ACTIVITY OF THE SPANISH PURSE SEINE FLEET IN THE INDIAN OCEAN AND BY-CATCH DATA OBTAINED FROM OBSERVER PROGRAMMES CONDUCTED IN 2003 AND 2004

by

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Abstract

This preliminary document shows some of the results obtained to date under the PNDB undertaken by the Spanish Oceanographic Institute (IEO). The data analysed was obtained during 11 campaigns with observers from the PNDB-IEO in 2003 and 2004, over 336 observation days. The duration of the fishing manoeuvre is seen to increase according to the catch of the set, and the duration of the catch does not depend on the type of school where the catches are made. Practically all of the null sets resulted from fishery over free schools, the most important reason being that the fish slipped through and escaped under the net. By day the search time (33% of total daily activity) is the most important of all. In relation to FADS fishery, the average value per campaign was of 41 sightings or visits (though, depending on the period or vessel behaviour, values may vary considerably: 0 – 123 per trip). On observer campaigns, the average number of objects deployed was 17 per trip (range 0 to 70) and fishing with FADs resulted in around 15 sets per trip (range 2 to 24). And finally, the paper lists the fauna obtained during observer campaigns, including the scientific name of the species, the family to which it belongs, abbreviation (subsequently used in the graphs) and incidence over object or free school.

1. Introduction

Observer data provides valuable information about different aspects of fisheries. It is essential that such data be analysed with the utmost care, owing to important biases that may occur when coverage is low or extrapolation is performed without bearing in mind strata (space, time, fleet, type of fishery, etc), which minimise these biases through statistical analysis.

Data collection by scientific observers accompanying the European purse seine fleet in the Indian Ocean—as is the case with the Spanish fleet—is included in a National Database Plan (PNDB), which aims to collect information about fishery aspects that cannot be obtained from fishing logs, sampling in port and offloads.

This preliminary document shows some of the results obtained to date under the PNDB undertaken by the Spanish Oceanographic Institute (IEO).

The information presented covers four areas: broadly speaking, the data obtained to date and their relation to fishery data, a more detailed analysis of the duration of fishing manoeuvres, data about fishing over floating objects and, finally, accessory fauna in purse seine catches per school type.

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The duration of the fishing manoeuvre is a basic parameter for fisheries where the search time is used as a unit of effort. Subsequently, the time used in casting the net, hauling the fish on board and hauling in the net must be subtracted from the total search time. This time will vary according to the number of sets undertaken and the resulting catches.

Considerable information has been obtained about tropical tuna catches over artificial floating objects, but very little is known about the behaviour of tuna boats with objects in their area of action and during a trip (number of visits made to an object, how many are successful, number of objects deployed, etc).

Moreover, in addition to target species, tropical tuna purse seine fisheries catch several accessory species that are associated with free schools of tuna and particularly with floating objects. Aside from minor tuna not targeted by the fleet, accessory species include other species of fish and turtles and more rarely (in the case of the Indian and Atlantic Oceans) cetaceans. This document analyses the various groups of accessory species.

2. Material and methods

The data analysed was obtained during 11 campaigns with observers from the PNDB-IEO in 2003 and 2004, over 336 observation days.

These data have been grouped into half-hourly intervals to analyse the sets. The duration of the null sets per type of association (free school and FADs) has also been studied. Likewise, the positive sets have been grouped according to type of association, by considering the size of the catch obtained in each set.

Observers complete a form referring to “objects” each time the vessel performs an operation connected to a FAD. The objects are grouped into “deployed”, “visited” and “fished”, and several data are taken from each operation. This document only analyses data from the “nature or type of object” and the future use of each object, in each of the operations connected to the FADs.

Five groups of accessory species have been considered for data concerning accompanying fauna: billfishes, sharks, turtles, other fish and cetaceans—though no catch was produced for the latter group. In turn, the data have been grouped according to the fishing mode (object and free school). Given the scarce coverage, the data have not been extrapolated to the entire fishery.

3. Results

Table 1 gives the most important data about PNDB-IEO observer activity, divided into six month periods, in 2003 and 2004.

Table 2 compares a series of data from the fishery and the PNDB-IEO for 2003 and 2004.

By way of example, Figure 1 graphically shows some of the routes followed by the purse seiners on a trip (night and day), as well as the location of the fisheries.

Figure 2 displays the location of the sets per type of association, undertaken in the presence of observers.

Figures 3 and 4 show the distribution of the duration of the fishing manoeuvre according to the catch per set in both types of association (free schools and FADs). The duration of the fishing manoeuvre is seen to increase according to the catch of the set, and the duration of the catch does not depend on the type of school where the catches are made.

