Analysis of activity data obtained from supply vessels' logbooks implemented by the Spanish fleet and associated in Indian Ocean

by

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SUMMARY

The present paper is based on data collected from logbooks filled in, from 2004 to 2010, by supply vessels providing support to the Spanish purse-seine fleet and associated in the Indian Ocean.
From November 2004 to June of the current year, the data implemented by 16 ships have been registered, with a total of 14388 days at sea. The activities carried out by this fleet which are directly related to fishing operations of purse seiners are analysed.

KEYWORDS

Supply vessels, Purse seiner, Indian Ocean, Tropical tuna, FADs, floating objects, fishing effort

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INTRODUCTION

Spanish supply boats began to work in waters of Indian Ocean in the end of 90'. They are actually (in 2010) 11 vessels with power between 500 and 2960 hp. Most of them have been built after year 2000 and, in some cases they are reconverted bait boats (IOTC database). These boats work alongside the tuna purse-seine fleet, providing support for all kinds of operations and contributing to improve fishing performance. It is considered that the activities of supply vessels are an integral part of the fishing effort exerted by the purse seine fleet (IOTC 2010) so their importance to know supplies' level of activity.

This fleet is comprised by navigating vessels which major activity is to observe (visit, collection and replacement of objects), build and deploy floating objects (FADs), except for two of them (only one from April 2010) permanently anchored on the seamount called '*Coco de Mer'*, acting themselves as FADs. Another activity consists of locating and recovering objects to carry out a follow-up, so supply vessels make an assessment of school size and species. They can also indirectly provide relief for the fishing vessels by transporting provisions, the injured, tackle and so on. When they detect an object with fish, they notify the purse-seiner/s (normally one, occasionally two) they are associated with in order for them to undertake the fishery. In some occasions, navigating supplies anchor on a seamount for days even months.

Considering that fish effort of purse seiners is conditioned anyway by the activities carried out by supply vessels they operate in collaboration to, the contribution of specific information coming from logbooks and other experiences made from observers data in Indian ocean (Arrizabalaga *et al*. 2001) can contribute to analyse the factors influencing the effectiveness of purse seine fishery over tropical tuna. For this reason it is important to know the levels of activity of supply vessels (number of days at sea) as much as number and type of objects they work with.

MATERIAL AND METHODS

Since 2004, the Spanish Fisheries Office located in Seychelles has distributed logbooks (Delgado de Molina *et al*. 2004) to supply vessels supporting the Spanish purse-seine fleet and associated operating in the Indian Ocean. Data about the activities of this fleet are continuously obtained, thus improving the coverage of those collected by observers. All the information collected has been processed in an *Access* database.

This fleet puts into port infrequently and many vessels operate under a not EU flag. This has hampered distribution of the supply logbooks, but fortunately the response has been positive in most of cases. The quality of the information supplied largely depends on the skipper, with some vessels providing precise details about their activities, while others rarely give any.

It has been recollected not only information from Spanish fleet (Spanish supplies and foreign supplies supporting Spanish purse seiners activities) but also from associated vessels (foreign ships with Spanish interests) that voluntarily send the filled in logbooks.

The different activities of this fleet were calculated taking into account that most of supply vessels dedicate an almost fixed number of hours a day to each kind of manoeuvre. Some operations are registered once a day (exploring, route, malfunction, anchorage on a seamount…). In these cases, it has been measured the length of the activity depending on their respective characteristics (12h for routes, 24h for anchorage…). Other operations are noted more than once a day (deployment, visit of objects…), in these cases, it has been considered the main activity of the day and the average number of hours between de first and the last registration.

RESULTS

The number of supply vessels working in collaboration with the Spanish and foreign with Spanish interests purse-seine fleet in the Indian Ocean in recent years is given in **Table 1**. Since 1999, the year in which follow-up on this fleet began, the number has gradually increased, reaching a maximum of 15 in 2004 and settling at 13 from 2005 to 2007 (Sarralde *et al.* 2007). In 2008, the number of supply vessels suffered a decrease probably owed to pirate attacks and it has recovered in 2009. The number of purse seiners associated to supplies (recovering data from 2004 was impossible) has been almost constant during these years (practically 9 ships) and it has been increased from 2006. It has to be taken into account that in recent years we have been reported much more data.
As it was mentioned, during 2009, one of the two supply vessels anchored on '*Coco de Mer*' was moved to Port Victoria, Seychelles, owing to pirates' attacks and the other one was sold in April 2010 and it is not operating in Indian Ocean.

