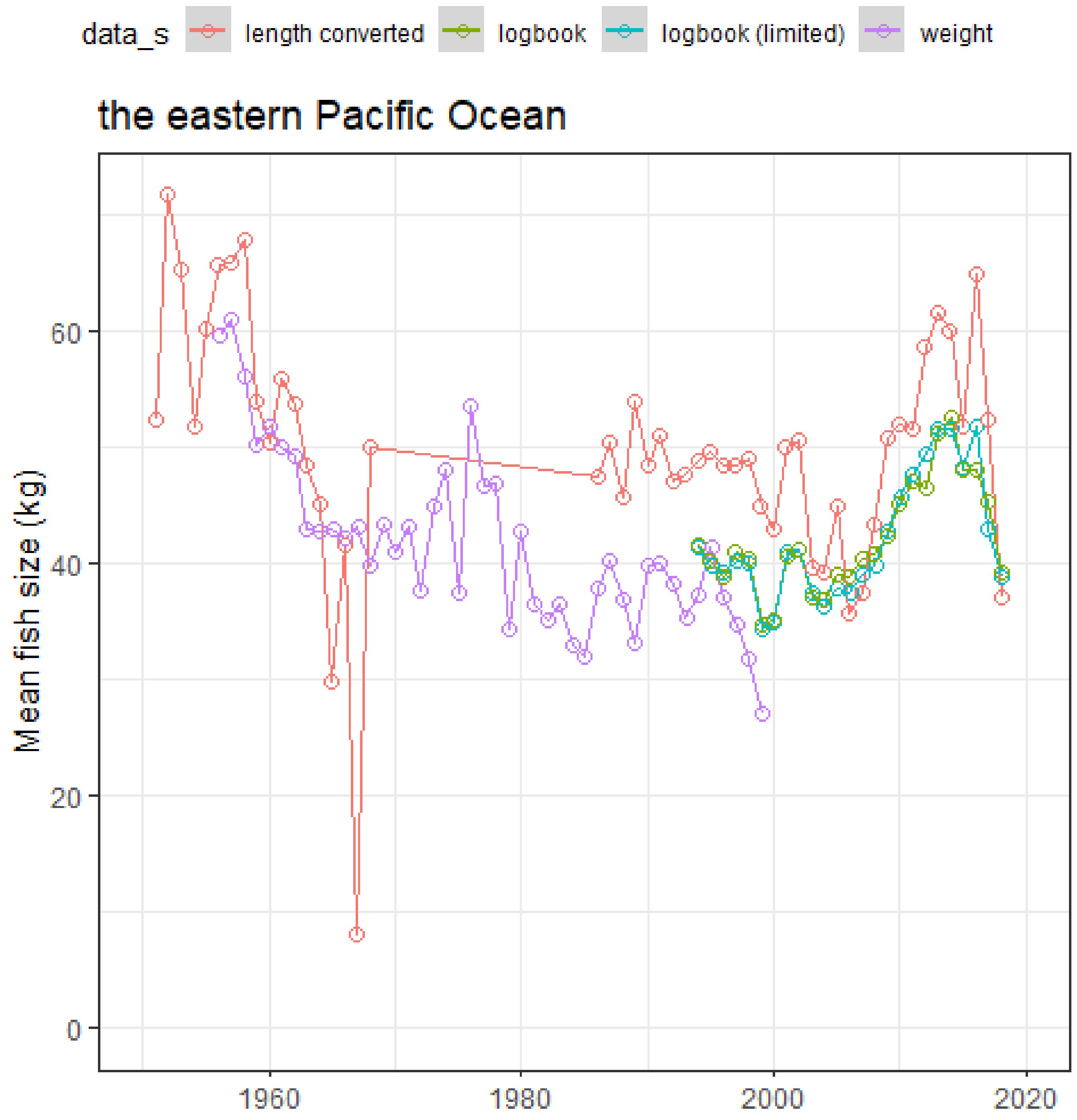


- ✓ Possible causes

3. Wrong conversion

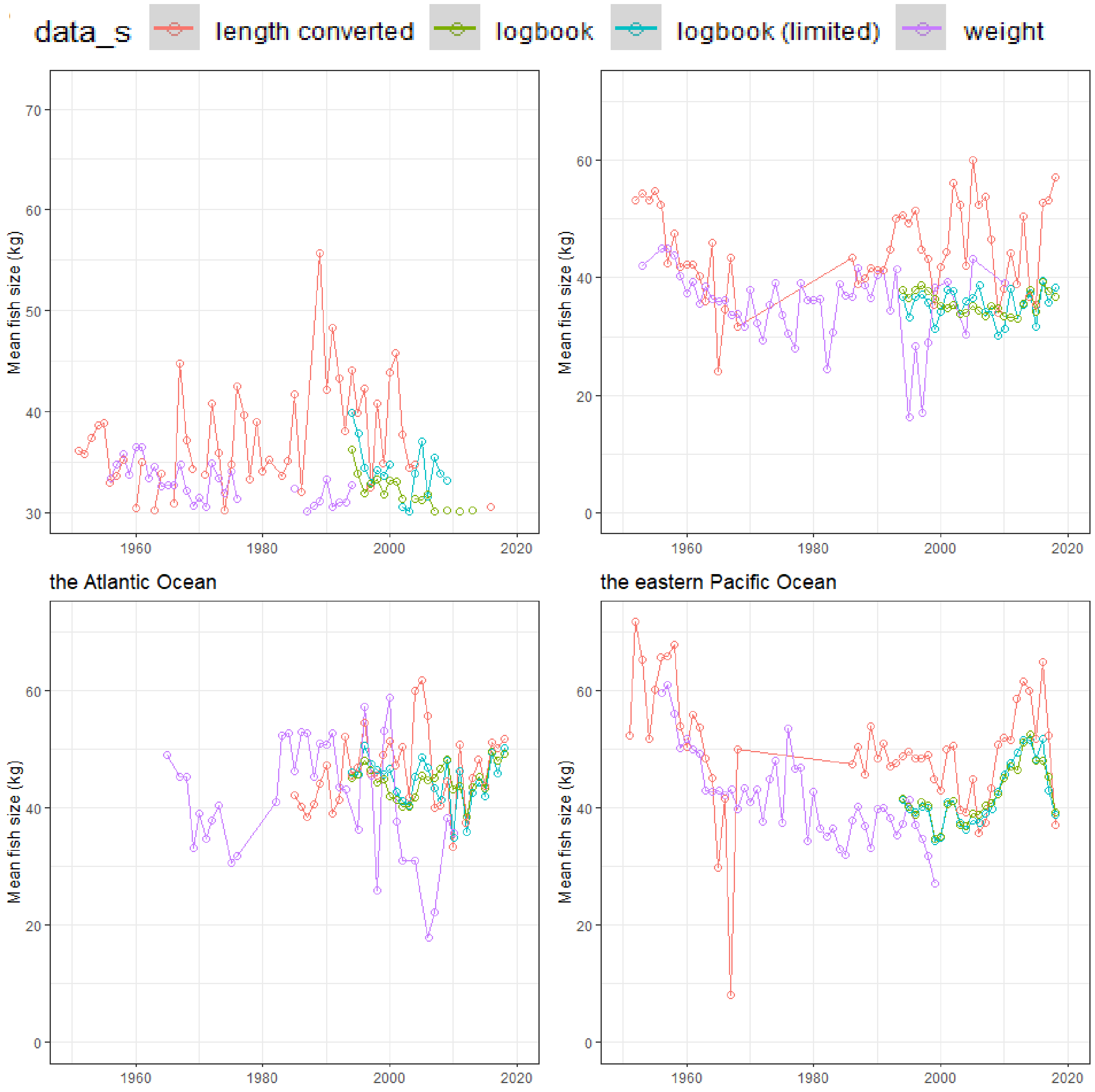
- ✓ In the Atlantic Ocean, there was good consistency among these three data sets, while in the IO there was differences even same convert equation for round weight - GG weight is used for the two Ocean. Thus, the round weight - Fork length equation possibly introduce the difference.
- ✓ In the WCPO high fluctuation of length converted one was observed. It may partially result from small number of length data.
- ✓ Convert equation may affect partially this difference.

