SCIENTIFIC COMMITTEE
SEVENTH REGULAR SESSION

9-17 August 2011
Pohnpei, Federated States of Micronesia

Misreporting of purse seine catches of skipjack and yellowfin-bigeye on logsheets

WCPFC-SC7-2011/ST-WP-02

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Abstract

This paper compares logsheet-declared estimates of species composition, in particular the percentage of skipjack in purse seine sets (%SKJ), with independent estimates provided by observers. The main findings are as follows:

- The %SKJ in observed associated sets is substantially higher on logsheets compared to estimates derived from the visual estimates of purse seine catch by species by observers;
- The %SKJ in observed unassociated sets is also over-reported on logsheets in comparison to observers' estimates, but the difference is not as great as for associated sets;
- For many fleets, the frequency of associated sets declared on logsheets as containing 90-100% skipjack appears to be unrealistically high (~63% of sets as declared on logsheets, compared with ~23% of sets as recorded by observers);
- The visual estimates of species composition provided by observers are reasonably consistent with their sampling data;
- These results support the current methodology of estimating the three-species (skipjack, yellowfin, bigeye) species composition of purse seine catches using observer sampling data (corrected for 'grab' sampling selectivity bias), as compared to the previous method of using the sampling data to disaggregate only yellowfin and bigeye tuna; and
- The apparent consistency between the observers' visual and sample-based estimates of species composition is encouraging and may allow greater use of the visual estimates to be made in routine fishery monitoring.

Introduction

Logsheet reports of catch and effort provide the raw materials for estimating total catches of purse seiners in the western and central Pacific. It is well recognized that the catches of the individual species – skipjack, yellowfin and bigeye tuna – are not accurately specified on logsheets by all fleets. In particular, most fleets do not separate yellowfin and bigeye on logsheet entries because of the difficulties of identifying and quantifying the usually small amounts of bigeye tuna in purse seine catches. For this reason, sampling by observers or port samplers has been used to estimate the amounts of yellowfin and bigeye in the catch declared as 'yellowfin' on purse seine logsheets.

Until recently, it has been assumed that the logsheet declarations of catches of skipjack and yellowfin+bigeye were unbiased. However, as observer catch sampling data began to accumulate, evidence has mounted that skipjack was overestimated and yellowfin+bigeye underestimated on

logsheets. This led to the adoption of a new methodology for estimating purse seine species composition, whereby the three-species composition was estimated from observer sampling data and 'selectivity' bias that was detected in observer 'grab' sampling was corrected using data from paired 'grab' and 'spill' sampling trials (Lawson 2007, 2010).

The use of the new procedure to estimate the three-species composition of purse seine catches has resulted in major changes in the estimates of skipjack, yellowfin and bigeye catches, with skipjack catches being reduced and yellowfin and bigeye catches being increased (see Tables 5 and 6, Williams 2011). The new methodology relies on the premise that the observer sampling, adjusted for 'grab' sampling selectivity bias, provides an unbiased estimate of the percentage of skipjack in the catch whereas the logsheet declarations do not. To date, there have been no reliable and comprehensive data available that could be used to test this assumption. The objective of this paper is to undertake a detailed examination of logsheet data across all major fleets operating in the western and central Pacific purse seine fishery to see if there is independent evidence in the data of misreporting of species composition, and in particular, the percentage of skipjack in the catch.

Methods and Data

We examined logsheet data classified by fleet (flag or nationality) and set type (associate and unassociated) on a set by set basis to evaluate the consistency of the reported species composition of individual sets across fleets. Data were restricted to the period 2005 – 2010 to facilitate comparison with observer data; however historical logsheet data back to 1995 were also examined for time-series trends. Within fleet and set type categories, sets were classified according to the percentage of skipjack (%SKJ) in the sets: 0 – 10%, 10 – 20%, …., 90 – 100%.

From previous work (e.g., Hampton and Bailey 1993) and general knowledge of the fishery, we expected to see the following general patterns in the data:

- For associated sets, we expected mainly sets containing both skipjack and yellowfin (+bigeye) in various proportions, with relatively few sets containing very high (90-100%) or very low (0-10%) skipjack.
- For unassociated sets, we expected a much greater proportion of pure species sets, i.e. sets containing a high proportion (90-100%) of either skipjack or yellowfin. This is because free-swimming schools of tuna are often mono-specific and of specific sizes.