Table 2 shows the total days at sea registered by year and the average length of the trips for each vessel (total days at sea/number of trips), numbered from 1 to 16, considering a trip the time between two port calls. Records exist from November 2004 to June 2010.
The main reasons to entry into port were to refuel, change the crew or breakdown, although trips may also be interrupted to transport an injured person, or to collect material, etc.
The average trip length is particularly high in case the vessel had been anchored on a seamount.

Table 3 outlines the coverage of the activity with the supplies' logbooks. Year 2004 started in November. To calculate the percentages it has been considered 365 days per year and ship, taking into account the total number of supply vessels coupled to purse seiners by year and the registered time they have spent at port.

The main activities recorded in the supplies' logbooks are deploying or visiting objects (natural or artificial, marked or not with buoys) and navigating/exploring. At night, some ships use to navigate if they are not seeding objects. The percentage of time by year and activity is shown in **Figure 1.** Most of the time (37%) is dedicated to navigation, with or without searching, to observations (only visits, buoys replacements, shipment of objects, adding of buoys to natural objects, etc) (35%), or to deployment of FADs (28%) (see **Figure 2**). Quality of data has improved constantly, so in the first years of coverage, the main activity noted in logbooks was navigation (58% in 2004) and this has been defined as other activities from 2006 on. Navigation is also the main activity noted down each time a new vessel (or skipper) in Indian Ocean fills in the logbook for the first time.

Figure 3 shows the percentage per activity taking into account the number of times that each operation has been recorded and not the time (in hours) for each one. The main activities recorded were related to observations (visits, calling a purse seiner, etc.) and supposed a 48.8% of the total registrations. The recordings of deployments were noted in logbooks a 26.2% of the total of registrations and the times that the activity "navigation/route" was recorded supposed a 19.8%. The rest of the activities are minority (5.2%) and related to seamount anchorage, drifts, days at port, etc.

Among the 13113 registered data of visits/observations - see **Table 4**- there have been 1792 records of objects replacements (mainly changes of old/not own buoys for new ones or other changes in some components of the FAD like bamboo canes or net) or additions of buoys (mainly at logs found at sea or artificial objects like ropes or pieces of boards), 2595 records of objects collected with no fish by the supply vessels and 8726 data of visits to objects without changing (only visits). In addition, there have been also 7198 registrations of objects seeded.

From the 14969 registrations of types of objects (**Table 5**), a 3.5% (532) were natural objects found at sea (logs, canes, a piece of a death whale…) and only 116 of them were not marked with buoys. The visit to artificial objects without buoys marking them is anecdotic (233 data). The majority of the objects visited were FADs with artificial materials (canes, nets, buoy, etc.) (a 93.9%).

There were 168 registrations of sightings of free schools (**Table 6**) following skippers' estimations. Most of them were schools of *Katsuwonus pelamis* (42%).

There were 5870 (21% of the 27437 total registrations in database) direct observations of tuna schools associated to objects (**Table 7**) which estimations varied between 1 and 200 tons (13.7 tons of media). Only 29 of these observations (a 0.1%) leaded to the anchorage of the supply vessel on a seamount and from another 87 (1.5%) it was decided to call an associated purse-seiner. Most of these schools, 2832 data (48%) were associated to FADs (**Table 8**) and 425 (7%) of them were associated to natural objects (logs, trees, etc.) found at sea. Presumably undefined objects are FADs.

In the total registration data the code for "*Notifying purse seiner*" and "*Arrival of purse seiner*" was only noted down in 143 cases (0.5%). Despite the fact that this is one of the codes that gives an idea of the direct effectiveness of supply vessels on fishing, it is one detail that skippers seem reluctant to give. When they call a purse-seiner because they have detected fish, they normally wait and "look after" the object until the purse-seiner arrives.

Seven of the sixteen ships recorded at the moment have been any time anchored on a seamount. Two of them were permanently anchored on '*Coco de Mer'* (0º25'N; 56º01'E) and, from the navigating vessels, only five of them have registered data about this activity. The maximum days were 46 in '*Coco de Mer'* for one of these vessels. Other one has been anchored inside Mozambique's Channel for two days (14º10'S; 41º28'E). So, in total, only 135 of the 14388 days at sea recorded were dedicated to aggregate schools of tuna in seamounts (0.9%).

Table 9 and **Figure 4** show the number and percentage, respectively, of the types of buoys employed per type and year that the skippers have registered in logbooks. There are much more buoys registered in the database but it has been counted only those which have data concerning to type in case it was correctly noted down. It must be considered that in recent years it has been compiled much more information about the kind of buoy but it still remains general data without specifications (skippers register only the name of the company who sells the buoys).

