# ENHANCED MONITORING OF LARGE PELAGIC FISHES CAUGHT BY THE VENEZUELAN ARTISANAL OFF-SHORE FLEET TARGETING TUNA AND TUNA-LIKE SPECIES IN THE CARIBBEAN SEA AND ADJACENT NORTHWESTERN ATLANTIC WATERS: AN UPDATE ANALYSIS

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*SUMMARY*

*At-sea and port sampling to monitor the Venezuelan artisanal off-shore (VAOS) fleet targeting tuna and tuna-like species using pelagic longline gear continued for the second year of a three year project funded by the Japanese Data & Management Improvement Program (JDMIP). Sampling continued in JuanGriego (Island of Margarita) and Morro de Puerto Santo in the northeastern mainland coast from March to December 2012. At-sea sampling consisted of 40 observed trips by 7 trained Captains, totaling 52 trips since the beginning of the Project. The total numbers of sets observed for all trips covered were 573 in which the number of hooks averaged about 2000 hooks/set. Most trips occurred in the southeastern Caribbean Sea in two clusters, one southwest of the Grenadine islands and the other around the 65°W line; another cluster occurred E-SE of Trinidad, but some trips moved off-shore operating off N-NE of Surinam. The overall main target species reported, measured and sexed included, 3433 sailfish (80-196 cm LJFL), and 425 white marlin (106-182 cm LJFL), 26 longbill spearfish (126-179 cm LJFL), 25 roundscale spearfish (128-170 cm LJFL), 13 blue marlin (127-291 cm LJFL), and 424 dolphinfish (50-156 cm FL). Secondary target species included catches of 254 silky sharks (FAL) which consisted mostly of small individuals (25-190 cm FL) and 33 scalloped hammerhead (SPL) sharks (48-175 cm FL), both species were the most common sharks caught. The tuna sample was mostly formed by 466 BLF (30-100 cm FL), 56 YFT (78-131 cm FL), and 29 BET (59-103 cm FL). Port sampling activities recorded landings from 61 vessels during the overall sampling period, all billfish and shark species were identified and length measures were recorded, all shark specimens were sexed.*

*RÉSUMÉ*

*L'échantillonnage en mer et au port afin d'effectuer un suivi de la flottille artisanale vénézuélienne (VAOS) ciblant en haute mer les thonidés et les espèces apparentées à la palangre pélagique s'est poursuivi pour la deuxième année d'un projet de trois ans financé par le Projet d'amélioration des données et de la gestion du Japon (JDMIP). L'échantillonnage s'est poursuivi à Juan Griego (île Margarita) et à Morro de Puerto Santo au Nord-Est de la côte de mars à décembre 2012. L'échantillonnage en mer s'est effectué dans le cadre de 40 sorties observées par sept capitaines formés, au total 52 sorties depuis le début du projet. Le nombre total d'opérations observées pour toutes les sorties couvertes s'est chiffré à 573, et le nombre d'hameçons s'est situé en moyenne à environ 2.000 hameçons/opération. La plupart des sorties sont survenues au Sud-Est de la mer des Caraïbes en deux groupes, un au Sud-Ouest des îles Grenadine et l'autre aux alentours de la ligne de 65ºW ; un autre groupe est survenu à l'E-SE de Trinidad, mais certaines sorties ont eu lieu au large, au N-NE du Suriname. Les principales espèces cibles déclarées, mesurées et dont on a identifié le sexe incluaient 3.433 voiliers (80-196 cm LJFL), 425 makaires blancs (106-182 cm LJFL), 26 makaires bécunes (126-179 cm LJFL), 25 makaires épées, (128-170 cm LJFL), 13 makaires bleus (127-291 cm LJFL) et 424 coryphènes communes (50-156 cm FL). Les espèces cibles secondaires comprenaient les prises de 254 requins soyeux (FAL) qui étaient principalement constitués de petits spécimens (25-190 cm FL) et de 33 requins-marteaux halicornes (SPL) (48-175 cm FL), ces deux espèces étant les requins les plus communément capturés. L'échantillon des thonidés a été essentiellement constitué de 466 thons à nageoires noires (30-100 cm FL), de 56 albacores (78-131 cm FL), et de 29 thons obèses (59-103 cm FL). Les activités d'échantillonnage au port ont consisté à consigner les débarquements de 61 navires pendant toute la période d'échantillonnage ; toutes les espèces d'istiophoridés et de requins ont été identifiées et les longueurs ont été enregistrées ; l'on a déterminé le sexe de tous les spécimens de requins.*

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*RESUMEN*

*Ha continuado por segundo año, de un proyecto de tres años financiado por el Programa de Japón para la mejora de la ordenación y los datos (JDMIP), el muestreo en puerto y en el mar para hacer un seguimiento de la flota artesanal de bajura venezolana (VAOS) dirigida a los túnidos y especies afines utilizando el palangre pelágico. El muestreo ha continuado en Juan Griego (Isla Margarita) y Morro de Puerto Santo en la costa nordeste del continente desde marzo hasta diciembre de 2012. El muestreo en el mar consistió en 40 mareas observadas por 7 capitanes entrenados, alcanzando un total de 52 mareas desde el inicio del proyecto. El número total de lances observados en todas las mareas cubiertas ha sido de 573, en los que el número medio de anzuelos era de 2000 anzuelos/lance. La mayoría de las mareas se realizaron en el Caribe sudoriental, en dos grupos, uno al sudoeste de las islas Granadinas y el otro en las cercanías de la línea de 65ºW. Otro grupo se produjo E-SE de Tinidad pero algunas mareas se trasladaron a alta mar, operando en N-NE de Surinam. Las principales especies objetivo comunicadas, incluida la medición y determinación del sexo fueron: 3433 peces vela (80-196 cm LJFL), 425 agujas blancas (106-182 cm LJFL), 26 agujas picudas (126-179 cm LJFL), 25 marlines peto (128-170 cm LJFL), 13 agujas azules (127-291 cm LJFL) y 424 dorados (50-156 cm FL). Las especies objetivo secundarias incluían capturas de 254 tiburones jaquetones (FAL), compuestas sobre todo por ejemplares pequeños (25-190 cm FL) y por 33 cornudas comunes (48-175 cm FL) que fueron las especies más comunes de tiburones capturadas. Los túnidos muestreados fueron sobre todo 466 BLF (30-100 cm FL), 56 YFT (78-131 cm FL) y 29 BET (59-103 cm FL). En el marco de las actividades de muestreo en puerto se muestrearon los desembarques de 61 buques durante el periodo de muestreo total, se identificaron todas las especies de tiburones e istiofóridos, se consignaron todas las mediciones de talla y se determinó el sexo de todos los ejemplares de tiburones.*

*KEYWORDS*

*Artisanal fishery, Pelagic longline,*
*Caribbean Sea, Venezuela, Billfish, Sharks, Tunas*

## Introduction

The Venezuelan small scale artisanal fleet that targets tuna and tuna-like species known as 'Flota Artesanal Costa-Afuera' (*i.e.*, Artisanal Off-shore fleet, VAOS fleet) by the National Fishery Agency (INSOPESCA), operates on the same fishing areas as the Venezuelan industrial tuna fleets (PS, BB, and LL) in the Caribbean Sea and adjacent Atlantic waters. As shown by Arocha et al. (2013), the VAOS fleet deploying pelagic longline gear is formed by vessels in the range of 11-18 m in length, mainly targeting dolphinfish (DOL) and billfishes (BIL), and tunas and sharks as secondary targets; in which the pelagic longline fishing operations of the fleet consists of fishing between 400 and 1040 hooks per set, normally using live sardine (*Sardinella aurita*) as bait. The dynamics of this fleet has made difficult a constant monitoring program, and the few studies available are from the mid 1990s (Marcano et al., 1995), which point out that most of the catch is landed without species identification, with the exception of the fishery directed at *Scomberomorus sp* (KGM/BRS) that is one of the oldest fisheries in Venezuela (Marcano *et al*., 1998).

Considering that the JDMIP is for data improvement to be submitted to ICCAT, a three-year project was developed to help Venezuela's Fishery Agency to fulfill the new ICCAT RECs that calls for CPCs to develop alternative scientific monitoring approach in fleets with vessels around 15 m, by implementing a reliable monitoring system for the VAOS fleet targeting tuna and tuna-like species that would be undertaken by the National Fishery Agency (INSOPESCA) once completed. The present document reports on the updated activities conducted since the beginning of the project in June-2011 through December 2012.

## Methods

The procedure developed to collect, process, and store the data from the VAOS fleet were detailed in Arocha *et* al. (2013) and consisted in at-sea and port sampling activities in two key communities where most of the vessels of this fleet targeting tuna and tuna-like species are based, Morro de Puerto Santo-Sucre in the mainland and JuanGriego, in Margarita Island (**Figure 1**).

The at-sea sampling activity continued to be based on self reporting by the same the trained Captains operating during the first year of the project. The validating procedure continued to be similar to the one implemented during the first year of the project, which consisted of debriefing the Captain upon arrival of the vessel to port, review the information recorded in the data forms, and confirm species identification with images provided by the Captain. Fishing effort in number of hooks per 1000 and catch rates (CPUE) based on the number of fish per 1000 hooks were examined spatially for every important group of species and presented in 1° square bins over the bathymetry of the fishing area.

Port sampling activities continued to be based on vessel availability to be sampled by project port samplers. Once a vessel was selected, the sampling process consisted of recording the fishing operations and sampling the landed catch for species identification and length measurements of billfish, tuna, and shark species.