As a comparison to the logsheet data, we also examined the records of observers, who report visual estimates of catch by species for each set independently to the logsheet entries by the captain or fishing master.

Results and Discussion

As expected, the overall patterns of %SKJ in purse seine associated and unassociated sets are very different, with a wide range of %SKJ in associated sets and a concentration of sets in the 0-10% and 90-100% categories for unassociated sets (Figure 1). However, while the distributions of %SKJ are similar for unassociated sets between logsheet and observer records, the two data sources show very different patterns for associated sets. In particular, the logsheet records show a preponderance of sets (>60% of all associated sets) in the 90-100% category. While the 90-100% category is also the largest for the observer data, it is <25% of all sets, with the categories of smaller %SKJ being much more common than in the logsheet data (Figure 1). This discrepancy between the logsheet and observer records occurs to

various degrees in all fleets[2] with the exception of Spain and Kiribati (for which the observers report more 90-100%SKJ sets than the logsheets) and Solomon Islands (for which the logsheet and observer records match quite well) (Figure 2).

When matched observer and logsheet recordings of %SKJ in associated sets are compared, we see many more instances of the logsheet reporting higher %SKJ than the observer than vice versa (Figure 3). This pattern is evident for large, moderate and small set tonnages. A similar, albeit less obvious discrepancy is also evident for unassociated sets (Figure 4). There is no apparent bias however in the reporting of total catches of purse seine sets (Figure 5).

Comparisons of the total %SKJ aggregated over 2005-2010 as declared on logheets with the observers' visual estimates and estimates based on the observers' species composition sampling data (corrected for 'grab' sampling selectivity bias) suggest that (i) the observer sample-based estimates are reasonably consistent with the observer's visual estimates for both associated and unassociated sets; and (ii) both sets of observer-based estimates report significantly lower %SKJ than are reported on logsheets, with the discrepancy, as expected, being greater for associated sets (Table 1).

We also examined the proportion of associated sets declared on logsheets to contain 90-100% skipjack for evidence of changes over time for various fleets (Figure 6). Most of the fleets exhibit increasing trends (e.g., FSM, Japan, Korea, PNG, Philippines, USA, Vanuatu), while a few show decreasing (e.g., China, Marshall Islands) or no (Spain, Kiribati, Solomon Islands) trends.

Conclusions

The analyses presented confirm that logsheet declarations of species composition in associated sets in particular, and to a lesser extent unassociated sets, are biased towards skipjack. The degree of bias varies among fleets and may also vary over time. This conclusion supports the current methodology of estimating purse seine species composition using the three-species approach applied to observer sampling data.

The observer visual and sample-based estimates of %SKJ were generally consistent. While this needs to be investigated in more detail, it may be possible to make better use of the observers' visual estimates of purse seine species composition in routine fishery monitoring.

References

Hampton, J. and K. Bailey. 1993. Fishing for tunas associated with floating objects: a review of the western Pacific fishery. Tuna and Billfish Assessment Programme Technical Report No. 31. South Pacific Commission, Noumea, New Caledonia.

Lawson, T.A. 2007. Further analysis of the proportion of bigeye in 'yellowfin plus bigeye' caught by purse seiners in the WCPFC Statistical Area. Information Paper ST–IP–5. Third Regular Session of the WCPFC Scientific Committee, 13–24 August 2006, Honolulu, Hawaii, United States of America. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

[2] Note that observer coverage (in terms of processed data available for this analysis) by fleet for the period 2005-2010 has varied greatly, from a low of 3% to a high of 35% (Figure 2).

Lawson, T.A. 2010. Update on the estimation of selectivity bias based on paired spill and grab samples collected by observers on purse seiners in the Western and Central Pacific Ocean. Working Paper ST-WP–2. Sixth Regular Session of the Scientific Committee of the WCPFC. Nuku'alofa, Tonga. 10–19 August 2010.

Williams, P. 2011. Estimates of annual catches in the WCPFC statistical area. Information Paper ST-IP-1. Seventh Regular Session of the Scientific Committee of the WCPFC. Pohnpei, Federated States of Micronesia. 9–17 August 2011.

