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NEW DATA ON THE RATIO BETWEEN FIN AND BODY WEIGHTS FOR SHARK SPECIES CAUGHT BY THE PORTUGUESE SURFACE LONGLINE FLEET

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RESUMEN

In past years there has been a debate regarding the ratios between fin and body weight for sharks. This debate has been particularly important in Europe where a 5% value was implemented by EC in 2003. Herein we report new data on the conversion rates for four pelagic shark species (BSH-Blue shark, Prionace glauca; FAL-Silky shark, Carcharhinus falciformis;OCS-Oceanic whitetip shark, Carcharhinus longimanus; SPZ-Smooth hammerhead shark, Sphyrna zygaena) caught in the equatorial area of the Atlantic Ocean (between 5ºN and 5ºS) by the Portuguese longliners targeting swordfish.

RÉSUMÉ

*Au cours des dernières années, un débat a eu lieu sur les ratios entre le poids des nageoires et le poids corporel des requins. Ce débat a été particulièrement important en Europe où une valeur de 5% a été mise en œuvre par la CE en 2003. Le présent document fournit de nouvelles données sur les taux de conversion pour quatre espèces de requins pélagiques (requin peau bleue (*Prionace glauca*), requin soyeux (*Carcharhinus falciformis*), requin océanique (*Carcharhinus longimanus*) et requin-marteau commun (*Sphyrna zygaena*)) capturés dans la zone équatoriale de l'océan Atlantique (entre 5ºN et 5ºS) par les palangriers portugais ciblant l'espadon.*

RESUMEN

Durante años pasados se ha producido un debate acerca de las ratios entre las aletas y el peso del cuerpo para los tiburones. Este debate ha sido especialmente importante en Europa donde la CE implementó en 2003 una cifra del 5%. En este documento se comunican nuevos datos acerca de las tasas de conversión de cuatro especies de tiburones pelágicos (BSH-tintorera, Prionace glauca, *FAL-tiburón jaquetón,* Carcharhinus falciformis, *OCS-jaquetón de ley,* Carcharhinus longimanus, *SPZ-pez martillo,* Sphyrna zygaena*) capturadas en la zona ecuatorial del océano Atlántico (entre 5ºN y 5ºS) por los palangreros portugueses que se dirigen al pez espada.*

KEYWORDS

Conversion factors, fins weight vs body weight, pelagic sharks, Equatorial area, Atlantic Ocean

1. Introduction

The most valuable parts of the majority of sharks species are their fins, which are considered a delicacy in Asian cuisine. Shark meat is less profitable, which results in a strong economic incentive to a practice called shark finning - cut off the fins and discard the carcass back into the sea. Such practice has caused considerable discussion worldwide, leading to the adoption of shark finning regulations in several fisheries. This is also the case in Europe, that in June 2003 adopted a Regulation (Council of the European Union) on the removal of shark fins on-board vessels, which was intended to prevent the practice of shark finning within the European fleet (one of the world's largest shark fishing entities). Such Regulation established that "in no case shall the theoretical weight of the fins exceed 5% of the live weight of shark catch" (Article 4.5(EC) No. 1185/2003).
As reported by Hareide *et al.* (2007), most finning regulations mandate a simple conversion factor between the weight of shark fins and the weight of the remainder of the body brought to the dock, verifying that all fins have

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As reported by Hareide *et al.* (2007), most finning regulations mandate a simple conversion factor between the weight of shark fins and the weight of the remainder of the body brought to the dock, verifying that all fins have a body to match, in an attempt to ensure that finning does not take place. Difficulties arise when conversion factors vary between fisheries, often because of different processing techniques, and the highest ratios drive the regulations. Discrepancies arise from keeping different numbers of fins from each carcass and/or cutting sharks differently when removing the fins so that more or less shark meat is left attached.

