

## PROPOSALS FOR THE IMPROVEMENT OF THE ESTIMATION OF THE OVERALL LONGLINE EFFORT DISTRIBUTION (EFFDIS) IN THE ICCAT AREA

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### SUMMARY

*This document presents a brief review of the previous methods of estimation of the total longline effort as well as suggestions on improving this estimation as discussed by the 2013 WGSAM. The most recent calculation of EffDIS conducted in 2009 used the nine major ICCAT tuna and tuna like species to obtain Task I global nominal catches (in weight) and CPUE's from partial catch and effort (Task II) statistics. The current model basic assumption considers that catch rates are equivalent at partial and global level. Comparing the results with previous estimates (obtained during inter-sessional meetings on Ecosystems in 2007 and 2008) the global results do not show major differences. However, at more disaggregated levels the differences are larger for certain flags. In the majority of the cases, large relative variations are usually associated with various improvements and corrections made to some specific datasets. Global geographical distribution shows a small increase near the Venezuela waters due to various corrections made to spatial distributions of catch and effort statistics from Venezuela in several years. Recommended areas for improvement of EffDIS estimation are presented in order to stimulate discussion and finalise the methods that should be used in the future.*

### RÉSUMÉ

*Ce document présente brièvement les méthodes utilisées antérieurement pour estimer l'effort palangrier total ainsi que des suggestions pour améliorer cette estimation, comme le WGSAM en a débattu en 2013. Le calcul le plus récent de EffDIS réalisé en 2009 utilisait les neuf principales espèces de thonidés et d'espèces apparentées de l'ICCAT pour obtenir les prises nominales globales de la Tâche I (en poids) et les CPUE à partir des statistiques partielles de prise et d'effort (Tâche II). Le postulat fondamental du modèle actuel considère que les taux de capture sont équivalents au niveau partiel et global. Si l'on compare les résultats avec des estimations antérieures (obtenus pendant les réunions intersessions du Sous-comité des écosystèmes en 2007 et 2008), les résultats globaux ne font pas apparaître de grandes différences. Or, à des niveaux plus désagrégés, les différences sont importantes pour certains pavillons. Dans la majorité des cas, de grandes variations relatives sont habituellement associées à diverses améliorations et corrections effectuées à certains jeux de données spécifiques. La distribution géographique globale fait apparaître une faible augmentation près des eaux vénézuéliennes en raison de diverses corrections apportées aux distributions spatiales des statistiques de prise et d'effort du Venezuela au cours de plusieurs années. Les domaines recommandés d'amélioration de l'estimation de EffDIS sont présentés afin de stimuler les discussions et de finaliser les méthodes qui devraient être utilisées à l'avenir.*

### RESUMEN

*Este documento presenta una breve revisión de los métodos anteriores de estimación del esfuerzo total de palangre, así como sugerencias para mejorar esta estimación, tal y como discutió el WGSAM en 2013. El cálculo más reciente de EffDIS realizado en 2009 utilizaba las nueve especies principales de túnidos y especies afines de ICCAT para obtener capturas nominales globales de Tarea I (en peso) y las CPUE a partir de estadísticas parciales de captura y esfuerzo (Tarea II). El supuesto base del modelo actual considera que las tasas de captura son equivalentes a nivel parcial y global. Al comparar los resultados con estimaciones anteriores (obtenidas durante reuniones intersesiones del Subcomité de ecosistemas en 2007 y 2008), los resultados globales no mostraban diferencias importantes. Sin embargo, a niveles más*

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*disgregados las diferencias eran mayores para algunos pabellones. En la mayoría de los casos, las importantes variaciones relativas se suelen asociar con diferentes mejoras y correcciones de algunos conjuntos de datos específicos. La distribución geográfica global muestra un pequeño incremento cerca de las aguas de Venezuela debido a las diferentes correcciones realizadas en las distribuciones espaciales de estadísticas de captura y esfuerzo de Venezuela durante varios años. Se presentan campos recomendados para mejorar la estimación de EffDIS con el fin de impulsar los debates y finalizar los métodos que deberían usarse en el futuro.*

#### KEYWORDS

*Fishery statistics, Fishing Effort, Longline fisheries, Time-space distribution*

### 1. Overview of past and current estimation techniques

This document is effectively an update of SCRS/2013/021 including additional suggestions raised during the 2013 Sub Committee on Ecosystems meeting. The original overview and observations on the Effdis estimation method have been preserved in this document for easy reference as to how it has been estimated in the past. Primarily updated is section 3 (Future methods to improve estimation of EffDIS).