Table 1. Estimates of percentage of skipjack (%SKJ) in purse seine associated and unassociated sets over the period 2005-2010. Logsheet estimates refer to the %SKJ declared by the vessel operator on logsheets; Observer visual estimates refer to the %SKJ estimated visually by the observer on a set by set basis; Observer sample estimates refer to estimates based on three-species species composition samples taken by observers, adjusted for 'grab' sample selectivity bias. All estimates have been raised to reflect total catches and account for uneven observer coverage across fleets.

	Associated sets %SKJ	Unassociated sets %SKJ
Logsheet estimates	86.2	78.1
Observer visual estimates	74.6	72.9
Observer sample estimates	72.8	71.5

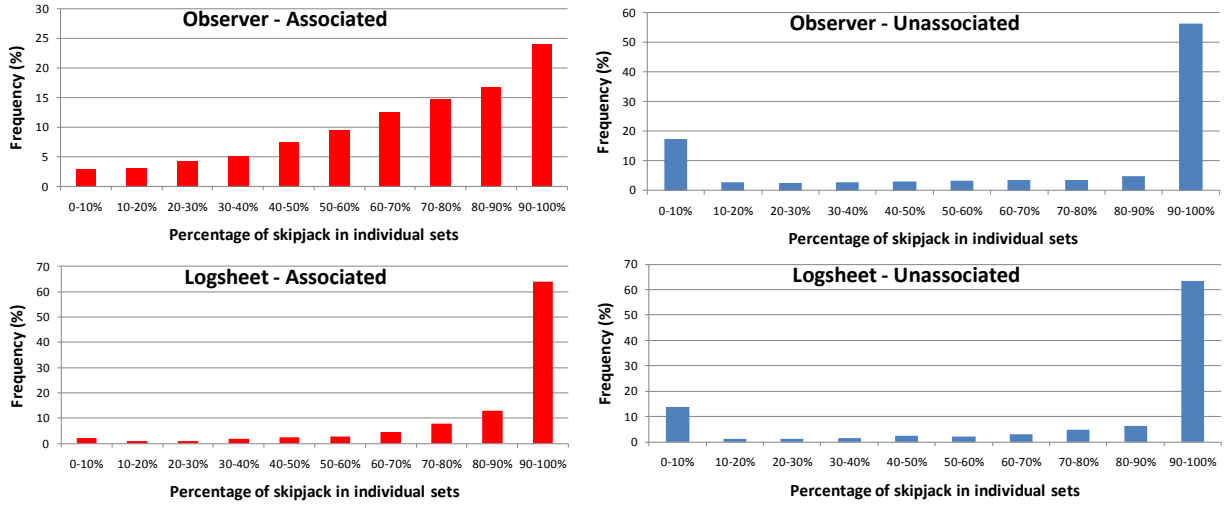

Figure 1. Frequency distributions of the percentage of skipjack in observed purse seine associated sets, as recorded on logsheets and by observers.

