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# PRELIMINARY ANALYSIS OF THE SPATIAL DISTRIBUTION OF JUVENILE BIGEYE TUNA CATCHES FROM EQUATORIAL WCPO PURSE SEINE FISHERIES

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**S. J. Harley and Timothy Lawson**

Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia

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Shelton Harley and Timothy Lawson

## SUMMARY

In considering potential management measures to address overfishing of bigeye tuna (BET) there has been interest in determining the spatial distribution of juvenile BET within the WCPO. This paper provides the first step in this analysis, outlining the current data and highlighting the important issues that need to be resolved to correctly address this question.

The current BET catch estimates available at a 1x1 degree spatial resolution are known to be biased. The nature of the bias appears to change with longitude within the equatorial WCPO. At present there are insufficient data to correct the 1x1 degree catch estimates. The biased data indicate a strong trend of increasing catches from east to west in the WCPO but a trend in catch rates that increases from west to east. Preliminary corrections at the level of the bigeye tuna assessment region, suggest that the catch trend is likely to be stronger (i.e. even higher catches in the west), whereas the CPUE trend is likely to be less pronounced.

Continuation of the spill sampling approach, in particular the application of this technique to the vessels that fish in the easternmost portion of the equatorial WCPO, should provide the basis for improved information to reconstruct a new spatially resolved catch data set to address issues associated with spatial variation.

## DATA

Purse-seine operational catch and effort data recorded on logsheets are stored by the SPC Oceanic Fisheries Programme in the "*s_best*" database; the logsheet data have been raised to represent the total catch and effort, and are stratified by year, month, areas of 1° latitude by 1° longitude, school association and flag. Bigeye catches are often substantially under-reported on logsheets, therefore, for most fleets, the proportions of bigeye and yellowfin in the combined catch of "yellowfin plus bigeye" are modified in *s_best* using uncorrected grab samples collected by observers (Lawson 2007). The estimates of skipjack catches in *s_best* are not modified. Since skipjack are often over-reported on logsheets, skipjack catches are generally biased upwards, while the estimates of catches of yellowfin and bigeye are biased downwards. The fleets for which bigeye and yellowfin are not modified in *s_best* include the Japanese fleet since 1996[1], the

[1] The aggregated data in *s_best* covering the Japanese fleet are provided by Japan; the proportions of bigeye and yellowfin data prior to 1996 are modified.

domestic fleets of Indonesia and the Philippines, the Spanish fleet and other fleets operating from the Eastern Pacific Ocean.

Species compositions determined from grab samples collected by observers are known to be biased because of the size selectivity of observers, who tend to under-select smaller fish (Lawson 2009, 2010). The magnitude of the selectivity bias has been estimated using paired spill and grab samples collected by observers and the estimates have been used to correct the species compositions determined from the grab samples collected during 1996–2009. The corrected grab samples have, in turn, been used to adjust the catch data used in MULTIFAN-CL (MFCL) assessments of bigeye, yellowfin and skipjack, which consist of data in *s_best* that have been grouped by year, quarter, MFCL area and school association type (associated or unassociated). Data covering the domestic fleets of Indonesia and the Philippines were excluded from the adjusted MFCL data. Otherwise, in deriving the adjusted MFCL data, all data in *s_best* were adjusted with grab samples corrected for selectivity bias; data in *s_best* covering the other fleets mentioned in the previous paragraph were not treated separately.

In all of the results provided below, the purse seine fisheries of Indonesia and the Philippines are excluded. Also, as bigeye tuna catches from purse seine fisheries come almost exclusively from sets of natural and artificial floating objects (FADs) we have focused only on catches and CPUE from these sets.

# RESULTS

The spatial distribution of BET purse seine catches and CPUE determined from *s_best* are provided in Figure 1 and show that larger catches have occurred in the western WCPO whereas the highest CPUE has been attained to the east of the 180 degree meridian. When the amount of effort is considered (Figure 2) it is clear that the levels of effort in the regions with high CPUE is far less than that in the areas of lower CPUE.