In recent years, the estimation of a quantitative global longline effort, spread in time and space (respectively, month and 5° by 5° degree squares) for the entire Atlantic Ocean (dataset referenced from now on as “EffDIS”) has become an important tool used by the ICCAT Scientific Community. In particular, the Sub-Committee on Ecosystems often uses this dataset to study the impact of longline fisheries in sea birds populations.

A preliminary attempt to estimate EffDIS was made during the Ecosystems meeting held in Madrid in February 2007 (Anon. 2008). Only the first 10 major longline fleets (ranked in function of Task II catch and effort data availability) were considered and the time/space stratification adopted was the trimester and 5x5 degree squares. The remaining fleets with Task I (T1NC) catches but without partial Task II catch and effort (T2CE) information were grouped in a combined flag called “others” and its efforts spread, in each year, across the 5x5 squares of the 10 major flags.

Afterwards, various problems were found in the raw (T2CE) statistics provided by several ICCAT parties. The errors found (effort units, wrong geographical squares, T2CE dataset duplications for the same year and flag) were corrected during 2008, and an improved EffDIS estimation was presented by the Secretariat to the Ecosystems meeting held in Madrid in February 2008 (Anon. 2009). The major improvements were made on the time stratification adopted (by month) and the inclusion of 7 additional longline flags (17 in total) with sufficient T2CE information. This flag inclusion reduced the overall weight of “others” fleets group (remainder longline fleets with catches) from about 17% in to around 13% of the global effort.

A further revised estimation of EffDIS was carried out in 2009 (Palma and Gallego 2010). The updated methodology consisted basically in raising the partial longline effort available in T2CE by the yearly global catch ratios (of 9 major species: bluefin, yellowfin, albacore, bigeye, skipjack, sailfish, blue marlin, white marlin, swordfish) between T1NC and T2CE. This approach assumed that, T2CE partial information fully represents the overall time-space allocation of the longline effort of a given flag in a given year. Only T2CE datasets with enough time/area resolution (time: month or quarter; area: 1° by 1° or 5° by 5° squares) and effort in hooks were used in the estimates. The valid T2CE data was used to rank the flags.

Whenever required, species catch compositions from T2CE reported in number of fish were converted to weight, using estimated mean weights by flag, species and year, obtained from Task II size samples. This procedure was applied in each majority to Japan and United States. When, for a given species, flag and year, no size samples were available, mean weight substitutions were applied in the following order:

1. Obtain an equivalent mean weight from reported catch-at-size (if available)
2. Substitute by the mean weight average of two previous years (if available)
3. Substitute by the mean weight of the posterior year (if available)
4. Substitute by the mean weight of a similar flag

An important difference existed in the way the mean weights were calculated (when comparing with the calculations presented in Anon. 2008 and Anon. 2009). Mean weights were now calculated taking into account the size class limit (lower/central/upper limits) instead of a general assumption that all size was considered to be in central point. Furthermore only one dataset per flag/year was used (instead of an arithmetic mean of various mean weights obtained from various datasets available for the same flag and year, e.g.: size samples in number, size samples in weight, catch at size, etc.). It is known that, for large tuna species this can affect the mean weight estimations. This adjustment was incorporated, because the Secretariat made a large revision during 2008 to the identification of the size class types, limits and units in the Task- 2 size sampling database. This change in calculations was expected to slightly affect the effort estimations of flags who reports T2CE in number of fish only (mainly Japan that reports samples in upper limits, and United States that reports size samples in central point).

The generic substitution rule adopted for the cases of a given flag/year combination where there is no T2CE data was to use the T2CE dataset of the closest year (preferably year before) of the same flag. No other substitution criterion was adopted. During 2007, many corrections were made to the T2CE raw data and incorporated in the EffDIS estimations presented to the Sub-Committee in Ecosystems (details in Anon. 2009). During 2008 the Secretariat found additional errors documented in Palma and Gallego (2010). Finally, all the datasets incorporated and revised in T1NC statistics were also included in the new estimations.