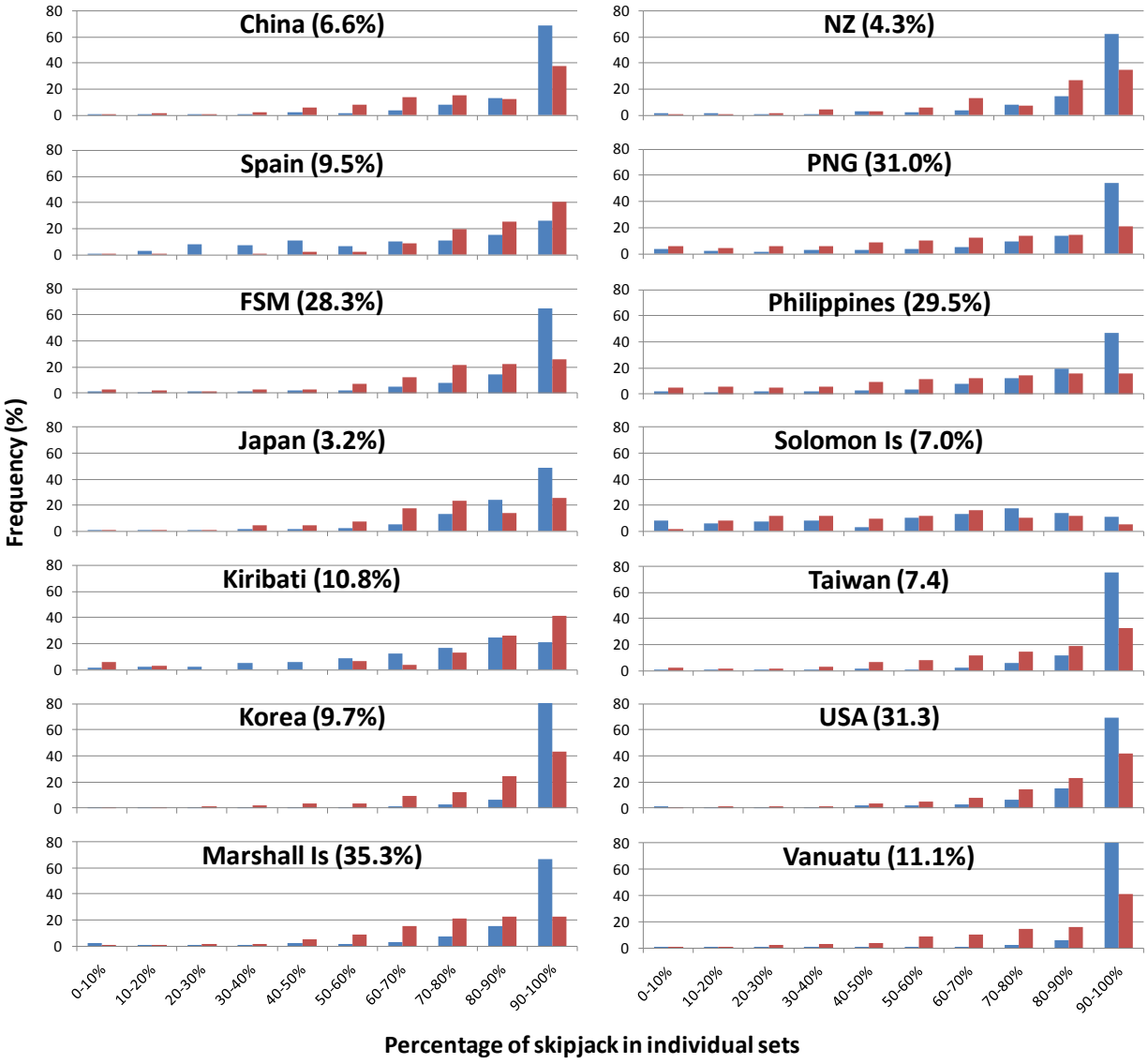

Figure 2. Frequency distributions of the percentage of skipjack in individual observed purse seine associated sets, by flag. The blue histograms are the logsheet records, while the red histograms are the observer records. The percentages refer to the fleet-specific observer coverage rates (observed total catch/total catch x 100%) during the period 2005-2010.