Considering only the longitudinal patterns (Figure 3), the trends in catch, FAD sets, and CPUE are more evident. Average CPUE from 160W eastward is 5.4 times greater than that to the west of 160W.

The MFCL catch estimates of BET, adjusted with grab samples corrected for selectivity bias, are considerably higher than the traditional *s_best* estimates: In region 3 the adjusted estimates are 6.5 times higher for the period 2000-09 while in region 4 they are 3 times higher (Figure 4). There are differences in the fleets that operate in each region. Fleets that operate in both the WCPO and the Eastern Pacific Ocean (EPO) fish almost exclusively in region 4 when they fish in the WCPO and are the only fleets to operate in the far east of region 4 (Figure 5).

The impact of the MFCL data adjusted with grab samples corrected for selectivity bias on the longitudinal trends and maps of catches and CPUE are provided in Figure 6 and Figure 7. Again we note that the correction has been done only at the level of the MFCL region – not at the level of 1x1 degree square or vessel flag so finer scale spatial patterns, or those due to vessel flag are not taken into account in the correction. The strong longitudinal patterns in catch and CPUE remain, but the catch pattern is stronger and the CPUE pattern is slightly weaker with the difference between eastern and western CPUE reduced from 5.4 times to 3.7 times. It is

probable that this difference will be even less once finer-scale, and flag based corrections are possible.

Fleet specific fishing patterns, in particular the limited overlap between the EP and other fleets also suggest that fishing fleet operational and/or reporting practices may, in addition to longitude, be a major factor in the patterns of BET CPUE. The collection of spill samples by observers, in particular on the vessels that fish in the eastern extent of the equatorial WCPO, should provide improved information to reconstruct a new spatially resolved catch data set to address spatial issues.

# REFERENCES


Lawson, T.A. 2007. Analysis of the proportion of bigeye in 'yellowfin plus bigeye' caught by purse seiners in the WCPFC Statistical Area. Information Paper SC3–ST–IP5. Third Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission, 13–24 August 2007, Honolulu, Hawaii, United States of America. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia http://www.wcpfc.int/sc3/pdf/ST%20IP-5.pdf

Lawson, T.A. 2009. Selectivity bias in grab samples and other factors affecting the analysis of species composition data collected by observers on purse seiners in the Western and Central Pacific Ocean. Working Paper SC5–ST–WP3. Fifth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission, 10–21 August 2009, Port Vila, Vanuatu. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia http://www.wcpfc.int/system/files/documents/meetings/scientific-committee/5th-regular-session/statistics-swg/working-papers/SC5-ST-WP-03%20%5BSensitivity%20analysis%20-%20species%20coposition%5D.pdf

Lawson, T.A. 2010. an update on the estimation of selectivity bias in grab samples collected by observers on purse seiners in the Western and Central Pacific Ocean. Working Paper SC6–ST–WP2. Sixth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission, 10–19 August 2010, Nuka'alofa, Tonga. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia

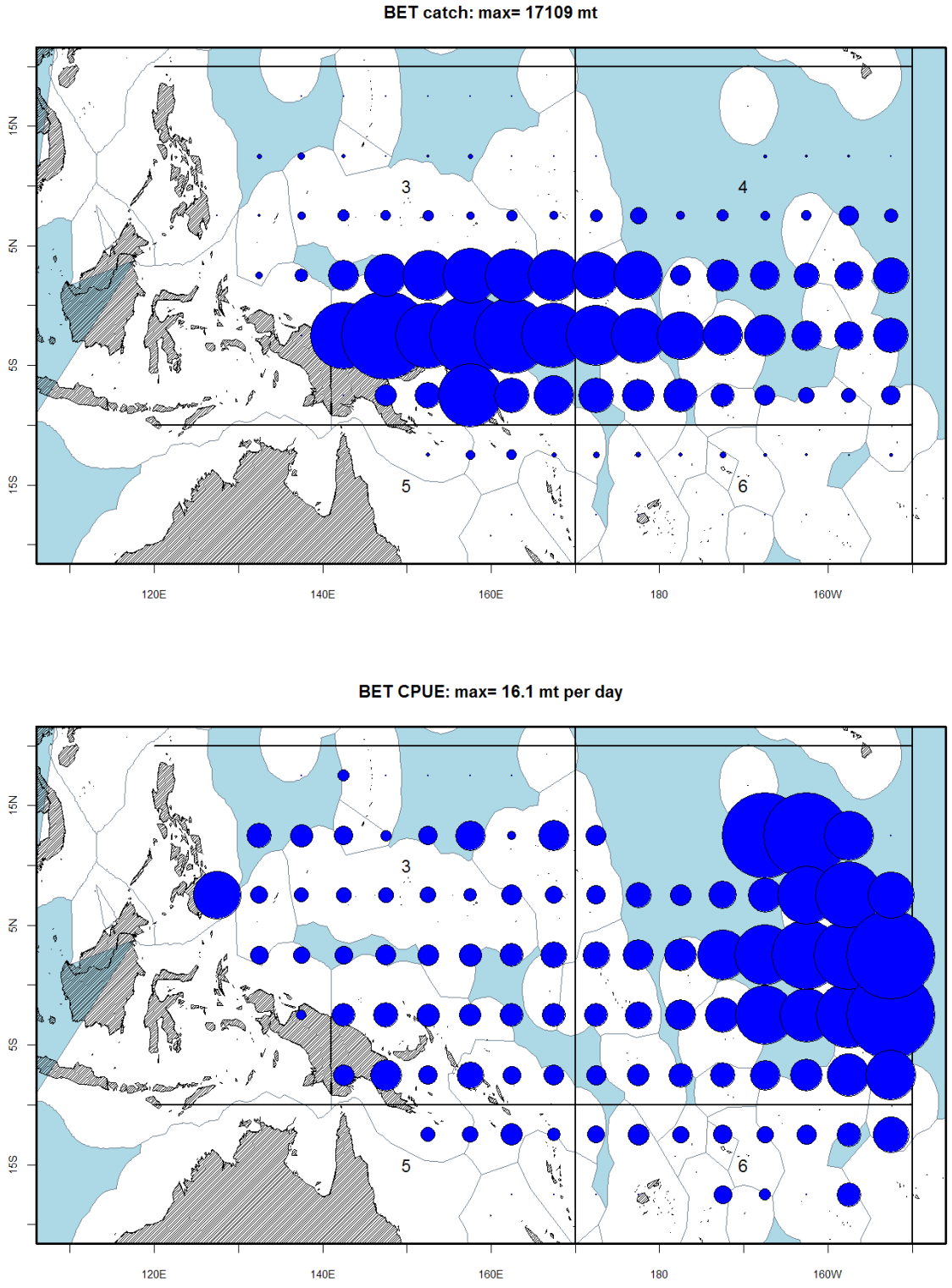


**Figure 1: (top) Bigeye purse seine catches based on the "s_best" database for 2000-09 from FAD sets by 5x5 degree squares for the area between 20N and 20S; (bottom) Bigeye purse seine CPUE (mt per set) based on the "s_best" database for 2000-09 from FAD sets by 5x5 degree squares for the area between 20N and 20S. The six regions assumed in the BET assessment are overlaid, but note that the labels for regions 1 and 2 (north of 20N) are not shown and the label for region 4 (eastern equatorial WCPO) is hidden.**

