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Summary of the transhipment of shark products by longliners in the Indian Ocean

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This paper is presented for consideration by the Working Party on Ecosystems and Bycatch. All data used were obtained on request from the IOTC Secretariat in accordance with Resolution 12/02.

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Introduction

The Indian Ocean Tuna Commission (IOTC) Regional Observer Programme (ROP) monitors transhipments at sea between large-scale tuna longline fishing vessels (LSTLVs) and carrier vessels. This programme has been operating in the IOTC area under Resolution 11/05 since 1 January 2009 (initially under Resolution 06/02, followed by 08/02). This Resolution requires observers deployed on carrier vessels to verify the identity of the LSTLV and monitor quantities of transhipped products to ensure they are consistent with those recorded in the transhipment declaration. Monitoring of transhipments enhances the traceability of products and the programme also helps deter Illegal, Unreported and Unregulated (IUU) activity in the Indian Ocean region.

Although sharks are not part of the 16 species directly under the IOTC mandate, sharks are frequently caught as bycatch in association with other species, and can be as much a target as tuna for some fleets (WPEB, 2012). As such, the IOTC Members and non-Contracting Parties are required to report information at the same level of detail as for the 16 IOTC species (Resolution 10/02). Nevertheless, many IOTC Members and Cooperating non-Contracting Parties (CPCs) fail to submit complete, accurate and timely shark catch records. The lack of appropriate reporting of catch and effort data by some deep-freezing longline fisheries is highlighted in Appendix VIII of the 2012 WPEB final report. As the ROP has 100% observer coverage across transhipments occurring on the high seas, the data collected by observers on carrier vessels can provide another information source on the extent of shark fishing by longline vessels in the Indian Ocean. A preliminary analysis of this information is summarised below.

Total transhipped products

Between January 2009 and December 2012[2], the ROP monitored a total of 18,455 transhipments from LSTLVs of which 1379 involved sharks or shark products. The quantity of products transhipped in the northwest has declined over time, as the location of transhipments has contracted with the highest concentration of products transhipped increasingly in the central Indian Ocean. Another substantial cluster of transhipments occurs along the edge of the South African EEZ and runs east to west (Figure 1). The transhipment data do not reflect the precise location where the catches were taken, but are indicative of the general area of capture as the carrier vessels undertake most of the movement. Data were aggregated in 5 x 5 degree squares so while it appears that some transhipments took place inside EEZs, this programme is only tasked to monitor high seas transhipments so all of the positions mapped are located outside the EEZ boundaries. Observers also record whether at-sea transhipments take place within an EEZ (but do not collect further information on this) but to date there have been none.

[2] As reporting to the Secretary takes place on 15th September, the data available for 2013 were not included.

