# Re-processing of the fisheries statistics for the French purse seine fishing fleet during 1981-1990

E Chassot*, L Floch†, P Dewals*, P Chavance†, V Fonteneau‡

## SUMMARY

*Data sampling procedures for the French purse seine fleet of the Indian Ocean evolved throughout the 1980s with the progressive expansion of the fishery and did not meet the criteria used for the current sampling protocol of the European purse seine fishery. The stratification and method used for processing the data also differed from the current methodology that has been implemented in the Indian Ocean since 1991. Here, we used the multispecies size samples collected during 1990-1992 to re-process the fisheries statistical data of the French purse seine fleet based on the current processing methodology. The method assumes that the composition of the catch was stable over years and differed across strata which are defined by large spatial areas, quarters, and fishing mode, i.e. free-swimming and fish aggregating device associated schools. The size structure of the catch raised to the nominal catch was also estimated. Overall, the re-processing resulted in small relative changes in the catch of yellowfin and skipjack, i.e. 4.6% and 2% over 1981-1990, respectively, while the catch of bigeye increased by about 28%. The annual changes in magnitude and mean weight of the catch vary between species and fishing modes and do not show clear patterns in relation with the variability in fishing grounds and seasonality of the fishery. We argue that the new time series of monthly spatially-aggregated catch data constitute a significant improvement as they are based on a large number of samples that were collected in a way consistent with the sampling protocol currently used for the EU purse seine fishery.*

*KEYWORDS: Katsuwonus pelamis, Thunnus albacares, Thunnus obesus*

*Institut de Recherche pour le Développement, UMR 212 EME (IRD/Ifremer/UM2), BP570, Victoria, SEYCHELLES
†IRD, UMR 212 EME (IRD/Ifremer/UM2), Avenue Jean Monnet, BP 171, 34 203 Sète Cedex, FRANCE
‡FIESTA, 9 Boulevard Porée, 35 400 Saint Malo, FRANCE

## 1. Introduction

The species composition of the catch of tropical tuna purse seiners as declared in the logbooks has been known for some time to be biased due to misidentification of juveniles of tunas (Fonteneau, 1976). In the Indian Ocean, sampling operations conducted during the unloading of the purse seiners and devoted to the estimation of the species composition of the catch started in 1984 (Hallier et al., 1991). The characteristics of the sampling method (e.g. number of fishes, selected wells) evolved throughout the 1980s in relation with the fisheries expansion and the logistical constraints imposed by the fishery (Pianet, 1999). Based on the data available at this time, some procedures were implemented to correct the species composition of the catch (Hallier et al., 1991). A few years later, the results of a EU Research programme (Pallarés and Hallier, 1997) founded the basis of the sampling and processing procedures of the European purse seine fisheries statistical data that are still in use nowadays. In particular, the programme defined an optimal stratified sampling design to account for the variability of the species and size composition of the catch in time and space as well as from a technical point of view, i.e. with regards to the fishing mode used. The main objective of the present analysis was to re-process the size and species composition of the catch declared to the IOTC over the period 1981-1990 based on the current sampling protocol and procedure to get consistent time series of catch (numbers and biomass) over 1981-2012.

## 2. Materials and Methods

A total of 1871, 133, and 2 samples were collected during 1990-1992 during the unloading of European and associated flags purse seiners in the ports of Victoria (Seychelles), Diego Suarez (Madagascar) and Mombasa (Kenya), respectively. Samples consisted in the identification and measure of the length of tunas, with large tunas (>70 cm) being mostly measured in predorsal length ($L_D$). $L_D$ were then converted to fork length ($F_L$) through species-specific conversion keys. 95% of the samples included >55 fishes and the median size of a sample was 255 individuals. The stratification of the current sampling design is composed of the 4 quarters of the year, of 5 large areas that were fished during 1981-1992, and of the 2 principal fishing modes of the fishery, i.e. free-swimming schools (FSC) and fish aggregating device (FAD) associated schools (Fig. 1). The number of samples by stratum appeared unbalanced but closely matched the distribution of the catch in each stratum, in relation with the seasonality of the fleet and its concentration in the core area of the Seychelles during the 1980s (Table 1).

The average species composition of the catch was computed in each stratum and used to correct the logbook catches of the purse seiners. Each sample was weighted by the weight of the fishing sets from which the samples were made. The size data available for 1990-1992 were also used to estimate an average size composition for each species in each stratum and derive monthly spatially-aggregated size datasets raised to the total nominal catch.