The existence of sets that are too lengthy—because of high catches or fishing incidents—hinders the adjustment criteria (D. Gaertner, 1999). To date, there have been very few sets of long duration (over 4 hours). Consequently, they have not been analysed.

Figure 5 gives the duration and number of null sets per association. Most null sets are collected in under two hours. Similarly, most null sets occur in those aimed at free schools.

A set aimed at a free school lasts on average 2 hr 24 min., while sets over target schools last 3 hr 6 min. This may be due to the fact that the size of the fish caught influences the time taken to haul in the gear when a large amount of fish have been enmeshed (Delgado de Molina, 97).

Figure 6 explains why the set was not performed after sighting a shoal (jumping, birds, etc) or a floating object. In both cases, detection was not accompanied by fish, and the school was very small.

Figure 7 gives the reasons for a null set. Practically all of the null sets resulted from fishery over free schools, the most important reason being that the fish slipped through and escaped under the net.

Figure 8 shows the distribution—in percentages—of the average time devoted by each vessel to each activity. Evidently the most important is the impossibility of performing activities at night (except for navigation). By day the search time (33% of total daily activity) is the most important of all.

Table 3 gives the results of tuna boat behaviour with floating objects from 11 observer campaigns analysed to date.

The most important activity is the periodic visit or random sighting of FADs. The average value per campaign was of 41 sightings or visits (though, depending on the period or vessel behaviour, values may vary considerably: 0 – 123 per trip). On observer campaigns, the average number of objects deployed was 17 per trip (range 0 to 70) and fishing with FADs resulted in around 15 sets per trip (range 2 to 24).

Most activities related to objects are undertaken using artificial floating objects. For fisheries, the most important is fishing over floating objects, followed by fishing with trees (9%), fishing over randomly found objects which were then buoyed (8%), and with supply vessels (6%).

Figure 9 shows the distribution of operations carried out with FADs. Figure 10 shows the various operations performed with aggregated objects according to type. The raft with buoy (most used conventional object) is involved in most operations (visit, deployment and fishing). Finally, Figure 11 shows the future of the visited and “fished” objects. In most cases, the object is abandoned, but a significant percentage is buoyed for follow-up. No floating objects have been reported as having been destroyed.

As for associated fauna, Table 4 lists the fauna obtained during observer campaigns, including the scientific name of the species, the family to which it belongs, abbreviation (subsequently used in the graphs) and incidence over object or free school.

Figure 12 shows the catches of the various groups of accessory fauna in tonnes and number, and over object and free school. The figure above includes a column for sharks (except the whale-shark), and below the other groups have been considered except other fish.

Figure 13 shows give the weight ratio and number of the various groups of accessory fauna caught over FADs and free schools.

Figures 14 to 17 give the weight ratio and number of the main species caught over objects and free schools billfishes, sharks, other fish and turtles, respectively.

4. BIBLIOGRAPHY

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GAERTNER, D., 1999. Programa de Investigación IRD / IEO. Eficacia de los atuneros cerqueros y esfuerzos reales (ESTHER). Mimeo. Proyecto 98 / 061 de la DG XIV de la UE.

	1º quarter 2003	2º quarter 2003	1º quarter 2004	2º quarter 2004
Nº trips	1	3	1	6
Nº observation days	18	84	7	227
Nº + set free school	1	6	4	24
Nº - set free school	2	6	3	23
Nº + set object	2	48	1	100
Nº - set object	0	1	0	3
Total catch free school	20	652	73	1236
Total catch object	78	2880	18	4554
Discard free school	0.0	1.0	0.0	54.0
Discard object	0.0	95.0	0.0	232.0

Table 1. Number of campaigns, observation days and number of sets, catches and discards per mode of fishing.

Year	2003	2004
	nº fishing days	
Observers	102	234
Fishery	4468	4730
	Total catch	
Observers	3630	4572
Fishery	176200	154106
	nº sets	
Observers	66	158
Fishery	3801	4247

Table 2. Comparison of fishery data and data obtained by PNDB-IEO observers.

Indian Ocean 2003-2004	**PNDB IEO**	**Observers FAD's**		
	Nº Trips	**11**		
		visited	**deployed**	**fished**
	FAD's	448	189	163
	Average / trip	41	17	15
Code	**FAD type**	%	%	%
3	**Tree**	7.4	1.1	9.2
4	**Carrion**	0.2		
6	**Raft with buoy**	64.1	92.6	61.3
9	**Supply**			6.1
10	**Box**	6.0	1.1	3.1
11	**Ropes**	2.7		1.8
12	**Net**	0.2		
13	**Plastic**	1.6	0.5	2.5
14	**Previous**	6.7	1.1	8.0
99	**Others**	11.2	3.7	8.0
Code	**FAD's Devenir**	%		%
1	**Abandoned**	47.1		39.9
2	**Bouyed**	23.9		25.2
3	**Hauled on board**	11.6		9.2
4	**Destroyed**			
5	**Sunk**	0.2		
9	**Others**	17.2		25.8

Table 3. Operations with objects: visited, deployed and fished according to type and future of the object in %.