The technology used for the FADs is developing very quickly. From data reported since 2004, the fleet currently use a majority of buoys with satellite transmission (mainly via *Inmarsat* D+) and worldwide coverage, so the ship equipment automatically calls the server and then enters the access codes to download the information. The information received by mail contains data about position (GPS), transmitted 2-9 times a day, temperature (SST) and battery status. Radio buoys like *Serpe*, which depend on good transmission conditions, are actually nearly out of use while buoys with satellite transmission and other equipments like sounder and sonar have become a majority (*Satlink* f.e.). Most of the buoys actually employed include sonar (50 kHz and 500W) to control the quantity of the fish underneath, recovery flashes to be located at night and have nearly no aerial parts to be difficult to see, visually or by radars. The majority of these buoys have a mushroom shape to be stable on sea (up to 31x46 cm as dimensions). Some of them even transmit information about their course and speed. They work at water temperatures from -5ºC to 40ºC.

Table 10 shows the average and maximum number of operations with buoys per vessel. The average number of objects deployed per day is nearly 5, and the average number of objects visited is nearly 2.
Deployment is carried out on one or two consecutive days, with approximately one hour separation between each (8-10 miles distance).
The maximum number of visits to objects in one day was nearly 8, while the maximum number of objects deployed in one day was nearly 15.

From 2006 to 2009, this fleet moved within the following geographical limits (**Figure 5**): 20ºN (Arabian Sea), 20ºS (Mozambique Channel), 93ºE (near Andaman Sea) and to the W, along the east African coast (from Adan Gulf to Mozambique Channel). The major ports visited were Port Victoria (Seychelles) for crew relaying, gas-oil… and Antsiranana (Madagascar) mainly to restore the vessel,

though there have been also movements to Phuket (Thailand), Colombo (Sri-Lanka), Male (Maldives), Port Louis (Mauritius), etc.

From 2008-2009, the activities near Somalia's waters have been reduced owing to pirates' attacks and the activities inside the Mozambique's Chanel have been much more in the last three years.

There are two predominant large circular currents in Indian Ocean, one in the northern hemisphere flowing clockwise and one south of the equator moving anticlockwise. As seen in the maps (**Figure 6**), seeding zones usually are at north-west of this ocean in order to be able to recover buoys. During the winter monsoon, however, currents in the north are reversed, so then the seeding zones are located at south. There is also another current flowing inside the Mozambique's Chanel (Agulhas current); as a result, many visits of objects are done in this zone during the first half of the year.

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***Table 1**. Number of supply vessels coupled to Spanish purse-seiners and associated fleet by year*

Year	nº Supplies	nº Purse-seiners associated
1999	6	7
2000	7	9
2001	5	5
2002	8	9
2003	8	9
2004	15	-
2005	13	10
2006	13	19
2007	13	17
2008	11	14
2009	14	16
2010	11	14

***Table 2**. Total number of days at sea registered and average trip length per vessel (November 2004-June 2010) by year*

Supply vessel code	Nov 2004	2005	2006	2007	2008	2009	Jun 2010	Total days at sea	Average trip length
1	-	285	336	301	-	-	-	**922**	71
2	-	-	134	329	273	130	-	**866**	41
3	-	-	-	-	-	66	44	**110**	55
4	-	139	303	223	352	315	145	**1477**	43
5	-	-	-	-	-	172	114	**286**	48
6	-	-	86	328	358	229	145	**1146**	48
7	-	-	262	358	209	19	111	**959**	53
8	-	-	-	49	341	192	-	**582**	97
9	-	87	350	339	250	271	-	**1297**	50
10	-	186	174	350	317	295	-	**1322**	57
11	-	-	160	351	321	52	-	**884**	59
12	28	358	324	354	314	341	148	**1867**	46
13	-	179	301	349	306	324	69	**1528**	51
14	-	-	-	-	-	107	-	**107**	36
15	56	349	330	264	-	-	-	**999**	42
16	-	-	-	-	-	-	36	**36**	36
Total	**84**	**1583**	**2760**	**3595**	**3041**	**2513**	**812**	**14388**	**50**