## 3. Results

The average spatial distribution of the updated catch for the French purse seine fleet during 1981-1990 is shown in figure 2. Overall, the re-processing resulted in small relative changes in the catch of yellowfin and skipjack, i.e. 4.6% and 2% over 1981-1990, respectively, while the catch of bigeye increased by about

28% (Fig. 3). The changes mainly concerned the catch on FADs which are generally composed of a mix of skipjack with juveniles of yellowfin and bigeye. The catch of yellowfin on FSC was little affected by the re-processing while the catch of yellowfin on FAD increased during 1983-1985 and decreased thereafter (Fig. 4a-b). The catch of skipjack showed small variations for FSC and an increase during 1986-1990 (Fig. 4c-d). Finally, the re-processing affected the catch of bigeye for both fishing modes, showing an overall increase in all years except for 1986 on FADs (Fig. 4e-f).

The mean weights of the 3 species were strongly modified by the re-processing, showing annual variations largely differing from the ones available in the IOTC database (Fig. 5). Although the size structure was considered constant in each stratum, the annual variations in catch over space and time resulted in significant variations in weight trends. The re-processing resulted in the mean weight of yellowfin increasing and decreasing for FSC and FAD fishing, respectively (Fig. 5a-b). The average weights of skipjack during 1981-1990 caught on both free-swimming and FAD-associated schools were not strongly modified by the re-processing but the temporal trends in weight strongly differed (Fig. 5c-d). Finally, the re-processing resulted in a major increase in bigeye weight on FSC (from <10 kg to >20 kg) while the weight of bigeye on FADs was found to be smoothed and comprised between 4 and 5 kg during 1981-1990.

## 4.   Conclusions

The re-processing of the time-series of catch covering the period 1981-1990 for the French purse seine fleet is based on the strong assumption that the species and size composition of the catch has remained stable across large areas and quarters during 1981-1990. This is obviously not true as the abundance of the 3 stocks of tropical tunas has varied during the 1980s and the species composition in tuna schools is highly variable at local and mesoscales due to a combination of effects of social behaviour and environmentally-driven movements that are unresolved and difficult to untangle. We argue, nevertheless, that the new time series constitute a major improvement as the purse seine fishery of the Indian Ocean has showed very stable seasonal patterns over the last 3 decades, with a clockwise rotation in space from Seychelles to Somalia that is strongly related to the fishing mode used (Chassot et al., 2013). Hence, the spatio-seasonal variability is generally larger than the annual changes in species composition. In addition, the historical processing was based on multispecies size-samples that were not appropriate to estimate species composition and whose quality and characteristics varied during 1984-1990. By contrast, the re-processing relies on a large number of samples that were collected in a way consistent with the sampling protocol currently used for the EU purse seine fishery. This enables to have a good consistency in the data processing (sampling, stratification, method) and time series of catch over 1981-2012.

## References

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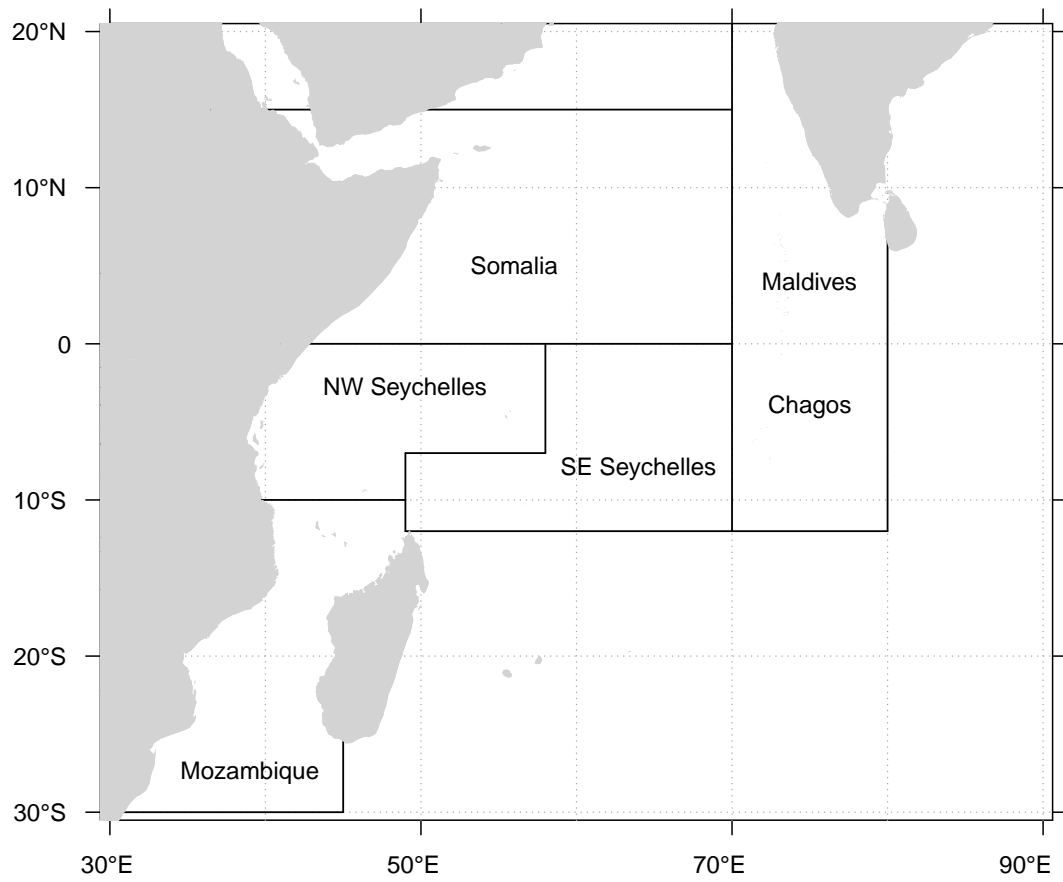
## 5. Figures