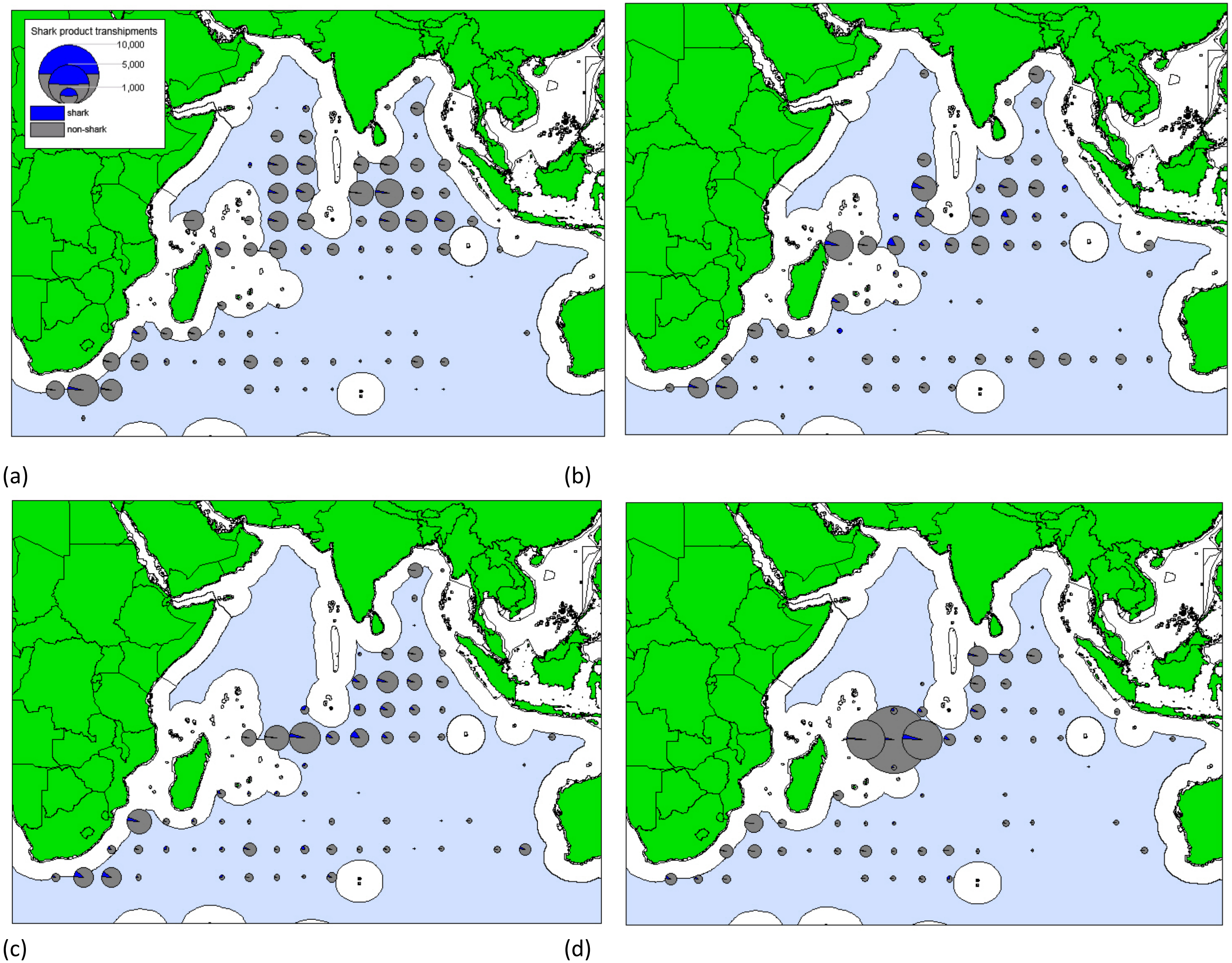


Figure 1. Location of transhipments of shark and non-shark products (by weight) transhipped by year: (a) 2009, (b) 2010, (c) 2011 and (d) 2012.

The total quantity of products transhipped between 2009 and 2012 has ranged between 36,000t and 60,000t, while the quantity of shark products transhipped has ranged between 1600t and 2400t. Shark represented 4.62% of the total weight of all products and 3.42% of the total number of products transhipped (Table 1). This is lower than the estimated 20–40% of catches by deep-freezing tuna longliners (WPEB, 2012), but the same issues with the paucity of information of levels of discarding occur here as with other methods of reporting and the differences in types of products transhipped is another complicating factor.

Table 1. Proportion of total transhipped products formed of shark species

	2009	2010	2011	2012	Total
By weight	3%	6.14%	6.36%	3.74%	4.62%
By number	2.38%	3.75%	4.58%	3.38%	3.42%

While there are only four complete years to compare, results indicate there was a decrease in total quantity of products transhipped in 2010 and 2011, followed by an increase in 2012. During the same time period, the total quantity of shark products showed the opposite trend, with an increased amount transhipped

during 2010 and 2011 (

Figure *2*). It is interesting to compare this trend with Figure 3 which shows longline effort in the Indian Ocean between 2009 and 2012. This figure highlights the lack of fishing effort in the western Indian Ocean during 2010 and 2011, possibly due to the displacement of fishing effort by longliners caused by the threat of piracy (WPTT, 2012), corresponding to the period with higher quantities of shark products transhipped.

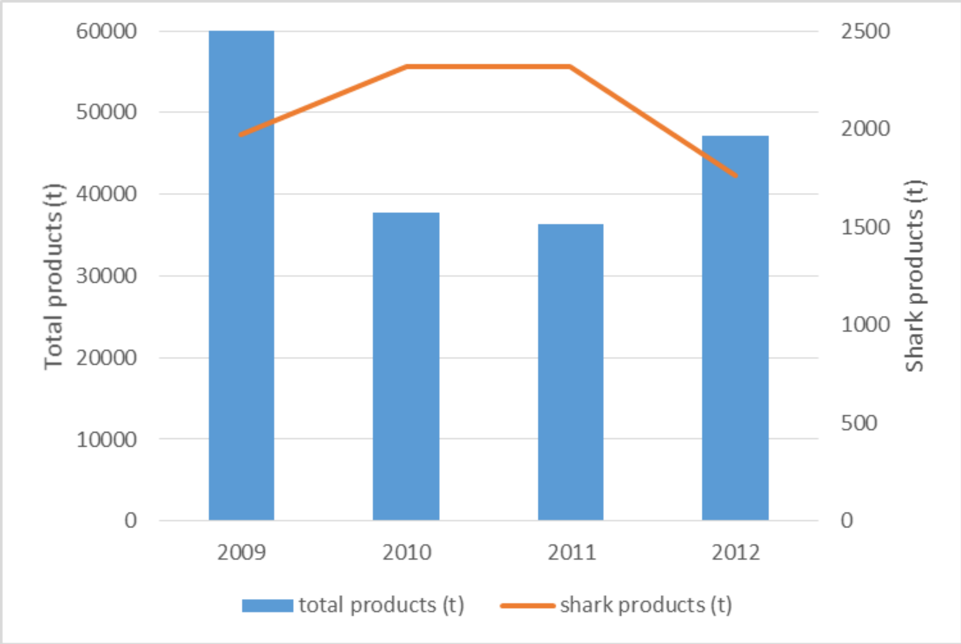


Figure 2. Total quantities of all products and shark products transhipped between 2009 and 2012.