## 2. Findings and observations on past methods

After the first attempt to estimate EffDIS in 2007, various problems were found on the raw (T2CE) statistics provided by the ICCAT parties. The errors found (effort units, wrong geographical squares, T2CE dataset duplications for the same year and flag) were corrected during 2008, and an improved EffDIS estimation was presented by the Secretariat to the Ecosystems meeting held in Madrid in February 2008 (Anon. 2009). The major improvements were made on the time stratification adopted (by month) and the inclusion of 7 additional longline flags (17 in total) with sufficient T2CE information. This flag inclusion reduced the overall weight of “others” fleets group (remainder longline fleets with catches) from about 17% to around 13% of the global effort.

Other minor problems were found in the raw data in 2008, and a new revision was made to EffDIS in order to incorporate the respective corrections, the revisions made for 2005 and 2006 data and new 2007 estimations. The total number of hooks obtained per year in the 2009 study is shown in **Figure 1** (for comparison, the same series estimated during the 2007 and 2008 Ecosystems meetings are also included). The changes in the total number of hooks per flag and year (comparison between Anon. 2008 and Palma and Gallego, 2010) are shown in **Figure 2**. The major differences obtained were for Japan, Venezuela, Panama, South Africa, and the flag group “others”. Other primary results from the 2009 study by Palma and Gallego are the geographical (5° by 5° squares) distribution of hooks for the period 1950-2007 which are shown in **Figure 3**. Hooks estimations based on substitutions (yellow portions of pies) indicates a reasonable concentration in the Atlantic northeast (concentration of historical Spanish catches), Mediterranean (historical catches of EU-Cyprus and EU-Greece), Atlantic northwest (historical USA catches), Atlantic southwest (historical Brazilian catches) and western central Atlantic (historical Venezuelan catches). As it was expected, the hooks of the flag “others” (blue portions of pies) are homogeneously spread (and in function of the weight of each square) across the entire Atlantic. Lastly the estimates of the geographical (5 by 5 degree square) distribution of the longline total effort by decade from that study is shown in **Figure 4**.

The revisions made to the T2CE database improved its consistency and quality in longline fisheries. However, there were many data gaps and deficiencies that required a committed participation of the Scientific Community of ICCAT (in particular the Head Scientists of each ICCAT Party) in a historical T2CE recovery plan. For sure, this commitment was seen to be the best mode of improving significantly the EffDIS estimations.

A general observation on the 2009 estimation attempt was that this method was highly sensitive to the completeness of the species catch composition (all 9 species caught must be reported) in T2CE to reflect the T1NC longline catch composition per Flag. The lack of one or more species in catch and effort, underestimates the nominal CPUE's and overestimates the total effort. It was also highly sensitive to the mean weights estimated for each species (which requires good and representative sampling data). Mean weights have also a similar effect than the omission of species in T2CE (lower/higher mean weights underestimate/overestimate CPUE's and overestimate/underestimate the total effort). The “others” flag group represents uncertainty in the estimations (representing from 10 to 17% over the last decade). Part of this uncertainty (NEI longline catches) cannot be easily corrected. However, a large amount of it (related mainly to EU-Italy, Morocco, Uruguay, Canada, EU-Portugal and Philippines) can be corrected if the correspondent T2CE information could be recovered.

### 3. Future methods to improve estimation of EffDIS

The SCECO specifically drew attention to the following recommendations for improving the EffDIS dataset that were recommended by the secretariat, including where possible:

- That data series reported by quarter or year be resubmitted by month.
- That data series reported without spatial information, or by stratification larger than 5° by 5° be resubmitted using at least a 5° by 5° stratification
- That data series reported without longline effort be revised to include the corresponding effort
- Recover historical datasets, particularly prior to 1991. - The availability of information, particularly prior to 1991 is deficient. Should these data be recovered, it would greatly improve EffDIS estimations.
- Expand the number of species used in the raising of effort using the ratio of T2CE to T1NC to include major shark species (blue, porbeagle, and mako). This action would improve estimation of total effort. Note: EffDIS estimates are sensitive to species composition. A more complete characterization of species composition could be helpful.
- Differentiating Atlantic and Mediterranean fishing effort and revising/improving the most important Mediterranean Sea Task II catch and effort series.
- To investigate the possibility of integrating into the analysis metadata regarding fleet behaviour targeting, (aiming to identify fleet profiles) in order to achieve more accurate projections of relative effort of fishing fleets. This would be achieved by profiling the various longline fleets according to their fishing operations and dynamics. This would facilitate the estimation of EffDIS based on more realistic projections of the various fleet operations. It is clear that for example, the Spanish fleet targeting swordfish does not operate in the same manner as the longline fleets of South Africa. By characterizing these differences, more realistic projections of relative effort can be obtained.
- Examine suitability of assumptions for raising fleets (e.g., U.S. and Japan assumed to report full information and are not currently raised).