***Table 3**. Coverage of supplies by logbook (days/year)*

Year	Coverage
2004	2%
2005	31%
2006	60%
2007	75%
2008	69%
2009	71%
2010	94%

***Table 4.** Number of visits/observations and deployments per year*

Year	Deployments	Only Visits	Collection	Replacements
2004	10	38	26	2
2005	614	1079	320	76
2006	1332	2027	426	148
2007	1923	1859	793	279
2008	1506	1410	566	280
2009	1500	1832	377	816
2010	313	481	87	191
Total	**7198**	**8726**	**2595**	**1792**
		Total visits: 13113		

***Table 5.** Number and percentage of objects registered by type*

Types of objects	Number	Percentage
Natural materials without buoy (log, grass, etc.)	532	3.5%
Natural materials with buoy	116	0.8%
Artificial materials without buoy (boxes, ropes, etc.)	233	1.5%
Artificial materials with buoy	14058	93.9%
Mixed materials (log and ropes f.e.)	24	0.2%
Mixed materials with buoy	6	0.1%
Total	**14969**	

Table 6. *Number and percentage of free schools by type registered by the skipper*

Types of free schools	Number	Percentage
Free schools of SKJ	71	42%
Free schools of YFT	31	18%
Free schools mixed (YFT and SKJ)	2	1%
Free schools undefined	64	38%
Total	**168**	

Table 7. *Number of observations of tuna schools associated to objects, per year (visits, while anchored on a seamount and leading to the call of an associated purse seiner)*

Years	Visit	Anchorage	Calling a purse-seiner	Total
2004	33	-	-	**33**
2005	551	2	13	**566**
2006	1124	1	15	**1140**
2007	968	22	4	**994**
2008	1017	-	29	**1046**
2009	1570	4	26	**1600**
2010	491	-	-	**491**
Total	**5754**	**29**	**87**	**5870**

Table 8. Types of objects associated to observations of tuna schools per year

Years	FADs	Logs	Undefined objects	Total
2004	33	-	-	**33**
2005	535	16	15	**566**
2006	1092	31	17	**1140**
2007	788	23	183	**994**
2008	81	63	902	**1046**
2009	190	237	1173	**1600**
2010	113	55	323	**491**
Total	**2832**	**425**	**2613**	**5870**

Table 9. *Number of buoys per type registered and year*

Main Characteristics		Sonar	Type of Buoy	Years 2004	2005	2006	2007	2008	2009	2010	Total
Satellite communication and solar panels			MDS	-	-	-	251	985	1015	57	**2308**
	Rapid response		M2i	-	-	-	-	9	4	-	**13**
		Yes	M3i	-	-	-	-	-	1	11	**12**
	Dish shape	Yes	TUNABAL/ZUNIBAL	48	1217	2176	1419	979	1865	489	**8193**
Satellite communication and batteries			MDP ó MDP+	-	-	-	272	391	128	18	**809**
			D+	-	486	752	1617	706	805	-	**4366**
Radio frequency	and satellite		RYOKUSEI	-	15	3	3	-	-	-	**21**
	GPS		SERPE	27	294	75	9	3	1	1	**410**
			Total	**75**	**2012**	**3006**	**3571**	**3073**	**3819**	**576**	**16132**

Table 10. *Average and maximum number of FADs deployment and visiting of objects (artificial or natural) by day and vessel and mean*

	Deployments		Visits	
Vessel code	**Max**	**Average**	**Max**	**Mean**
1	1	1.0	2	1.0
2	20	6.0	10	2.2
3	16	10.0	7	2.1
4	15	3.4	11	1.6
5	11	4.7	4	1.8
6	6	2.3	6	1.3
7	16	5.6	12	1.9
9	19	5.5	12	2.4
10	21	6.3	13	2.0
11	22	5.7	5	1.7
12	19	4.0	10	1.8
13	14	4.5	12	2.1
15	16	5.8	9	1.9
16	11	4.4	5	2.4
Media	**14.8**	**4.9**	**8.4**	**1.9**