Portuguese catches of pelagic sharks are mostly due to the surface long-line fishery primarily targeting swordfish, where the blue shark is largely the most important by-catch species. In the beginning of the Portuguese swordfish fishery (1980s) pelagic sharks were not properly discriminated in the logbooks and/or in the catch statistics, but their fins were collected to be exported to Asian markets, while the remaining body parts were usually discarded back to the sea. However, this practice was left about 15 years ago, as a result of the increase in the global demand for shark products, which started in the late 1980s but mostly during the 1990s. Thus, landings and reports in the logbooks of pelagic sharks have increased, reflecting a change in marketing of these species and the increasing interest of the international markets by shark products.

As mentioned by Cortés and Neer (2006), from a management perspective, banning shark finning required establishing conversion factors between fin weight and dressed carcass weight to ensure that the landed fins correspond to the carcasses being landed and not to those of discarded sharks if fins are not landed still attached to the body. In recent years a number of authors have studied (Mejuto & Garcia-Cortés, 2004, 2008; Santos & Garcia, 2005; Cortés & Neer, 2006) and reviewed (Anon., 2006; Hareide *et al.* 2007) fin to body weight ratios for different pelagic sharks species, revealing different figures between species and fleets. The present study represents a further contribution to the knowledge on the ratios between fins and body weight for four pelagic shark species (BSH - Blue shark, *Prionace glauca*; FAL - Silky shark, *Carcharhinus falciformis*; OCS - Oceanic whitetip shark, *Carcharhinus longimanus*; SPZ - Smooth hammerhead shark, *Sphyrna zygaena*) caught by the Portuguese longline fleet in the Equatorial area (between 5ºN and 5ºS). To the authors' best knowledge, limited attention has been given to two of these species (belonging to the Genus *Carcharhinus*).

2. Materials and methods

The data reported in the present study was collected within the Portuguese observer program for the long-line mainland based fleet targeting swordfish, between February 2006 and August 2007. A total of 639 individuals of 4 pelagic shark species (BSH - Blue shark, *Prionace glauca*; FAL - Silky shark, *Carcharhinus falciformis*; OCS - Oceanic whitetip shark, *Carcharhinus longimanus*; SPZ - Smooth hammerhead shark, *Sphyrna zygaena*) were sampled. Sampled specimens were caught in the Equatorial area of the Atlantic Ocean (between 5ºN and 5ºS), corresponding to ICCAT fishing areas 96 and 97. Individual round and dressed wet weight was determined with a top loading digital balance to an accuracy of 0.5 kg. All fins (1^{st} and 2^{nd} dorsal, pectorals, annals, pelvics and caudal) from each specimen were weighted (wet weight), by means of a digital balance to an accuracy of 0.001 kg. Their extraction was done with a knife, following Portuguese fishermen current practice, near the base of each fin (see **Figure** 1).

As no significant differences were found between fin to body weight relationships obtained for the East and West areas, relationships were calculated for the combined data set too.

3. Results and discussion

The results obtained in the estimation of different body weights - fins weights relationships for the 4 pelagic shark species, along with several sample descriptive statistics, are given in **Tables 1 to 4**. The obtained plots are shown in **Figures 2 to 5**. It is worthy of note that the results presented herein might be used only on a preliminary basis, as they were obtained from a relatively small sample size. However, the determination coefficients are high for most cases, the exception being that for the blue shark on the Equatorial area of the Western Atlantic ($r^2 < 0.7$). On the other hand, no significant differences were observed between the ratios found for the East and West areas of study.