Fishes / Peces

Family / Familia	Species / Especie		Name / Nombre - FishBase		COD.
Lamnidae	***Isurus oxyrinchus*** Rafinesque 1810		Shortfin mako		**IOX**
	Marrajo dientuso / Carito	OBJETO: 1		BANCO LIBRE: 0	
Rhincodontidae	***Rhincodon typus*** Smith 1828		Whale shark		**RTY**
	Tiburón ballena	OBJETO: 1		BANCO LIBRE: 1	
Carcharhinidae	***Carcharhinus longimanus*** (Poey 1861)		Oceanic whitetip shark		**CLO**
	Tiburón oceánico / Cazón	OBJETO: 28		BANCO LIBRE: 3	
Carcharhinidae	***Carcharhinus falciformis*** (Müller & Henle 1839)		Silki shark		**CFA**
	Jaquetón	OBJETO: 75		BANCO LIBRE: 3	
Sphyrnidae			Hammerhead		**FSP**
	Peces martillo	OBJETO: 1		BANCO LIBRE: 0	
Sphyrnidae	***Sphyrna lewini*** (Griffith & Smith 1834)		Scalloped hammerhead		**SLE**
	Cornuda común	OBJETO: 0		BANCO LIBRE: 1	
Dasyatidae			Stingrays		**FDA**
		OBJETO: 2		BANCO LIBRE: 2	
Dasyatidae	***Dasyatis violacea*** (Bonaparte 1832)		Pelagic stingray		**DVI**
	Chucho	OBJETO: 4		BANCO LIBRE: 1	
Myliobatidae	***Manta birostris*** (Walbaum 1792)		Giant manta		**MBA**
	Manta gigante / Manta	OBJETO: 2		BANCO LIBRE: 0	
Myliobatidae	***Mobula mobular*** (Bonnaterre 1788)		Devil fish		**MOM**
	Manta	OBJETO: 0		BANCO LIBRE: 7	
Myliobatidae	***Mobula tarapacana*** (Philippi 1893)		Chilean devil ray		**MCO**
	Diablo gigante de Guinea	OBJETO: 1		BANCO LIBRE: 0	
RAJIFORMES			Rays		**RAX**
	Raya NO IDENTIFICADA	OBJETO: 1		BANCO LIBRE: 1	
Belonidae			Needlefishes		**FBL**
		OBJETO: 4		BANCO LIBRE: 0	
Belonidae	***Ablennes hians*** (Valenciennes 1846)		Fiat needlefish		**BEA**
	Aguja americana	OBJETO: 6		BANCO LIBRE: 0	
Belonidae	***Tylosurus crocodilus*** (Péron & Lesueur 1821)		Hound needlefish		**TCC**
	Aguja	OBJETO: 1		BANCO LIBRE: 0	
Fistulariidae			Cornetfishes		**FFI**
		OBJETO: 0		BANCO LIBRE: 1	
Carangidae			Jacks and pompanos		**FCR**
	Carángidos	OBJETO: 8		BANCO LIBRE: 0	
Carangidae	***Decapterus macarellus*** (Cuvier 1833)		Mackerel scad		**CLM**
	Antonino	OBJETO: 50		BANCO LIBRE: 0	
Carangidae	***Caranx sexfasciatus*** Quoy & Gaimard 1825		Bigeye trevally		**CRS**
	Caballa	OBJETO: 50		BANCO LIBRE: 0	
Carangidae	***Caranx crysos*** (Mitchill 1815)		Blue runner		**CRY**
	Cojinua negra	OBJETO: 1		BANCO LIBRE: 0	
Carangidae	***Seriola rivoliana*** Valenciennes 1833		Almaco jack		**SER**
	Blanquilla / Pez limón	OBJETO: 19		BANCO LIBRE: 0	
Carangidae	***Naucrates ductor*** (Linnaeus 1758)		Pilotfish		**NAD**
	Pez piloto	OBJETO: 1		BANCO LIBRE: 2	
Carangidae	***Elagatis bipinnulata*** (Quoy & Gaimard 1825)		Rainbow runner		**ELP**
	Banano / Macarela salmón	OBJETO: 103		BANCO LIBRE: 3	