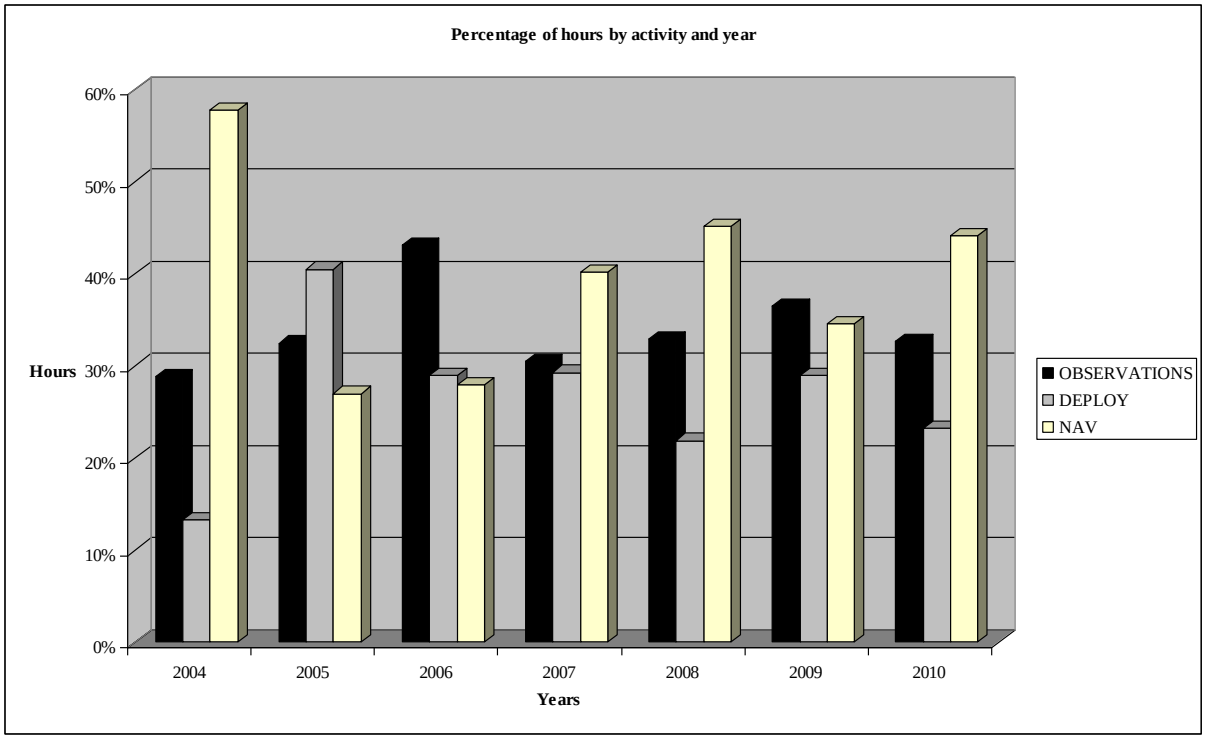

Figure 1. *Time used per main type of activity and year in percentages (observations, deployments and navigation)*

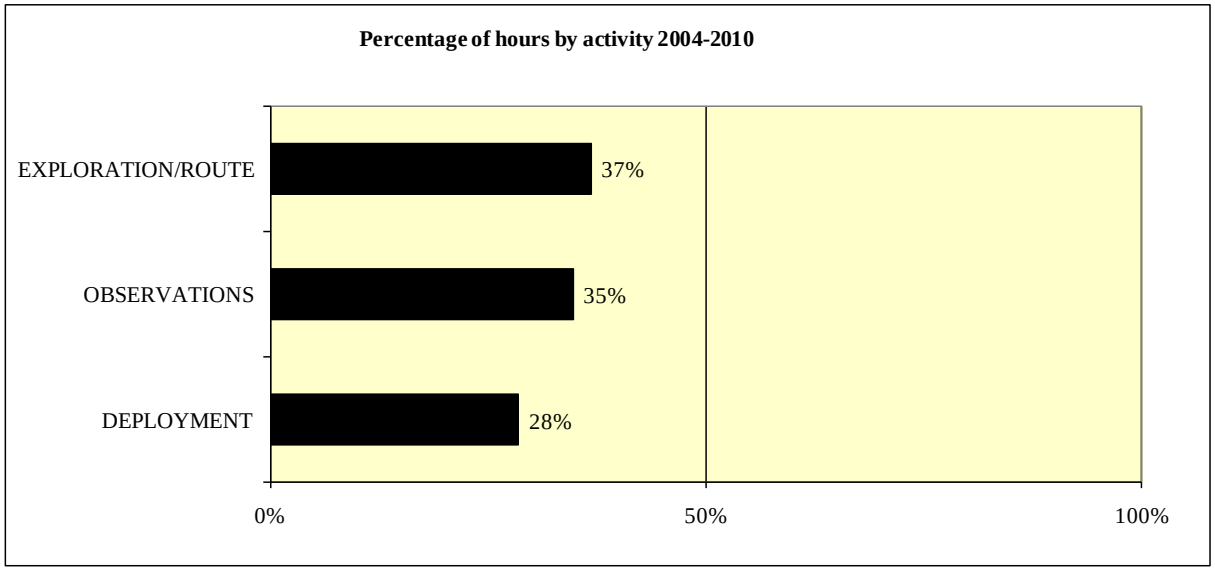

Figure 2. *Time used per main type of activity, in percentages, from November 2004 to June 2010*