All data collected is entered in an MSACCESS format and reported to ICCAT Secretariat every 6 months. Biological samples collected include tissue samples from istiophorid and shark species for genetic ID; shark jaws were collected for similar looking species for identification purposes; and gonads from sailfish are weighted for developing a gonad index.

## Results

### *At-sea sampling*

At-sea sampling activities involved 52 observed trips that were conducted from June 2011 through the end of the second year of the Project in December 2012 (**Table 1**). The sampling activities consisted of 1 scientific observer covered trip from JuanGriego (Margarita I.) in August 2011, and 51 Captain observed trips covered between November 2011 and December 2012. The spatial distribution of the observed sets is concentrated in four clusters within the fishing area, although the most southern one (off Surinam waters) is less dense than the rest (**Figure 1)**. During the second year of the project most of the observed trips were from the Captains based in Margarita Island, and only five observed trips were from the mainland community (Morro Pto. Santo) mostly due to the long *Scomberomorus sp* season in which most of the vessels from that community were involved.

A total of 573 sets have been observed and the data recorded, in which an average of about 2000 hooks/set were fished during the 52 trips. During these trips, a total of 23 species were identified, in which length measurements and sex identification were recorded. The total landed catch of all observed trips was represented by 68.2% DOL, followed by 21.5% SAI, and the remaining 10.3% was mainly represented by BLF (4.2%), WHM (2.6%) and FAL (1.4%) (see **Table 1**).

The landed catch from this fleet has been normally separated and reported as four gross commercial species groups which correspond to dolphinfish (mainly *Coryphaena hippurus*), billfishes (five species), tunas (five species), and sharks (5-9 species). However, there are some commercial variations in the reported catch in billfish, in which the reported catch is further separated into '*palagar*' (group four species) and '*aguja*' (=BUM). Tunas and sharks can also be further separated, in tunas the separation can be between '*albacora*' (=BLF), '*atún aleta amarilla*'(YFT) and '*atún ojo gordo*' (BET), but in sharks is mostly '*cazón*' (for all shark species), and occasionally '*tiburón*' (when is for large oceanic sharks like SMA). The information recorded from the 573 pelagic longline sets contributed to separate the catch composition from the commercial species groups into the catch composition by species, in which the catch composition by species was examined seasonally (**Table 2**). The results indicate that for the billfish species, there is a clear seasonality that differs among species; for the most common species caught, SAI, catches are high year-round but peak in the 2$^{nd}$ and 3$^{rd}$ quarter, while BUM, SPF, SPG are more common during the 1$^{st}$ quarter of the year, and WHM peaks during the 4$^{th}$ and 1$^{st}$ quarter. In tunas, the most common species (BLF), the catch is highest during the last two quarters of the year, and YFT appears to be more common during the first quarter. In shark, only 2 species stand out in the landed catch, FAL and SPL, in which FAL is more common during the 1$^{st}$ and 2$^{nd}$ quarter, while SPL is during the 4$^{th}$ quarter.

The spatial distribution of the fishing effort, expressed as total number of hooks, is presented in 1° square bins over the bathymetry of the fishing area (**Figure 2**). The results indicate that overall fishing effort was mostly concentrated in areas where the shelf break is more prominent, like in the Caribbean Sea around the 65°W line, and in the Atlantic around the shelf break off the Orinoco river delta (9°N, 59°W), but in general fishing effort was distributed throughout the fishing area. However, the spatial fishing effort varied seasonally, during the 1st quarter the fishing effort was concentrated off the Orinoco river delta in the Atlantic and SW of the Grenadine islands in the Caribbean Sea. In the 2nd quarter, the overall fishing effort was reduced but was concentrated off the Orinoco river delta in the Atlantic, and in the Caribbean SW of the Grenadine islands and west of the 65°W line. In the 3rd quarter, the fishing effort increased around the 65°W line in the Caribbean Sea, and off the Orinoco river delta and E of Trinidad in the Atlantic. Finally, during the 4th quarter the fishing effort increased across the Caribbean Sea and shifted south off the Orinoco river delta in the Atlantic.

The relative abundance or catch rate (CPUE) spatial distribution by species showed that in the case of the most relevant billfish species in the catches, sailfish (SAI) was distributed throughout the fishing area, white marlin (WHM) was present in 3 areas (around the 65°W line, SW of the Grenadine islands, and off the Orinoco river delta), while blue marlin (BUM) was more locally restricted to around the 65°W line in the Caribbean and along the shelf break off the Orinoco river delta in the Atlantic (**Figure 3**). Due to the highly migratory nature of the species, the spatial distribution of the catch rate in the billfish species changes seasonally, SAI was present throughout the year across the fishing area, but during the 2nd quarter SAI catch rates indicated that it was the most common of the billfishes across the fishing area. White marlin was common during the 1st and 4th quarters, catch rates were concentrated around the 65°W line in the Caribbean and off the Orinoco river delta in the Atlantic; during the 3rd quarter catch rates of WHM persisted around the 65°W line in the Caribbean. Blue marlin catch rates appeared more common off the Orinoco river delta in the Atlantic during the 1st, 3rd and 4th quarters and around the 65°W line in the Caribbean during the 1st, 2nd, and 4th quarters.

In tunas, the catch rate spatial distribution was marked by the predominance of blackfin tuna (BLF) in the Caribbean Sea, with high catch rates NE Margarita Island, while BET catch rates were observed off Suriman, and ALB were off the central coast of Venezuela in the Caribbean in areas where the shelf break is close to the coast (**Figure 4**). Catch rates for YFT were higher in Atlantic area, off Guyana and off the Orinoco river delta. Spatial catch rates showed seasonal variation between tuna species. ALB catch rates were only present during the 1st quarter of the year, while BLF catch rates were present throughout the year but with the highest catch rates during the 4th quarter in the Caribbean, and during the 1st quarter, south of the Grenadine islands and E-SE of Trinidad. The highest catch rates of BET were only observed during the 4th quarter off Surinam, while important YFT catch rates were only observed during the 1st quarter off the Orinoco river delta, but they were present in the rest of the year as well, but in smaller quantities.

The spatial distribution of shark catch rates revealed that silky sharks (FAL) are spread throughout the fishing area but show higher CPUEs in the Atlantic, off Guyana and the Orinoco river delta when compared to those observed in the Caribbean Sea (**Figure 5**). The second most important shark species, the smooth hammerhead shark (SPL), showed the highest CPUE north of Trinidad, but also important catch rates were present in the Atlantic along the shelf break of Trinidad, Venezuela and Guyana. Dusky sharks (DUS) showed high catch rates SE and SW of the Grenadine islands, but it was the only area where the species was caught and it was only during one trip. Blue shark (BSH) catch rates were very low and mostly observed in the Caribbean Sea over open and deep waters, and in the Atlantic side as well, where catch rates were only observed off E of Trinidad in open waters. Silky sharks catch rates were present throughout the year but in different areas that vary seasonally as shown by the spatial distribution of the catch rates. Smooth hammerhead showed important catch rates during all quarters except the 3rd when no SPL were caught. BSH was present during the first three quarters of the year, while DUS was only present in the 4th quarter, when the only trip that caught DUS took place.

The species sampled during the 52 observed trips were classified into target species, and secondary target species (**Table 3**). The main target species measured and sexed included 424 DOL ( $\bar{x}$ = 93.4 cm FL), 3433 SAI ( $\bar{x}$ =161.0 cm LJFL), 425 WHM ( $\bar{x}$ =151.0 cm LJFL), 26 SPF ( $\bar{x}$ =150.8 cm LJFL), 25 SPG ( $\bar{x}$ =139.9 cm LJFL) and 13 BUM ( $\bar{x}$ =184.9 cm LJFL). The secondary target species included sharks as well as tuna species. Among these, a total of 4 shark and one ray species were measured and sexed. Noteworthy were the catches of FAL which consisted mostly of small individuals ( $\bar{x}$ =70.0 cm FL) and SPL ( $\bar{x}$ =116.5 cm FL). The tuna sample was mostly formed by 466 BLF ( $\bar{x}$ =61.1 cm FL), followed by YFT, ALB, and BET (**Table 3**). As the number of size samples increased over the time period, the size frequency distributions (SFD) of the most relevant species in the catch appear with a more *normal*-like distribution (**Figure 6**). The SFD in SAI and WHM denotes the presence of small specimens (<140 cm LJFL) in the catch, and is more evident in the catch of WHM in which a second smaller mode (~135 cm LJFL) is observed for smaller fish. The SFD in FAL is skewed towards the

smaller individuals, where a *normal*-like distribution is observed for specimens of 50-90 cm FL followed by a small group of individuals of 100-125 cm FL, and few larger specimens (>140 cm FL). The SFD of BLF show a mode at 60 cm FL, thus the catch appeared to be formed largely by adult mature fish; although a small group of specimens <40 cm FL was present in the catch as well as some scattered large individuals (>80 cm FL). Finally, the SFD of DOL largely consisted of females between 50 and 115 cm FL.

The condition when the fish is brought on board continued to be recorded, the results indicated that the highest proportion of live specimens were among the shark species, in which the majority of the shark species were alive (90-100%) when hauled on deck, with exception of SPL the percentage alive dropped to 69.7%. In billfishes, the condition varied, 32.8% alive in SAI versus 69.1% in SPF; but in general for the rest of the billfish coming up alive was below 50%. While in tunas, the highest proportion alive (>70%) was in BET followed by YFT, but the number of fish was low compared to BLF, where the proportion of live fish was ~40%.

