



# EXPLORING THE POTENTIAL FOR MISREPORTING OF LENGTH SAMPLES BY LONGLINE CREW AND LIKELY CONSEQUENCES ON INDICES OF ABUNDANCE DERIVED FROM LOGBOOK REPORTS

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# THE CONTEXT

- Most stock assessments of tuna and tuna-like species rely heavily on indices of abundance derived from data reported by skippers/crew on longline vessels
- Data collected by longline vessel crew includes:
  - Logbooks containing the total number of specimens caught on each longline set
  - Samples including Individual Lengths/weights of the fish caught
- Fisheries Agencies in each country process the information and report it in aggregated format to the IOTC according to the data requirements applicable
- Reports need to be as complete as possible to avoid the introduction of unwanted bias, including:
  - Logbooks that record all the fish that was caught by the fishing gear, irrespective of its ultimate fate (i.e. all retained catches, bycatch and discards)
  - Fish should be sampled for length aiming at obtaining length frequency distributions that are representative of the total fish caught for each of the species undergoing sampling (random samples consisting of lengths taken from all components of the catch)

# BACKGROUND

- IOTC: Hoyle et al. Identified several issues affecting the lengths reported for longliners of Taiwan since the year 2003. The IOTC WPTT decided to discard using length samples for this fleet since 2003 for the assessments of yellowfin tuna and bigeye tuna.
- ICCAT: The Secretariat identified increases in average length/weight from the samples reported for longliners of Taiwan, over the time series (pers. comm.). Taiwanese scientists reviewed the data and re-submitted the length samples time-series based mostly on data collected by observers.
- IATTC has acknowledged difficulties to reconcile the results from its last stock assessment of yellowfin tuna with trends in abundance (decreasing) and trends in average weights of yellowfin tuna from longline fleets, mainly Japan (increasing).
  - High grading is among the likely scenarios contemplated by IATTC Staff to explain the above inconsistency
- High grading seems to be an issue for Asian longliners, at the global scale.

# THE HYPOTHESIS

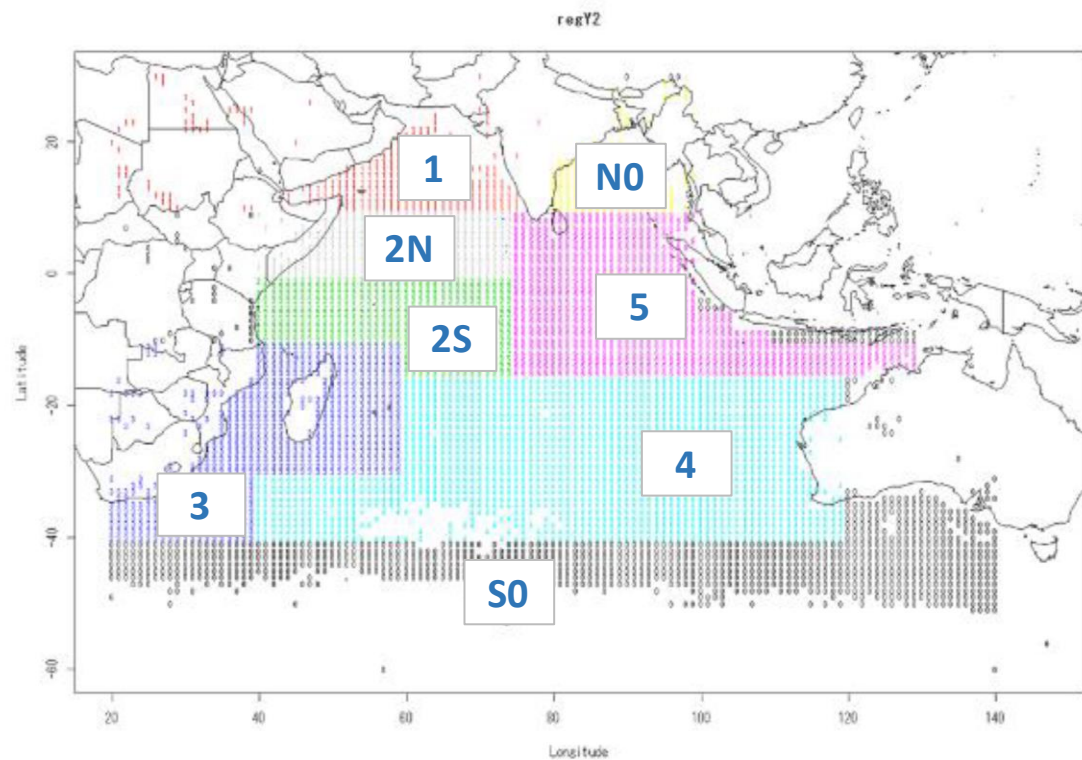
- The crew of longliners is responsible to complete logbooks, including numbers of fish caught by species and length samples.
- If the crew has been misreporting lengths, not recording the small specimens (either because they are discarded or retained as bycatch due to them not reaching the minimum size to be able to be eligible for the sashimi markets, as those discriminate by size) we can assume that the total numbers of specimens reported in logbooks are also missing those small fish;
- There are various consequences:
  - Nominal Catch: Total catch in weight of the species under consideration is wrong because it misses the weight corresponding to the small specimens for which the numbers have been omitted in logbooks
  - Catch rates (indices of abundance): The indices of abundance derived from such data are wrong because they miss the unreported small specimens
  - The selectivity of the longline gear estimated for each stock is wrong
- All this could highly compromise the quality of assessments that rely heavily on these data, as it is the case of YFT and BET assessments in the IOTC and other tRFMOs

# DATA SOURCES AND PREPARATION

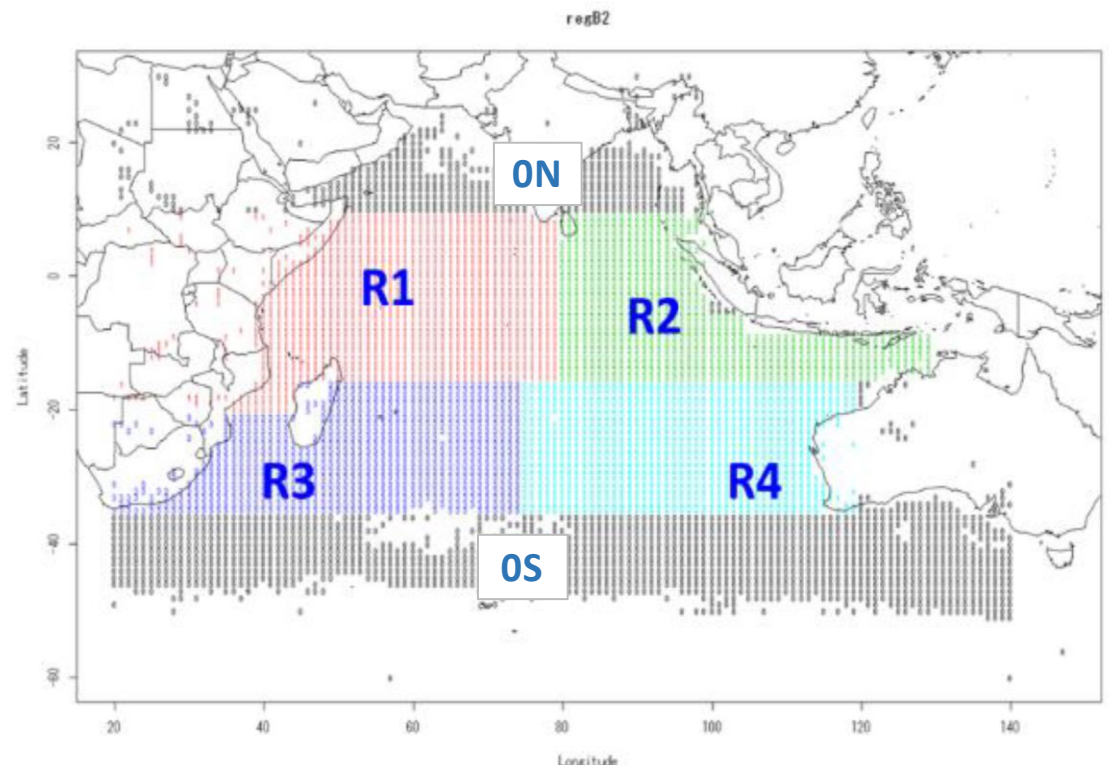
- Nominal catch, catch and effort and length frequency samples files downloaded from the IOTC Web Site
- Preparation of a file including:
  - Catch and effort data for the longline fisheries of Japan, Taiwan (excluding fresh-tuna longliners), Republic of Korea, Seychelles and China.
  - Available length samples (2cm length bins) for YFT and BET for the above fisheries
    - Data includes gears LL (mostly data recorded by the vessel crew) and LLOB (data recorded by observers)
  - Catch, effort and length data were aggregated by Species, Fleet, Gear, Year, Quarter and Assessment area
    - Only data from 1980-2017 were used as there are no lengths before 1980 for Taiwan
- Data was prepared using the same areas as those used for the LL CPUE standardization of YFT and BET (as proposed by Hoyle et al Cluster analysis)