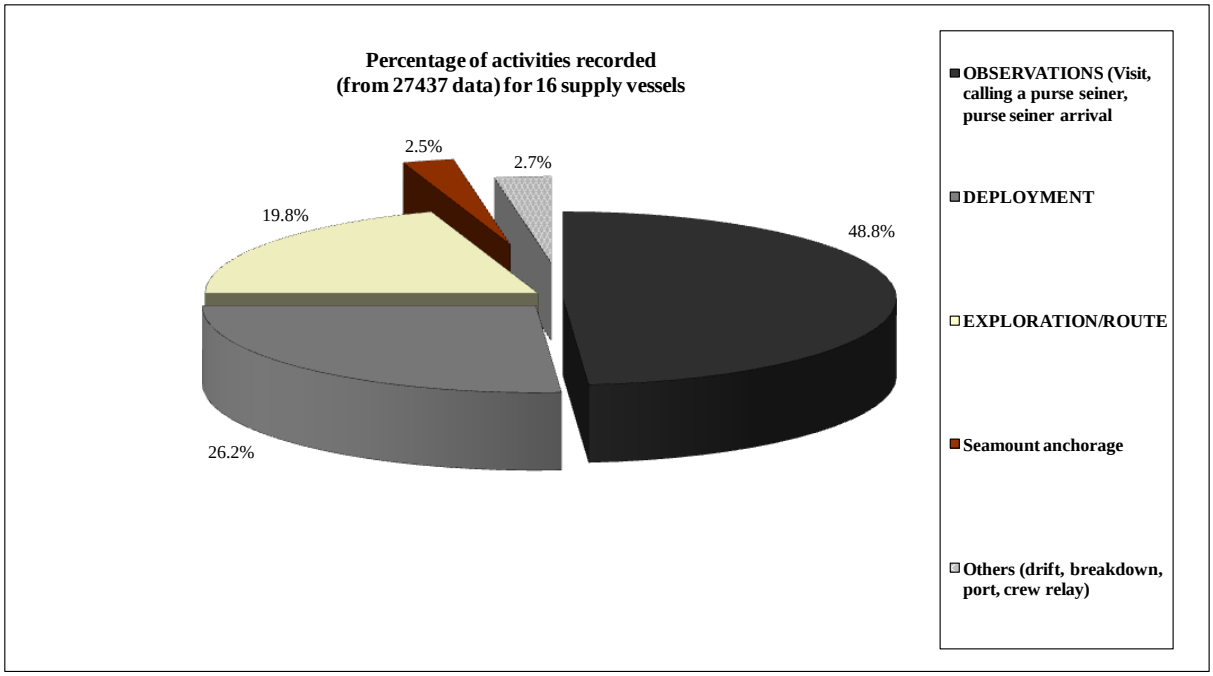

Figure 3. *Percentages per type of activity from 2004 to 2010*

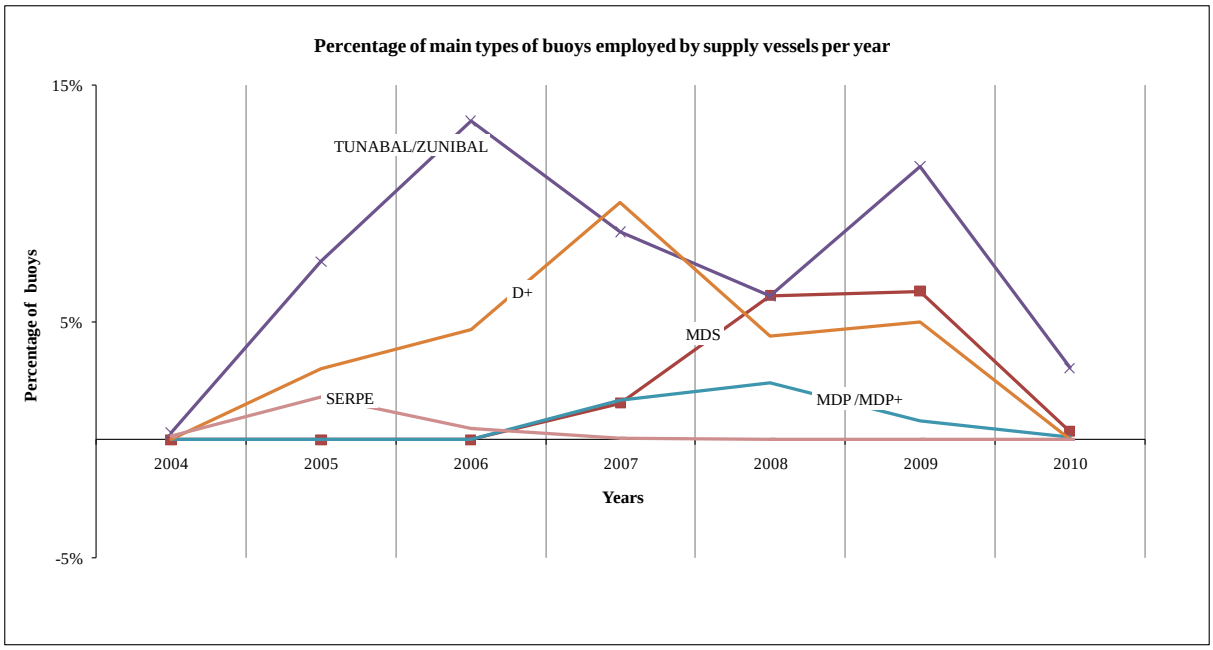

Figure 4. *Percentage of main types of buoys employed by