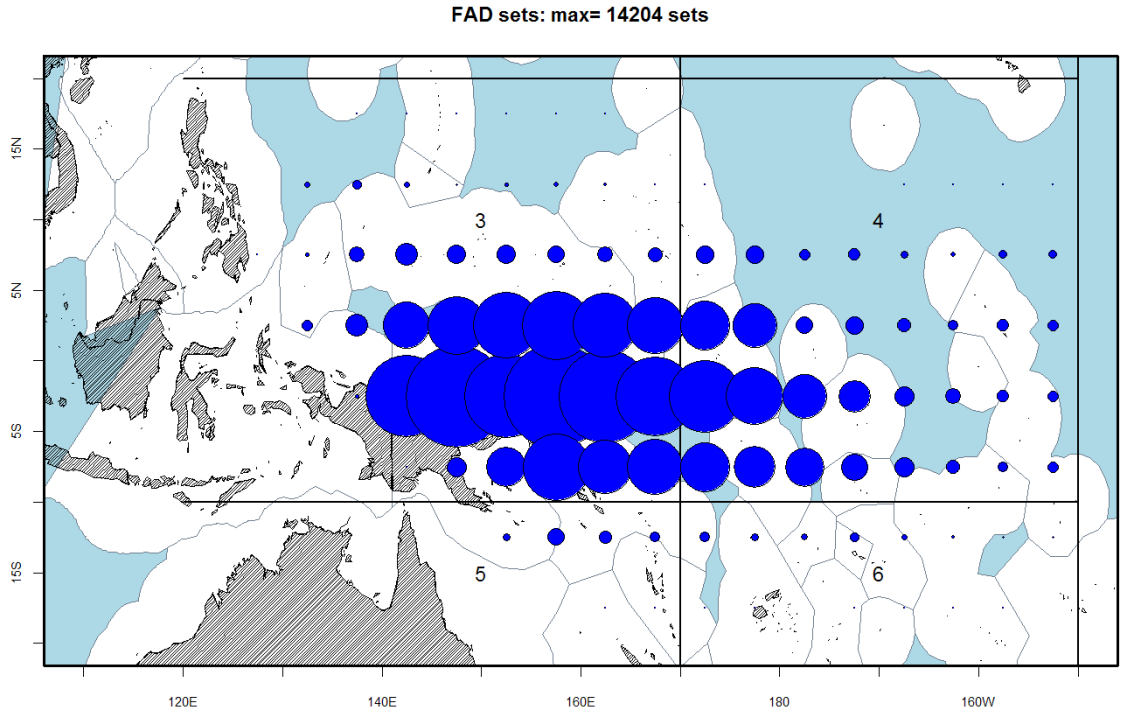


**Figure 2: Number of FAD sets (effort) for 2000-09 by 5x5 degree squares for the area between 20N and 20S.**

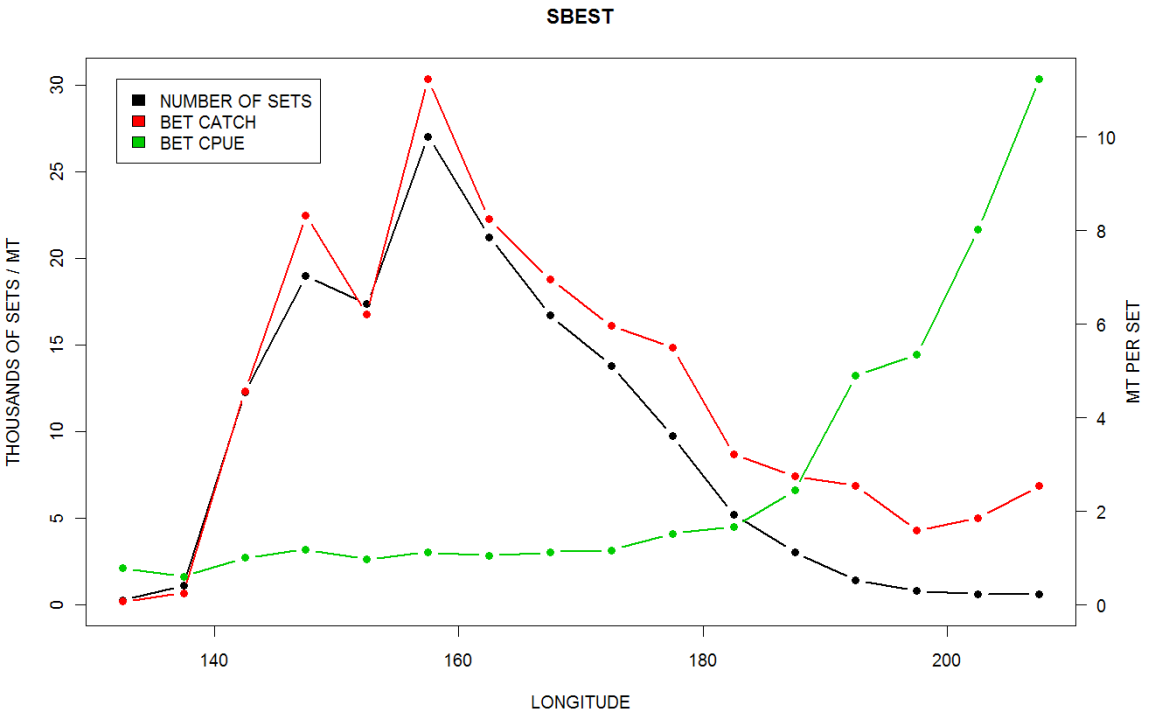


**Figure 3: Longitudinal patterns in catch, CPUE, and