# CPUE STANDARDIZATION AREAS

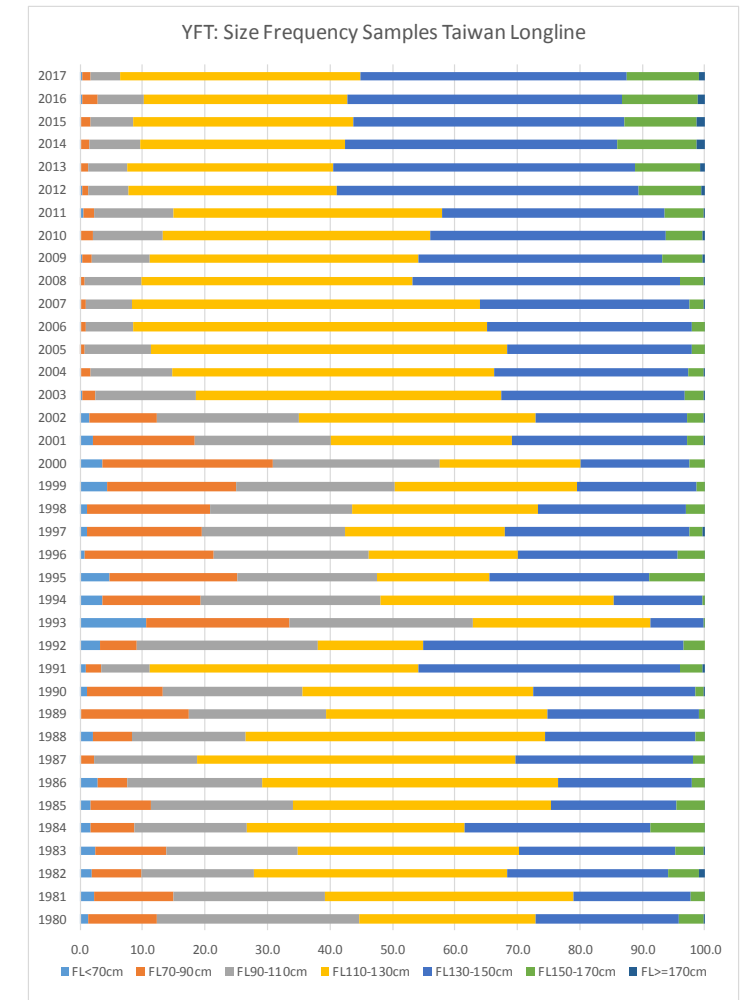
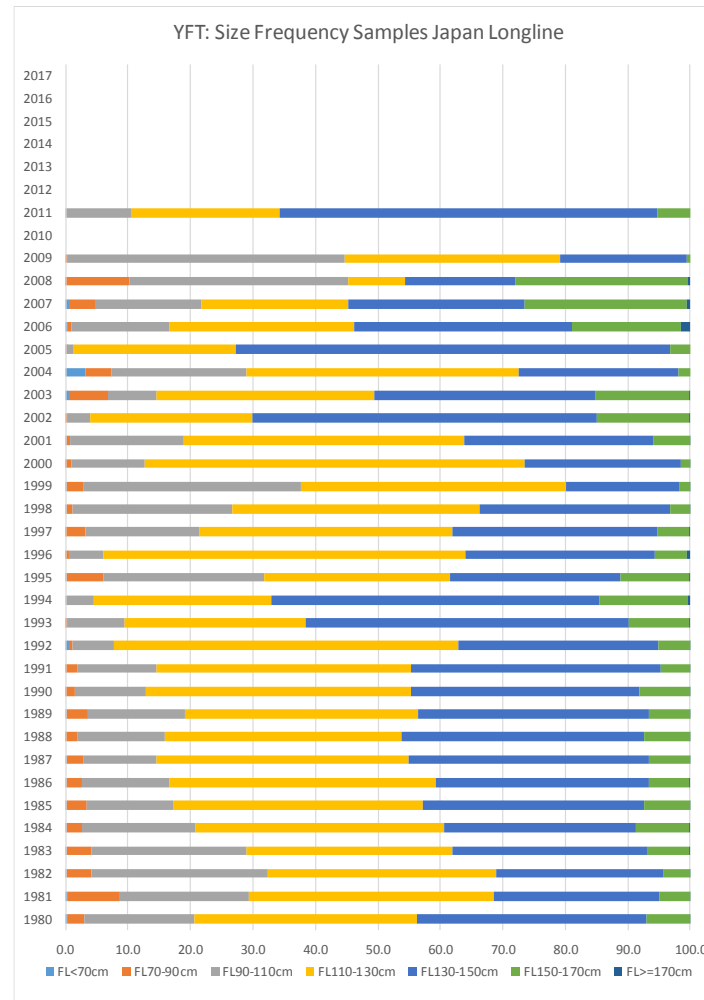
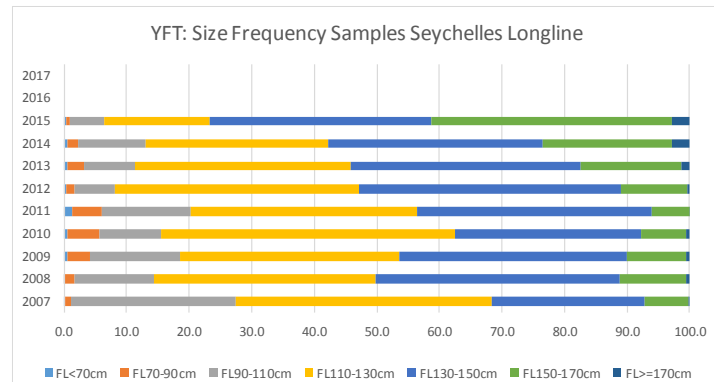
## ■ YELLOWFIN TUNA (YFT)



