Data reporting challenges associated with spanning across the IOTC/ICCAT boundary: a case study of shortfin mako *Isurus oxyrinchus*

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Abstract

South Africa's geographical location is such that the IOTC/ICCAT boundary is incorporated in its EEZ at 20 degrees longitude, approximately offshore of Cape Agulhas. This offshore area is locally known as the Agulhas Bank; a renowned fishing bank that exhibits high productivity and diversity as a result of the temperate Atlantic and sub-tropical Indian Oceans meeting. As such, many large pelagic species aggregate on the Agulhas Bank attracting relatively high fishing pressure. This creates a number of RFMO reporting issues. It is common for species-specific catch data from South Africa to exhibit high inter-annual variability which is not an indication of performance but rather an artefact of 'criss-crossing' the RFMO boundary. For example, an increase of 87% in shortfin mako (*Isurus oxyrinchus*) catches was observed from 2015 to 2016 which can be attributed to the fishery straddling the IOTC/ICCAT boundary line. This was due to a minor movement eastward by the fishery resulting in a higher proportion of fish being caught in the IOTC region. Consequently, a significant increase catch statistics was observed, which was accompanied by a reciprocal decrease in catch in the ICCAT area of competence. This paper aims to highlight a number of RFMO data reporting issues that arise from fishing the IOTC/ICCAT boundary and to open dialogue amongst CPCs and the secretariat to address these issues to avoid emphasizing erroneous statistics that may be an artefact the current RFMO management boundary.

Keywords

RFMO boundary, data reporting, catch statistics, CPUE, mixed stock, observer programme

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Introduction

South Africa's geographic location is such that the IOTC/ICCAT boundary is incorporated in its EEZ at 20 degrees longitude, approximately offshore of Cape Agulhas. This offshore area is locally known as the Agulhas Bank; a renowned fishing bank that exhibits high productivity and diversity as a result of the temperate Atlantic and sub-tropical Indian Oceans meeting. As such, many large pelagic species aggregate on the Agulhas Bank attracting relatively high fishing pressure. A significant proportion of South Africa's Large Pelagic catch statistics can be attributed to this localised Agulhas Bank area, which includes a RFMO management boundary. This creates a number of RFMO reporting issues and catch data from fishing trips which straddle the IOTC/ICCAT boundary line may emphasize erroneous statistics that are an artefact of this management boundary.

While the jurisdiction boundary of the two regional fisheries management organisations (i.e. IOTC/ICCAT) remains a necessity, questions remain on how South African scientists should deal with this artificial boundary and the transient species and fishers that 'ignore' this boundary. The possibility of the movement of large pelagic species into both adjacent ocean basins may render the IOTC/ICCAT jurisdiction boundary inappropriate for stock assessment purposes. When a stock exceeds the political boundaries or the predicted range of the stock, and neighbouring stocks of the same species mix boundaries, important factors to consider are to what degree are the stocks mixing, are the mixed stocks reproductively isolated or not and how is the catch accounted for in each of the neighbouring stock assessments. Unfortunately, these considerations remain unanswered for a number of species.

This paper aims to highlight data reporting issues that arise from fishing the IOTC/ICCAT boundary and to open dialogue amongst CPCs and the secretariat to address these issues to avoid emphasizing erroneous statistics that may be an artefact the current RFMO management boundary. This is done using South African shortfin mako (*Isurus oxyrinchus*) catch data as a case study.

Data Description and Methods

South African shortfin mako catch data from the pelagic longline sector were interrogated for the period 2003 to 2016. The data were spatially aggregated into a 1 × 1 degree grid and subset according to RFMO area of competence. For the latter, IOTC data included all longline sets that started at longitude >20 degrees and ICCAT <20 degrees, according to RFMO reporting routine.

To investigate the influence that the 20 degree longitude RFMO boundary may have had on annual shortfin mako catches that South Africa reported to the IOTC, annual catches were re-estimated to include data for all longline sets that started at longitude >18 degrees. As such, a 'transition' boundary was created to accommodate the area of high shortfin mako catches which straddles the current 20 degree boundary (Figure 1). Catch statistics of shortfin mako derived by confining area to the true IOTC boundary (>20 degrees) were compared to those derived by extending the area to include the 'transition' boundary (>18 degrees). Catch statistics of shortfin mako for all CPCs in the IOTC area of competence were downloaded from the IOTC website (http://www.iotc.org/documents/nominal-catch-species-and-gear-vessel-flag-reporting-country) and the comparison describe above was repeated to illustrate the magnitude of South African shortfin mako catch as a proportion of the total catch in the IOTC area of competence.