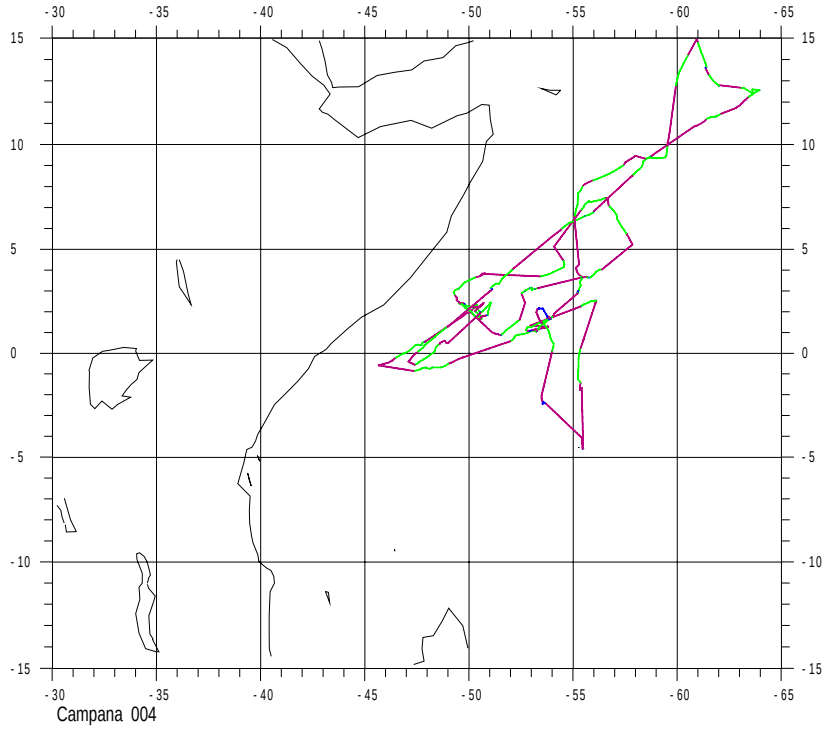
Family / Familia	Species / Especie	Name / Nombre - FishBase	COD.
Carangidae	***Uraspis secunda*** (Poey 1860)	Cottonmouth jack	**CUS**
	Jurel volantín / Boca blanca OBJETO: 51	BANCO LIBRE: 1	
Carangidae	***Uraspis helvola*** (Forster, 1801)	Whitemouth jack	**CUH**
	Caramelo OBJETO: 24	BANCO LIBRE: 0	
Coryphaenidae		Dolphinfishes	**FCO**
	OBJETO: 1	BANCO LIBRE: 1	
Coryphaenidae	***Coryphaena hippurus*** Linnaeus 1758	Common dolphinfish	**COH**
	Lampuga / Dorado común OBJETO: 98	BANCO LIBRE: 3	
Coryphaenidae	***Coryphaena equiselis*** Linnaeus 1758	Pompano dolphinfish	**COE**
	Dorado OBJETO: 1	BANCO LIBRE: 0	
Lobotidae	***Lobotes surinamensis*** (Bloch 1790)	Atlantic tripletail	**LOB**
	Dormilona OBJETO: 61	BANCO LIBRE: 1	
Echeneidae		Remoras	**FEC**
	Rémoras OBJETO: 1	BANCO LIBRE: 0	
Echeneidae	***Remora remora*** (Linnaeus 1758)	Common remora	**REM**
	Rémora OBJETO: 3	BANCO LIBRE: 1	
Echeneidae	***Remorina albescens*** (Temminck & Schlegel 1845)	White suckerfish	**REA**
	Pegador OBJETO: 1	BANCO LIBRE: 0	
Echeneidae	***Remora australis*** (Bennett, 1840)	Whalesucker	**RAU**
	Rémora OBJETO: 1	BANCO LIBRE: 0	
Kyphosidae	***Kyphosus cinerascens*** (Forsskål 1775)	Blue sea chub	**KPC**
	OBJETO: 17	BANCO LIBRE: 0	
Kyphosidae	***Kyphosus sectatrix*** (Linnaeus 1766)	Bermuda sea chub	**KPS**
	Chopón OBJETO: 23	BANCO LIBRE: 1	
Kyphosidae	***Kyphosus vaigiensis*** (Quoy & Gaimard 1825)	Brassy chub	**KPV**
	OBJETO: 6	BANCO LIBRE: 0	
Kyphosidae	***Kyphosus*** spp	Sea chubs	**FKY**
	OBJETO: 1	BANCO LIBRE: 0	
Pomacentridae		Damselfishes	**FPO**
	OBJETO: 1	BANCO LIBRE: 0	
Ephippidae	***Platax*** spp	Batfishes	**PLS**
	OBJETO: 6	BANCO LIBRE: 0	
Zanclidae	***Zanclus cornutus*** (Linnaeus 1758)	Moorish idol	**ZAC**
	Ídolo moro OBJETO: 0	BANCO LIBRE: 1	
Scombridae	***Acanthocybium solandri*** (Cuvier 1832)	Wahoo	**WAH**
	Peto OBJETO: 60	BANCO LIBRE: 2	
Istiophoridae		Billfishes	**FIS**
	Peces con espada OBJETO: 8	BANCO LIBRE: 1	
Istiophoridae	***Istiophorus platypterus*** (Shaw & Nodder 1792)	Indo-Pacific sailfish	**SAP**
	Pez vela del Índico OBJETO: 1	BANCO LIBRE: 0	
Istiophoridae	***Makaira nigricans*** Lacepède 1802	Atlantic blue marlin	**BUM**
	Aguja azul OBJETO: 1	BANCO LIBRE: 0	
Istiophoridae	***Makaira indica*** (Cuvier 1832)	Black marlin	**BLM**
	Aguja negra OBJETO: 19	BANCO LIBRE: 1	
Istiophoridae	***Tetrapturus audax*** (Philippi 1887)	Striped marlin	**STM**
	Marlín rayado OBJETO: 17	BANCO LIBRE: 0	