supply vessels from 2004 to 2010*

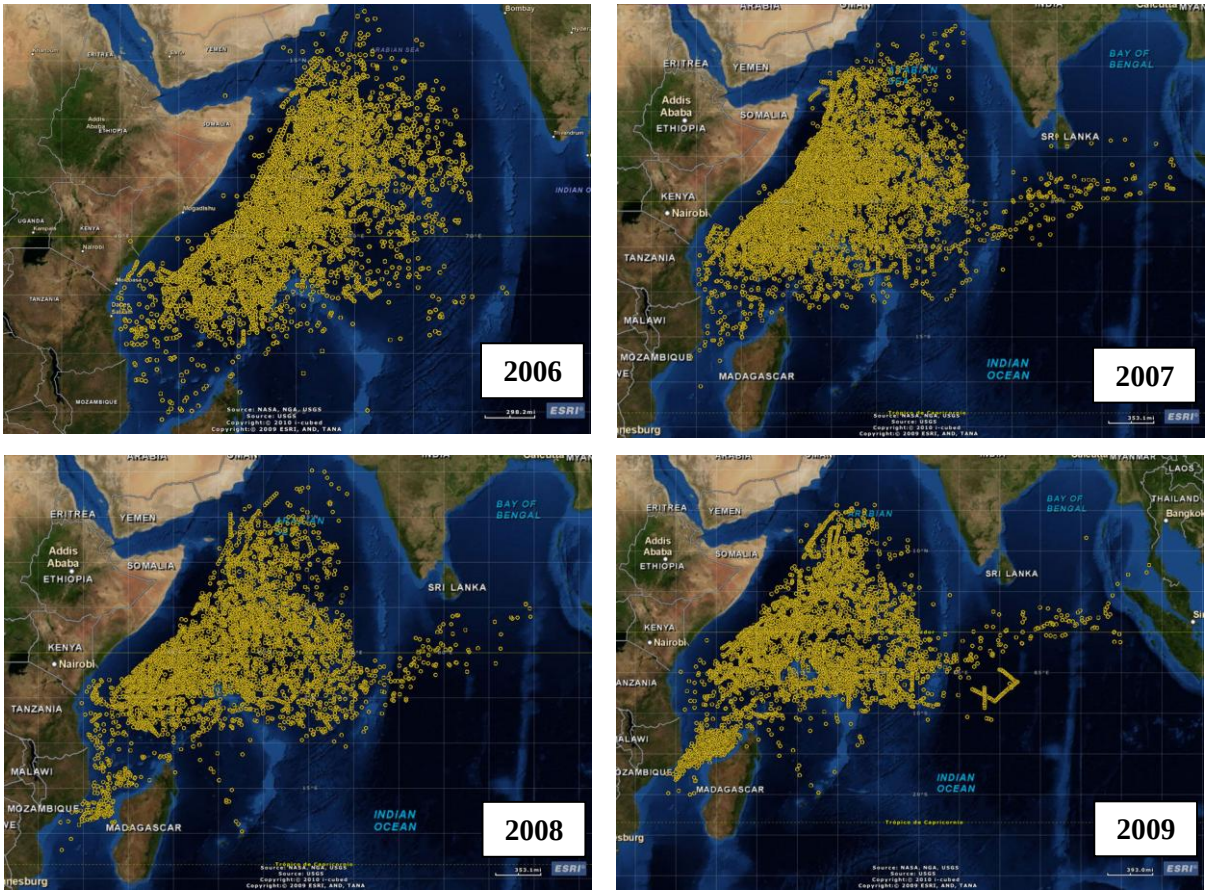

Figure 5. *Geographical distribution of supplies activities registered per year in the Indian Ocean from years 2006 to 2009*