The Secretariat noted that improvements to EffDIS began in 2007 and are ongoing. Some improvements are largely complete (i.e., most catch-effort data is now by month and by 5 by 5 degree square) while others are pending.

The 2013 SCECO made additional suggestions:

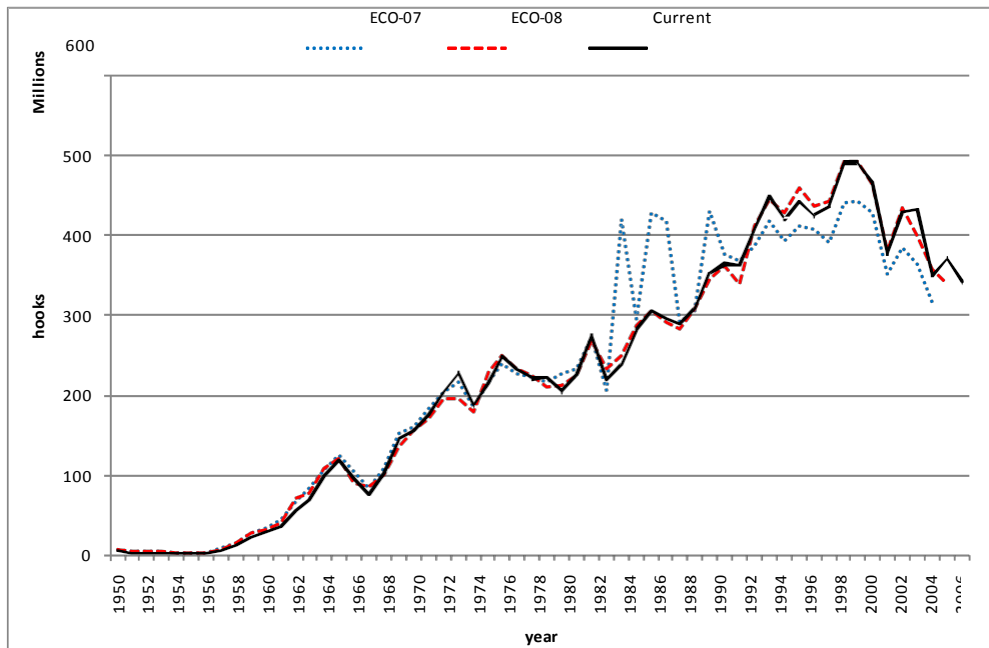
- An effort should be made to develop similar EffDIS estimates for the BB and PS gears. This would be particularly useful for evaluations of time-area closures.
- The Working Group recognizes the importance of accounting for changes in fishing operations and characteristics of the main fleets from each CPC operating within the ICCAT Convention area as these affect the efficiencies of the fleets for catching target and by-catch species. Documentation of these technological and behavioral changes is particularly important to understand the national reports of catch and effort annually submitted (Task II-CE). Taking into consideration also that CPCs are required to report fleet composition data (Task I-FC), it is recommended that CPCs present an SCRS document with the details of the fleet composition, sampling, coverage, and statistical methodology to estimate total catch, catch and effort, catch-at-size for each of the main fleet components. This report should also communicate the potential limitations and or restrictions of the data and information provided to be taking into account within any further analysis by the SCRS or the Secretariat.
- The uncertainty of EffDIS estimates should be characterized. Substitutions, raising ratios and proportion of unclassified fleets (“other”) should be clearly described in documentation.
- Additional methods of raising data should be explored (e.g., Rubin 1976) to evaluate their statistical rigor.
- Methods to cross-validate EffDIS estimates should be explored (e.g., VMS data).