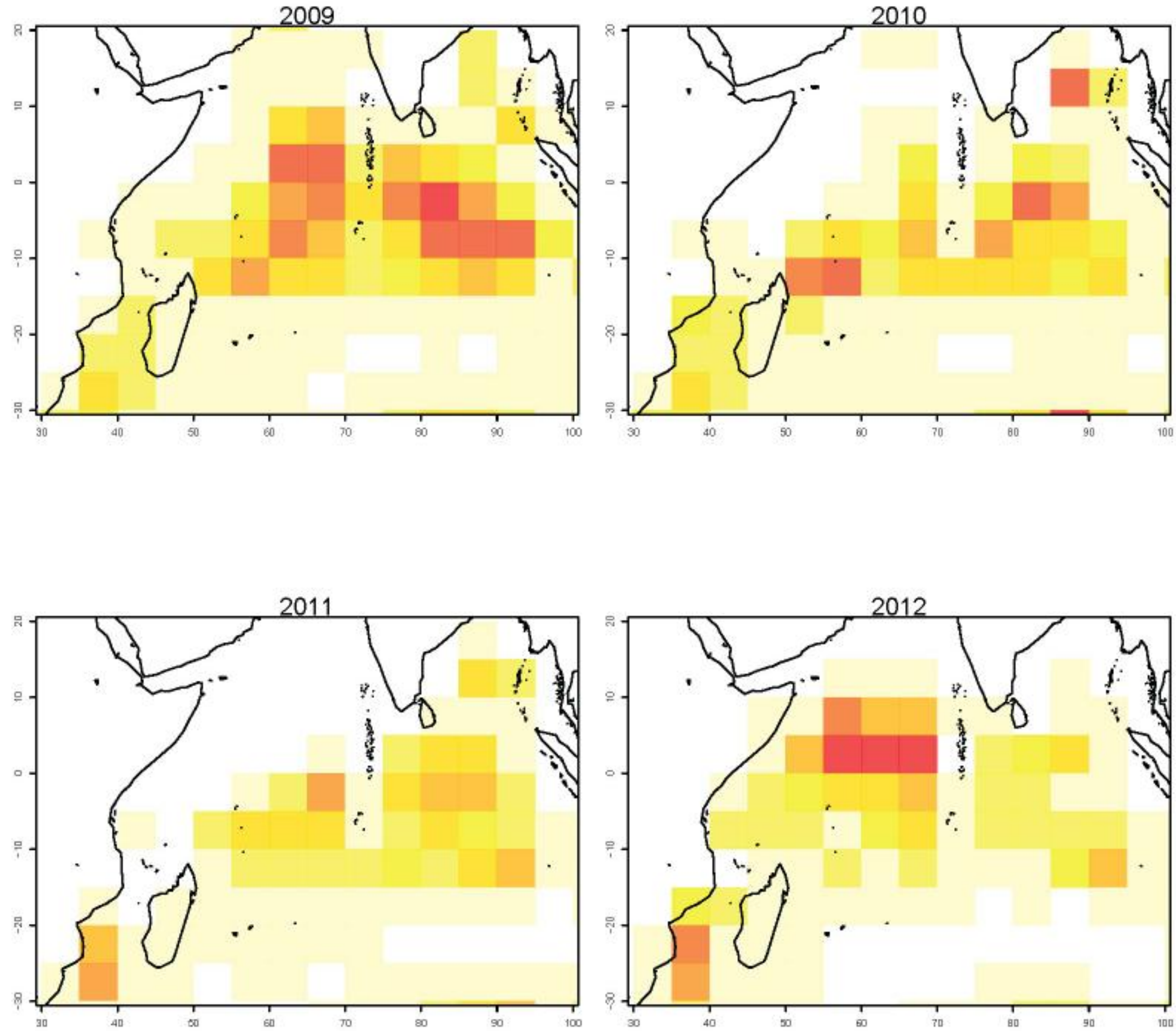


Figure 3. Longline fishing effort[3] (red = 9-10 million hooks and white = 0 hooks) in the Indian Ocean between 2009 and 2012

[3] Not using records in 'FDAYS' or the fresh longline fleet

Transhipment product types

Industrial longline catches are generally processed on-board before freezing. The following is a list of the IOTC-recognized product-type codes for the observer transhipment programme (IOTC, 2012), with descriptions:

- **GG**: Gilled & Gutted (heads usually attached)
- **DR**: Dressed (gilled, gutted, part or all of head off, fins off)
- **RD**: Rounded (fins may be off, though trunk not dressed/processed at all; whole)
- **FL**: Fillet (completely dressed fish, parted into fillets)
- **BM**: Belly Meat (a partial product; may be transhipped in sacks)
- **OT**: Other (any other unclassified product types)
- **NR**: Number (when the product type is un-observable and can only be tallied)
- **SF**: Shark fins (a partial product usually shipped in bundles)
- **HO**: Head Off (similar to dressed, but the head is always removed)

The most common product type in terms of total numbers was dressed weight (57% of products) and dressed weight with the head removed (18% of products). Shark fins formed a very small proportion of the number of products transhipped (<3%), as observers count the sacks shark fins are transhipped in as bundles rather than individual fins.