FAD sets based on the s_best database for the period 2000-09.**

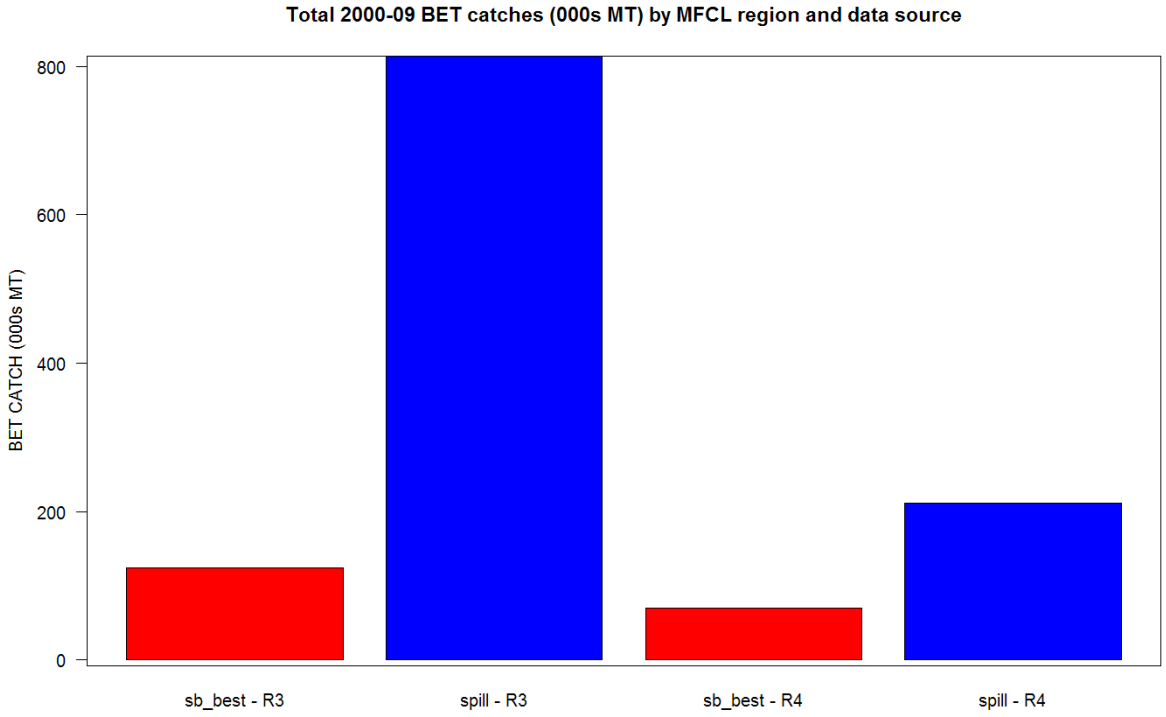


**Figure 4: Comparison of the s_best estimates of total BET FAD catch by region for the period 2000-09 to the totals of the adjusted MFCL data.**