*Port sampling*

A total of 61 vessels fishing that at least made 1 set with longline gear indicated that they were targeting either DOL (54%), BIL (18%), TUN (6%), or KGM (6%) (**Table 5**). The days at sea per trip were from as low as 3 to as long as 22 days, while the number of longline sets deployed in a single trip varied between 1 and 20 sets. The very low number of sets deployed occurred when the target was KGM, and skippers shifted to longline gear at the end of the trip when 1-4 longline sets were deployed before reaching port. The majority of the trips recorded fished in section 6 (51%) located in the Atlantic side, followed by sections 2 (20%) and 1 (15%) located in the Caribbean Sea (**Figure 7**). Total longline catch of the sampled trips averaged 2,125.5 kg (catch range 152-5600 kg); in which total catch of commercial species-group by trip like DOL averaged 1,156.1 kg (catch range 75-4315 kg), SAI averaged 494.2 kg (catch range 20-1900 kg), BLF averaged 174.5 kg (catch range 42-1439 kg), and SHK averaged 67.8 kg (catch range 17-2120 kg) (**see Table 5**). When a trip targeted KGM, the catch could vary between 1293-4646 kg in a single trip.

A total of 1689 specimens were identified to species, measured, and sexed in the case of shark species during port sampling activities in Morro de Pto. Santo and Margarita Island. Most of the sampled species were gutted and headed (BIL and most SHK), others were only gutted (TUN, DOL). In the case of billfishes (SAI, WHM, BUM, SPF, SPG), measurements were based on pectoral fin – fork length (PFL) measurements and convert them later to LJFL (see ICCAT Manual); however, for *T. pfluegieri* (SPF) and *T. georgii* (SPG), length conversions are not available yet, but the project continues on its efforts to generate them for these species. In the case if some shark species (FAL, SVD, SPL), those that were headed and gutted, the only measurement possible was the dorsal trunk (TR, length from origin of the anterior part of first dorsal fin to the origin of the anterior part of second dorsal fin). At present the project continues on its effort to generate conversion of TR to FL from samples measured in the at-sea sampling activity.

The species commonly sampled (measured) during port activities continued to include SAI (1200), BLF (311), YFT (65), WHM (34), FAL (30), SPL (22), and BUM (26), mean size and range length of the most common species measured are presented in **Table 4;** SFD for the sampled catch of SAI and BLF (**Figure 8**) show a *normal*-like distribution with a mode at 166 cm LJFL in SAI and at 60 cm FL in BLF.

**Concluding remarks**

The information presented in this update contributes with new high resolution data as well as new knowledge on the operations, detailed effort, and species specific catch of probably one of the most important artisanal fleets in the Caribbean and adjacent Atlantic that targets species under the ICCAT convention as it was intended in the objectives of the 3 year JDMIP project. The data presented in this document has been submitted to the ICCAT Secretariat to be incorporated with the rest of ICCAT statistics.

Several information segments have been improved with the updated information presented, among them are: 1. The spatial distribution of the fishing areas of the VAOS fleet using longline gear; as the spatial data increases it seems clear that the fleet operates in four clearly defined areas, two in the Caribbean Sea and two in the Atlantic side. 2. The species composition of the reported catch for all observed trips through to December 2012, annually as well as seasonally, is an important step to separate the reported landed catch by commercial species groups into species specific catch which will enable the scientists to produce better estimates of target/bycatch species landings from the VAOS fleet deploying longline gear. 3. The spatial and temporal distribution of the fishing effort as well as the spatial and temporal distribution of catch rates for each of the most important ICCAT interested species caught by the fleet that will contribute in the understanding of the fleet interaction with its

target species in the area over space and time. 4. The size structure of the catch of the most relevant species has been increased, and offers information on the size groups that are more vulnerable to the fleet's operations. It is likely that the size structure may change in time and area, as it has been observed in the Venezuelan industrial pelagic longline fleet (Arocha & Marcano, 2008; Arocha *et al*., 2012), but the available data preclude further examination until more data is acquired. Finally, preliminary information revealed that the 41 trips covered from JuanGriego (Margarita I.) represented around 30% of the total trips reported by the fleet based in JuanGriego to the offices of INSOPESCA in that locality.

Advances during the third year of the project (January to June 2013) include the completion of 15 observed trips (with trained Captains), of the 10-15 initially planned for the whole YEAR 3, and port sampling activities continue as planned.

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**Table 1**. Total number of sets and hooks fished by trip, and number of fish by species sampled in observed at-sea sampling activities in the Venezuelan Artisanal Off-Shore (VAOS) fleet from July 2011 to December 2012.

| TRIP NUM. | SETS | HOOKS | ALB | BET | BLF | BSH | BUM | DOL | DUS | FAL | KGM | OCS | PLS | SAI | SKJ | SMA | SPF | SPG | SPL | SPM | SPZ | TIG | WAH | WHM | YFT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12 | 25080 | | 1 | | 1 | | 235 | | 1 | | | 6 | 71 | | | | | | | | | 1 | 22 | |
| 2 | 14 | 32000 | | | | | 2 | 99 | | 1 | | | | 53 | | | | | | | 1 | | | 17 | 28 |
| 3 | 12 | 16950 | | | 54 | | | 97 | 10 | | | | | 5 | | | | | | | | | | | |
| 4 | 10 | 18720 | | 9 | | | | 94 | | | | | | 35 | 1 | | | | 7 | | | 1 | | | |
| 5 | 10 | 24960 | | | | | | 450 | | 104 | | | | 111 | | | 1 | | 5 | | | | | | |
| 6 | 10 | 24975 | 22 | | 5 | | | 7 | | 5 | | | | 40 | | | | | | | | | | 29 | 2 |
| 7 | 10 | 13200 | | | 5 | | | 174 | | 1 | | | | 31 | | | | | | | | | | | |
| 8 | 14 | 45000 | | | | | 1 | 790 | | | | | | 77 | | | | | | | | | | 61 | 13 |
| 9 | 13 | 35100 | | | 59 | 1 | 1 | 373 | | 8 | | | | 53 | | | 3 | | 1 | 1 | | | | 3 | |
| 10 | 8 | 11475 | | | | | | 18 | | 1 | | | | 43 | | | | | | | | | | 8 | |
| 11 | 14 | 36660 | 1 | | | | 1 | 508 | | 37 | | | | 129 | | 1 | | | 5 | | | | | 7 | |
| 12 | 16 | 65520 | | 2 | | 2 | 4 | 545 | | | | 1 | | 96 | | | 6 | 24 | | | | | 1 | 16 | |
| 13 | 16 | 42300 | | | | | | 328 | | 2 | | | | 138 | | | | | 1 | | | | | 30 | 4 |
| 14 | 6 | 21840 | | 24 | | | | 41 | | 6 | | | | 95 | | | | | | | | 1 | | | |
| 15 | 11 | 10000 | | | | | | 60 | | | | | | 160 | | | | | | | | | | | |
| 16 | 8 | 12540 | | | 18 | | | 73 | | | | | | 41 | | | | | | | | | 1 | | |
| 17 | 11 | 23400 | | | | | | 247 | | | | | | 55 | | | 2 | | 1 | | | | | 6 | |
| 18 | 15 | 29250 | | | 1 | 2 | | 343 | | 1 | | | | 88 | | | | | 2 | | | | | 7 | |
| 19 | 12 | 28080 | | | | | | 265 | | 17 | | 1 | | 82 | | | 2 | 2 | 2 | | | | | | |
| 20 | 7 | 14250 | | | 2 | 1 | | 179 | | 4 | | | | 32 | | | | | | | | | | | |
| 21 | 13 | 28700 | | | 13 | 3 | | 178 | | | | | | 54 | | | 3 | | | | | | | | |
| 22 | 9 | 18000 | | | 8 | | | 221 | | 1 | | | | 31 | | | | | | | | | | | |
| 23 | 12 | 25740 | | | | | 1 | 228 | | 11 | | | | 62 | | | 2 | | | | | | | 1 | |
| 24 | 12 | 18000 | | | | | | 92 | | | | | | 89 | | | | | | | | | | | |
| 25 | 7 | 10920 | | | | | | 285 | | | | | | 45 | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 9 | 10332 | | | | | | 345 | | | | | | 71 | | | | | | | | | | | |
| 27 | 11 | 26010 | | | 2 | | | 191 | | | | | | 83 | | | | | | | | | 15 | | 5 |
| 28 | 8 | 17940 | | | | | 2 | 300 | | | | | | 83 | | | 2 | | | | | | | 2 | |
| 29 | 9 | 11970 | | | | | | 357 | | 1 | | | | 57 | | | | | | | | | | | |
| 30 | 11 | 17250 | | | 3 | | | 151 | | | | | | 80 | | | | | | | | | | | |
| 31 | 9 | 18750 | | | | | | 95 | | | | | | 65 | | | | | | | | | 12 | 1 | |
| 32 | 13 | 26796 | | | | | | 375 | | 4 | | 1 | | 82 | | | 2 | | | | | | | 1 | |
| 33 | 8 | 10080 | | | | | | 573 | | | | | | 66 | | | | | | | | | | | |
| 34 | 9 | 11970 | | | | | 1 | 583 | | | | | | 82 | | | | | | | | | | | |
| 35 | 13 | 30576 | | | 9 | | | 241 | | | | | | 80 | | | | | | | | | 17 | 3 | 1 |
| 36 | 10 | 21112 | | | | | | 60 | | | | | | 67 | | | | | | | | | | 7 | |
| 37 | 8 | 11648 | | | | | | 28 | | | | | | 53 | | | | | | | | | | | |
| 38 | 24 | 63336 | 1 | | 11 | | 1 | 599 | | | | | | 60 | | | | | | | | | 23 | 35 | |
| 39 | 11 | 20160 | | | | | 1 | 157 | | 1 | | 3 | | 82 | | | | | | | | | | | |
| 40 | 9 | 13104 | | | | | | 32 | | | | | | 58 | | | | | | | | | | | |
| 41 | 11 | 11760 | | | | | | 70 | | 4 | | | | 41 | | | | | | | | | 1 | | |
| 42 | 11 | 15400 | | | | | | 68 | | | | | | 81 | | | | | | | | | | | |
| 43 | 10 | 24752 | | | 3 | | | 264 | | | | | | 28 | | | | 1 | | | | | 7 | 19 | |
| 44 | 13 | 31304 | | | 15 | | | 293 | | | | | | 38 | | | | | | | | | 13 | 18 | |
| 45 | 10 | 17160 | | | | | | 109 | | | | | | 122 | 1 | | 1 | | | | | | | | |
| 46 | 12 | 26910 | 2 | | 1 | | | 34 | | | | | | 43 | | | | | | | | | 3 | 50 | |
| 47 | 7 | 18480 | | | 220 | | | 23 | | 4 | | | | 9 | | | | | | | | | | | |
| 48 | 10 | 14000 | | | | | | 40 | | | | | | 90 | | | | | | | | | | | |
| 49 | 13 | 28290 | 1 | | 1 | | | 38 | | | 1 | | | 51 | | | | | | | | | 1 | 81 | |
| 50 | 10 | 21000 | | | | | | 83 | | 4 | | | | 84 | | | | | 2 | | | | | 2 | |
| 51 | 14 | 19600 | | | | | | 58 | | | | | | 129 | | | | | | | | | | | |
| 52 | 8 | 23520 | | | 255 | | | 27 | | 3 | | | | 14 | | | | | | | | | 3 | | |