## ■ BIGEYE TUNA (BET)



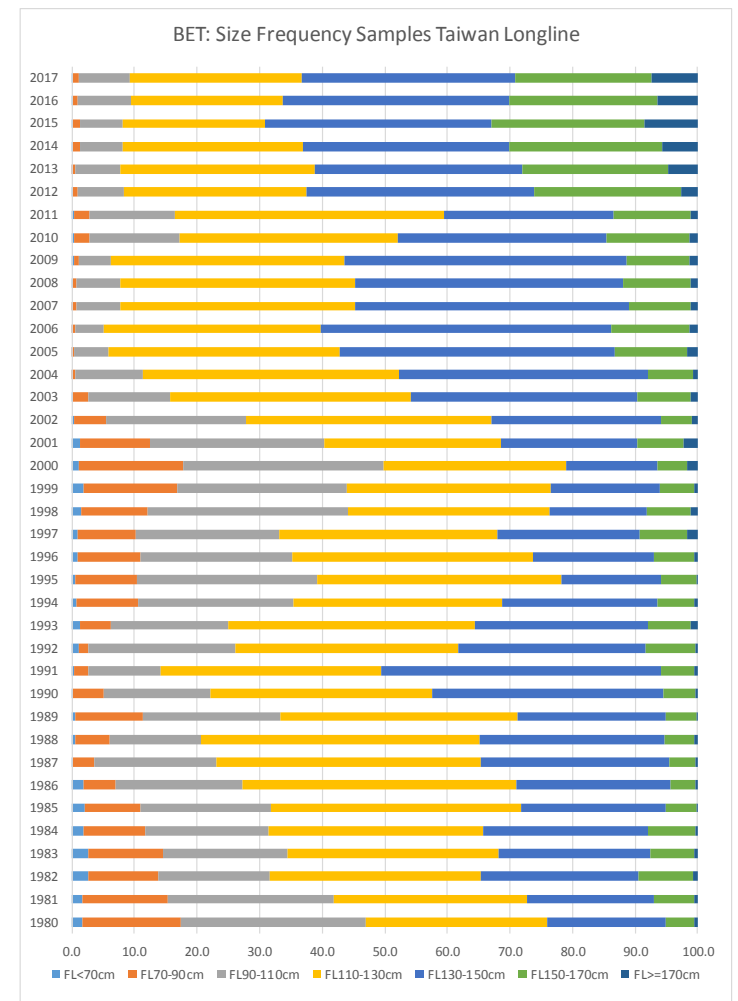
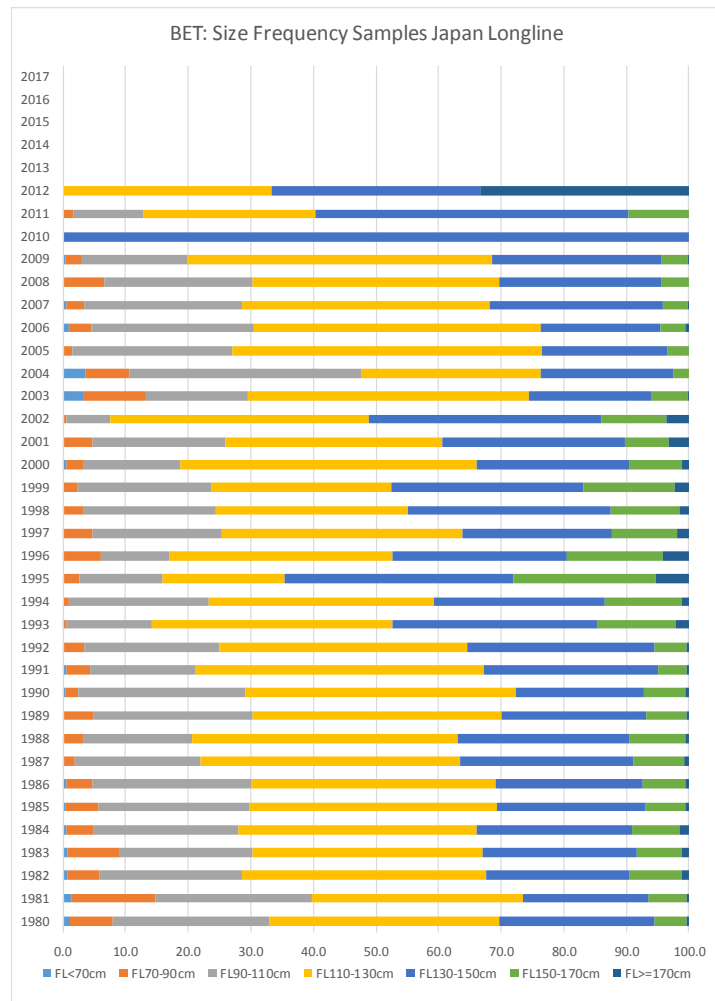
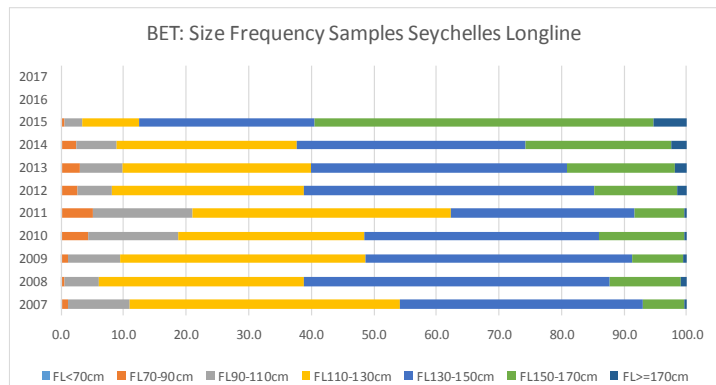
# EXPLORING THE DATA: ALL LENGTH SAMPLES POOLED (YFT)



- Yellowfin tuna:

- Taiwan: Small fish gradually disappears from samples, starting in 2002
- Seychelles: the less and less small fish in samples, over the years
- Japan: Not clear trend; lengths differ from those of other fleets