Family / Familia	Species / Especie		Name / Nombre - FishBase		COD.
Istiophoridae	***Tetrapturus angustirostris*** Tanaka 1915		Shortbill spearfish		**SHS**
	Marlín trompa corta	OBJETO: 2		BANCO LIBRE: 1	
Xiphiidae	***Xiphias gladius*** Linnaeus 1758		Swordfish		**SWO**
	Pez espada	OBJETO: 1		BANCO LIBRE: 0	
Gempylidae	***Ruvettus pretiosus*** Cocco 1833		Oilfish		**RUP**
	Escolar clavo	OBJETO: 8		BANCO LIBRE: 0	
Sphyraenidae	***Sphyraena barracuda*** (Walbaum 1792)		Great barracuda		**SPB**
	Barracuda	OBJETO: 17		BANCO LIBRE: 1	
Tetraodontidae			Puffers		**FTT**
		OBJETO: 1		BANCO LIBRE: 0	
Tetraodontidae	***Lagocephalus lagocephalus*** (Linnaeus 1758)		Oceanic ouffer		**LLA**
	Botete oceánico	OBJETO: 0		BANCO LIBRE: 2	
Diodontidae			Porcupinefishes		**DIO**
		OBJETO: 0		BANCO LIBRE: 1	
Diodontidae	***Diodon hystrix*** Linnaeus 1758		Spot-fin porcupinefish		**DIH**
	Pez erizo	OBJETO: 3		BANCO LIBRE: 0	
Monacanthidae	***Aluterus scriptus*** (Osbeck 1765)		Scrawled filefish		**BAS**
	Cachua	OBJETO: 4		BANCO LIBRE: 0	
Monacanthidae	***Aluterus monoceros*** (Linnaeus 1758)		Unicorn leatherjacket		**BAT**
	Chivo	OBJETO: 27		BANCO LIBRE: 0	
Balistidae			Triggerfishes		**FBA**
		OBJETO: 5		BANCO LIBRE: 0	
Balistidae	***Canthidermis maculata*** (Bloch 1786)		Spotted oceanic trigerfish		**BCM**
	Pinchudo	OBJETO: 103		BANCO LIBRE: 1	

Sea Turtles / Tortugas marinas

Family / Familia	Species / Especie		Name / Nombre - FAO		COD.
Cheloniidae	***Caretta caretta*** (Linnaeus, 1758)		Loggerhead turtle		**CCC**
	Tortuga boba / Caguama	OBJETO: 2		BANCO LIBRE: 0	
Cheloniidae	***Chelonia mydas*** (Linnaeus, 1758)		Green turtle		**CMM**
	Tortuga verde	OBJETO: 3		BANCO LIBRE: 0	
Cheloniidae	***Eretmochelys imbricata*** (Linnaeus, 1766)		Hawksbill turtle		**EIM**
	Tortuga carey	OBJETO: 4		BANCO LIBRE: 0	
Cheloniidae	***Lepidochelys kempi*** (Garman, 1880)		Kemp's ridley turtle		**LKE**
	Tortuga lora	OBJETO: 1		BANCO LIBRE: 0	

Table 4. List of fauna (scientific name, common name and abbreviations) and incidence of accessory species obtained during observer campaigns, distinguishing between object and free school.