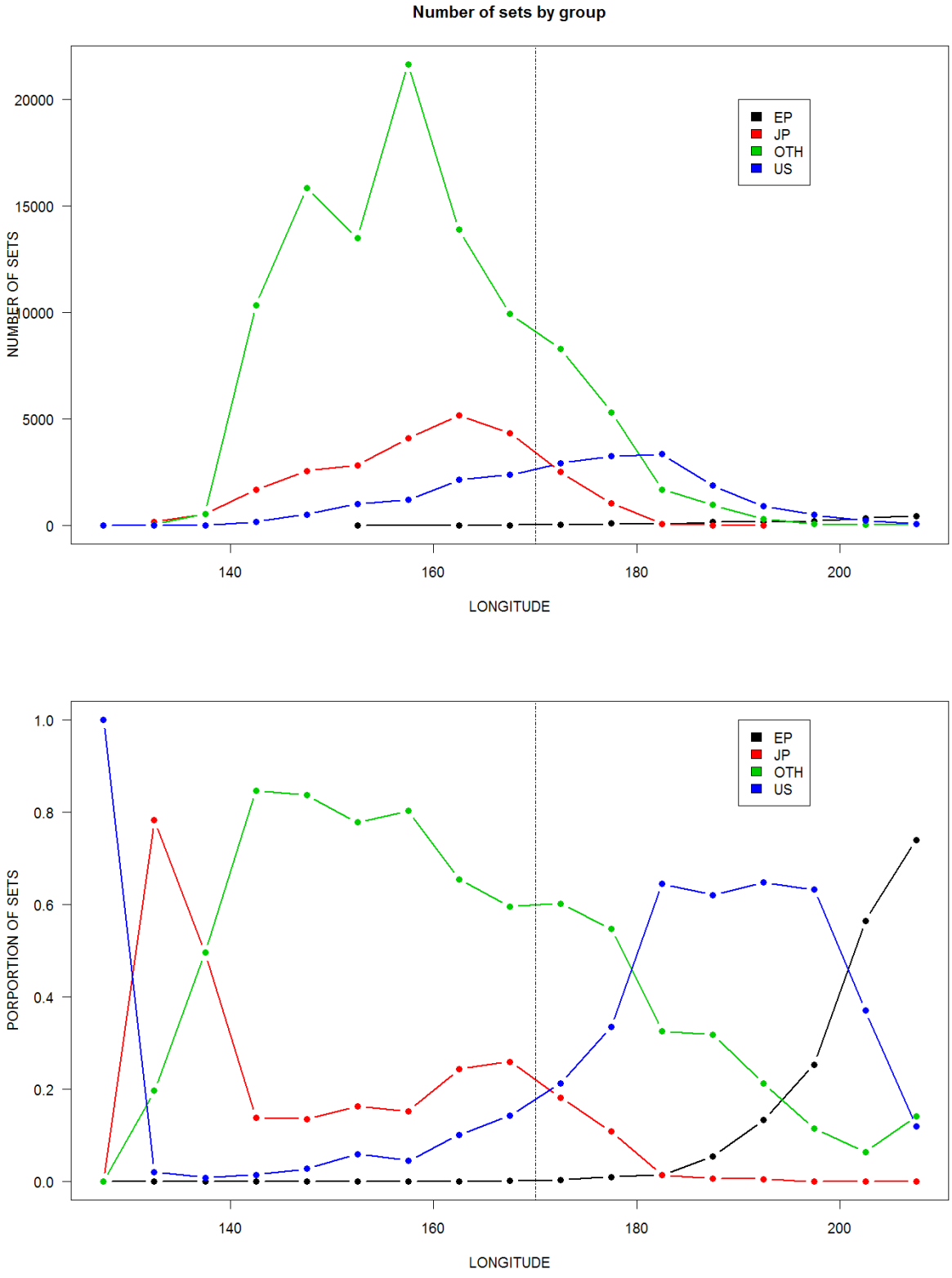


**Figure 5: Number (top) and proportion (bottom) of the FAD sets by 5 degree of longitude for four flag groupings for the period 2000-09 and the area between 20N and 20S. The vertical line at 170E represents the boundary between regions 3 and 4 in the assessment. The fleet groupings are: JP-Japan, US-United States, EP- fleets that also fish in the EPO, e.g., Spain, Ecuador, and El Salvador, and OTH-all other fleets combined.**