The mean FW/RW ratio for the different shark species was found to be between 4.64% (FAL) and 7.56% (OCS), while the mean FW/DW ratios found varied between 8.79% (SPZ) and 16.52% (OCS). For the blue shark the FW:RW result was slightly lower than those previously reported for the North Atlantic by Santos & Garcia (2005) and Mejuto & García-Cortés (2004), 6.56 and 6.53, respectively. Recently García-Cortés (2007) reported ratios for combined data for the Atlantic, Indian and Pacific Oceans with narrow ranges of 6.26%-6.31% and 6.47%-6.56%, depending on the type of datum and method used to calculate the averages. However, all these ratios are higher than the maximum allowed limit in EU of 5%. As regards to the FW/DW ratio the result obtained of 14.69% is similar to that reported by the latter authors, but considerably higher than in US fisheries, where a fin to carcass ratio of below 4% has been reported (in Hareide *et al*., 2007). For the smooth hammerhead shark, the results obtained of 5.77% and 8.79%, respectively for the FW:RW and FW:DW ratios, is similar to that reported by Mejuto & García-Cortés (2004) but considerably higher than that reported for the US fisheries. As regards to two species of the Genus *Carcharhinus*, the results found for the silky shark are much lower that those found for the oceanic whitetip shark, and in both cases below the values reported by Mejuto & García-Cortés (2004). However, the ratio of fin to body weight is not constant among the shark size range. One of the reasons for such variations can be fishermen procedures. Although all the observations were made on the same fishing vessel, from trip to trip there are some changes on the crew. In fact, some crew members trimmed slightly more off of the fins than others do.

The ratio most widely referred to in fisheries literature and used as the basis for several shark finning regulations is about 2% of fin to whole weight or 5% of fin to dressed and round weight (see review by Hareide *et al*. 2007). This has been the basis for the finning legislation in the USA and Canadian Regulations. Other figures are, however, quoted that give in a much higher fin ratio than the above, as is the case of studies regarding the Portuguese and Spanish fleets. As there is no reason to believe that the morphology of a shark species differs between the Northwest and the Northeast Atlantic, as observed in the present study, discrepancies in fin:body weight ratios can only arise from differences in the practices among the different fleets. This means that the different fleets are not using the same fins, the same parts of the fins, and/or the same dressing criteria.

In fact, it is relatively common practice for EU fleets to leave quantities of flesh attached to the base of the fins, as they wish to maximise fin weight (and hence, the price paid for the fins). On the other hand, it is increasing common the use of shark belly as bait. These contribute for heavier fins and a lighter carcass. Therefore, much higher fin:carcass ratios. According to Hareide *et al.* (2007), fin buyers subsequently trim excess flesh from the fins during preparation prior to export or sale to processors. The drawback of this practice for the fishermen is that fin quality and unit price is significantly reduced; tainting from the excess meat may even damage the valuable part of the fin. Merchants and importers in East Asia also pay lower prices for such fins (the value/kg of fins imported to Hong Kong, as reported by Hong Kong Customs, are lower for imports from Europe than elsewhere, including the USA).

The results presented herein, together with other studies on EU pelagic shark fisheries, reinforce the fact that the current EU regulation on fin ratio is not adjusted to the fleet practice and should be changed in accordance to scientific evidence. In fact, in order to comply with the current EU regulation, as shark carcasses are retained onboard, shark fins (the most valuable shark product) have to be discarded. In the case of the European fisheries, as previously suggested by the SCRS (ICCAT, 2006), if a combination of shark species were to be considered, the percentage would necessarily be very close to the values obtained for the blue shark because it is clearly the most prevalent species in the landings of the EU surface longline fleet. However, for compliance purposes, it could be more appropriate to use threshold values by species as blue shark, or groups of species, defined by means of their respective upper confidence limit values or other metrics.

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Table 1. Descriptive statistics and fin wet weight (FW) – round (RW) and dressed (DW) weight relationships parameters for the blue shark (*Prionace glauca*). N - sample size; RWT – round wet weight (kg); min - minimum; max - maximum; SD - standard deviation; SE - standard error; Equation refer to the linear regression: $FW = a + b$W, where a is the obtained constant, b is the slope, FW is the overall fins wet weight. CI - confidence interval.