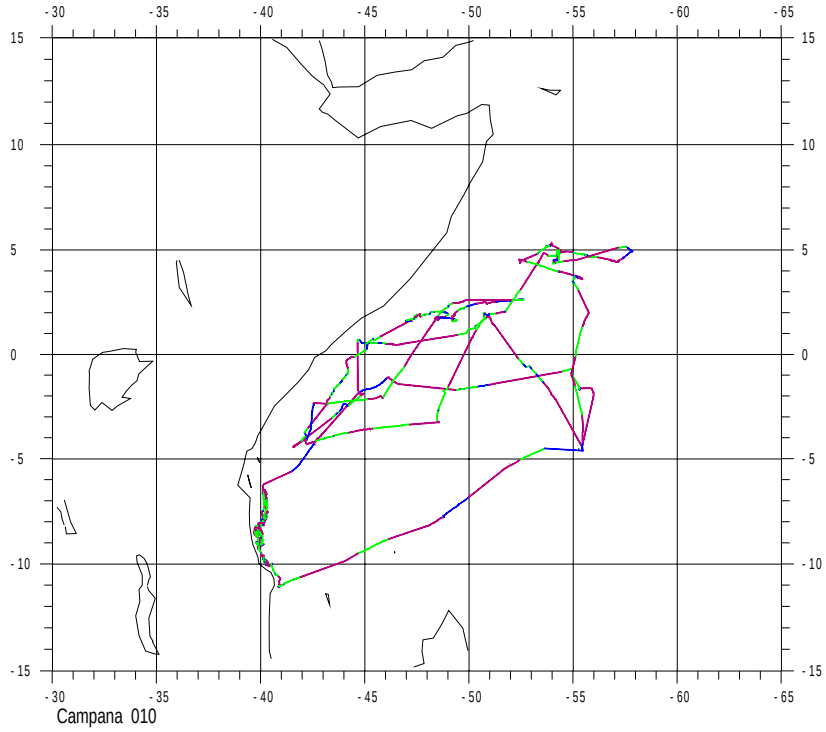


Figure 1. Two examples of trip routes (Green: general search; Blue: object search and Purple: night)

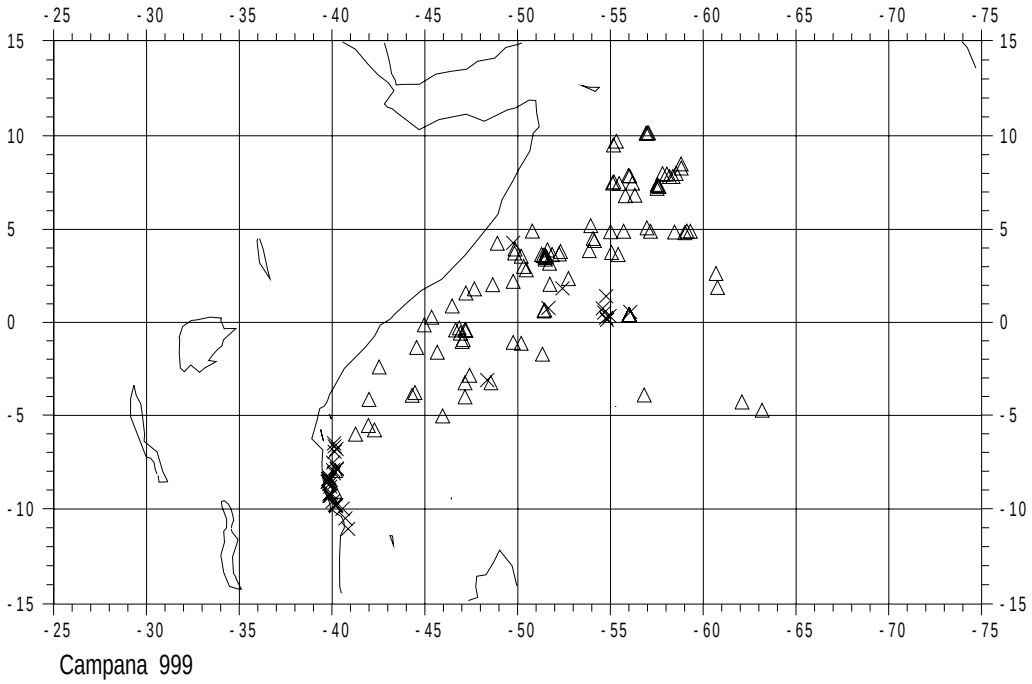


Figure 2. Position of all sets during observer campaigns (X → free school, triangle → object)