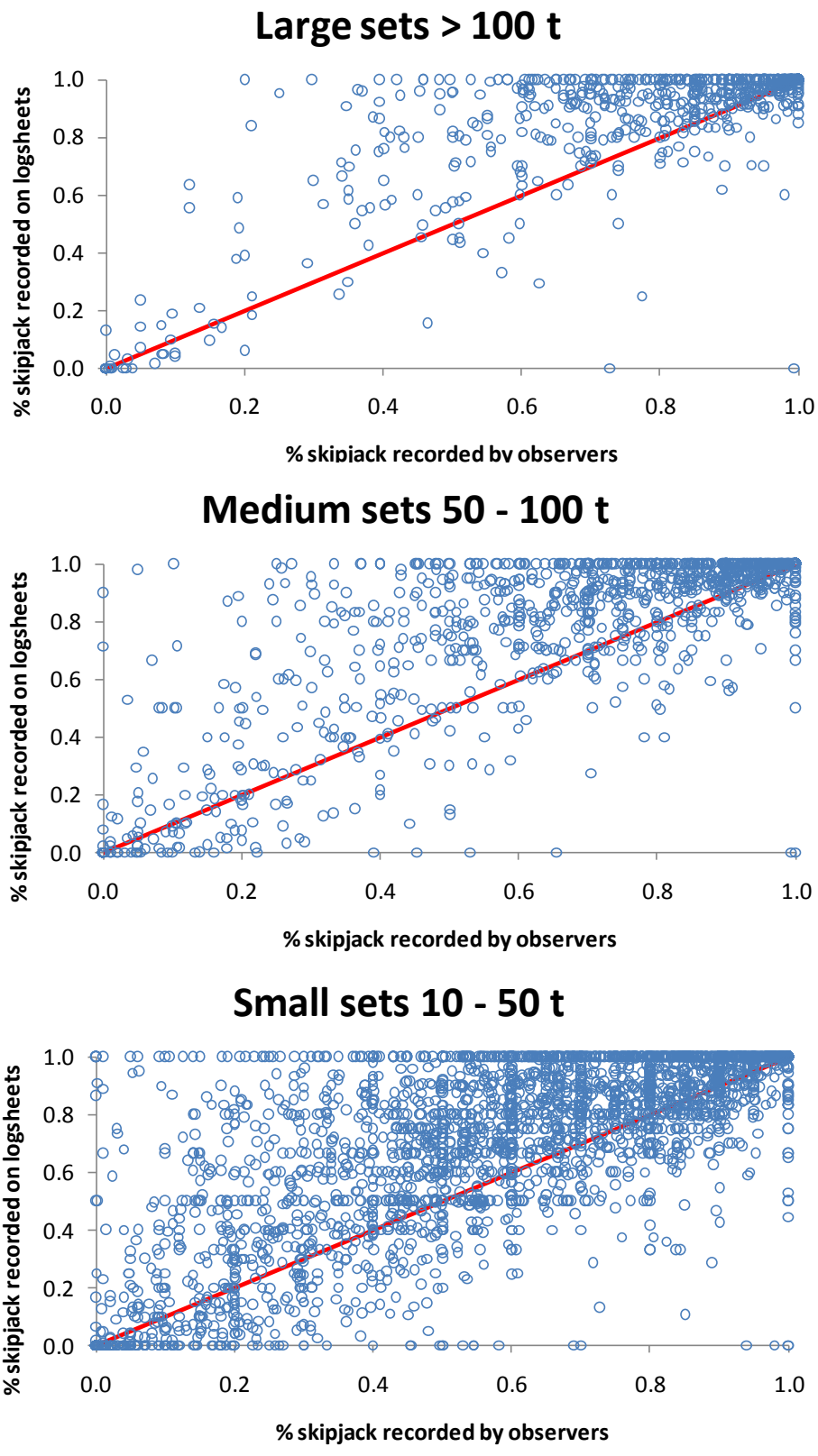

Figure 3. Scatter plots of matched observer and logsheet records of the percentage of skipjack in three size categories of ASSOCIATED purse seine sets.