To investigate how these shark product transhipments relate to quantities of sharks caught, conversion factors were applied to the various products types and species as detailed in Table 2. Conversion factors were applied by product type and species where information was available. The majority of studies on fin total body weight ratios are based on wet fin weight[4] (Table 3), however, shark fins were all transhipped as dried product. Therefore dried weights were converted to wet weights based on the relationship estimated by Rose et al. (2001) and subsequently converted to round weights based on the fin weight to rounded weight ratio described for Chinese longliners in Eastern Pacific Ocean (Table 4). This was aggregated for all species as the ratios are not particularly variable by species or size (Ariz et al., 2008). At 5.35%, this ratio was the lowest of all found in the literature and so provides a conservative estimate, based on the maximum quantity of rounded catch weight expected.

Table 2. Conversion factors for the various product types

Product type	Conversion to round weight (wet weight of whole fish) (RD)
GG, DR, HO, NR, OT	*Prionace glauca* (BSH): Round weight (RD) = Dressed weight (DR) * 2.4074 (Ramos-Cartelle et al., 2009 & Mejuto et al., 2009). *Isurus oxyrinchus (*SMA): Round weight (RD) = Dressed weight (DR) * 1.4541 (Mejuto et al., 2002). Other pelagic sharks (other SHK): Round weight (RD) = Dressed weight (DR) * 1.4 (except for species of Carcharhinidae: Round weight (RD) = Dressed weight (DR) * 2.0). (Ramos-Cartelle et al., 2009 & Mejuto et al., 2009).
FL	Live weight = shark fillet weight*2.4 (FAO)
BM	Cuts of belly meat are usually taken in addition to other products, so these were given zero weighting.
SF	Dry/wet fin ratio 44% (Rose et al., 2001)

[4] Although one study on dried fin weight was found cited by Hareide et al., (2007)

Table 3. Fin weight (FW) to round weight (RW)[5] ratios for the blue shark (*Prionace glauca*)

Fishery	**Sample size (n)**	**Mean ratio**	**Fin weight definition**	**Source**
Portuguese longline swordfish fishery Oct 2003 –May 2004	99	FW:RW 6.6%	Wet fin weight of all fins (1st and 2nd dorsal, both pectorals, anal, pelvic and entire caudal)	Neves dos Santos & Garcia (2005)
Spanish surface longline fishery	184	FW:RW 6.53%	Wet fin weight. Not clear exactly which fins are used. First dorsal, both pectoral and caudal fins at the least but in some cases other fins (e.g. pelvic) are included	Mejuto and García - Cortés (2004)
Chinese longliners, Eastern Pacific Ocean	16	FW:RW 5.35%	First dorsal fin, both pectorals and caudal fin (assume entire caudal fin). No indication whether wet or dry fin weight, but probably wet.	Dai, Xu & Sonng 2006) as cited in Hindmarsh (2007)
Spanish surface longliners, Indian Ocean	1360	FW:RW 5.7%	Wet fin weight	Ariz et al., 2008
Portuguese longline fishery targeting swordfish, SW Indian Ocean May-Sep 2011	447	FW:RW 6.02%	Wet weight of the fin set	Santos et al., 2011
US	28	FW:RW 0.6%	Dry fin weight	Casey, NMFS/NEFSC 1992 in Hareide et al., 2007.

In terms of numbers of product transhipped, the majority are dressed, some with the head removed. The relative numbers of different product types have not varied much over time, however, when the estimated round weight of sharks that are transhipped is analysed, it appears that since 2010, the dominant processing method has been finning (Figure 4). With the exception of 2009 and the particularly low levels of finned products transhipped in that year, the similarity in product types means that changes in the quantity of products transhipped are likely to reflect real changes in catches (of transhipping vessels), rather than simply reflecting changes in the dominant processing methods used over time.

[5] Generally unprocessed, although this is not specified in all studies.