**Table 2.** Species composition of the reported catch for all observed trips combined from July 2011 to December 2012. The species composition is reported as percentage by commercial species group and by species for each commercial group; the species composition is expressed seasonally (by quarters) and for all months combined.

| | | Q1 | Q2 | Q3 | Q4 | Combined |
|---|---|---|---|---|---|---|
| Commercial Species groups | TUN | 2.5 | 1.7 | 0.4 | 18.9 | 4.9 |
| | BIL | 21.0 | 27.2 | 22.2 | 32.5 | 24.7 |
| | KGM/WAH | 0.0 | 0.2 | 0.9 | 1.0 | 0.5 |
| | DOL | 73.0 | 69.3 | 76.1 | 46.4 | 68.1 |
| | SHK | 3.4 | 1.6 | 0.4 | 1.2 | 1.8 |
| TUNAS | ALB | 17.4 | 0.0 | 0.0 | 0.7 | 3.4 |
| | BET | 1.5 | 47.1 | 4.8 | 1.5 | 4.6 |
| | YFT | 14.4 | 5.9 | 4.8 | 4.8 | 6.5 |
| | SKJ | 0.0 | 0.0 | 0.0 | 0.3 | 0.3 |
| | BLF | 66.7 | 47.1 | 90.5 | 92.6 | 85.3 |
| BILLFISH | BUM | 0.6 | 0.1 | 0.4 | 0.3 | 0.4 |
| | SAI | 81.1 | 98.6 | 93.5 | 81.2 | 87.9 |
| | SPF | 1.1 | 0.9 | 0.4 | 0.1 | 0.6 |
| | SPG | 2.2 | 0.2 | 0.1 | 0.0 | 0.7 |
| | WHM | 15.0 | 0.1 | 5.7 | 18.4 | 10.4 |
| SHARKS | BSH | 2.7 | 8.5 | 5.6 | 0.0 | 3.5 |
| | DUS | 0.0 | 0.0 | 0.0 | 27.0 | 3.5 |
| | FAL | 87.4 | 83.0 | 38.9 | 43.2 | 77.8 |
| | OCS | 0.5 | 2.1 | 22.2 | 0.0 | 2.1 |
| | PLS | 0.0 | 0.0 | 33.3 | 0.0 | 2.1 |
| | SMA | 0.5 | 0.0 | 0.0 | 0.0 | 0.4 |
| | SPL | 8.2 | 4.3 | 0.0 | 24.3 | 9.2 |
| | SPM | 0.5 | 0.0 | 0.0 | 0.0 | 0.4 |
| | SPZ | 0.0 | 0.0 | 0.0 | 2.7 | 0.4 |
| | TIG | 0.0 | 2.1 | 0.0 | 2.7 | 0.7 |

**Table 3.** Size of target species in at-sea sampling activities in the Venezuelan Artisanal Off-Shore (VAOS) fleet from July 2011 to December 2012. Billfish species length measurement is LJFL, shark, tunas and shark species is FL, with the exception of PLS, which is disk width (DW). [1] Denotes increase in sample size from Year 1.

| | | Species | Min. | *mean (cm)* | Max. (cm) | Numbers |
|---|---|---|---|---|---|---|
| TARGET | | DOL | 50 | *93.4* | 156 | 424[1] |
| | BILLFISH | SAI | 80 | *161.0* | 196 | 3433[1] |
| | | WHM | 106 | *151.0* | 182 | 425[1] |
| | | SPG | 128 | *139.9* | 170 | 25 |
| | | SPF | 126 | *150.8* | 179 | 26[1] |
| | | BUM | 127 | *184.9* | 291 | 13[1] |
| SECONDARY TARGET | SHARKS | DUS | 10 | *61.5* | 94 | 10 |
| | | FAL | 25 | *70.0* | 190 | 254[1] |
| | | SPL | 48 | *116.5* | 175 | 33[1] |
| | | BSH | 160 | *188.4* | 220 | 9[1] |
| | | PLS | 51 | *58.7* | 68 | 27 |
| | TUNAS | YFT | 78 | *98.1* | 131 | 56[1] |
| | | ALB | 79 | *101.2* | 110 | 25[1] |
| | | BLF | 30 | *61.1* | 100 | 466[1] |
| | | BET | 59 | *80.9* | 103 | 29[1] |

**Table 4.** Recorded landed catch (kg) by species in port sampling activities in Morro Pto. Santo (MORR) and Margarita Island (MARG) by the Venezuelan Artisanal Off-Shore (VAOS) fleet from July 2011 to December 2012 when declared operating at least 1 pelagic longline set and/or declaring targeting tuna and tuna-like species. SPx refers to SPF or SPG; SH1 and SH2 refer to the 1st and 2nd most abundant shark species in the landings. FishArea: *see* **Figure 8**.