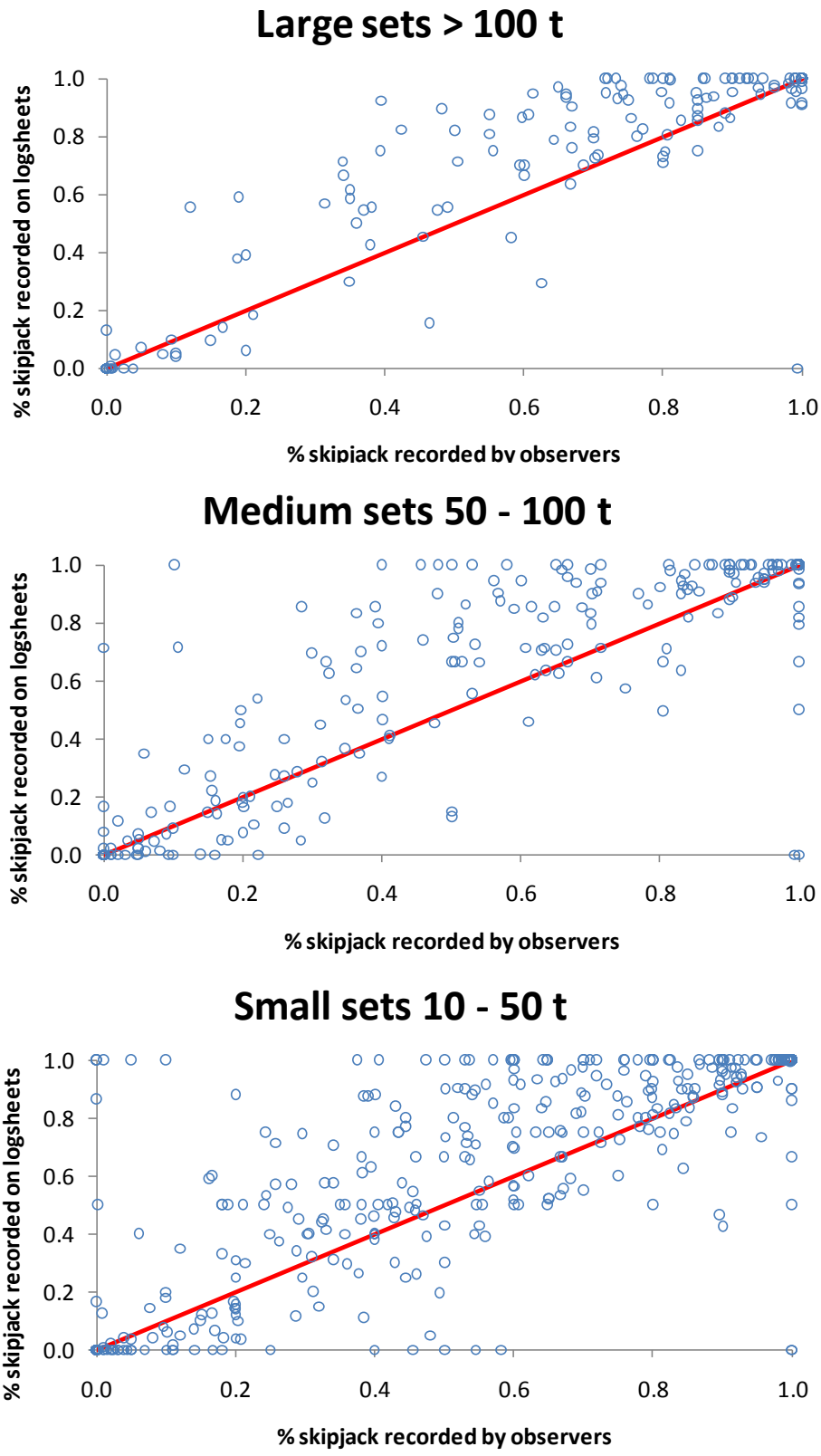

Figure 4. Scatter plots of matched observer and logsheet records of the percentage of skipjack in three size categories of UNASSOCIATED purse seine sets.

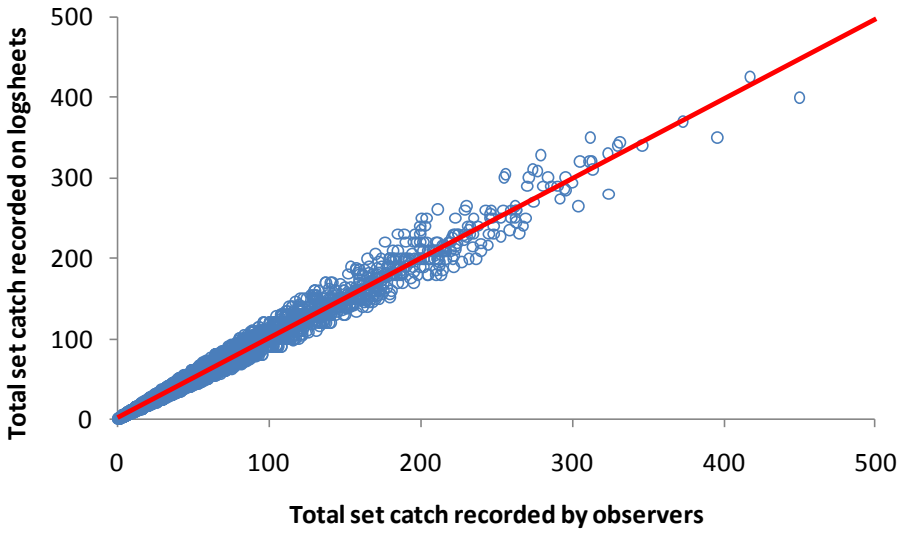

Figure 5. Scatter plot of matched observer and logsheet records of total catch from purse seine (both associated and unassociated) sets.