- ✓ If the trend is similar among data set, the size composition data may be able to use for stock assessment. If there is difference in the trend, we need further analysis whether or not the size data showed representativeness of the stock.



YFT

- ✓ For yellowfin tuna, there are similar differences among data sets.
- ✓ The spatial effect (first hypothesis) seems no effect (green – light green).


data_s
length converted
logbook
logbook (limited)
weight
Mean fish size (kg)
the Atlantic Ocean
the eastern Pacific Ocean
1960
1980
2000
2020

YFT

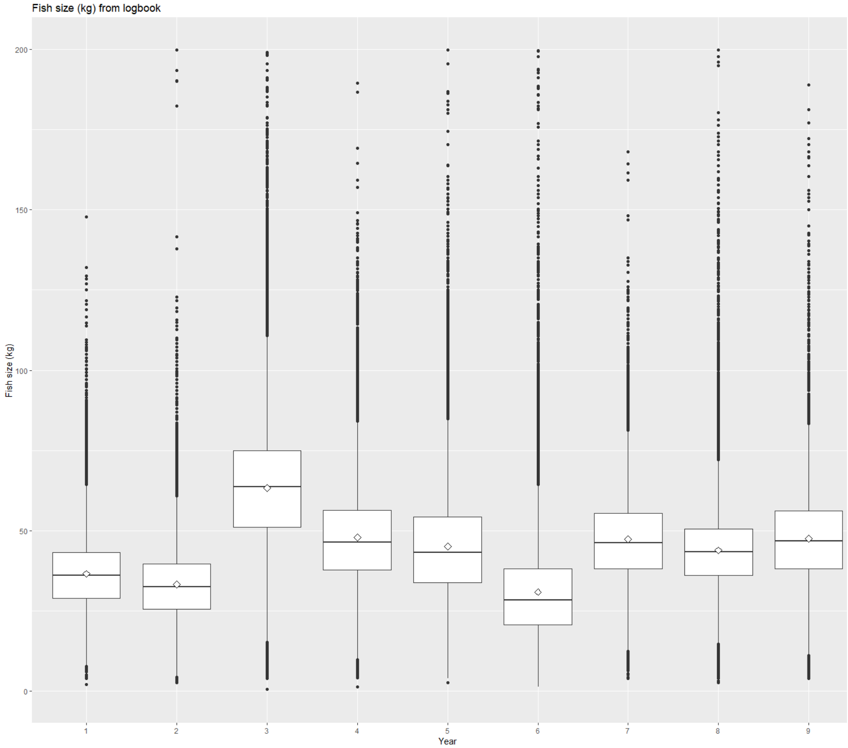
Summary of data variety

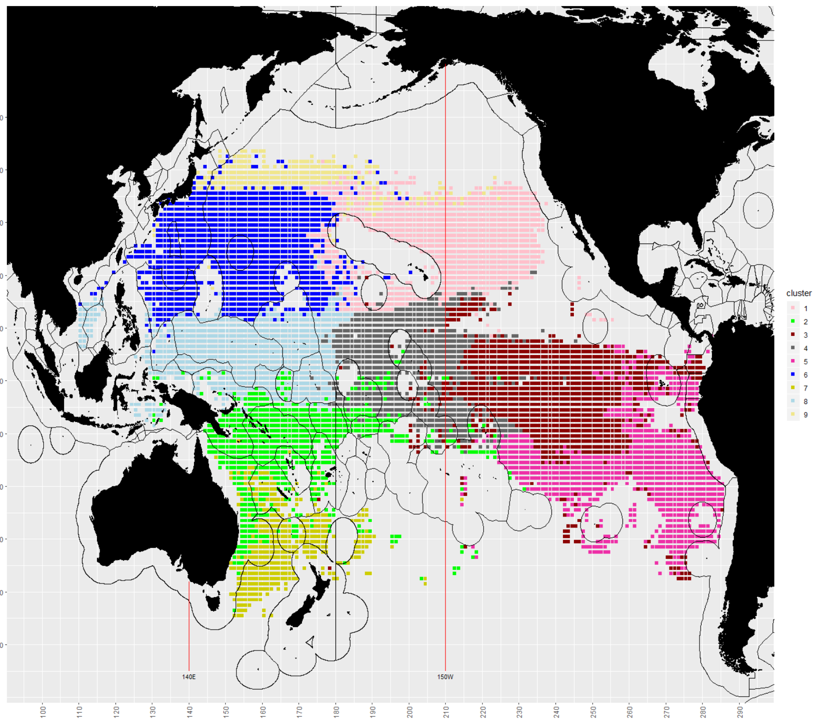
- ✓ In the EPO, there were average size differences among three size data sets before 2000 between length converted weight data and average weight from logbook. For this period, trend of these two data set was also different. Further analysis is needed to know the length composition data before around 2000 showed representativeness of stock or not.
- ✓ Three hypothesis were tested the reason for the differences, spatial effect (location difference of catch and size composition) partially explain the difference for BET, however it was not the case for YFT.