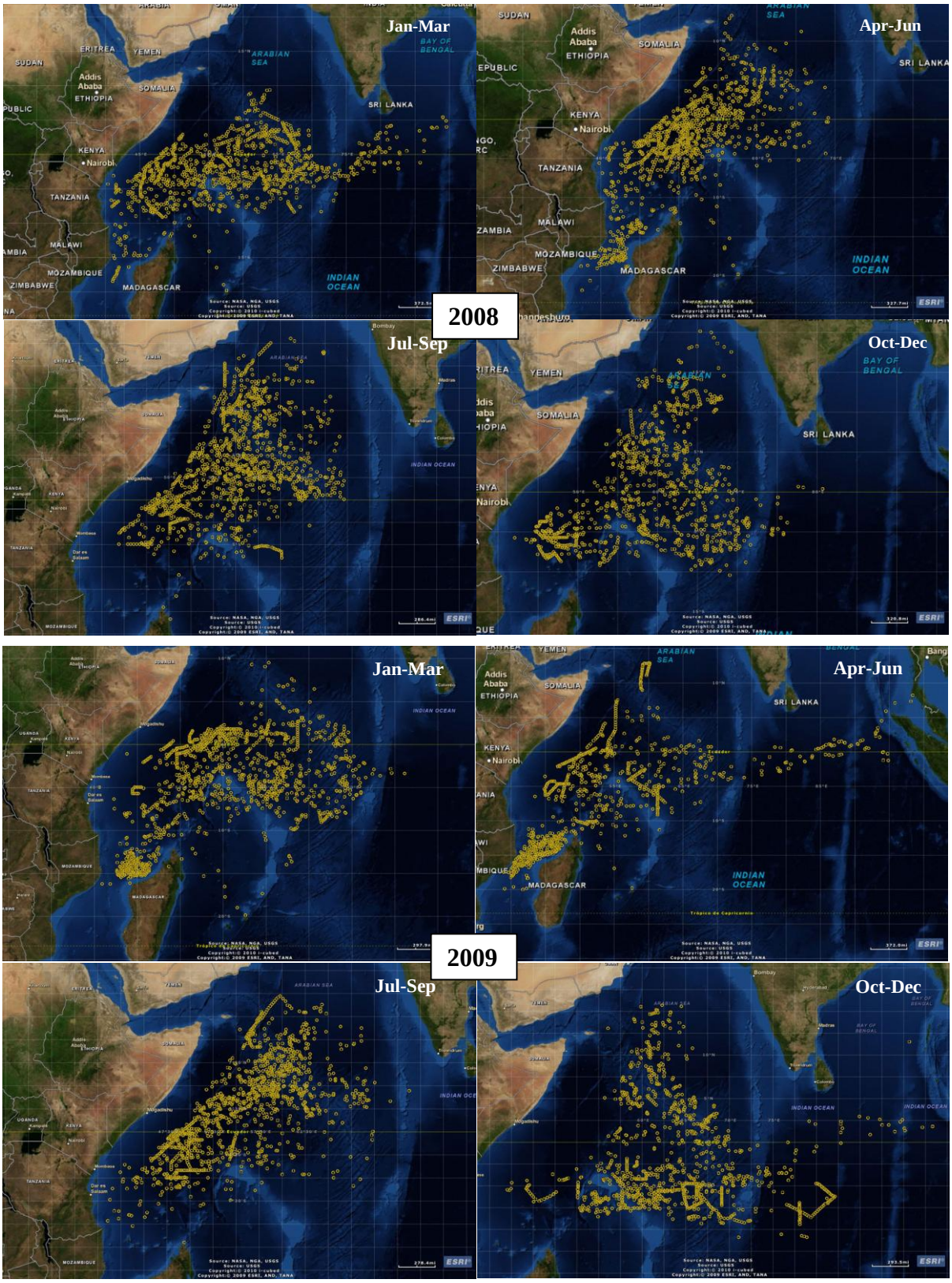

Figure 6*. Geographical positions of supply vessels for each quarter of years 2008 and 2009*