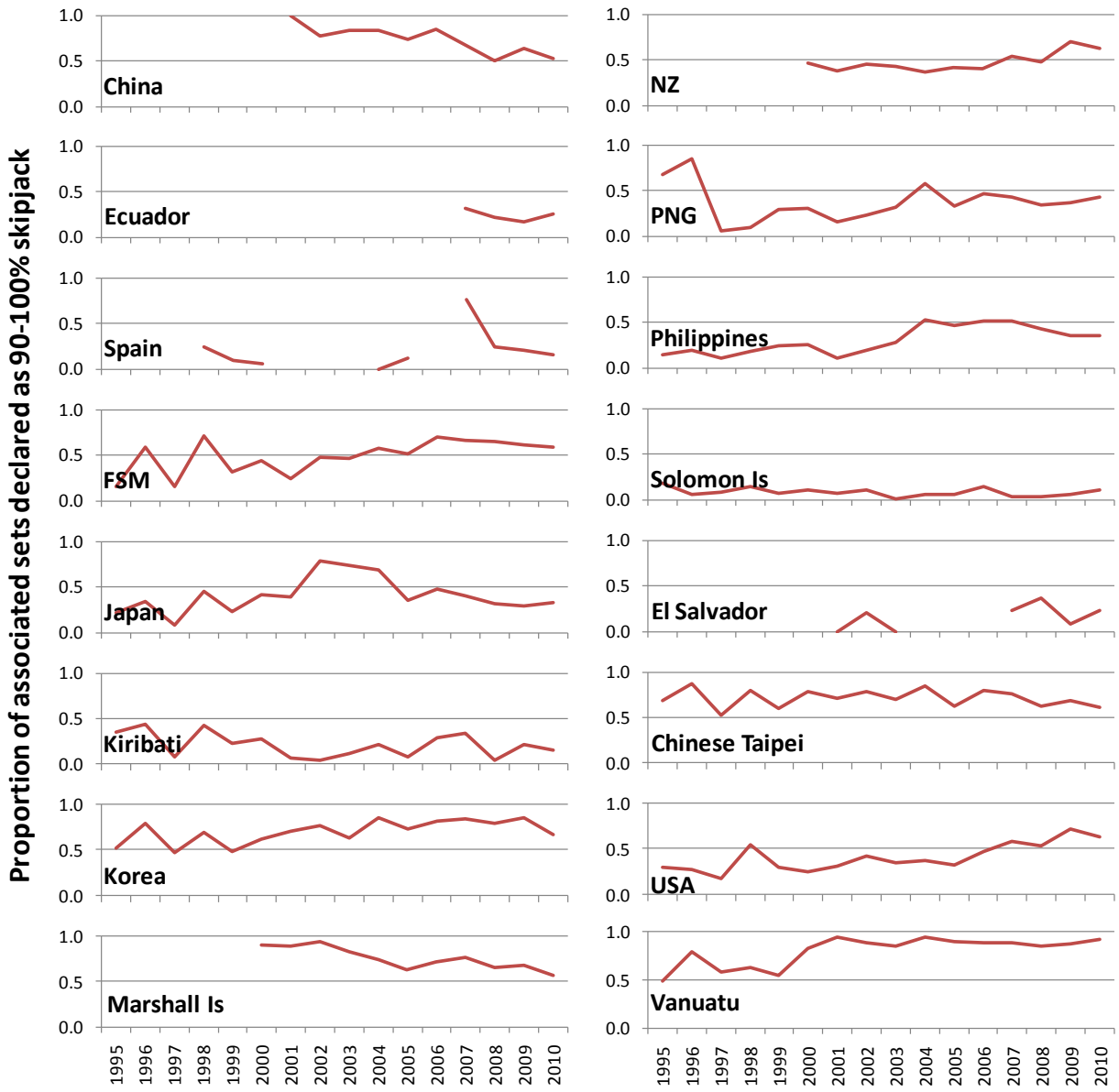

Figure 6. Time series of the proportion of associated sets declared on logsheets to comprise 90-100% skipjack, by fleet.