# EXPLORING THE DATA: ALL LENGTH SAMPLES POOLED (BET)



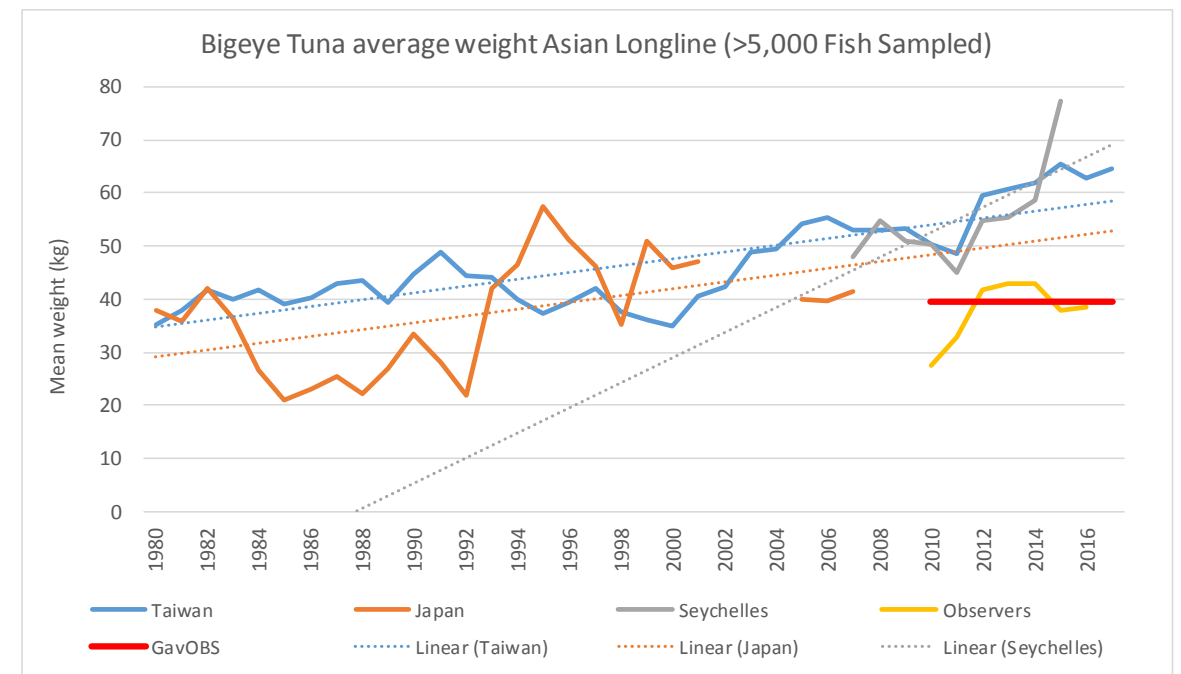
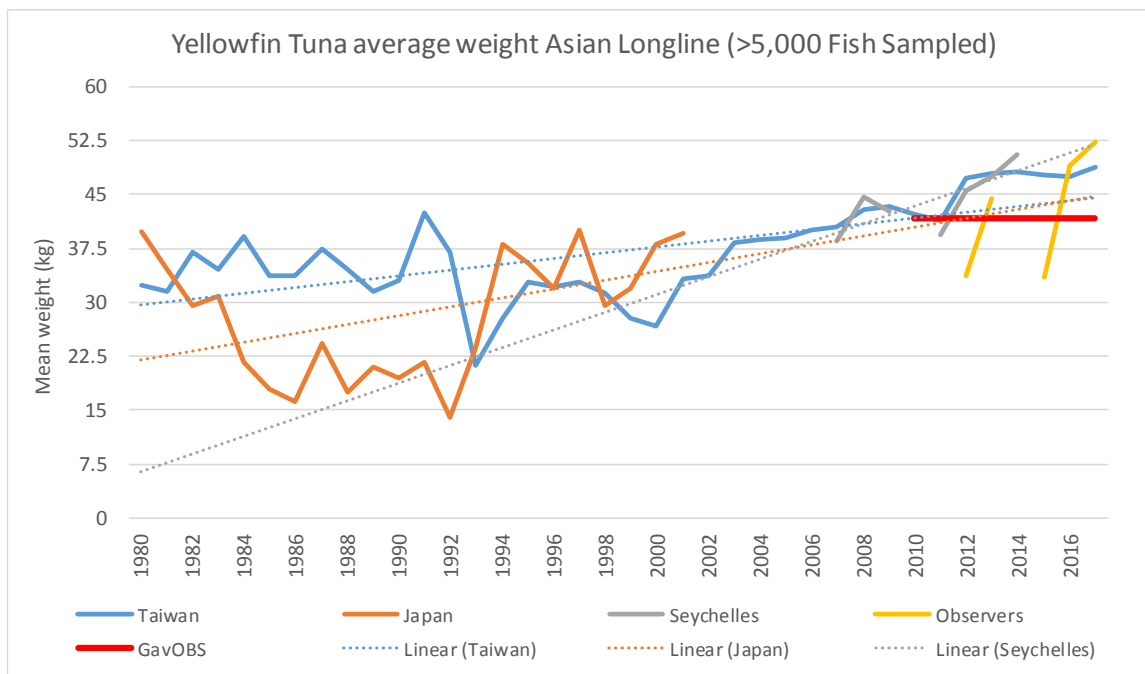
- Bigeye tuna:

- Taiwan: Small fish gradually disappears from samples, starting in 2002
- Seychelles: the less and less small fish in samples, over the years
- Japan: Not clear trend; lengths differ from those of other fleets



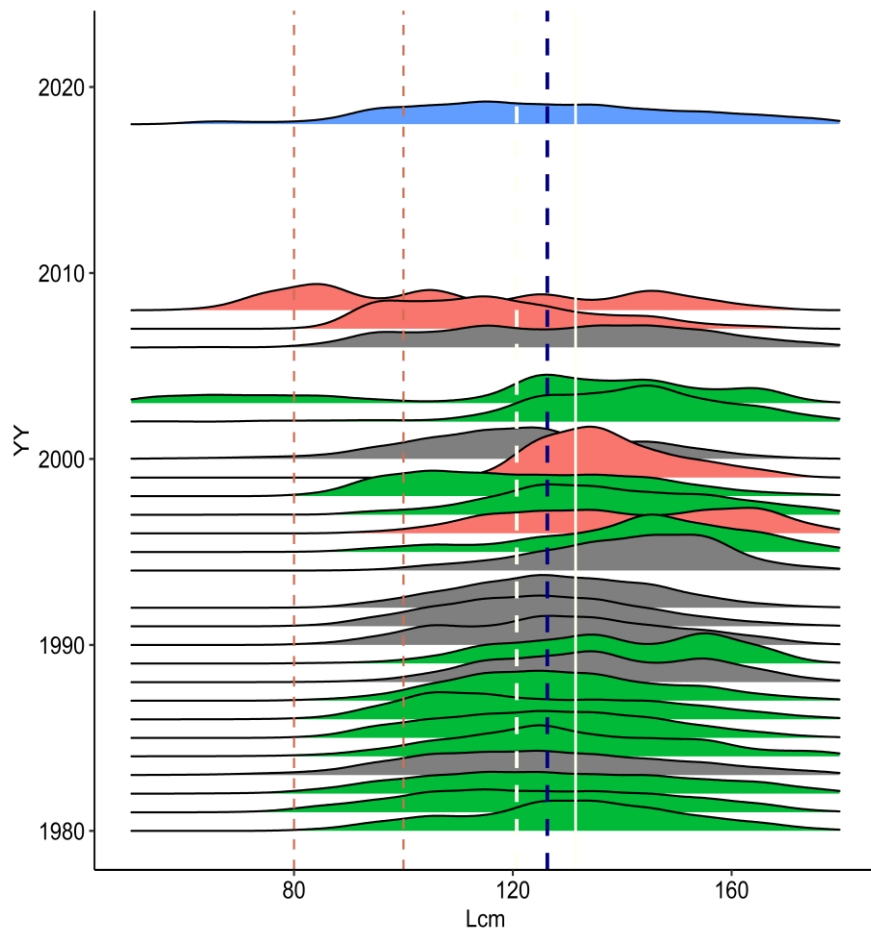
# EXPLORING THE DATA: TRENDS IN SAMPLED MEAN WEIGHTS

- Average weights of YFT and BET show an increasing trend on all fleets
- In recent years they are well above the values estimated from samples collected by observers, for both YFT & BET