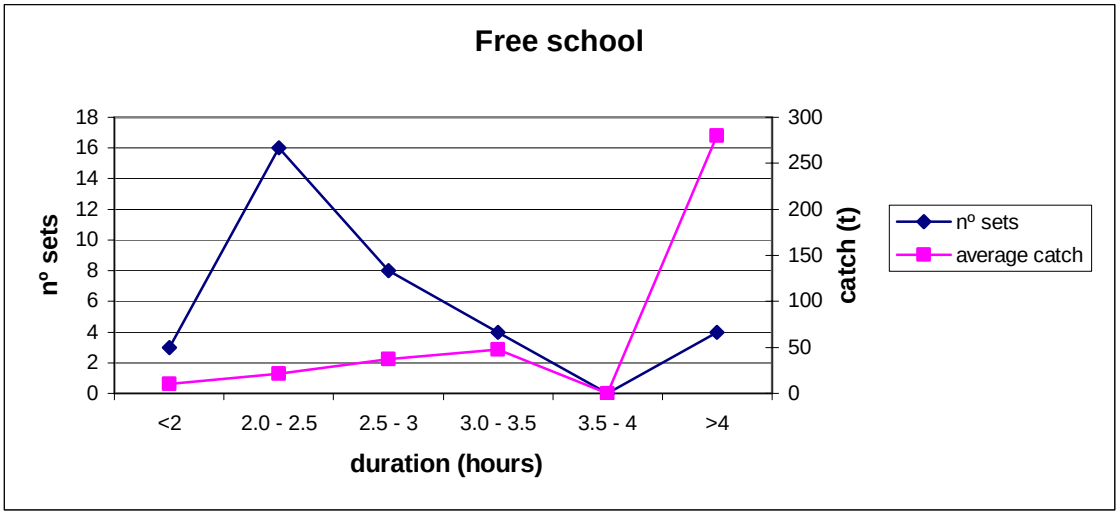


Figure 3. Distribution of positive set duration over free school and average catch obtained.

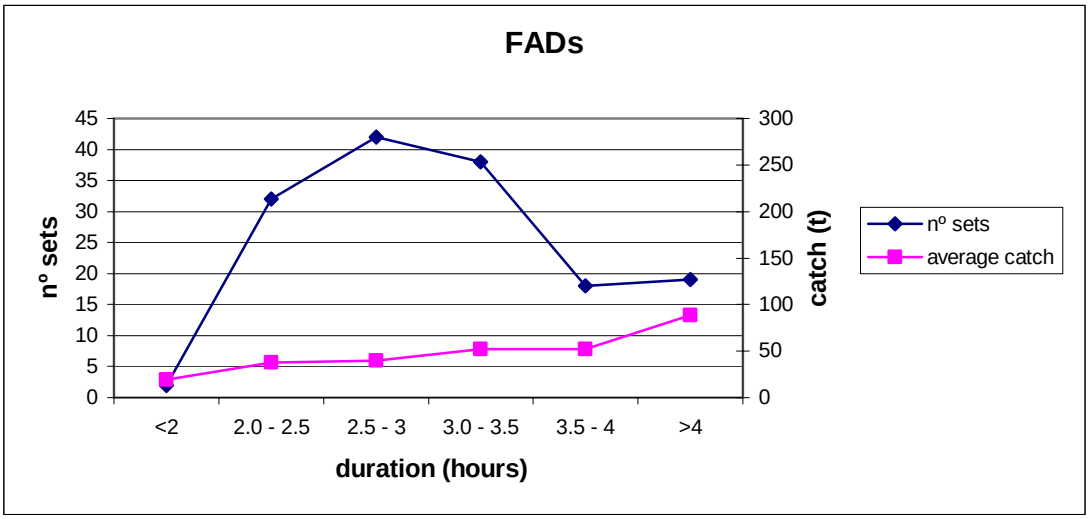


Figure 4. Distribution of positive sets over FAD's and average catch obtained.