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Results

The distribution of the annual shortfin mako catch by the South African pelagic longline sector straddles the 20 degree longitude IOTC/ICCAT boundary (Figure 1). However, the catch distribution is dynamic and high inter-annual variation has been observed. For example, the catch taken in the IOTC area as a proportion of total South African catch ranged from 37% to 61% and the standard deviation of annual catch data in the IOTC area was substantially larger than that for total South African catch (Table 1). Furthermore, in 2015 and 2016 the South African shortfin mako catch for the IOTC area was 290.6 and 543.6 tons, respectively. This is an increase of 87% between the two years, which is not a true reflection of the fisheries performance. Rather, the increase can be attributed to the fishery straddling the IOTC/ICCAT boundary line and a shift eastward by the stock from 2015 to 2016 resulted in a higher proportion of fish being caught in the IOTC region (Figure 2). This is accompanied by a reciprocal decrease in catch in the ICCAT area of competence.

The inclusion of data derived two degrees west of the RFMO boundary (longitude >18 degrees) had a considerable influence on catch statistics. By including this data, shortfin mako catch in 2015 increased from 286.7 to 722.5 tons (Table 2). This translated to the South African contribution to the total shortfin mako catch for the IOTC approximately doubling from 21.7% - 41.2% (Table 2).

The inclusion of the 'transition' boundary data also had an influence on shortfin mako catch trends (Figure 2). South African catch data, as currently reported to IOTC, exhibits a period of relative stable catch (200-300 tons) between 2012 and 2015, with a substantial increase to 867 tons in 2016. In contrast, the catch trend for data that includes the 'transition boundary' (>18 longitude) reveals a steady increase from 300 tons of shortfin mako in 2012 to 821 tons in 2016.

Discussion

The interrogation of shortfin mako catch data from the Agulhas Bank, a productive fishing area off Cape Agulhas that sits on the 20 degree RFMO boundary, has highlighted potential RFMO data reporting concerns. Specifically, the artificially high inter-annual variability and the potential for inconsistent catch trends associated with stocks that transition across the RFMO boundary. These may influence the outcome of stock assessments that include South African catch statistics. This is particularly true for shortfin mako as South Africa is a major contributor to total catch; approximately 32% of all reported catches in the IOTC area.

In 2017, an ICCAT assessment of shortfin mako estimated that the North Atlantic stock was both overfished (B_{2015}/B_{MSY}=0.63 to 0.85) and that overfishing was occurring (H_{2015}/H_{MSY}=1.93 to 3.58). Estimates for the South Atlantic assessment indicate that the stock was not overfished (B_{2015}/B_{MSY}=1.69 to 1.75) but that overfishing may be occurring (F_{2015}/F_{MSY}=0.86 to 1.07). South Africa accounts for the majority of reported shortfin mako in the IOTC area. Furthermore, the RFMO boundary bisects the preferred feeding ground for juveniles during winter and spring and potential nursery area, which is supported by high catch rates compared with fishing grounds further east (Foulis 2013, Groeneveld 2014). It is, therefore, important that South Africa makes every effort to provide meaningful data to ensure reliable estimates of shortfin mako stock status are attained. However, to fully understand the degree of mixing between Indian and Atlantic Ocean stocks, further tagging and genetic research in the area is required.

While this paper only examined the influence that the IOTC/ICCAT RFMO boundary had on catch statistics of shortfin mako, it is likely given observed movement patterns that similar circumstances occur for other species along this boundary. The perception that this problem is unique to South African fleets must be avoided, and foreign-flagged fleets that fish the RFMO management boundary in international waters must acknowledge the potential for bias in aggregating catch data either side of this boundary.

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Tables

Table 1. Annual catch statistics and associated standard deviations (SD) for total national catch and catch in the IOTC area of competence of shortfin mako (*Isurus oxyrinchus*) taken by the South African large pelagic longline sector for the period 2003-2016. The catch taken in the IOTC area is also expressed as a percentage of the total national catch to illustrate transient nature of the fisheries across the RFMO boundary, particularly from 2013 onwards.