Species (area)	*N*	*Mean FL (cm) (min-max)*	*Mean weight (kg) ± SD (min - max)*	*Mean Fin weight ± SD (min - max)*	*Equation*	*Determination coefficient (r^2)*	*SE of b (95% C.I. of b)*	*Mean % of fin weight ± SD (min - max)*
Prionace glauca (combined data)	191	200.4 ± 25.7 (150 – 272)	56.1 ± 24.9 (18.0 – 143.0)	3.321 ± 1.390 (1.051 - 8.501)	FW= 0.1475 + 0.0583 RW	0.959 (*P*<0.0001)	0.0006 (0.0572 - 0.0595)	6.14 ± 0.42 (5.22 – 7.44)
			23.2 ± 10.3 (7.5 – 59.6)		FW= 0.1412 + 0.1313 DW	0.955 (*P*<0.0001)	0.0016 (0.1380 - 0.1444)	14.69 ± 1.02 (12.53 – 17.88)
Prionace glauca (E Equatorial – 97)	167	201.5 ± 27.1 (150 - 272)	57.0 ± 26.4 (18.0 – 143.0)	3.377 ± 1.469 (1.051 – 8.501)	FW= 0.1587 + 0.0582 RW	0.962 (P<0.0001)	0.0006 (0.0570 – 0.0594)	6.15 ± 0.41 (5.37 – 7.44)
			23.6 ± 10.9 (7.5 – 59.6)		FW= 0.1451 + 0.1411 DW	0.969 (P<0.0001)	0.0016 (0.1379 - 0.1443)	14.84 ± 0.96 (12.53 – 17.88)
Prionace glauca (W Equatorial – 96)	24	192.8 ± 8.6 (175 - 205)	48.9 ± 7.4 (32.0 – 58.0)	2.935 ± 0.465 (2.119 – 3.831)	FW= 0.380 + 0.0522 RW	0.688 (P<0.0001)	0.0075 (0.0367 – 0.0678)	6.02 ± 0.54 (5.22 – 6.84)
			20.4 ± 3.1 (13.3 – 24.2)		FW= 0.379 + 0.1254 DW	0.689 (P<0.0001)	0.0180 (0.0881 - 0.1627)	14.45 ± 1.30 (12.53 – 16.41)

Table 2. Descriptive statistics and fin wet weight – round (RW) and dressed (DW) weight relationships parameters for the silky shark (*Carcharhinus falciformis*). N - sample size; RWT – round wet weight (kg); min - minimum; max - maximum; SD - standard deviation; SE - standard error; Equation refer to the linear regression: $FW = a + bW$, where a is the obtained constant, b is the slope, FW is the overall fins wet weight. CI - confidence interval.

Species (area)	*N*	*Mean FL (cm) (min-max)*	*Mean WT (kg) ± SD (min - max)*	*Mean Fin weight ± SD (min - max)*	*Equation*	*Determination coefficient (r^2)*	*SE of b (95% C.I. of b)*	*Mean % of fin weight ± SD (min - max)*
Carcharhinus falciformis (combined data)	175	159.4 ± 43.7 (65 – 221)	55.6 ± 38.7 (2.5 – 126.0)	2.582 ± 1.816 (0.142 - 5.998)	FW= -0.0146 + 0.0467 RW	0.968 (*P*<0.0001)	0.0004 (0.0459 - 0.0474)	4.64 ± 0.42 (3.62 – 6.48)
			29.3 ± 20.4 (1.3 – 66.3)		FW= -0.0094 + 0.0886 DW	0.967 (*P*<0.0001)	0.0008 (0.0870 - 0.0901)	8.90 ± 0.84 (6.99 – 12.31)
Carcharhinus falciformis (E Equatorial – 97)	93	156.9 ± 44.9 (65 - 219)	53.9 ± 38.9 (2.5 – 122.4)	2.487 ± 1.817 (0.142 – 1.817)	FW= -0.0169+ 0.0464 RW	0.968 (P<0.0001)	0.0005 (0.0454 – 0.0475)	4.61 ± 0.43 (3.81 – 6.48)
			27.9 ± 20.5 (1.3 – 64.4)		FW= 0.0268 + 0.0882 DW	0.967 (P<0.0001)	0.0010 (0.0862 - 0.0903)	8.98 ± 0.84 (7.05 – 12.31)
Carcharhinus falciformis (W Equatorial – 96)	82	162.1 ± 42.5 (67 – 221)	57.5 ± 38.6 (2.8 – 126.0)	2.684 ± 1.820 (0.159 – 5.998)	FW= -0.0108 + 0.0469 RW	0.959 (P<0.0001)	0.0005 (0.0458 – 0.0480)	4.67 ± 0.42 (3.62 – 5.72)
			30.8 ± 20.3 (1.5 – 66.3)		FW= -0.0580 + 0.0891 DW	0.956 (P<0.0001)	0.0011 (0.0868 - 0.0915)	8.73 ± 0.81 (6.99 – 10.87)