Figure 1: Map of the Indian Ocean showing the spatial stratification used in the data re-processing
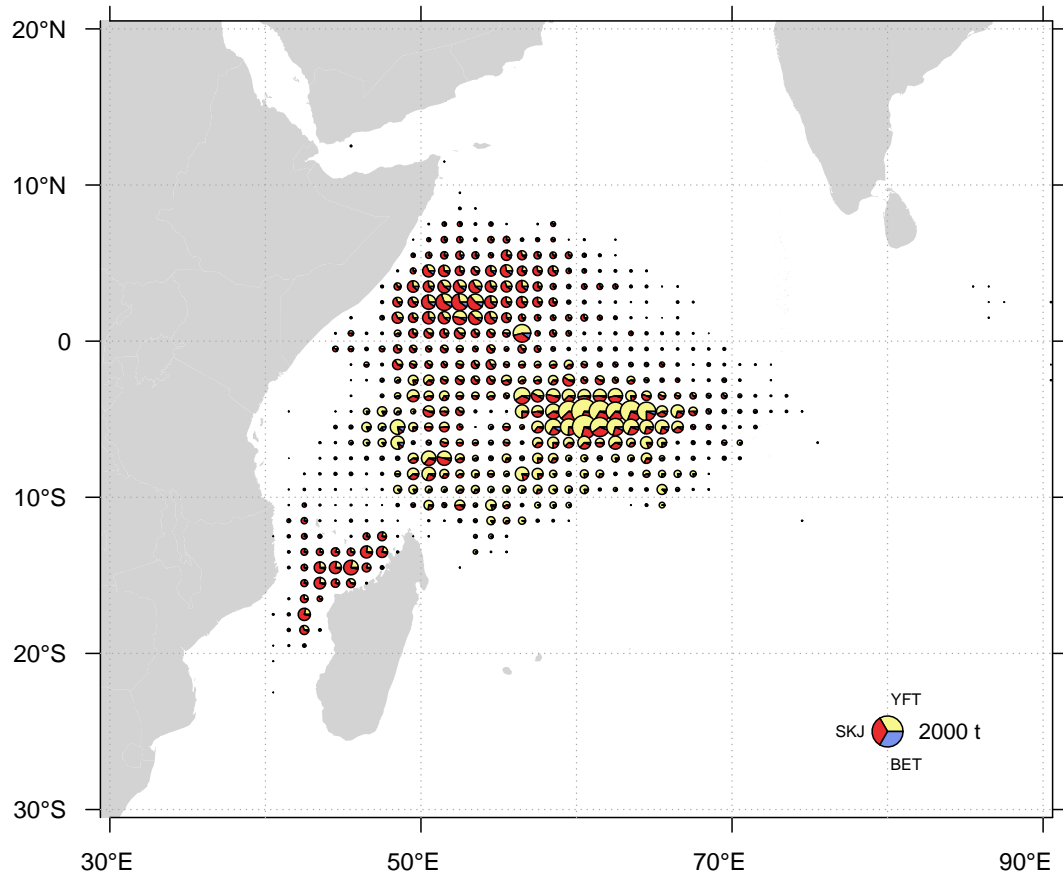
Figure 2: Spatial distribution of the updated catch for the French component of the EU purse seine fishery during 1981-1990 following the data re-processing
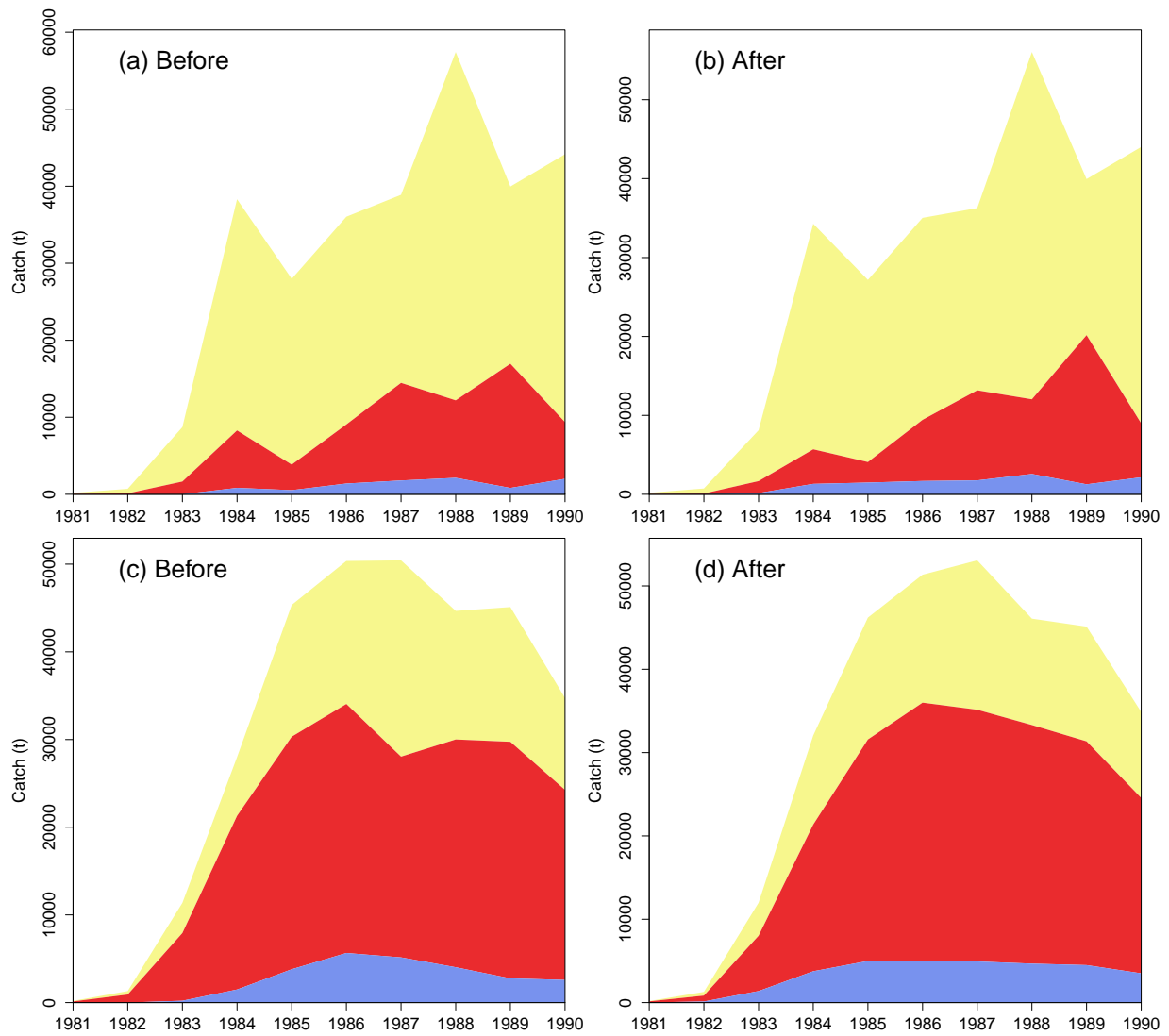