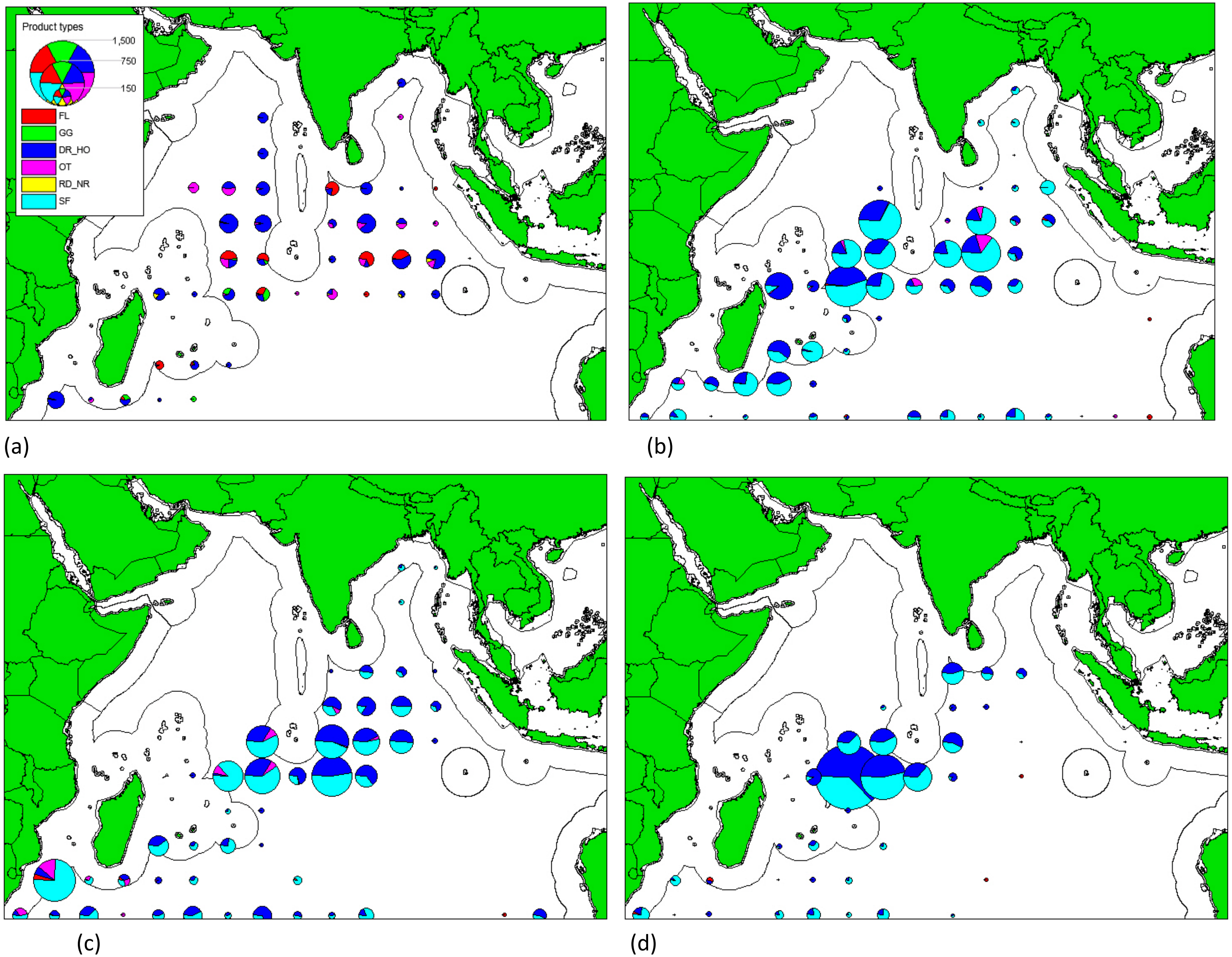
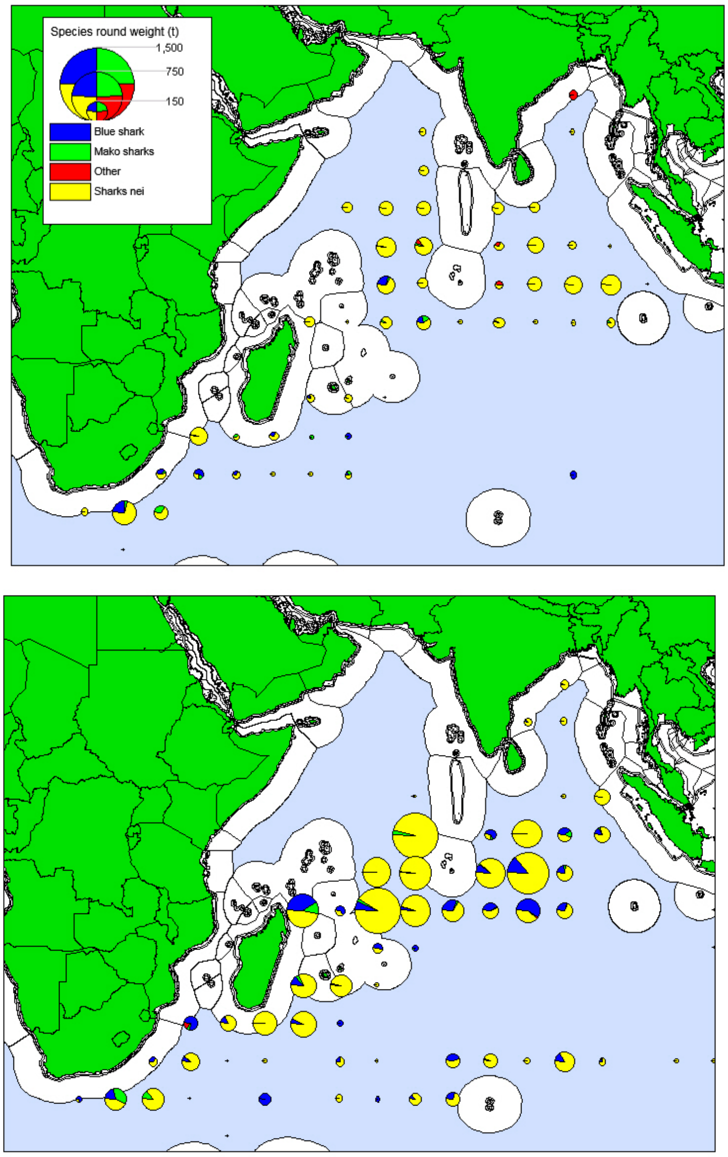