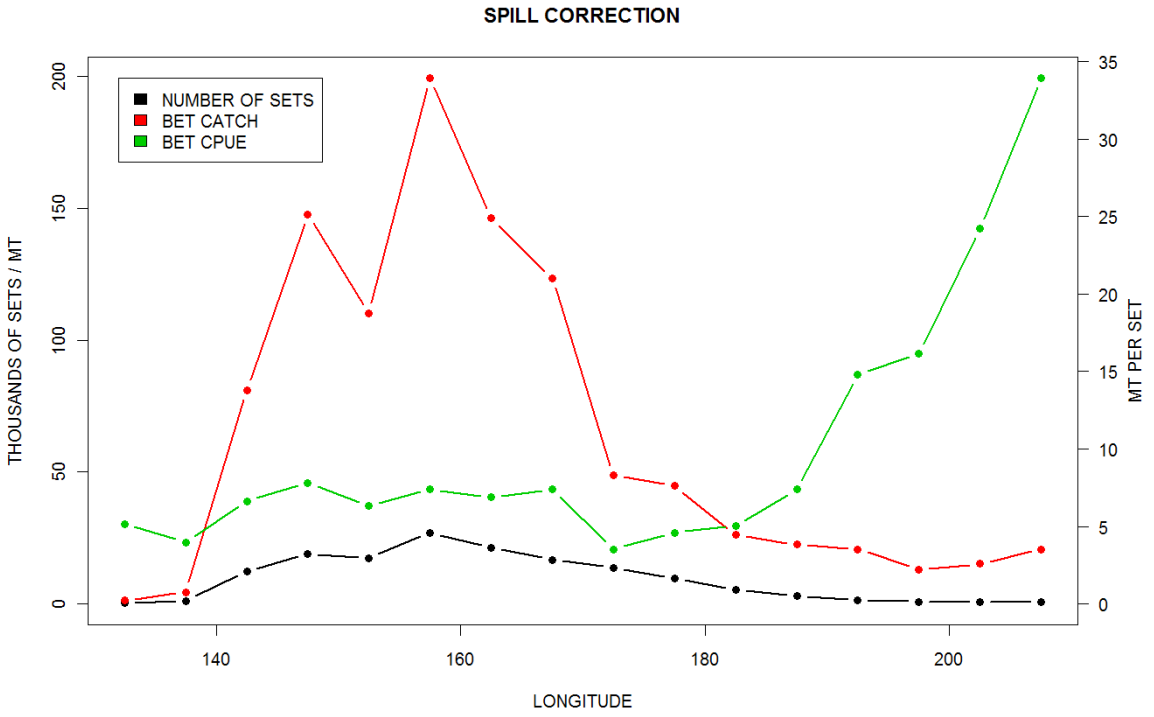


**Figure 6: Longitudinal patterns in catch, CPUE, and FAD sets based on the application of the adjusted MFCL data.**

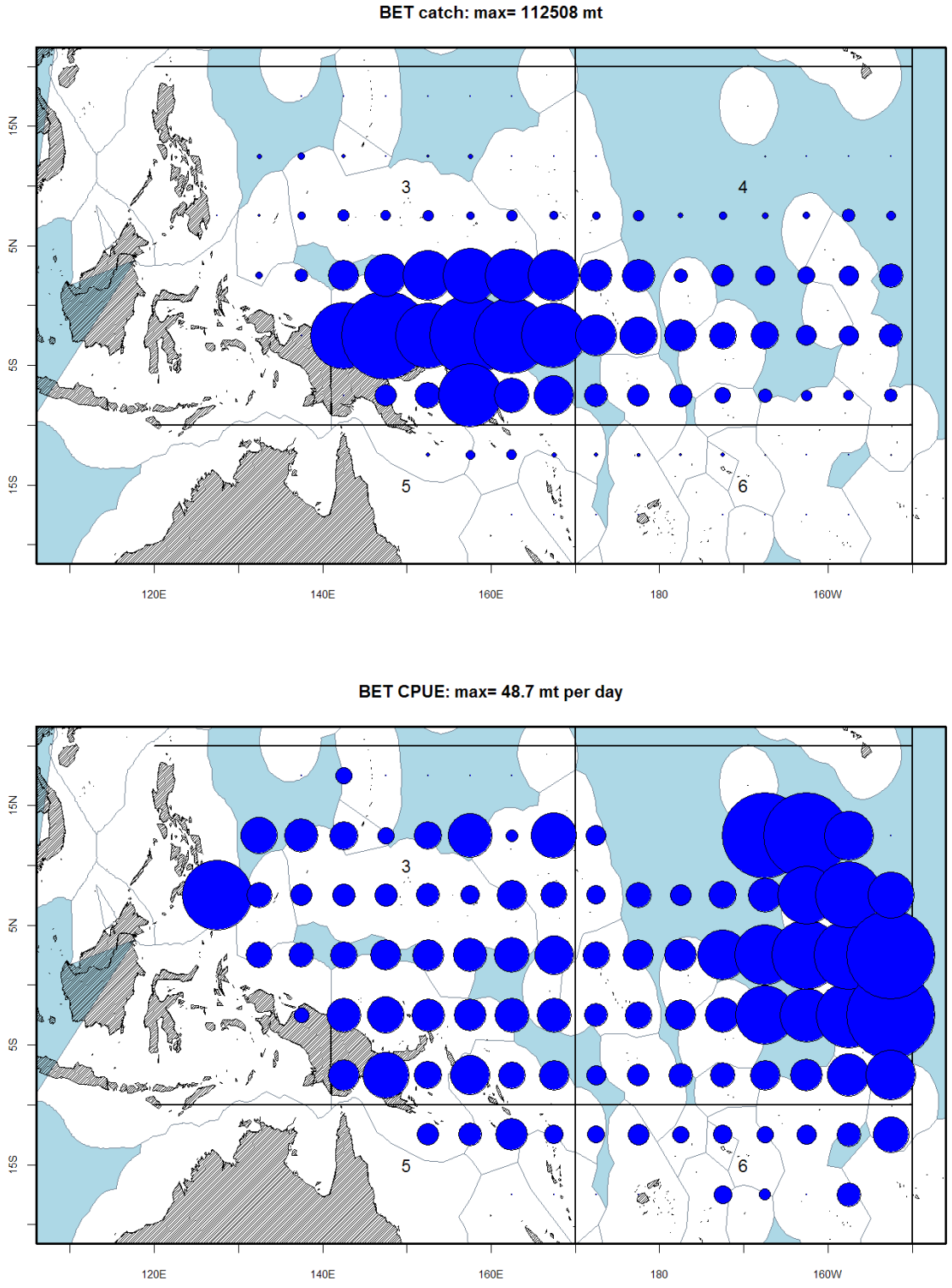


**Figure 7: (top) Bigeye purse seine catches based on the application of the adjusted MFCL data for 2000-09 from FAD sets by 5x5 degree squares for the area between 20N and 20S; (bottom) Bigeye purse seine CPUE (mt per set) based on the application of the adjusted MFCL data for 2000-09 from FAD sets by 5x5 degree squares for the area between 20N and 20S.**