## References

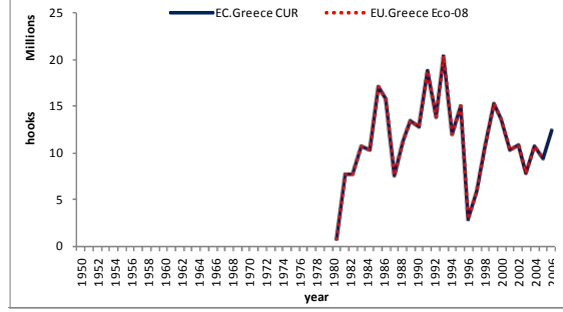
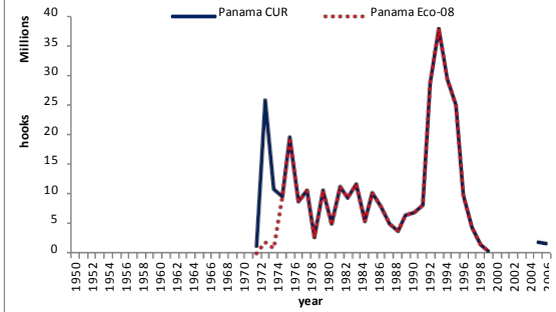
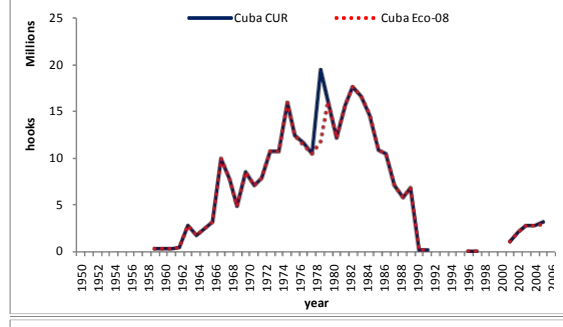
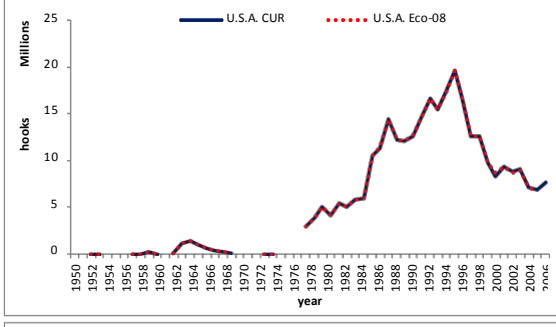
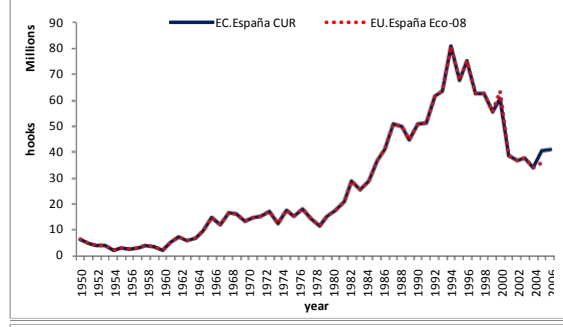