Figure 4. Estimated shark round weight transhipped by product type (round weight) (a) 2009, (b) 2010), (c) 2011 and (d) 2012

Species composition of transhipped products

Observers identified sharks by their taxonomic grouping during some transhipments, however, many records were not identified to species level and so many were simply labelled under the groups 'various sharks nei'. This group formed the vast majority of the number of shark products transhipped (60%). This was closely followed by another very broad grouping of 'pelagic sharks nei' (20%). The most common transhipped species identified was the blue shark (*Prionace glauca*) (16%), followed by mako sharks (*Isurus spp.*) (3%)



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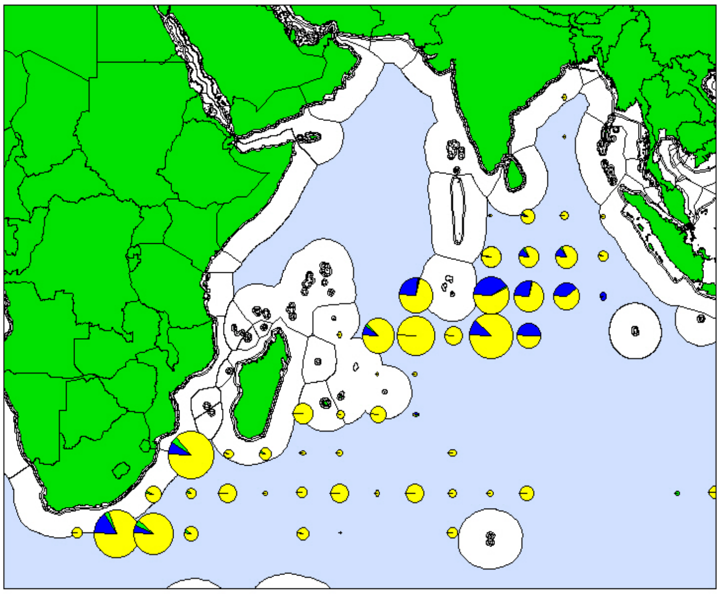
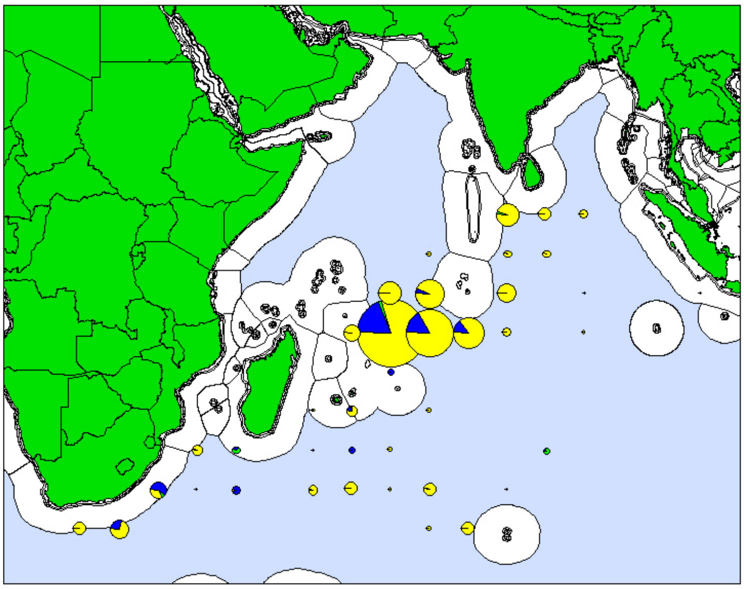




(c) (d)