| Port | Date | Target | D-at-sea | # sets | FishArea | SAI | WHM | BUM | SPx | SH1 | SH2 | KGM | BLF | DOL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MARG | Jul-11 | DOL | 16 | 6 | 6 | 922 | 0 | 0 | 0 | 38 | 0 | 0 | 90 | 0 | 1991 |
| MARG | Jul-11 | DOL | 12 | 8 | 6 | 926 | 0 | 0 | 0 | 0 | 0 | 0 | 70 | 1200 | 0 |
| MARG | Jul-11 | DOL | 6 | 6 | 1 | 570 | 0 | 0 | 0 | 28 | 0 | 0 | 0 | 730 | 1328 |
| MARG | Aug-11 | DOL | 4 | 4 | 1 | 276 | 0 | 0 | 0 | 0 | 0 | 0 | 42 | 308 | 626 |
| MARG | Aug-11 | DOL | 13 | 7 | 6 | 956 | 0 | 0 | 0 | 0 | 0 | 0 | 76 | 1161 | 2193 |
| MARG | Aug-11 | DOL | 5 | 3 | 1 | 495 | 0 | 0 | 0 | 35 | 0 | 0 | 0 | 130 | 680 |
| MARG | Aug-11 | DOL | 12 | 6 | 6 | 650 | 0 | 0 | 0 | 320 | 0 | 0 | 0 | 1098 | 2068 |
| MARG | Oct-11 | DOL | 16 | 10 | 6 | 760 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3440 | 4200 |
| MARG | Oct-11 | DOL | 16 | 12 | 6 | 1800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2400 | 4200 |
| MARG | Oct-11 | DOL | 15 | 2 | 6 | 140 | 0 | 0 | 0 | 0 | 0 | 0 | 110 | 163 | 413 |
| MARG | Oct-11 | DOL | 13 | 10 | 1 | 962 | 543 | 165 | 0 | 0 | 0 | 0 | 0 | 1380 | 3050 |
| MARG | Nov-11 | DOL | 11 | 11 | 3 | 1800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2000 | 3800 |
| MARG | Nov-11 | DOL | 13 | 11 | 6 | 1900 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22200 | 4100 |
| MARG | Nov-11 | DOL | 13 | 13 | 7 | 0 | 0 | 0 | 0 | 197 | 0 | 0 | 65 | 0 | 262 |
| MARG | Dec-11 | DOL | 8 | 8 | 2 | 0 | 0 | 0 | 0 | 120 | 0 | 0 | 43 | 0 | 163 |
| MARG | Feb-12 | BIL | 16 | 10 | 6 | 930 | 50 | 40 | 0 | 0 | 0 | 0 | 0 | 2230 | 3350 |
| MARG | Feb-12 | BIL | 16 | 11 | 6 | 1000 | 90 | 40 | 0 | 0 | 0 | 0 | 0 | 2300 | 3430 |
| MARG | Mar-12 | BIL | 14 | 14 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1041 | 969 | 2235 |
| MARG | Apr-12 | BIL | 10 | 8 | 2 | 26 | 0 | 900 | 0 | 930 | 0 | 0 | 1300 | 0 | 5600 |
| MARG | May-12 | BLF | 10 | 8 | 2 | 40 | 0 | 720 | 0 | 840 | 0 | 0 | 1090 | 0 | 5200 |
| MARG | May-12 | DOL | 10 | 7 | 2 | 380 | 0 | 0 | 0 | 53 | 0 | 0 | 0 | 1110 | 1543 |
| MARG | May-12 | DOL | 10 | 7 | 1 | 332 | 0 | 0 | 0 | 73 | 0 | 0 | 0 | 867 | 1272 |
| MARG | Jun-12 | DOL | 9 | 7 | 1 | 365 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1600 | 1965 |
| MARG | Jun-12 | DOL | 11 | 8 | 6 | 1207 | 12 | 0 | 0 | 25 | 0 | 0 | 1219 | 1787 | 4250 |
| MARG | Jun-12 | DOL | 12 | 9 | 6 | 1500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3000 | 4500 |
| MARG | Jul-12 | DOL | 14 | 9 | 7 | 584 | 0 | 42 | 0 | 0 | 0 | 0 | 626 | 1055 | 2307 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MARG | Aug-12 | DOL | 16 | 8 | 6 | 528 | 0 | 0 | 0 | 910 | 335 | 0 | 0 | 645 | 2418 |
| MARG | Aug-12 | BIL | 15 | 9 | 7 | 718 | 0 | 52 | 0 | 0 | 0 | 0 | 0 | 351 | 2621 |
| MARG | Nov-12 | BIL | 16 | 16 | 6 | 99 | 0 | 0 | 0 | 370 | 0 | 0 | 0 | 115 | 584 |
| MORR | Jul-11 | KGM | 22 | 20 | 6 | 0 | 0 | 0 | 0 | 17 | 0 | 4246 | 0 | 0 | 4263 |
| MORR | Aug-11 | BIL | 16 | 16 | 6 | 900 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 916 |
| MORR | Aug-11 | BLF | 7 | 7 | 2 | 20 | 0 | 0 | 0 | 116 | 0 | 0 | 1439 | 0 | 1575 |
| MORR | Oct-11 | KGM | 19 | 1 | 5 | 45 | 0 | 0 | 0 | 24 | 0 | 4000 | 0 | 100 | 4169 |
| MORR | Nov-11 | BLF | 16 | 14 | 6 | 602 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 602 |
| MORR | Nov-11 | BLF | 7 | 7 | 2 | 20 | 0 | 0 | 0 | 116 | 0 | 0 | 1439 | 0 | 1575 |
| MORR | Nov-11 | BLF | 14 | 12 | 6 | 592 | 10 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 617 |
| MORR | Nov-11 | DOL | 11 | 11 | 2 | 0 | 0 | 0 | 0 | 75 | 0 | 0 | 250 | 2000 | 2325 |
| MORR | Nov-11 | BLF | 12 | 10 | 6 | 243 | 0 | 0 | 0 | 0 | 0 | 3450 | 238 | 0 | 3931 |
| MORR | Dec-11 | BIL | 9 | 9 | 4 | 352 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 673 |
| MORR | Dec-11 | BIL | 17 | 17 | 6 | 273 | 0 | 0 | 0 | 52 | 0 | 0 | 0 | 0 | 5052 |
| MORR | Dec-11 | DOL | 12 | 12 | 7 | 252 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 980 | 2060 |
| MORR | Jan-12 | BIL | 6 | 5 | 6 | 289 | 0 | 0 | 119 | 0 | 0 | 0 | 0 | 75 | 464 |
| MORR | Jan-12 | BIL | 6 | 6 | 6 | 700 | 0 | 0 | 0 | 153 | 95 | 0 | 0 | 600 | 1584 |
| MORR | Jan-12 | DOL | 7 | 6 | 2 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 450 | 525 |
| MORR | Feb-12 | BIL | 14 | 14 | 7 | 627 | 0 | 0 | 0 | 0 | 0 | 1293 | 0 | 916 | 2836 |
| MORR | Feb-12 | BIL | 7 | 4 | 2 | 173 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 285 |
| MORR | Feb-12 | DOL | 19 | 16 | 6 | 455 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2468 | 3289 |
| MORR | Feb-12 | DOL | 17 | 17 | 6 | 659 | 31 | 0 | 33 | 0 | 0 | 0 | 0 | 4315 | 5038 |
| MORR | Feb-12 | DOL | 13 | 1 | 6 | 94 | 0 | 0 | 0 | 58 | 0 | 0 | 0 | 0 | 152 |
| MORR | Feb-12 | DOL | 9 | 9 | 5 | 300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 986 | 1286 |
| MORR | Mar-12 | DOL | 11 | 10 | 6 | 855 | 0 | 0 | 0 | 2120 | 0 | 0 | 0 | 1793 | 4768 |
| MORR | Mar-12 | BIL | 13 | 13 | 6 | 503 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 463 | 966 |
| MORR | Apr-12 | MERO | 12 | 2 | 1 | 62 | 0 | 0 | 0 | 0 | 0 | 0 | 126 | 0 | 2187 |
| | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MORR | Apr-12 | DOL | 13 | 13 | 2 | 0 | 0 | 0 | 0 | 140 | 0 | 0 | 450 | 545 | 1135 |
| MORR | May-12 | BLF | 3 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 200 | 0 | 200 |
| MORR | Oct-12 | BIL | 7 | 7 | 2 | 149 | 0 | 0 | 0 | 26 | 591 | 13 | 98 | 194 | 1071 |
| MORR | Oct-12 | BIL | 14 | 6 | 1 | 291 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 291 |
| MORR | Oct-12 | BIL | 12 | 4 | 6 | 742 | 0 | 0 | 32 | 38 | 38 | 0 | 0 | 0 | 850 |
| MORR | Dec-12 | DOL | 12 | 10 | 2 | 21 | 7 | 0 | | 66 | 0 | 0 | 168 | 88 | 368 |
| MORR | Dec-12 | DOL | | | 1 | | | | | | | | | | |
| MORR | Dec-12 | BIL | 12 | 8 | 6 | 1890 | 0 | 0 | 0 | 221 | 0 | 0 | 0 | 0 | 2111 |

**Table 5**. Species metrics (mean length, size range, and number of samples) from port sampling activities in Morro Pto. Santo (MORR) and Margarita Island (MARG) by the Venezuelan Artisanal Off-Shore (VAOS) fleet from July 2011 to December 2012 when operating at least 1 pelagic longline set and/or declaring targeting tuna and tuna-like species. BIL species length measurements are estimated LJFL, tuna species is FL, and SHK species is *TR (dorsal trunk).

| Species | Min. (cm) | *mean (cm)* | Max. (cm) | Numbers |
|---|---|---|---|---|
| **BUM** | 154 | *199.4* | 278 | 26 |
| **SAI** | 114 | *164.1* | 221 | 1200 |
| **WHM** | 130 | *156.7* | 192 | 34 |
| **BLF** | 28 | *57.1* | 90 | 311 |
| **YFT** | 55 | *82.8* | 110 | 65 |
| **FAL*** | 36 | *64.0* | 53 | 20 |
| **SPL*** | 47 | *94.0* | 44 | 22 |
| **BSH*** | 33 | *42.5* | 66 | 3 |
| **CCL*** | 26 | *39.0* | 79 | 5 |