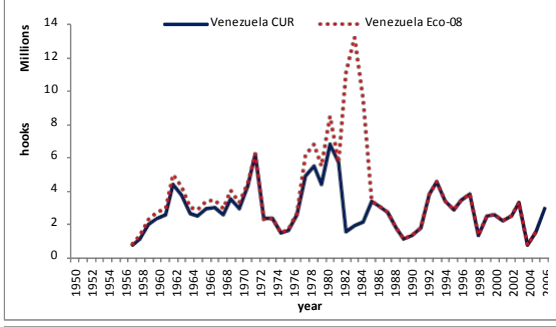
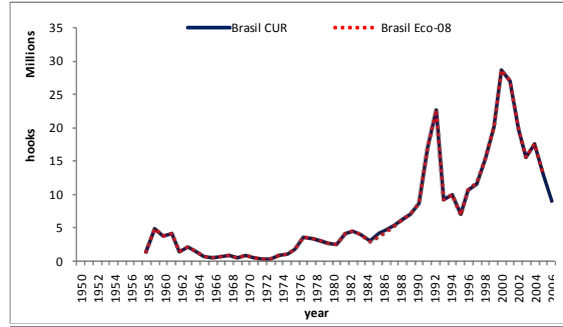
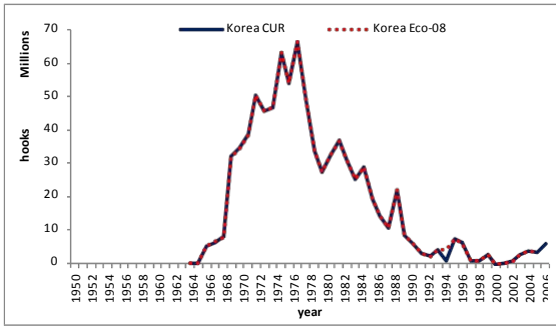
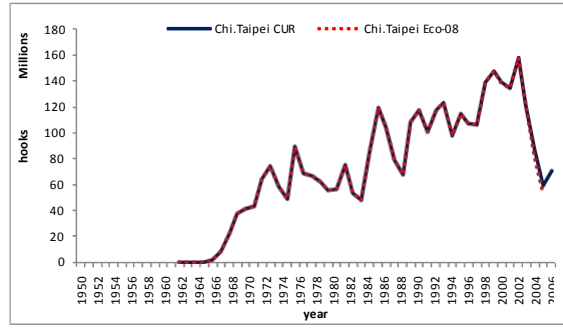
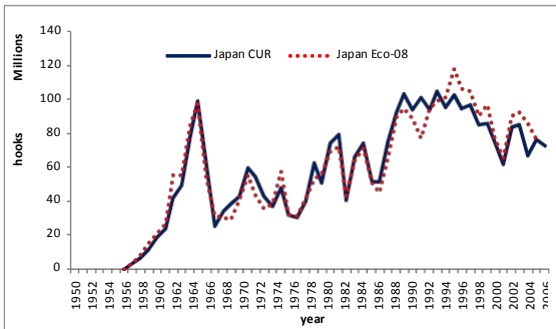