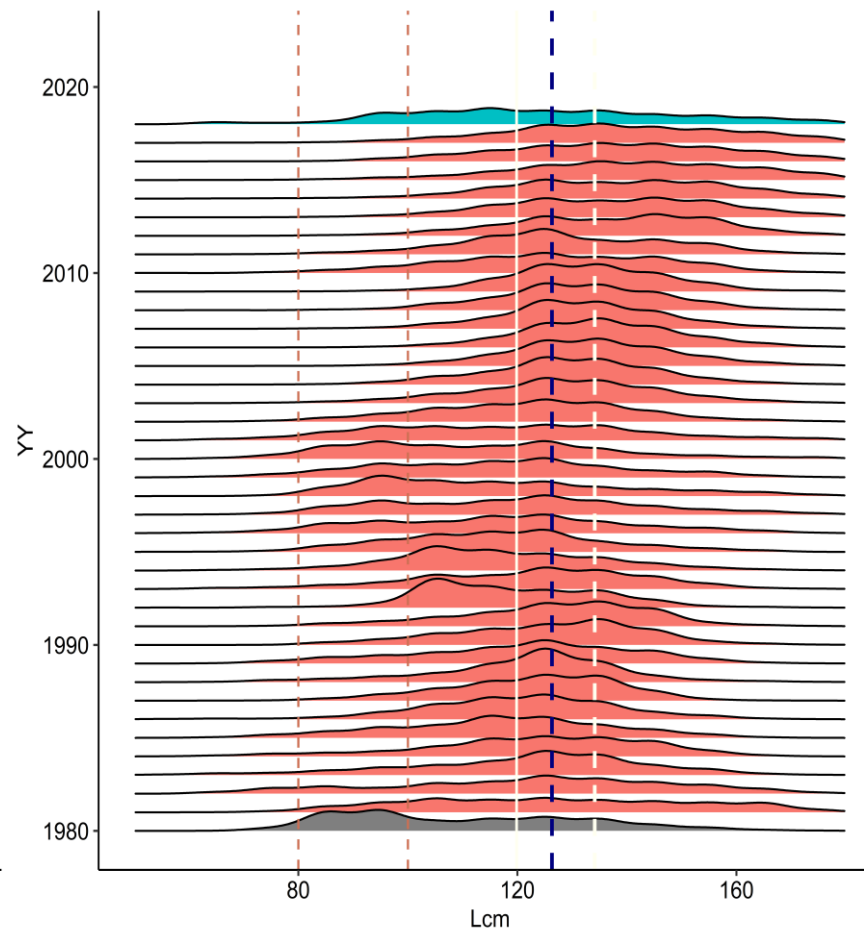


# EXPLORING THE DATA: BET R1: LENGTH DISTRIBUTIONS PER YEAR

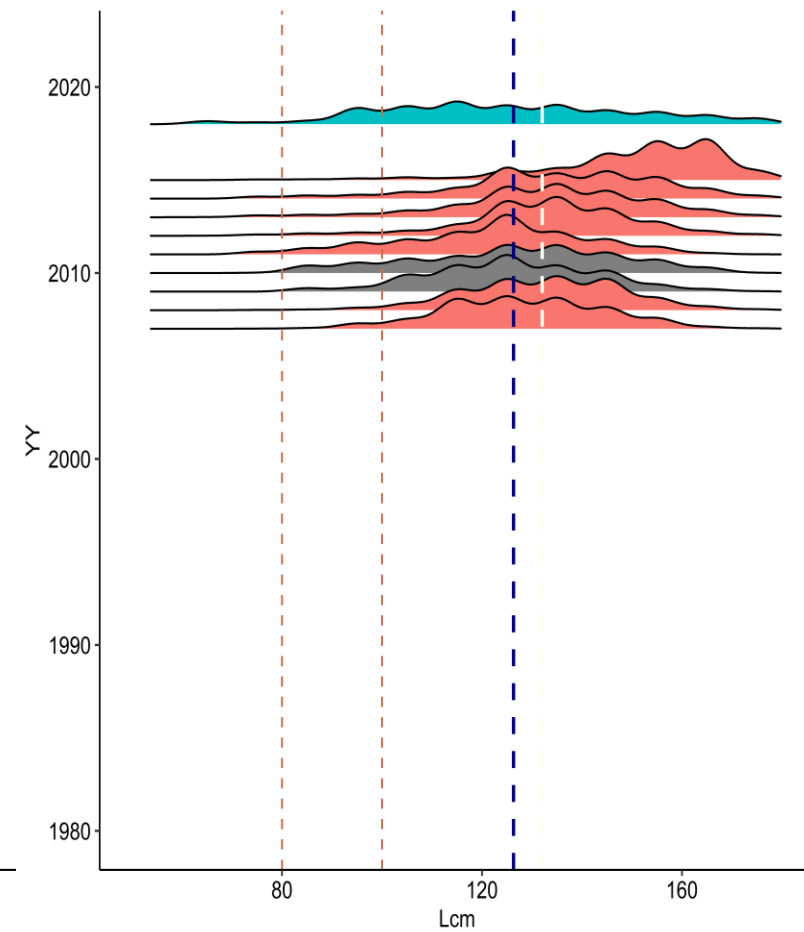
Length Frequency  
BET 1980-2017 JPN R1



Length Frequency  
BET 1980-2017 TWN R1

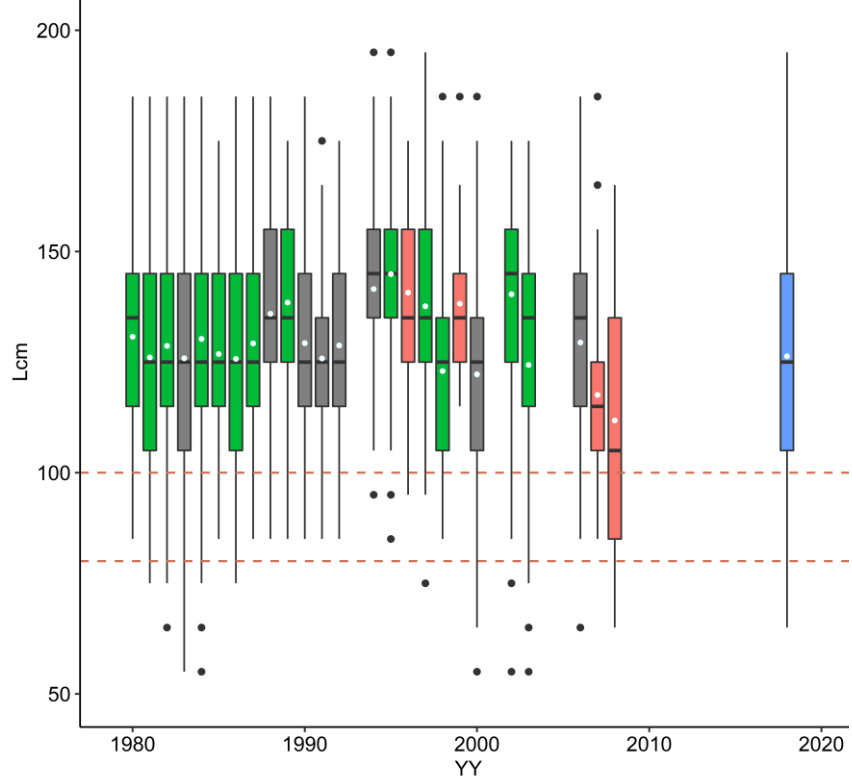


Length Frequency  
BET 1980-2017 SYC R1

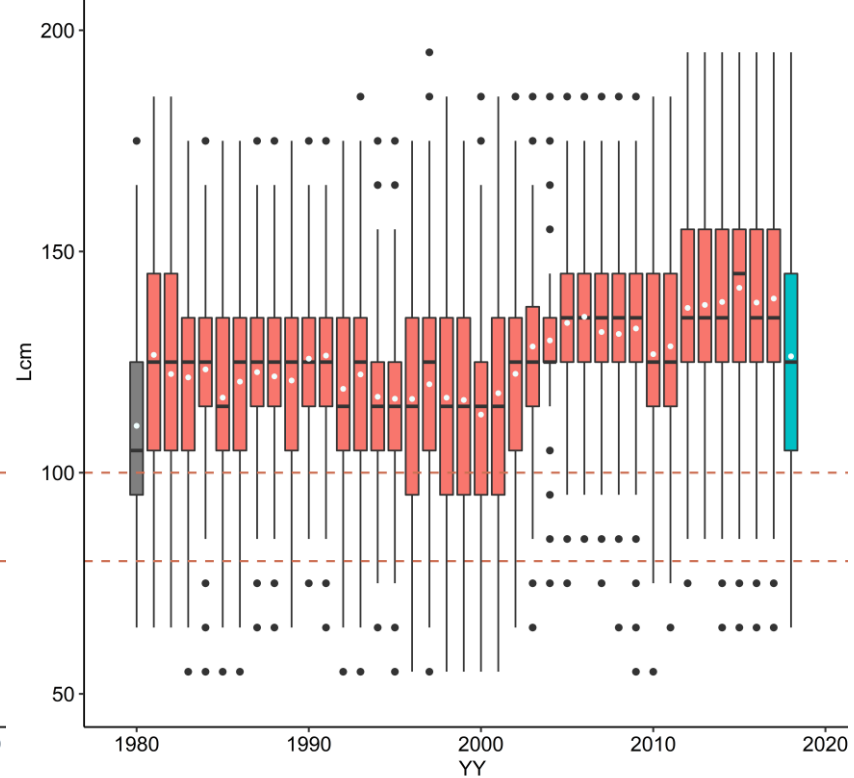