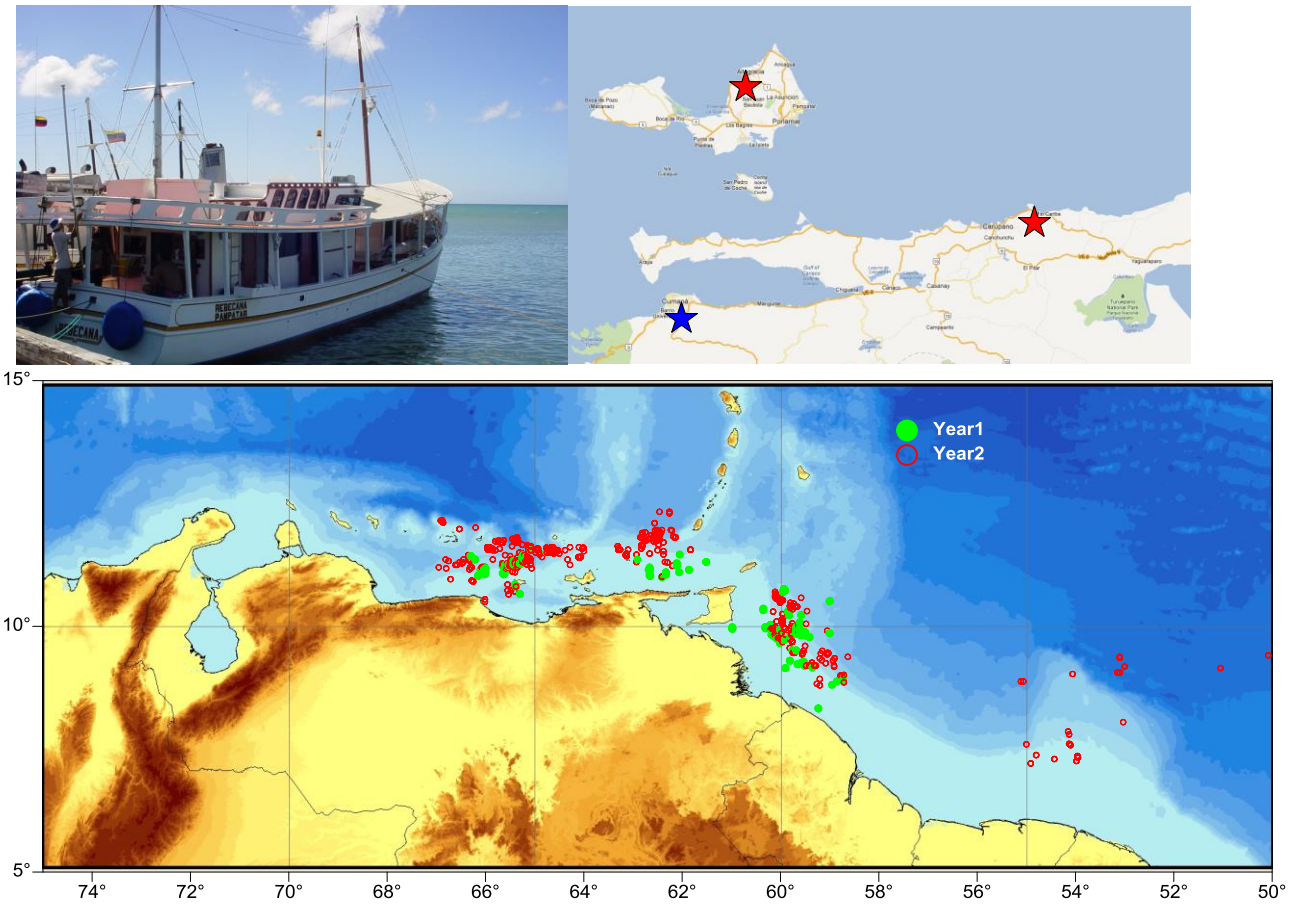


**Figure 1**. Typical vessel of the VAOS pelagic longline fleet; map showing sampling locations (Morro de Puerto Santo in the mainland, and JuanGriego in Margarita Island), and the location of the Instituto Oceanográfico de Venezuela-Universidad de Oriente (blue star). Map of spatial locations of sets per observed trip of the VAOS pelagic longline fleet from July 2011 to December 2012. Legend indicates the trips by year of the Project.

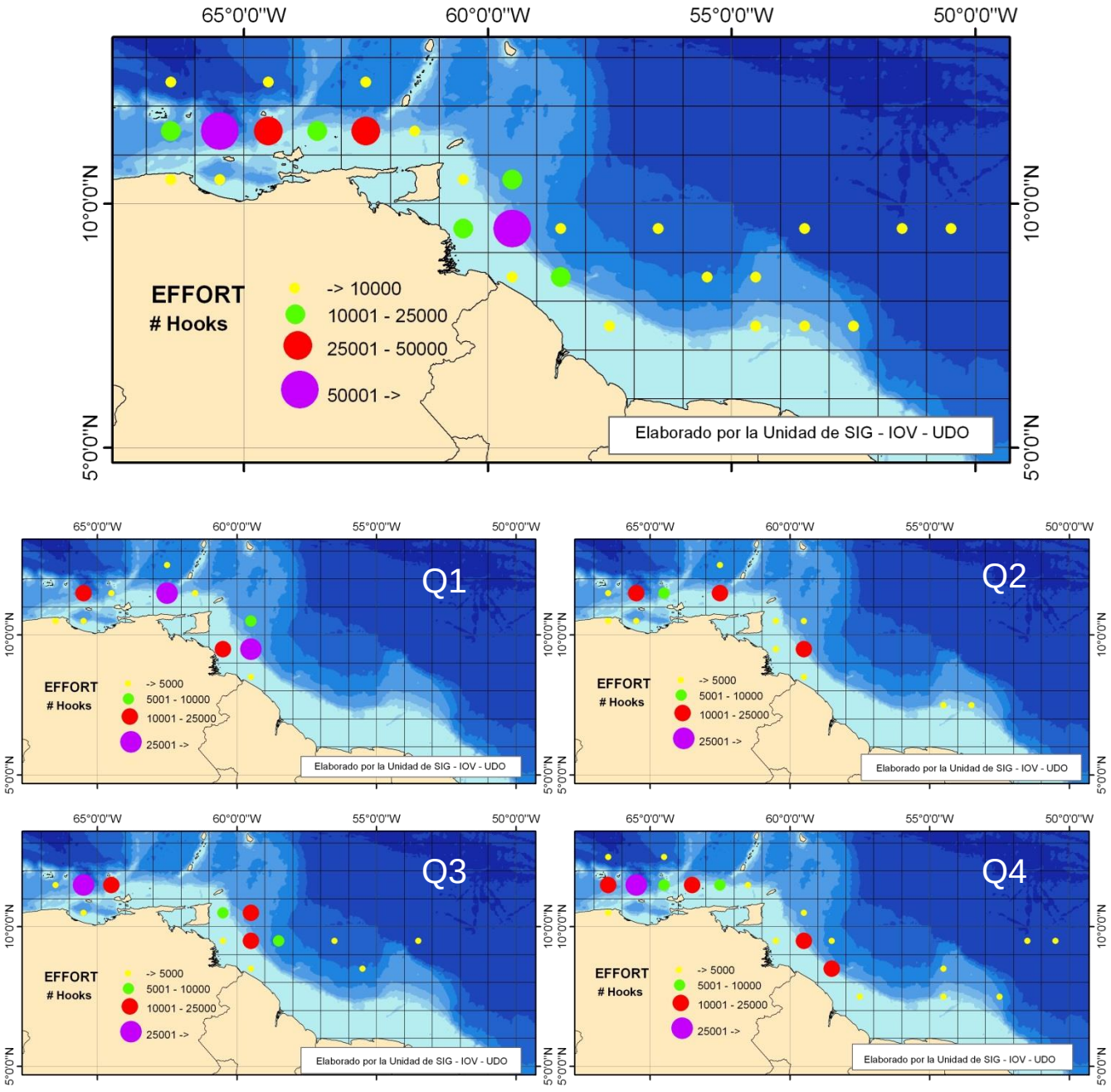


**Figure 2.** Overall spatial distribution of the total fishing effort (number of hooks) deployed by the VAOS fleet from July 2011 to December 2012; and seasonal (by quarters) fishing effort spatial distribution (bottom maps). Sizes of pies are proportional to the number of hooks in 1° square bin.

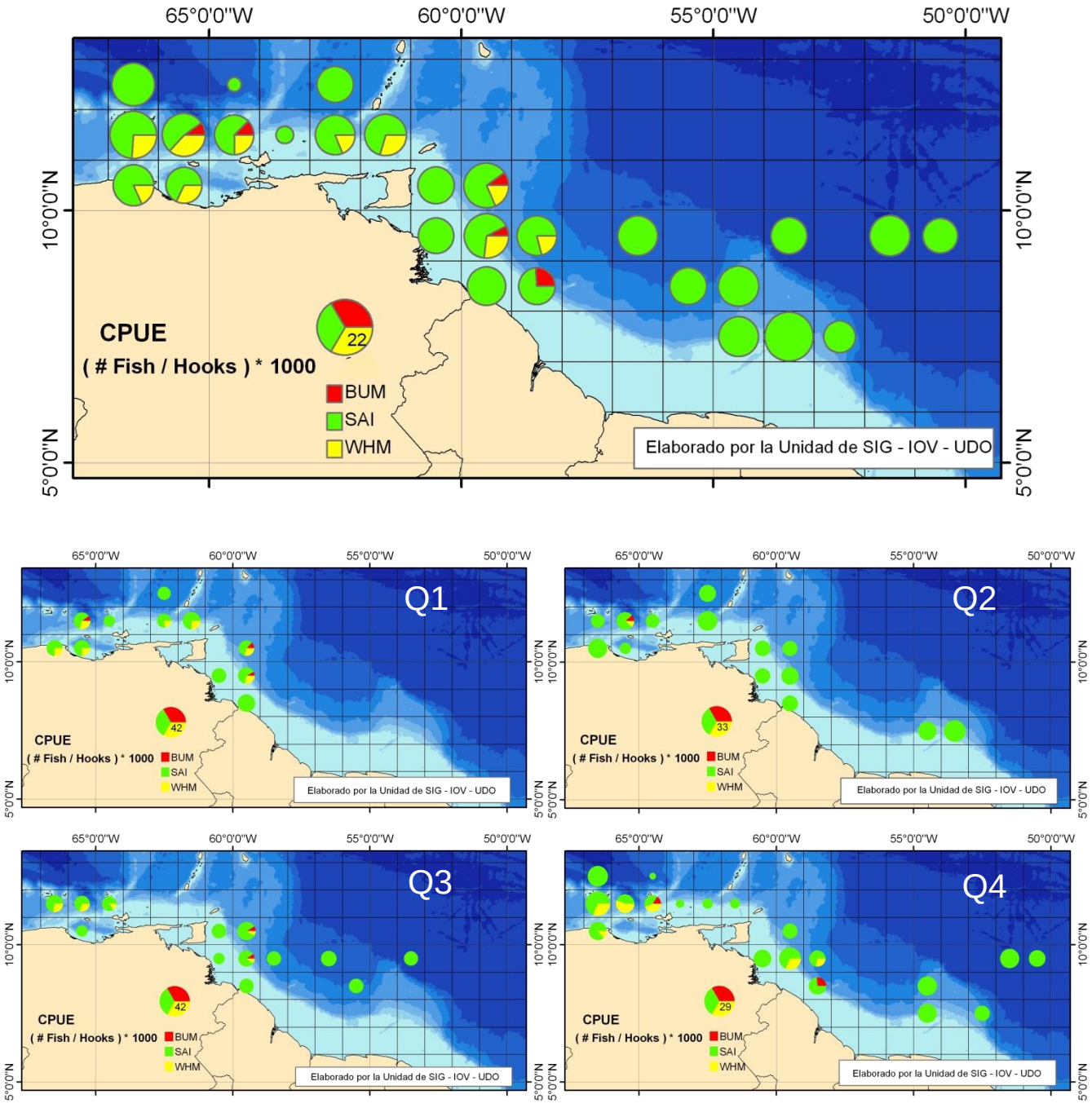


**Figure 3.** Overall spatial distribution of the relative abundance (CPUE) of the most common billfish species in the catch of the VAOS fleet from July 2011 to December 2012; and seasonal CPUE spatial distribution for the same group of billfish species (bottom maps). Sizes of pies are proportional to the number of fish in 1° square bin.