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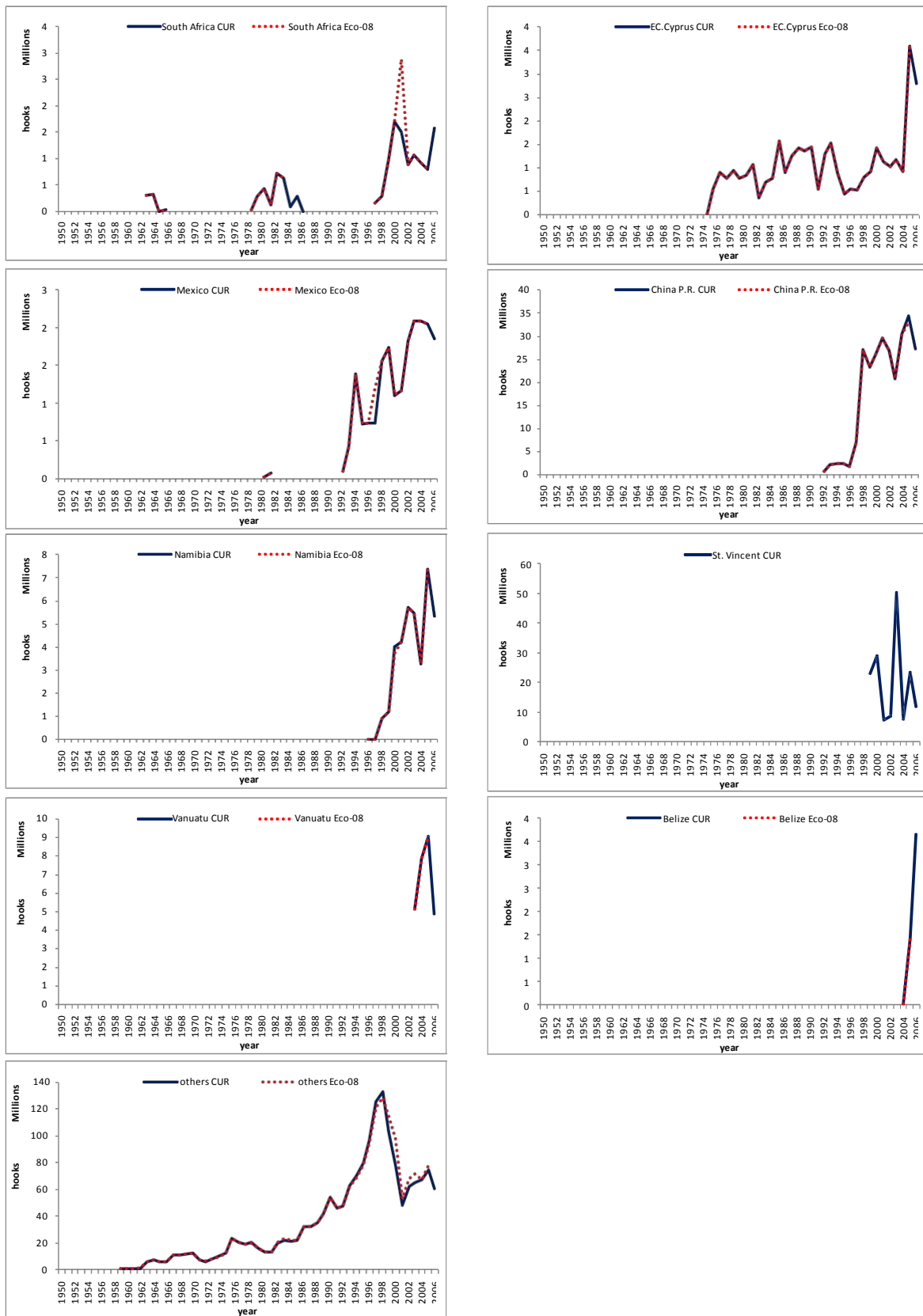
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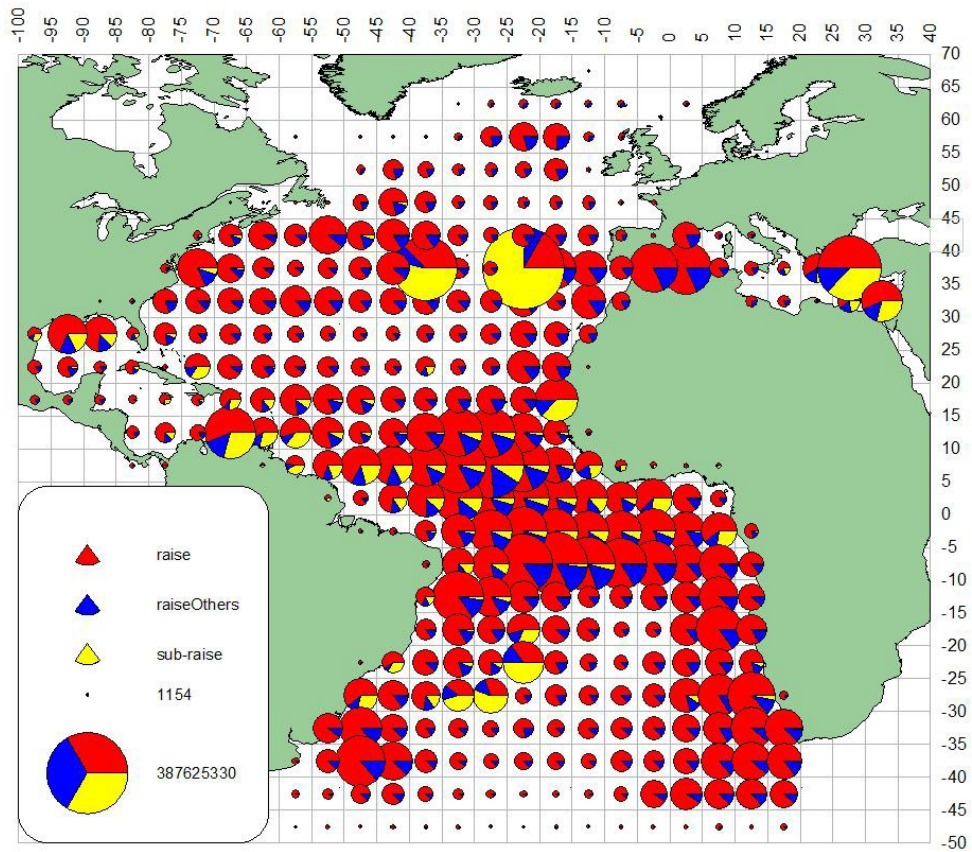