Figure 3: Cumulated catch of the French purse seine fishing fleet before and after re-processing on (a-b) free-swimming schools (c-d) and FAD-associated schools during 1981-1990
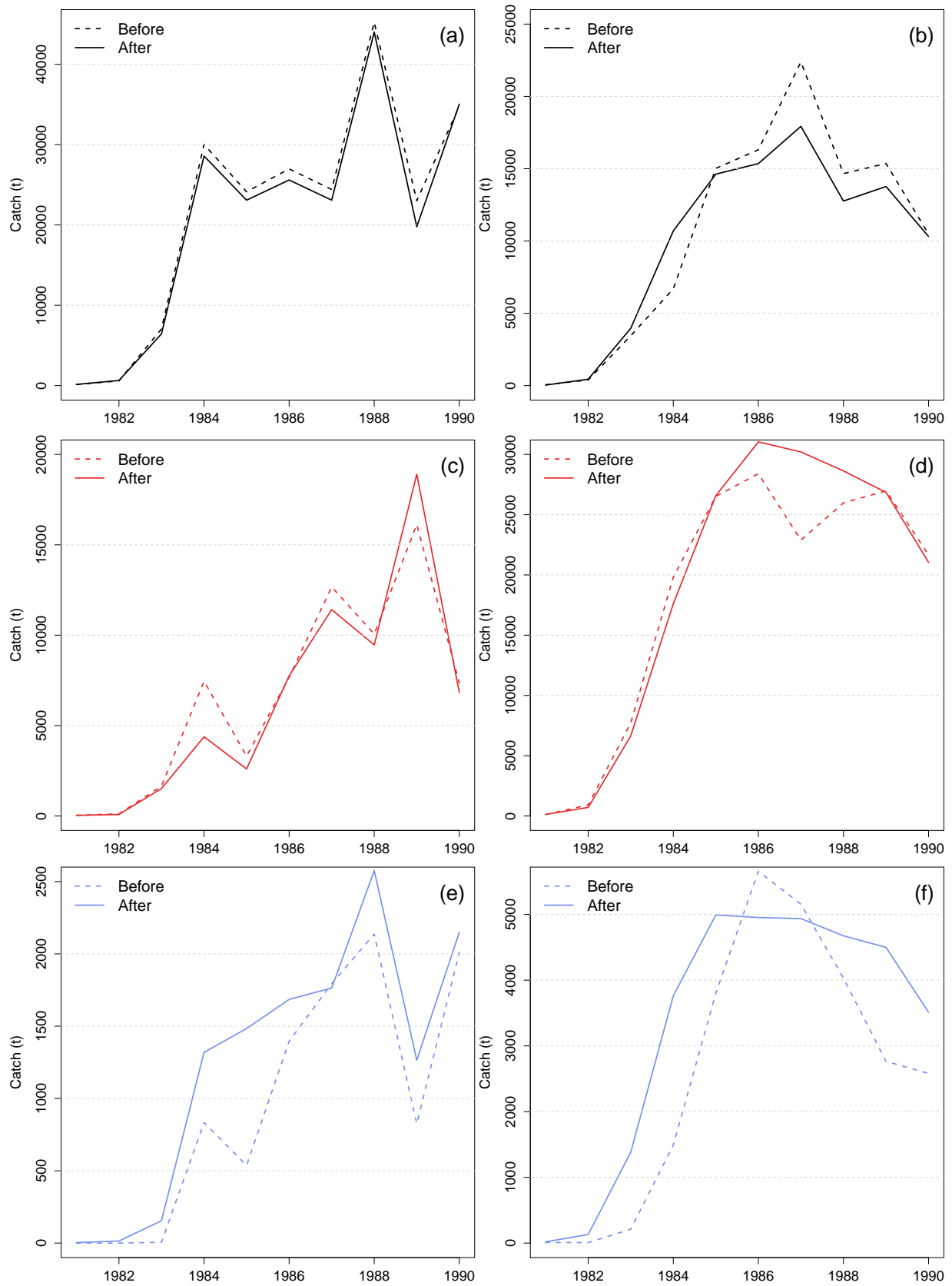
Figure 4: Changes in the catch of yellowfin (a-b), skipjack (c-d) and bigeye (e-f) on free-swimming schools (left-panel) and FAD-associated schools (right panel) following the data re-processing
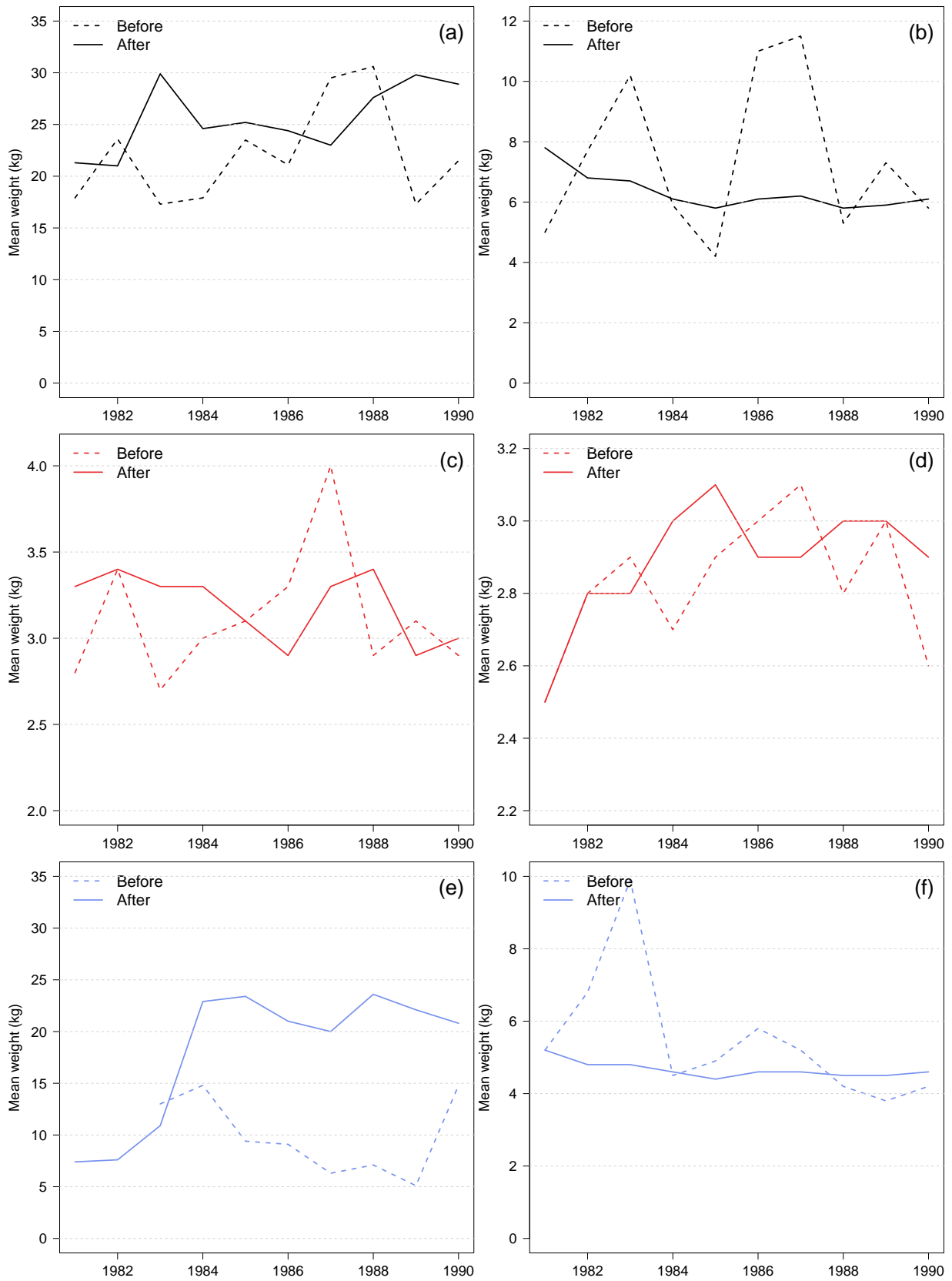
Figure 5: Changes in the annual weight of yellowfin (a-b), skipjack (c-d) and bigeye (e-f) on free-swimming schools (left panel) and FAD-associated schools (right panel) following the data re-processing

## 6. Tables

Table 1: Sampling design. Number of samples collected during 1990-1992 and used for the data reprocessing. FAD = Fish aggregating Device. FSC = Free-swimming school

| Quarter | Mode | NW Seychelles | SE Seychelles | Mozambique | Maldives-Chagos | Somalia |
|---|---|---|---|---|---|---|
| 1 | FAD | 8 | 76 | 19 | 1 | |
| 2 | FAD | 32 | 5 | 99 | | |
| 3 | FAD | 136 | 1 | | | 196 |
| 4 | FAD | 94 | 221 | | 3 | 159 |
| 1 | FSC | 22 | 402 | 5 | 4 | 1 |
| 2 | FSC | 127 | 18 | 6 | | |
| 3 | FSC | 162 | | | | 5 |
| 4 | FSC | 9 | 194 | | | 1 |