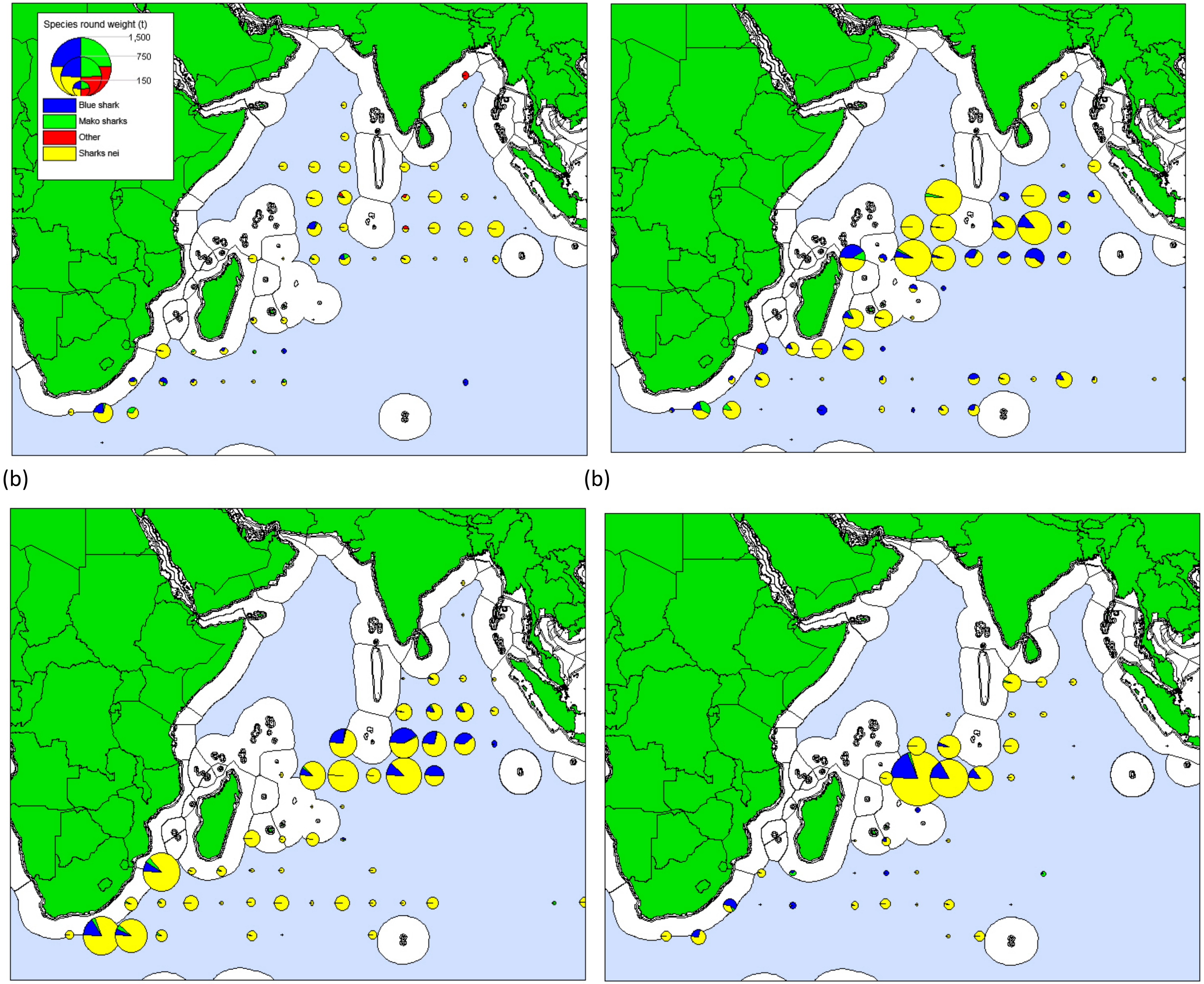
Figure 5). Other species identified included basking sharks (*Cetorhinus maximus)*, dogfish sharks (Squalidae), oceanic whitetip sharks (*Carcharhinus longimanus)*, hammerhead sharks (Sphyrnidae), copper sharks (*Carcharhinus brachyurus*) and tiger sharks *(Galeocerdo cuvier)* all forming a much lower proportion of products transhipped (<1%), although some of the species identifications are likely to be erroneous (Table 4).

There were no clear differences apparent in the type of processing method used for different species. Those species for which there was a substantial amount of data available (blue shark and mako sharks), had each been processed into a range of product types suggesting that changes in species composition are likely to reflect real changes in the species transhipped rather than simply changes in processing methods used. Nevertheless, there are some product types which are particularly difficult to obtain species-specific information from, such as dried fins and belly meat and so where these are higher there is likely to be an increased proportion of unidentified species.