Future work related to size data

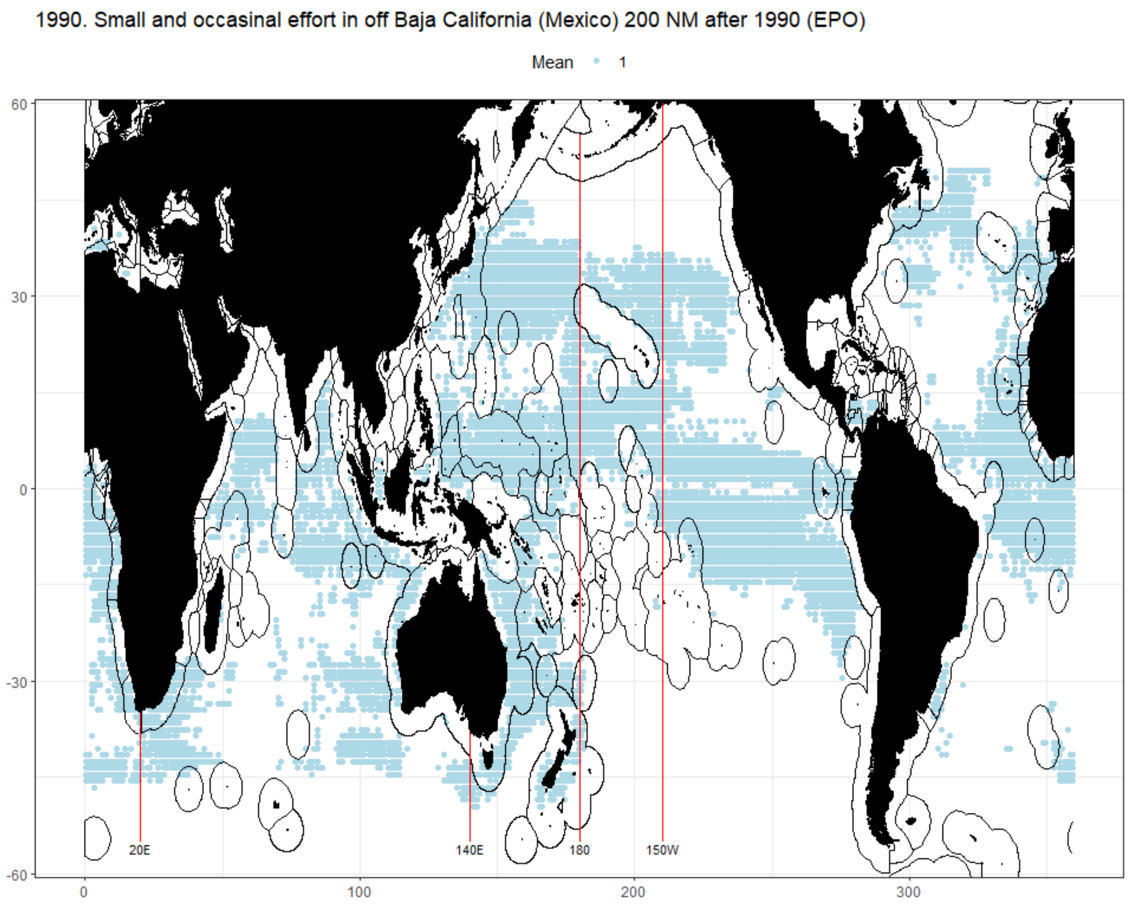
1. Relationship between gear configuration and fish size.
2. Cluster analysis to consider area definition for CPUE standardization for YFT.