# EXPLORING THE DATA: BET R I: LENGTH BOX PLOTS PER YEAR

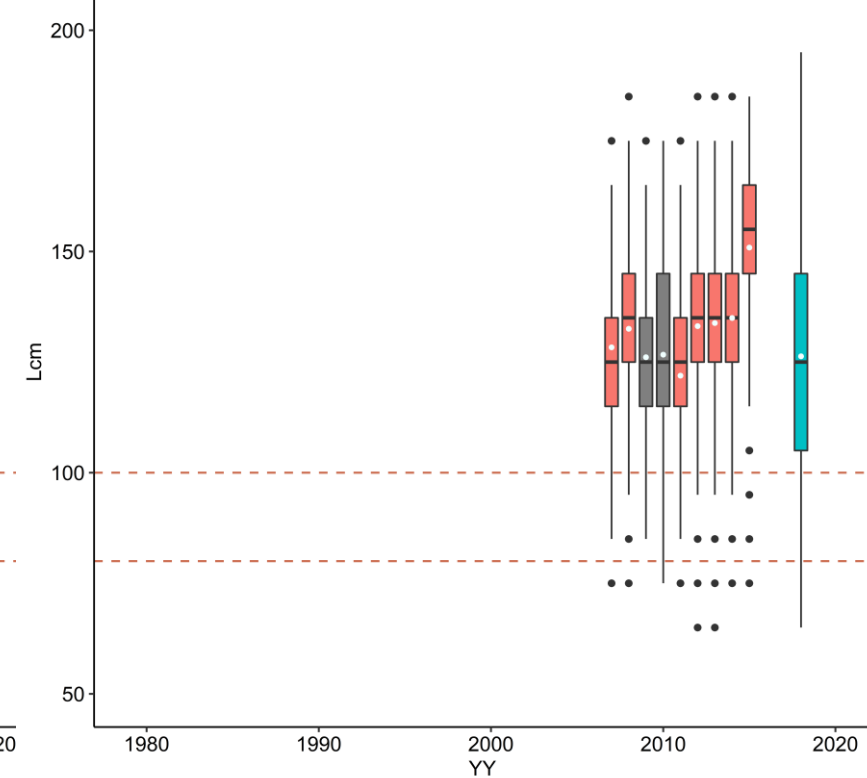
Length Frequency  
BET 1980-2017 JPN R1



Length Frequency  
BET 1980-2017 TWN R1

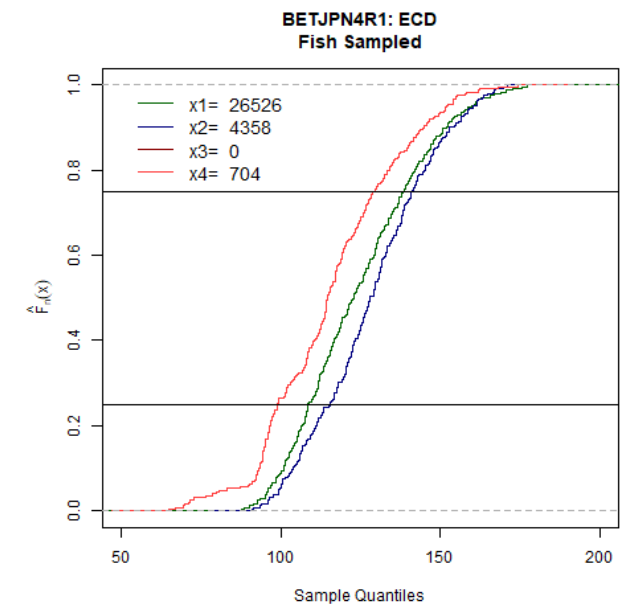
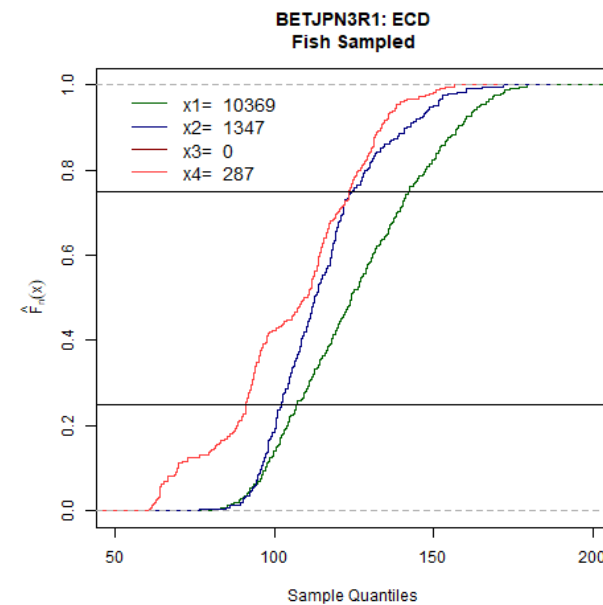
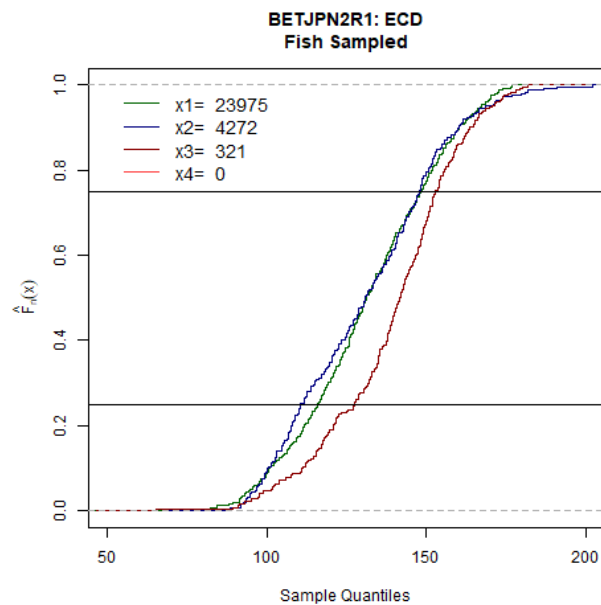
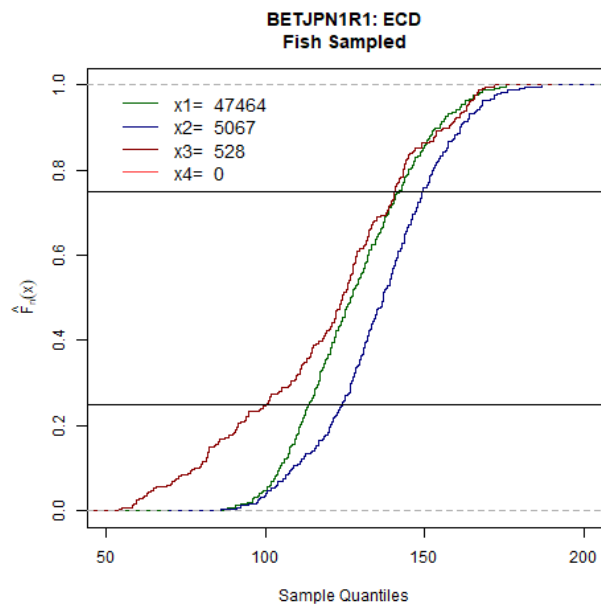