Table 4. Number of shark products and estimated shark round weight transhipped by species group

Species (group)	Coastal/pelagic	Total estimated round weight (t)	Total number of products
Various sharks nei	-	14,073.6	185,880
Pelagic Sharks nei	Pelagic	5120.7	61,154
Blue sharks (*Prionace glauca*)	Pelagic	3114.0	48,492
Mako sharks[6] (*Isurus paucus & Isurus oxyrinchus)*	Pelagic	589.0	10,192
Oceanic whitetip shark (*Carcharhinus longimanus)*	Pelagic	8.01	97
Hammerhead sharks (Sphyrnidae)	Coastal/semi-pelagic	3.9	266
Tiger shark *(Galeocerdo cuvier)*	Coastal/semi-pelagic	0.8	9
Basking sharks[7] (*Cetorhinus maximus)*	Pelagic	61.0	1,825
Copper shark/ bronze whaler/ narrowtooth shark[8] (*Carcharhinus brachyurus)*	Coastal	2.7	89
Dogfish sharks[9] (Squalidae)	Coastal	13.1	303
Total		**22,987.8**	**308,307**

[6] Longfin and shortfin makos were combined as very few were identified to species level.
[7] Potential observer error.
[8] Identified only at one deployment as dressed weight, so may be an observer error.
[9] Identified at only one deployment so may be an error.



(b) (b)

(c) (d)

Figure 5. Round weight of transhipped products by species (a) 2009 (b) 2010 (c) 2011 (d) 2012

Discussion and conclusions

Noting that the WPEB08 agreed on the need for a major data mining exercise, this paper suggests that transhipment data might provide a potentially useful source of useful information on the catch of sharks by longliners. As catches of sharks recorded in the IOTC database for the longline fleet are thought to be very incomplete (WPEB, 2012), these data can prove a useful additional source of information.

The main species transhipped were the blue shark (*Prionace glauca*) and mako sharks (*Isurus spp.*), however, many sharks were not identified to species level. Misidentification of shark species is also likely to be common as distinguishing between shark species is not always possible due to the variety of processing techniques used. The identification of species is usually compromised by the way in which different species are processed as identification keys usually refer to unprocessed specimens. Species identification of frozen fish (of various product types) will always be limited as compared to freshly caught, pre-dressed fish. The variable nature by which product is transhipped from one transhipment operation to another and even within a single transhipment operation can have significant influence on observers' methodology and in the ultimate effectiveness of successfully identifying and tallying transhipped product. Nevertheless, for these data to be more useful, improved taxonomic identification of sharks is needed. Prior experience working with pelagic (tuna and/or swordfish) longline fisheries and increased transhipment observer experience will greatly help the observers' species identification skills and tallying of product. LSTLVs can also assist by giving more detail in the transhipment declaration on the species of shark products transhipped, as currently records are only labelled 'sharks' as no further details are specified in Resolution 11/05. It is recommended that the most common species of shark are identified, where possible, consistent with Resolution 10/02.

While the converted weights provide a substantially better estimate of total catches compared with the total product weight of transhipments, they are still not very precise. Conversion factors are quite variable among product types, processors, species and sizes of fish (Miyake et al., 2010). The fin to body weight relationship is highly variable depending on species, type of cut/cutting method used and degree of drying of the shark and assumptions made on the dried to wet weight ratio are also highly variable (Fong and Anderson, 2002). Carcasses may be transhipped at one time while the fins of those sharks are transhipped later once they are dry, or they may be transhipped simultaneously so there is often no way of relating the fins to their carcass. There are also issues with some vessels shipping together and transferring different products from the same sharks, or fins being left to dry longer which the carcasses are transhipped.

The different criteria used by the various fleets for removing fins, processing the fish, drying fins on board, and retaining only some or different parts of fins explain the considerable differences in ratios obtained for a single species (Ariz et al, 2008). This makes application of a single conversion factor difficult without full knowledge of the methods used by each fleet. For less common methods of processing such as onboard filleting, there is less literature available. Estimates on conversion factors from product to fillets were highly variable, ranging from 41% to 61% (Rose et al., 2000; FAO). Ideally, conversion factors would be developed by fleet, species and product type. Nevertheless, the standardised weights allow a better comparison of the total shark quantity caught and transhipped than using only product information.

Another issues associated with the data are that these data are only for longline vessels which tranship shark products. The annual total catches of pelagic sharks recorded per year across the Indian Ocean are currently in the range of 50,000-60,000t (WPEB, 2012). The total quantity of shark products transhipped (5,747t annual average standardised round weight) therefore represents approximately 10% of the total pelagic shark catch. Transhipment also takes place in ports, namely Port Louis, Mauritius, for deep-freezing longline vessels. Use of this information together is likely to provide a more complete picture and reduce the bias associated with only observing at-sea-transhipments.

While these data are only provided at a 5° by 5° spatial scale, a finer level of resolution would not necessarily be much more useful as the location is only an indication of where the catches were taken and where sharks might be most heavily fished. Nevertheless, when used alongside other data to provide context, transhipment data can provide a useful complementary source of information.

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