Table 3. Descriptive statistics and fin wet weight – round (RW) and dressed (DW) weight relationships parameters for the oceanic whitetip shark (*Carcharhinus longimanus*). N - sample size; RWT – round wet weight (kg); min - minimum; max - maximum; SD - standard deviation; SE - standard error; Equation refer to the linear regression: *FW* = *a* + *b*W, where *a* is the obtained constant, *b* is the slope, FW is the overall fins wet weight. CI - confidence interval.

Species (area)	*N*	*Mean FL (cm) (min-max)*	*Mean WT (kg) ± SD (min - max)*	*Mean Fin weight ± SD (min - max)*	*Equation*	*Determination coefficient (r^2)*	*SE of b (95% C.I. of b)*	*Mean % of fin weight (± SD)*
Carcharhinus longimanus (combined data)	148	129.9 ± 26.1 (74 – 179)	27.2 ± 13.9 (3.5 – 68.0)	2.050 ± 1.050 (0.191 – 4.823)	FW= 0.0429 + 0.0739RW	0.943 (*P*<0.0001)	0.0012 (0.0715 - 0.0762)	7.56 ± 0.74 (5.46 – 9.60)
			12.7 ± 6.7 (1.1 – 32.0)		FW= 0.1133 + 0.1527DW	0.942 (*P*<0.0001)	0.0025 (0.1477 - 0.1577)	16.52 ± 1.74 (12.63 – 22.07)
Carcharhinus longimanus (E Equatorial – 97)	107	129.3 ± 26.2 (74 - 179)	26.7 ± 14.0 (3.5 – 68.0)	2.030 ± 1.066 (0.191 – 4.823)	FW= 0.0311 + 0.0747RW	0.945 (P<0.0001)	0.0014 (0.0720 – 0.0775)	7.58 ± 0.75 (5.46 – 9.60)
			12.5 ± 6.8 (1.1 – 32.0)		FW= 0.1091 + 0.1539DW	0.944 (P<0.0001)	0.0029 (7.107 - 7.635)	16.63 ± 1.75 (13.05 – 22.07)
Carcharhinus longimanus (W Equatorial – 96)	42	131.5 ± 26.3 (78 - 164)	28.3 ± 13.9 (78.0 – 164.0)	2.201 ± 1.019 (0.388 – 3.595)	FW= 0.0597 + 0.0722RW	0.942 (P<0.0001)	0.0023 (9.253 – 17.093)	7.49 ± 0.73 (5.72 – 8.98)
			13.2 ± 6.6 (2.1 – 24.0)		FW= 0.1123 + 0.1505DW	0.941 (P<0.0001)	0.0048 (0.1409 - 0.1602)	16.25 ± 1.70 (12.63 – 19.53)

Table 4. Descriptive statistics and fin wet weight – round (RW) and dressed (DW) weight relationships parameters for the smooth hammerhead shark (*Sphyrna zygaena*). N - sample size; RWT – round wet weight (kg); min - minimum; max - maximum; SD - standard deviation; SE - standard error; Equation refer to the linear regression: *FW* = *a* + *b*W, where *a* is the obtained constant, *b* is the slope, FW is the overall fins wet weight. CI - confidence interval.