Length Frequency  
BET 1980-2017 SYC R1



# EXPLORING THE DATA: BET RI: ECDF PER TIME-PERIOD & QUARTER

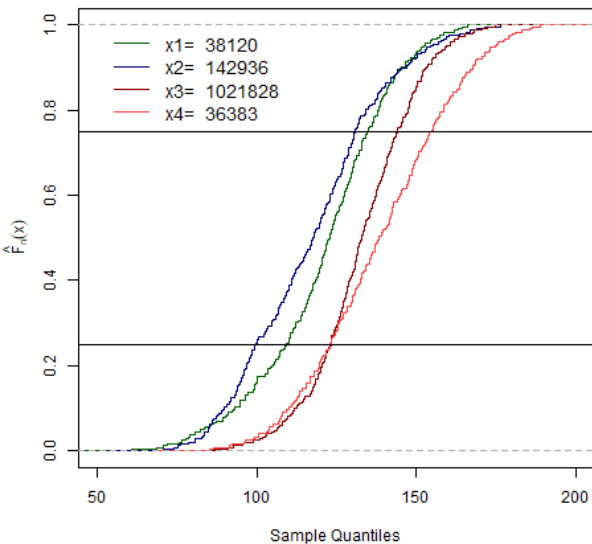
- Japan:
  - Lengths recorded by Crew: x1: 1980-89; x2: 1990-2001; x3: 2003-2014
  - Lengths recorded by observers: x4: 2010-17



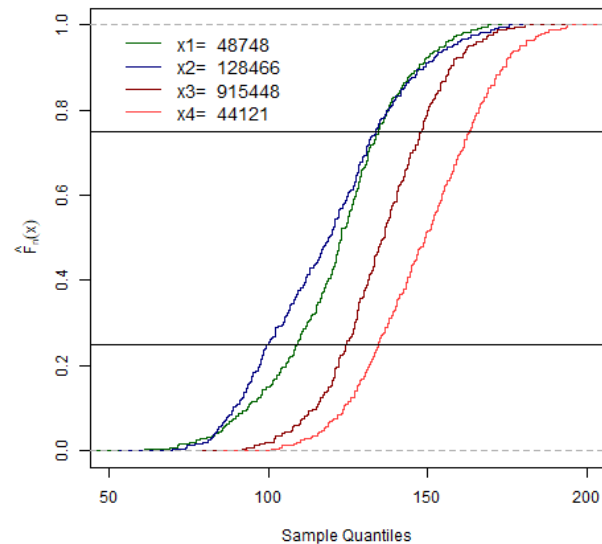
# EXPLORING THE DATA: BET RI: ECDF PER TIME-PERIOD & QUARTER

- Taiwan, Republic of Korea and Seychelles LL:
  - Lengths recorded by Crew: x1: 1980-89; x2: 1990-2001; x3: 2003-2014; x4: 2015-2017