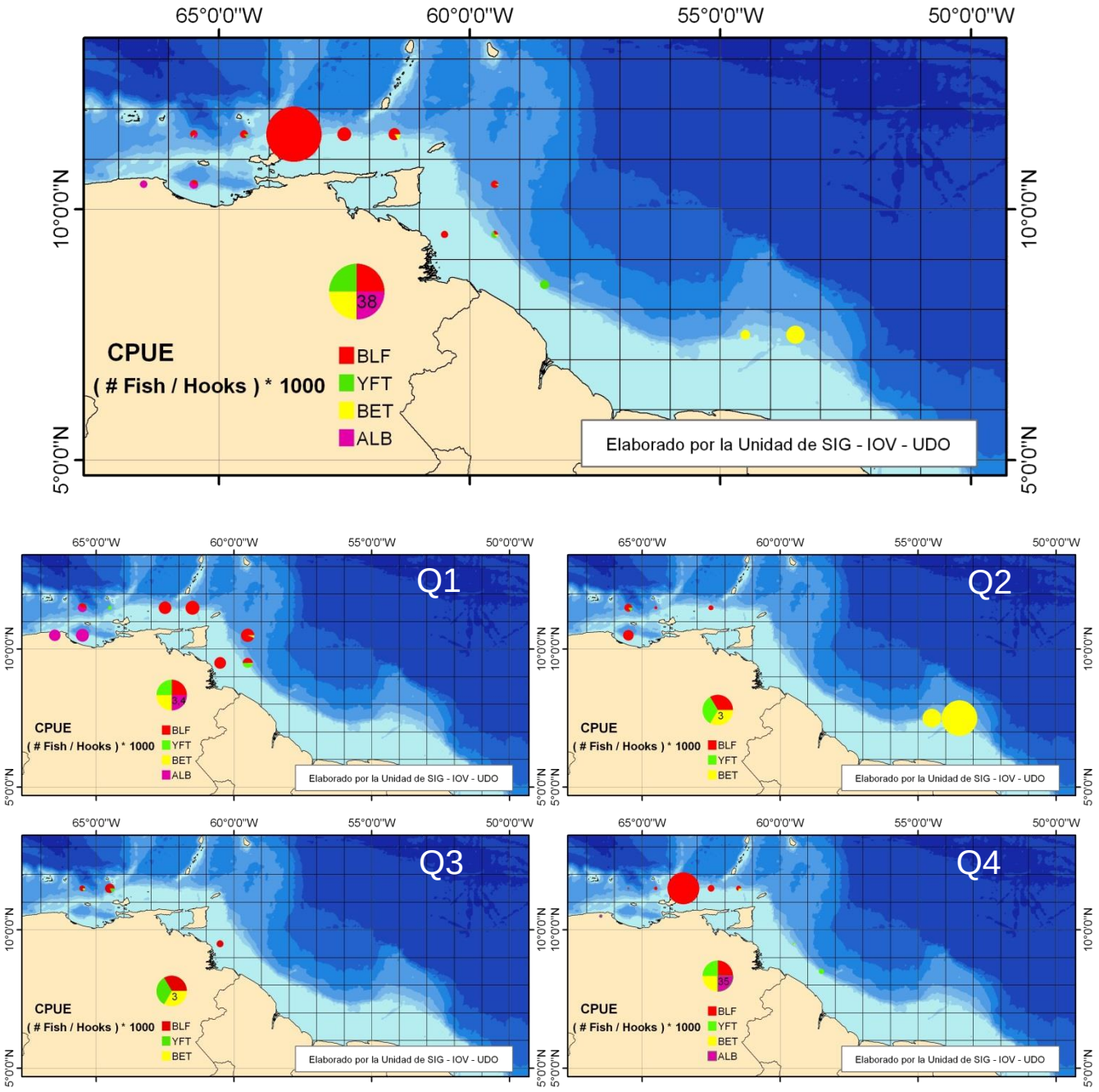


**Figure 4.** Overall spatial distribution of the relative abundance (CPUE) of the most common tuna species in the catch of the VAOS fleet from July 2011 to December 2012; and seasonal CPUE spatial distribution for the same group of tuna species (bottom maps). Sizes of pies are proportional to the number of fish in 1° square bin.

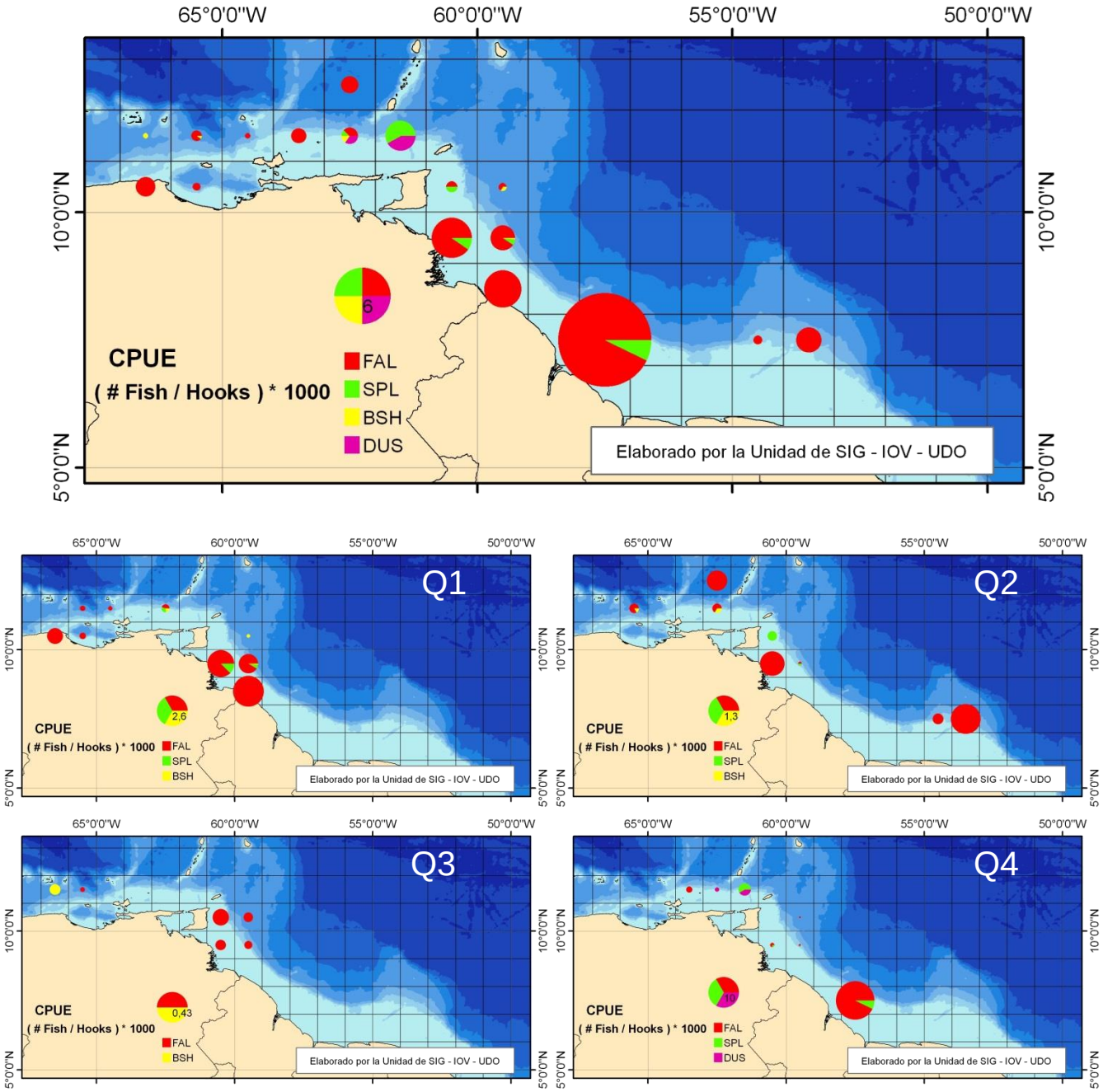


**Figure 5.** Overall spatial distribution of the relative abundance (CPUE) of the most common shark species in the catch of the VAOS fleet from July 2011 to December 2012; and seasonal CPUE spatial distribution for the same group of shark species (bottom maps). Sizes of pies are proportional to the number of fish in 1° square bin.