BET (9 clusters for PO)

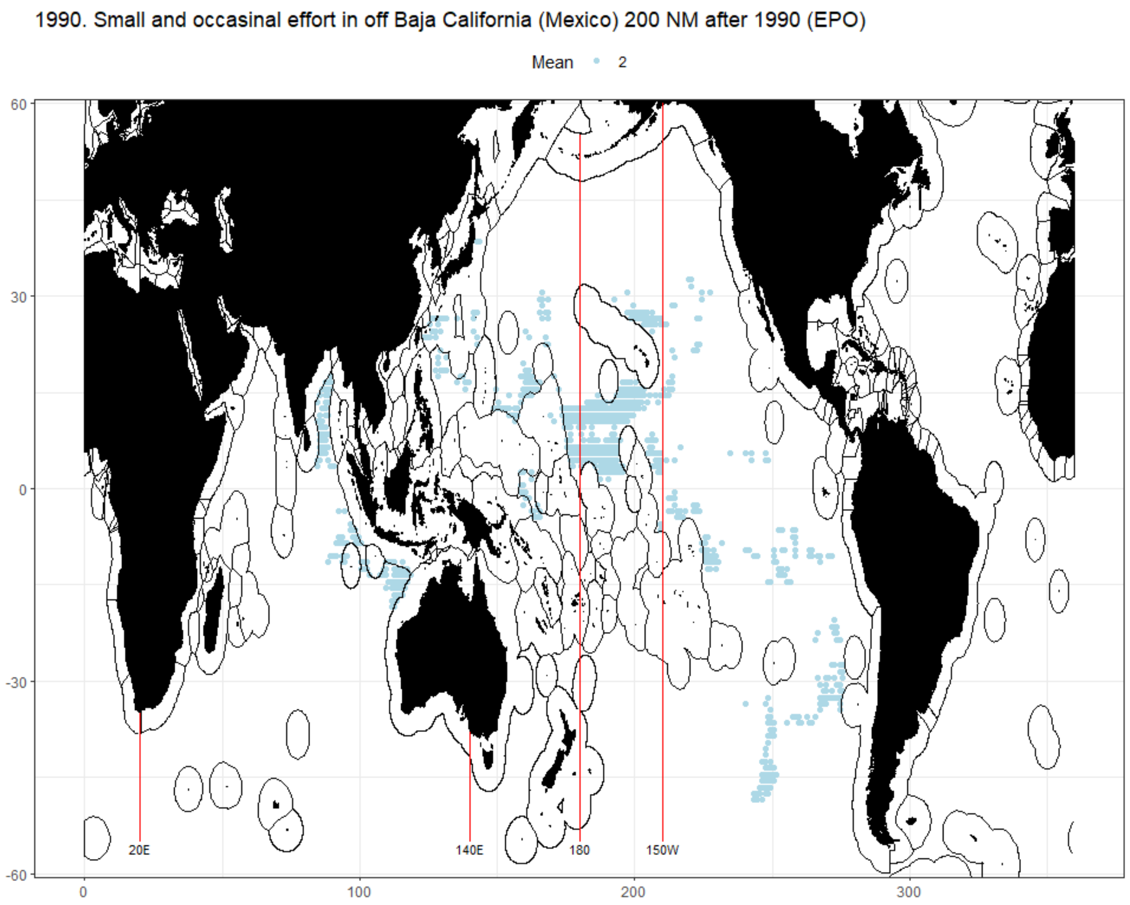




Commercial vessel



training vessel



- ✓ The fishing ground of commercial vessel and training vessel is comparable only in certain areas (vicinity of Japan, off Hawaii, off Johnston and some part of south EPO.

Figure 9. Comparison of fishing ground between commercial vessel and training vessel in 1990.