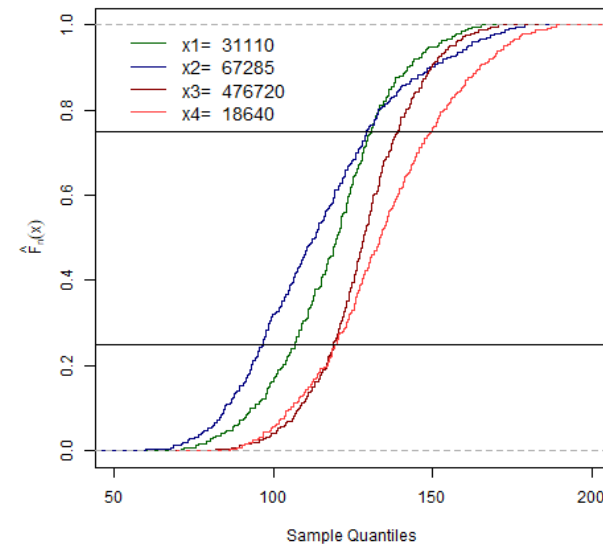
BETTWN1R1: ECD  
Fish Sampled



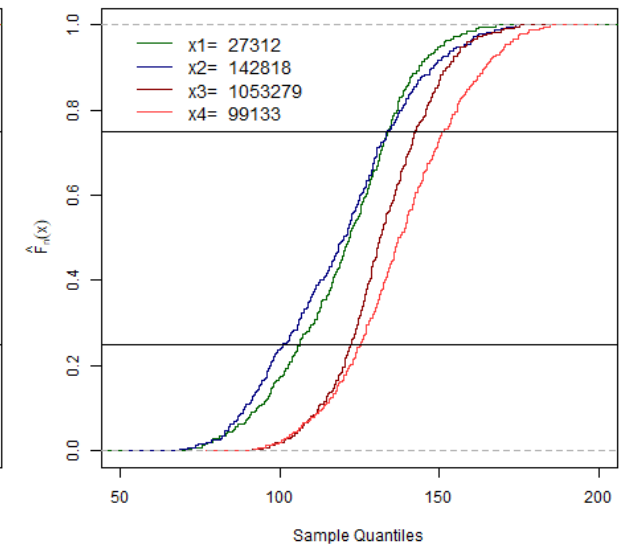
BETTWN2R1: ECD  
Fish Sampled



BETTWN3R1: ECD  
Fish Sampled

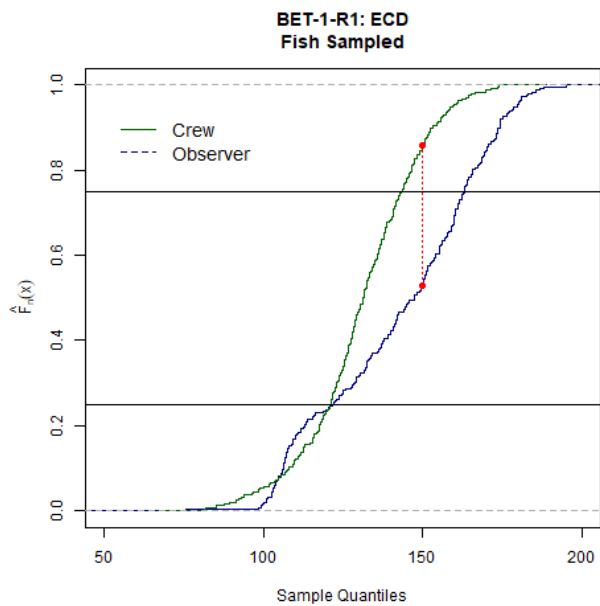


BETTWN4R1: ECD  
Fish Sampled

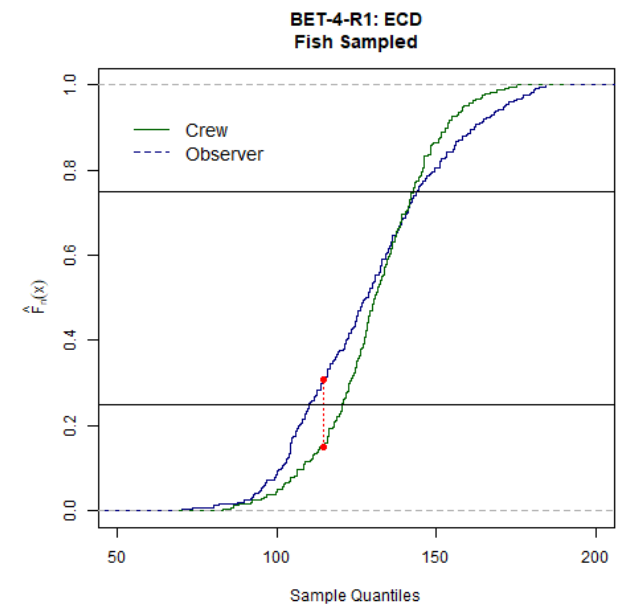
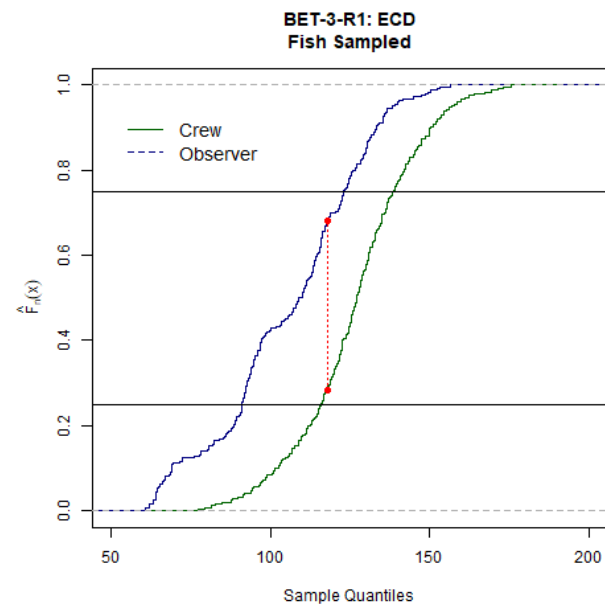


# EXPLORING THE DATA: BET R1: ECDF CREW VS. OBSERVERS

- Pooling all lengths from crew and observer samples for the period 2010-7, by species, area and quarter



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# KS-TESTS CREW VS. OBSERVERS 2010-17 (SPECIES-QUARTER-AREA)

DESC	SFCR	SFOB	KSp	KSD	TypeKS	CmnL	C1Qle	CavL	C3Qle	CmxL	OmnL	O1Qle	OavL	O3Qle	OmxL
BET-1-R1	1452838	596	2.7E-12	0.33	two-sided	82	121	131	143	174	76	122	147	163	195
BET-1-R2	472870	4239	1.4E-06	0.24	two-sided	71	112	125	137	170	64	100	115	130	165
BET-2-OS	46804	789	3.5E-02	0.13	two-sided	79	112	125	137	170	68	119	127	137	168
BET-2-R4	58105	1597	4.3E-01	0.08	two-sided	75	110	123	133	164	75	107	122	132	170
BET-3-OS	48877	709	1.0E-02	0.15	two-sided	81	110	121	131	163	83	114	126	134	180
BET-3-R1	683642	287	0.0E+00	0.40	two-sided	77	116	127	138	176	61	91	109	123	157
BET-3-R2	386356	3932	2.7E-08	0.27	two-sided	70	110	123	134	164	63	97	113	123	160
BET-3-R3	150277	276	2.4E-04	0.19	two-sided	76	109	121	131	163	47	93	114	140	183
BET-3-R4	103059	4150	2.9E-05	0.21	two-sided	80	109	120	131	160	77	105	112	127	161
BET-4-OS	23926	207	2.3E-04	0.19	two-sided	75	104	115	127	156	82	92	109	119	160
BET-4-R1	1506073	3337	3.5E-03	0.16	two-sided	83	121	131	143	175	70	110	128	144	184
BET-4-R2	671444	28278	1.7E-06	0.24	two-sided	72	114	127	138	170	63	100	117	131	165
BET-4-R3	26063	245	2.4E-04	0.19	two-sided	76	110	123	133	161	65	101	115	131	174
BET-4-R4	26557	235	0.0E+00	0.41	two-sided	73	107	120	131	160	67	94	98	115	167
YFT-1-2N	345809	544	8.9E-03	0.15	two-sided	73	115	125	133	161	105	120	126	134	177
YFT-1-2S	310125	980	1.0E-09	0.29	two-sided	74	117	128	138	167	11	119	136	156	181
YFT-1-3	76702	631	8.8E-06	0.22	two-sided	80	120	131	143	171	63	120	141	153	170
YFT-2-2S	176154	291	1.0E-04	0.20	two-sided	81	117	127	137	165	17	118	127	147	175
YFT-3-3	95943	2290	8.8E-07	0.24	two-sided	76	110	123	136	165	61	106	112	129	166
YFT-4-2S	425278	1463	4.9E-06	0.23	two-sided	76	119	128	137	168	11	99	127	142	181
YFT-4-3	111149	6882	3.2E-02	0.13	two-sided	85	118	128	137	167	68	116	125	144	174
YFT-4-5	257733	979	3.8E-10	0.30	two-sided	72	115	126	136	161	61	93	113	128	163

- Only 1 stratum in which observer and crew samples appear to come from the same distribution (BET-2-R4); not the case for the remaining 21.

DESC	Species-Quarter-Cluster Area
SFCR	Number of fish sampled for length (Crew)
SFOB	Number of fish sampled for length (Observers)
KSp	p-value Kolmogorov-Smirnov Test
KSD	D-statistic Kolmogorov-Smirnov Test
TypeKS	Type of Kolmogorov-Smirnov Test (standard two-sided)
CmnL	Minimum length measured by the Crew
C1Qle	Length corresponding to the first Quartile (Crew)
CavL	Average length from samples taken by the Crew
C3Qle	Length corresponding to the third Quartile (Crew)
CmxL	Maximum length measured by the Crew
OmnL	Minimum length measured by Observers
O1Qle	Length corresponding to the first Quartile (Observers)
OavL	Average length from samples taken by Observers
O3Qle	Length corresponding to the third Quartile (Observers)
OmxL	Maximum length measured by Observers

# MAIN RESULTS

- There seems to be a clear trend to catches of larger fish on Asian longliners, especially Taiwan & Seychelles
- This may be do to a change in targeting practices for both YFT and BET, with longliners targeting larger fish
  - However, there have not been reports of this by the fleet
- The signs from other oceans tend to point to a generalized underreporting of small fish (high-grading) by the crew
- Comparison of lengths taken by observers against those taken by the crew show large discrepancies between the two records
  - However, this comparison is compromised by the low amount of observer samples available
- Comparison of lengths taken by the crew over four different time periods tend to indicate that length distributions before and after 2003 are very different with the more and more larger fish in recent years
- The samples from Taiwan and Seychelles seem to be subject to a much higher bias than those from Japan



# CONCLUSION

- There are many signs that high-grading may be overspread in Asian longliners
- It is very likely that this affects not only length samples but also estimates of catch and numbers of fish in the logbooks, which would not include all the small fish not retained on board (discarded) or of no-commercial value (bycatch)
- Data have to be further explored but at this point it is very likely that high-grading will compromise the quality of any index of abundance derived from operational data of the Asian longline fleets, unless estimates are corrected to compensate for this underreporting (increases in mean weight of between 15-20kg over the period 1980-2017)
- The results of this work will be presented at the next IOTC WPTT and alternative assessments considering scenarios for high grading run and presented at that meeting
- It is recommended to identify other fisheries from which alternative indices of abundance (or at least trends in nominal CPUE) can be derived

THANKS FOR YOUR ATTENTION