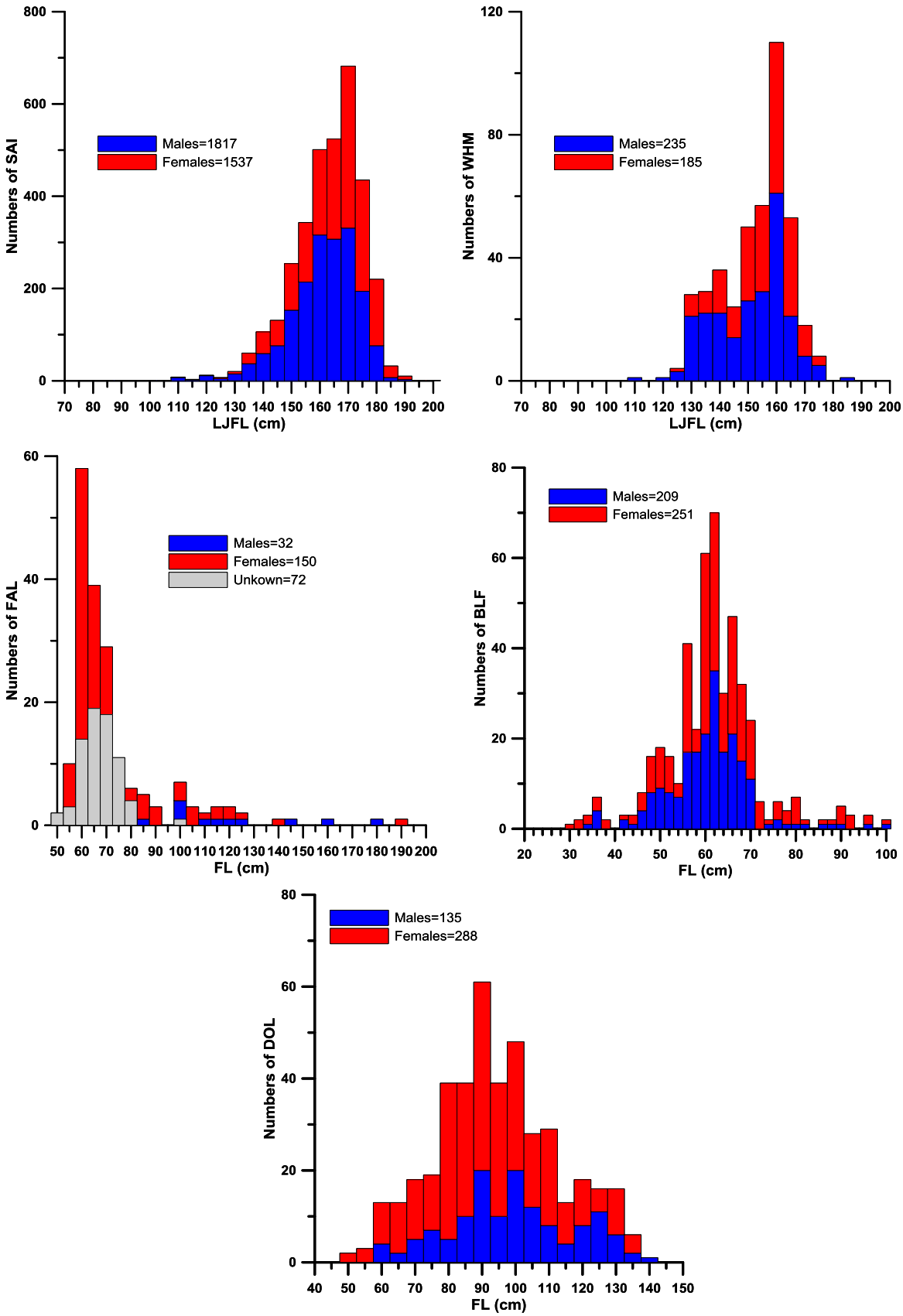


**Figure 6.** Size frequency distributions of the most frequent species caught by the VAOS fleet from July 2011 to December 2012.

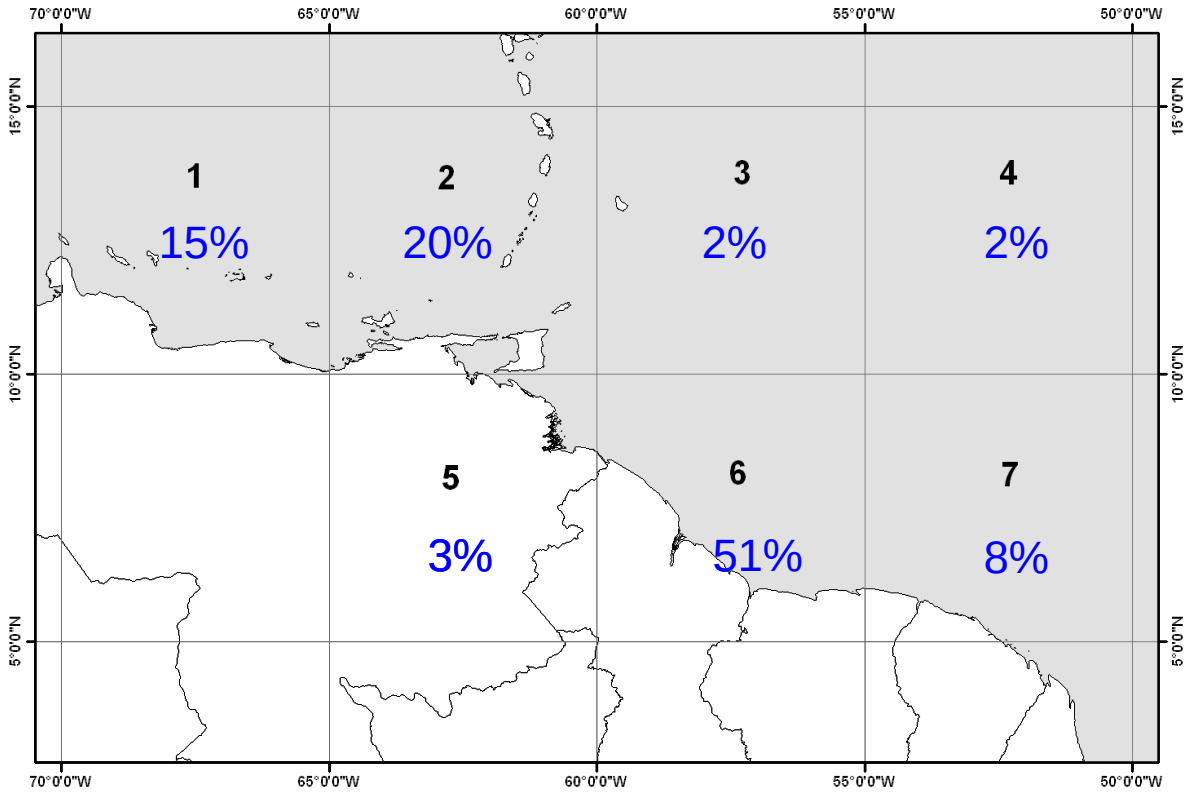


**Figure 7.** Fishing areas defined for the port sampling activities forms of the VAOS fleet in Morro Pto. Santo and Margarita Island from July 2011 to December 2012. Percentage in each fishing section reflects the number of trips fishing during the period of sampling.

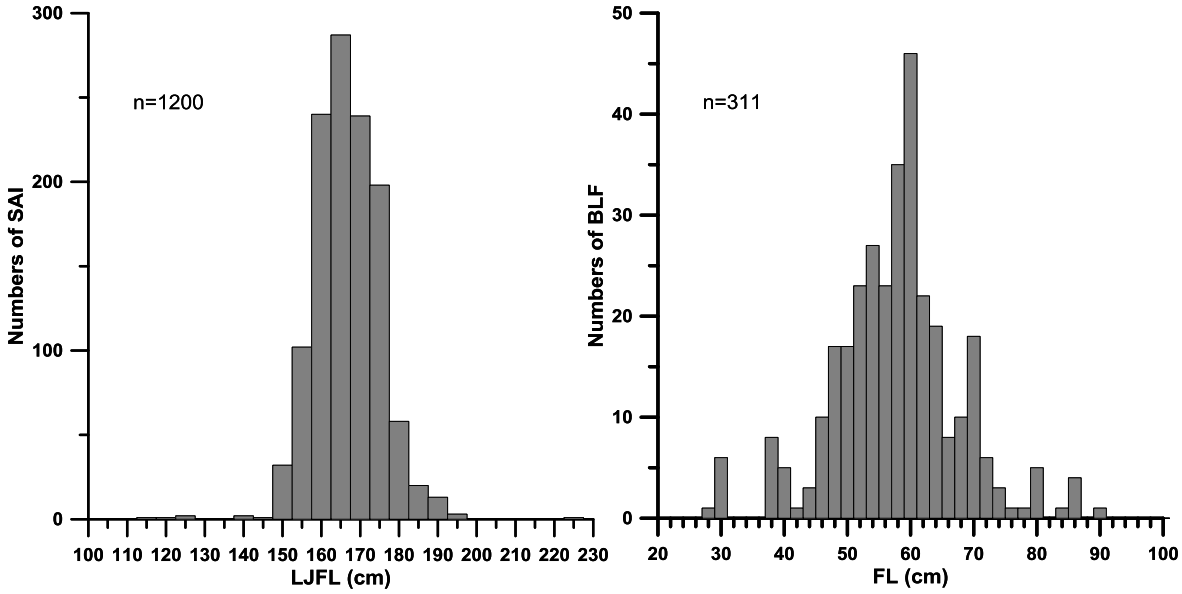


**Figure 8.** Size frequency distributions of the most frequent species landed by the sampled VAOS pelagic longline fleet in both communities (Morro Pto Santo and Margarita Island) from July 2011 to December 2012. Length measurements from SAI were converted from PFL for sexes combined (see ICCAT Manual).