**Figure 1.** Comparison of total hooks obtained in current study against equivalent estimations obtained in ECO-07 and ECO-08.



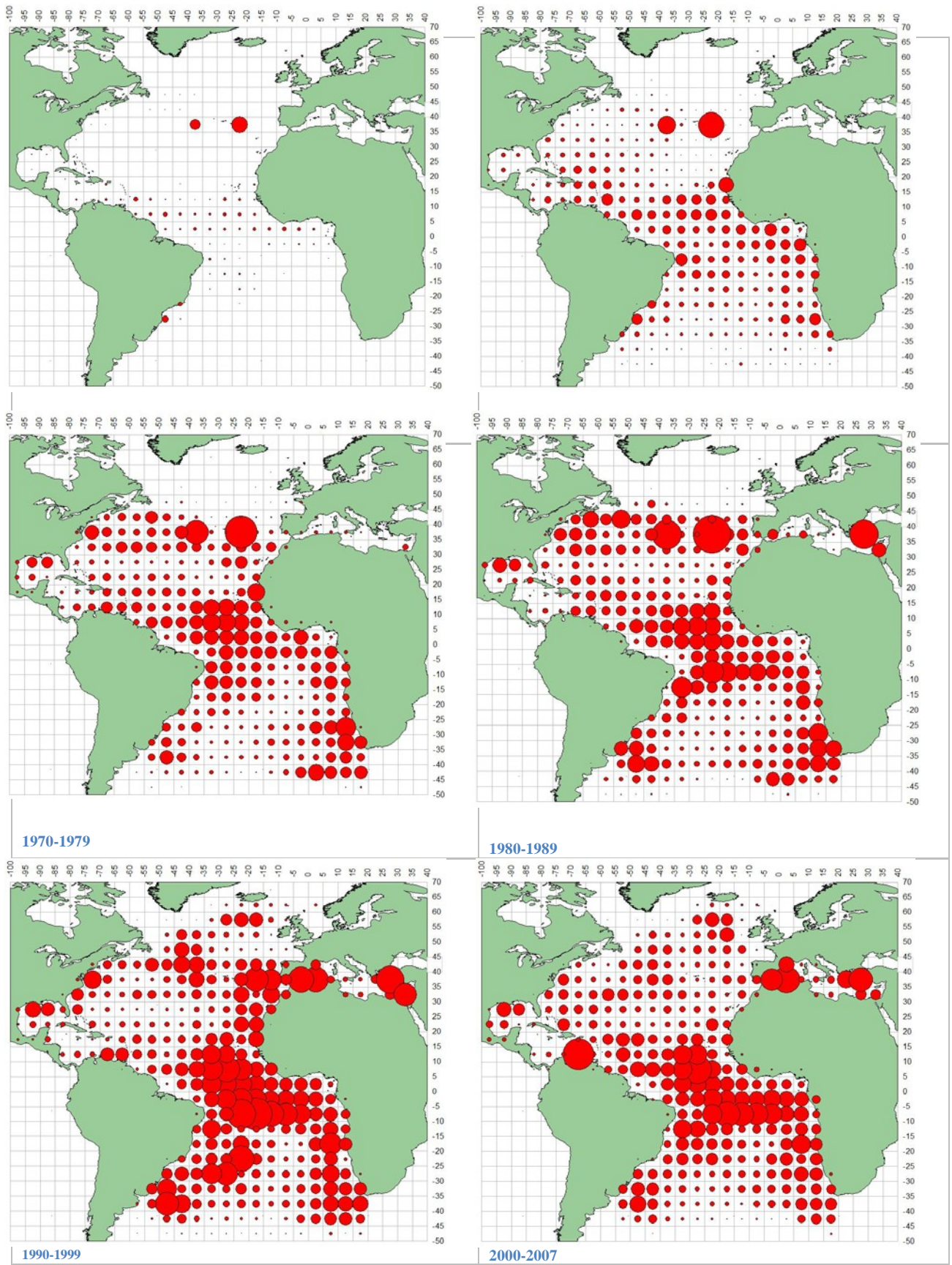


**Figure 2.** Total number of hooks by flag and year (CUR: Palma and Gallego 2010; Eco-08 Ecosystems 2008 estimations).



**Figure 3.** Total hooks spread across 5° by 5° degree squares for the entire period (1950-2007). Yellow portions of pies represent hooks estimations based on substitutions made. Blue portions are related to flag “others”.





**Figure 4.** Total hooks by decade and 5° by 5° degree squares (same scale).