Year	Total SMA catch by ZAF	SD of total SMA catch	Total SMA catch by ZAF in IOTC area	SD of SMA catch in the IOTC area	% of total SMA catch taken in IOTC area
2003	262.3	698.2	147.7	752.0	56.3
2004	644.3	982.8	543.1	1112.5	84.3
2005	678.0	819.2	566.5	875.8	83.5
2006	455.2	806.4	370.9	995.9	81.5
2007	538.6	685.1	355.9	694.1	66.1
2008	464.0	682.3	329.8	674.8	71.1
2009	462.5	564.2	316.1	614.6	68.3
2010	542.1	591.2	399.7	579.8	73.7
2011	626.6	606.9	424.0	594.3	67.7
2012	313.5	559.9	221.3	431.5	70.6
2013	481.4	681.5	304.4	712.2	63.2
2014	618.1	888.6	249.3	1012.0	40.3
2015	773.8	898.3	286.7	993.0	37.0
2016	867.5	1123.2	528.9	1415.6	61.0

Table 2. Annual catch statistics of shortfin mako (*Isurus oxyrinchus*) taken by the South African large pelagic longline sector for the period 2003-2016 within the IOTC area (Longitude >20 degrees) and for the extended 'transition' boundary (Longitude >18 degrees). These statistics are also expressed as a percentage of the total shortfin mako catch by all CPCs in the IOTC area of competence to illustrate the magnitude of South African catch.

Year	Annual SMA catch (mt) by ZAF in the IOTC area	% contribution by ZAF to total IOTC SMA catch	Annual SMA catch (mt) by ZAF (longitude >18)	% contribution by ZAF to total IOTC SMA catch (longitude > 18)
2003	147.7	9.3	236.9	14.2
2004	543.1	26.3	623.8	29.1
2005	566.5	23.6	657.9	26.4
2006	370.9	22.8	438.6	25.9
2007	355.9	26.2	506.5	33.6
2008	329.8	26.6	450.1	33.1
2009	316.1	34.0	437.3	41.7
2010	399.7	29.1	526.2	35.0
2011	424.0	30.0	609.6	38.1
2012	221.3	16.1	300.3	20.7
2013	304.4	20.2	448.3	27.1
2014	249.3	14.8	555.4	28.0
2015	286.7	21.7	722.5	41.2
2016	528.9	32.4	821.1	42.7

Figures

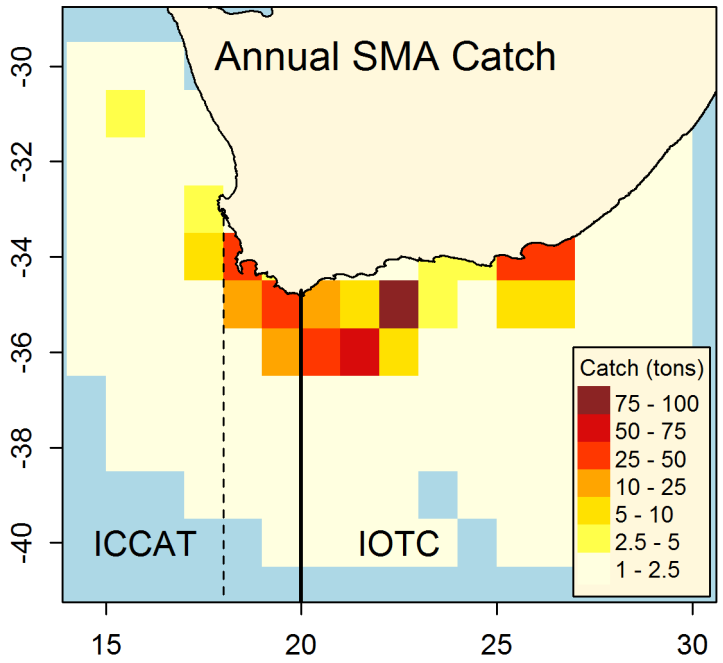

Figure 1. The average annual distribution of shortfin mako catches by the South African large pelagic longline sector for the period 2003-2016 aggregated into a 1 × 1 degree grid. The fishery straddles the 20 degree longitude IOTC/ICCAT boundary.