Species (area)	*N*	*Mean FL (cm) (min-max)*	*Mean WT (kg) ± SD (min - max)*	*Mean Fin weight ± SD (min - max)*	*Equation*	*Determination coefficient (r^2)*	*SE of b (95% C.I. of b)*	*Mean % of fin weight (± SD)*
Sphyrna zygaena (E Equatorial – 97)	126	174.4 ± 29.0 (115 - 228)	60.6 ± 33.2 (12.8 – 163.5)	3.466 ± 1.831 (0.723 – 8.203)	FW= 0.1619 + 0.0545RW	0.975 (P<0.0001)	0.0008 (0.0529 – 0.0561)	5.77 ± 0.48 (4.49 – 7.25)
			40.0 ± 22.3 (7.8 – 110.0)		FW= 0.2179 + 0.0812DW	0.974 (P<0.0001)	0.0012 (0.0788 - 0.0834)	8.79 ± 0.76 (6.99 – 11.21)

Figure 1. Example of the cutting practice onboard Portuguese longliners: blue shark dressed trunk and respective fins (IPIMAR, 2007).

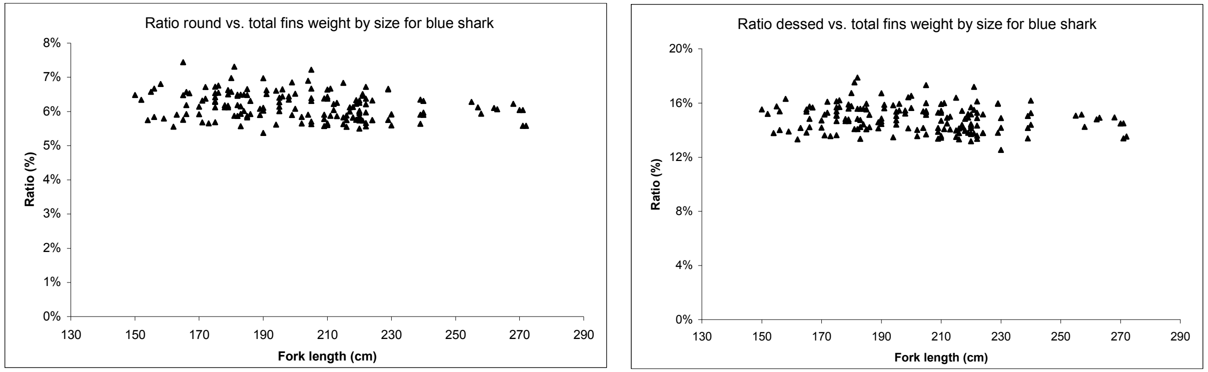

Figure 2. Plots of the individual body (round and dressed):fin weight ratios for *Prionace glauca* caught in the Equatorial area (between 5ºN and 5ºS) of the Atlantic Ocean (ICCAT areas 96 and 97).

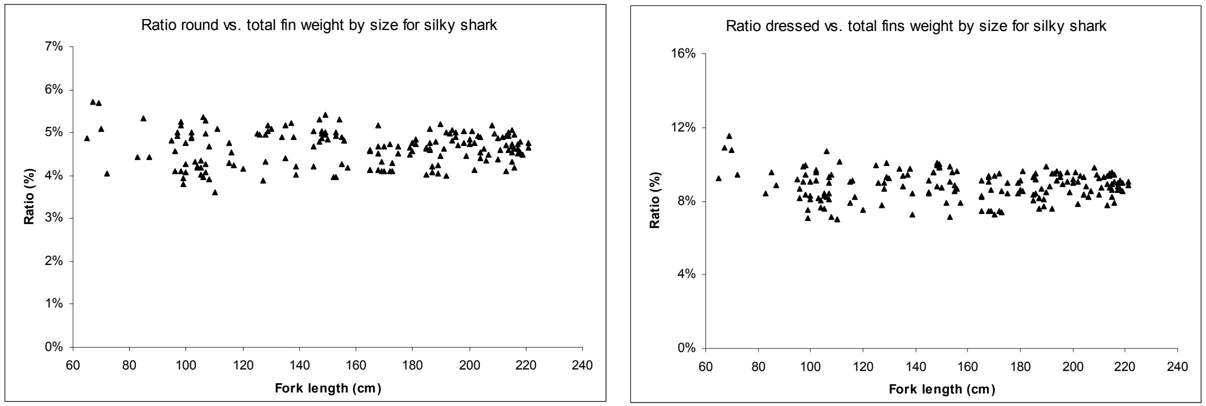

Figure 3. Plots of the individual body (round and dressed):fin weight ratios for *Carcharhinus falciformis* caught in the Equatorial area (between 5ºN and 5ºS) of the Atlantic Ocean (ICCAT areas 96 and 97).