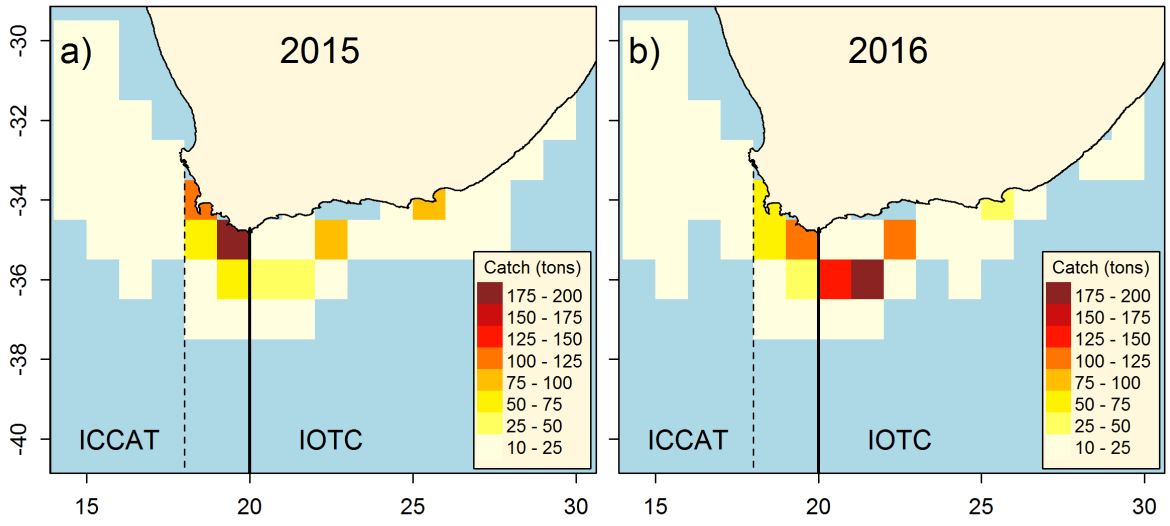

Figure 2. The distribution of shortfin mako catches by the South African large pelagic longline sector in (a) 2015 and (b) 2016 aggregated into a 1 × 1 degree grid. In 2015 the majority of catch was taken in the ICCAT area and a subsequent shift eastward resulted in the majority of catch being taken in the IOTC area in 2016. This spatial variability that transcends the RFMO boundary has a substantial influence on annual catch statistics reported to each RFMO.

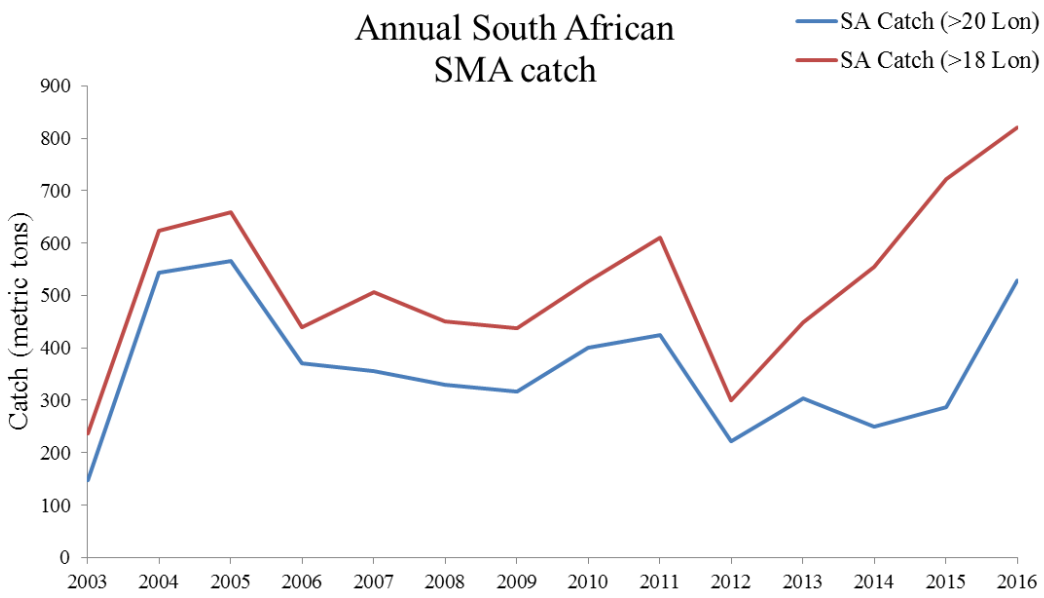

Figure 2. To investigate the influence that the 20 degree longitude RFMO boundary had on annual shortfin mako catches that South Africa reported to the IOTC annual catches were re-estimated to include data for all longline sets that started at longitude >18 degrees.