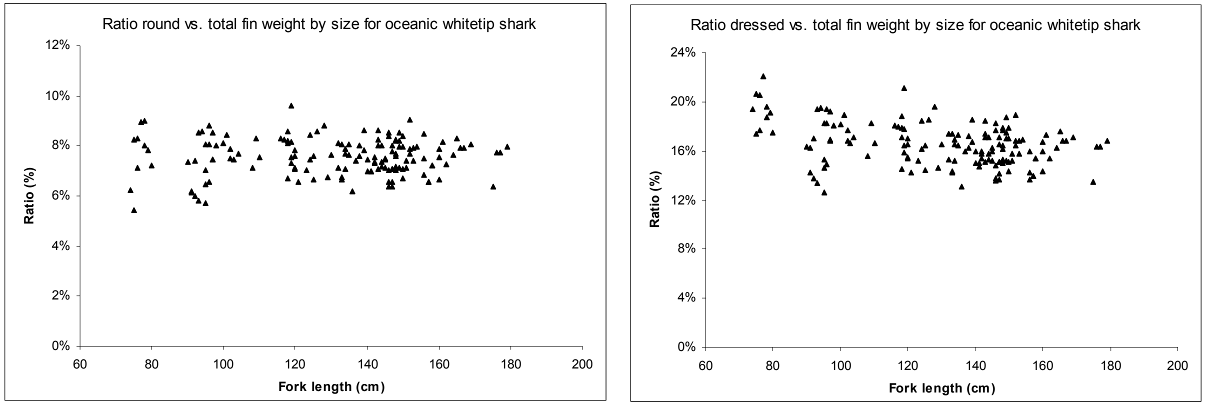

Figure 4. Plots of the individual body (round and dressed):fin weight ratios for *Carcharhinus longimanus* caught in the Equatorial area (between 5ºN and 5ºS) of the Atlantic Ocean (ICCAT areas 96 and 97).

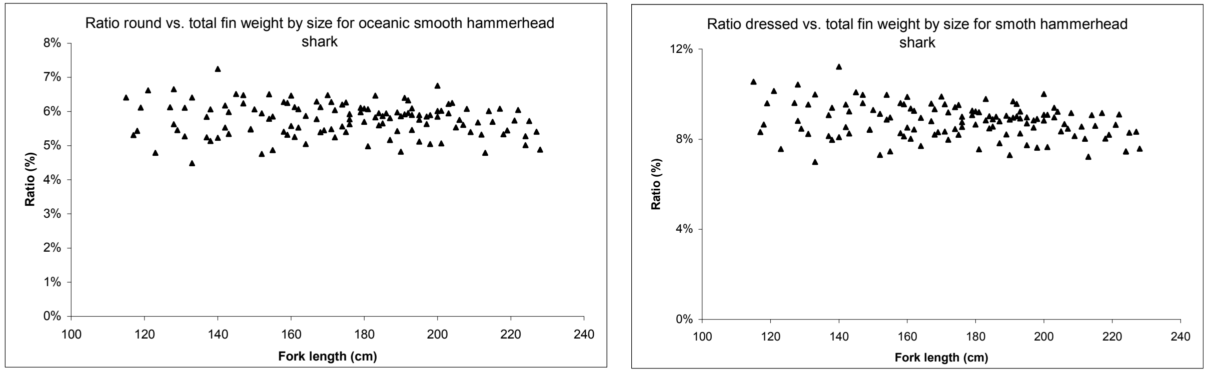

Figure 5. Plots of the individual body (round and dressed):fin weight ratios for *Sphyrna zygaena* caught in the Eastern Equatorial area (between 5ºN and 5ºS) of the Atlantic Ocean (ICCAT area 97).