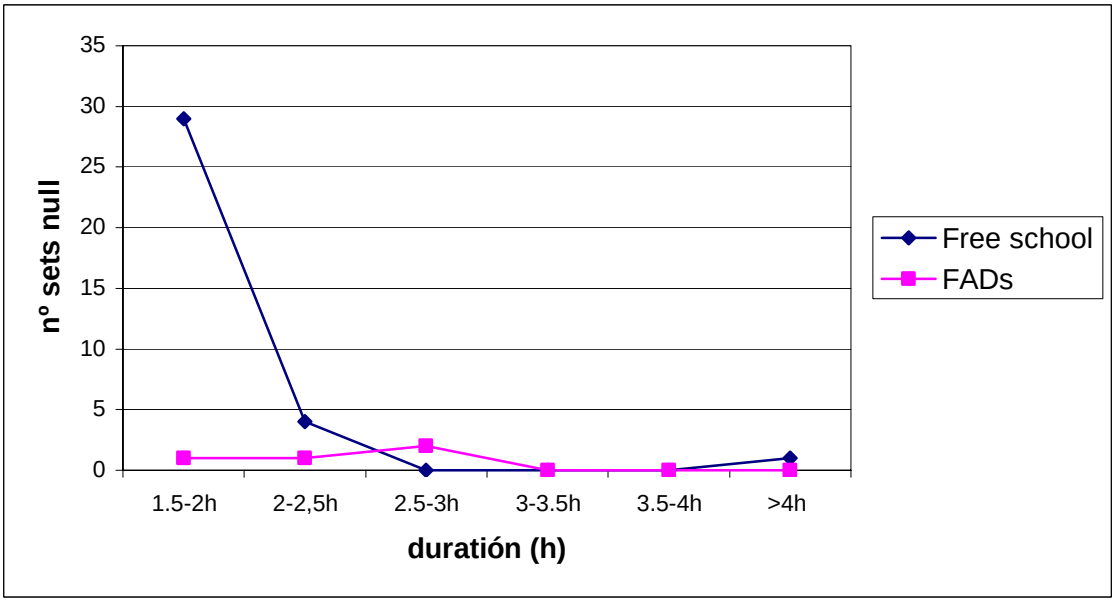


Figure 5. Distribution of null sets per type of association.

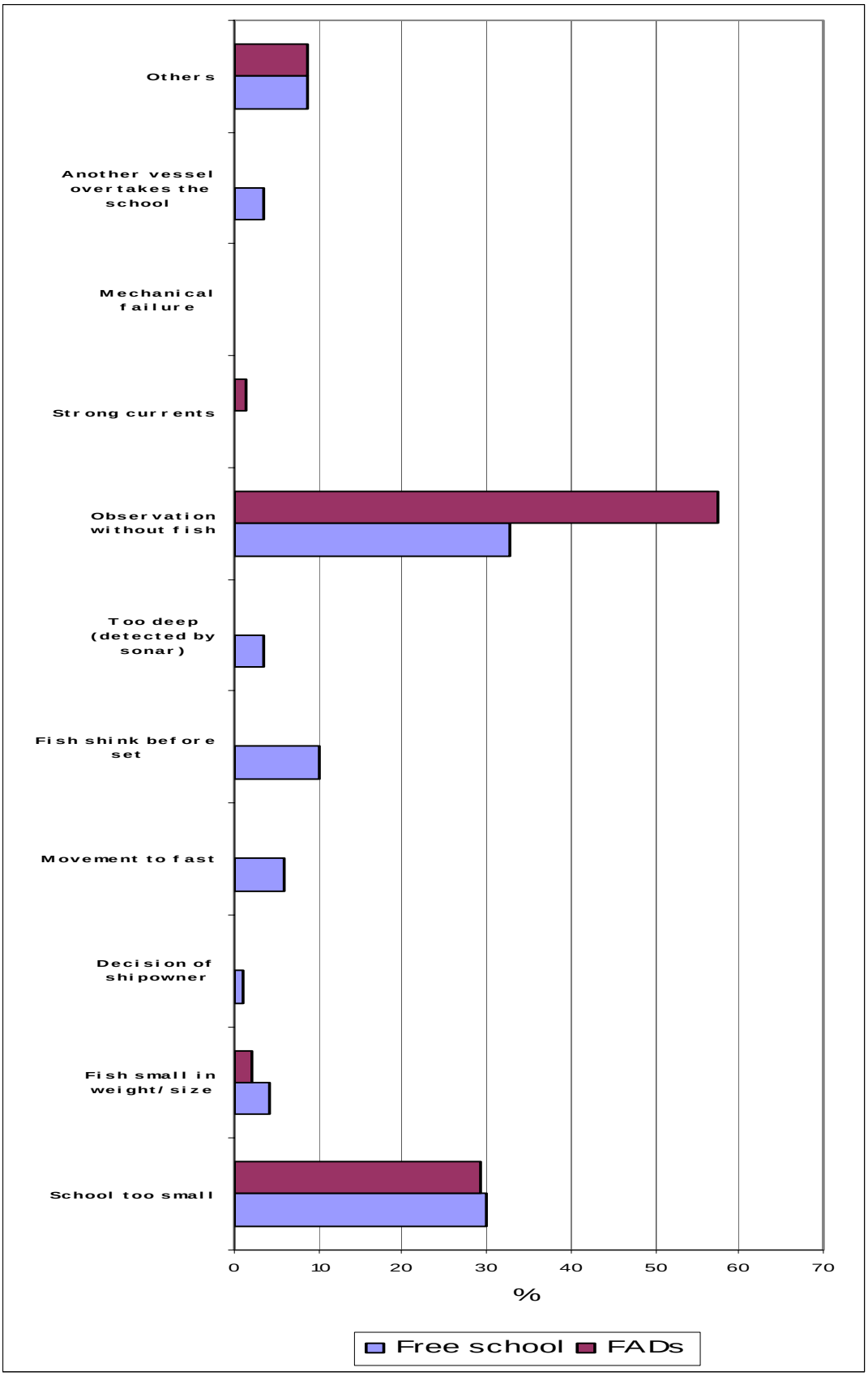


Figure 6. Reasons for not performing a set.

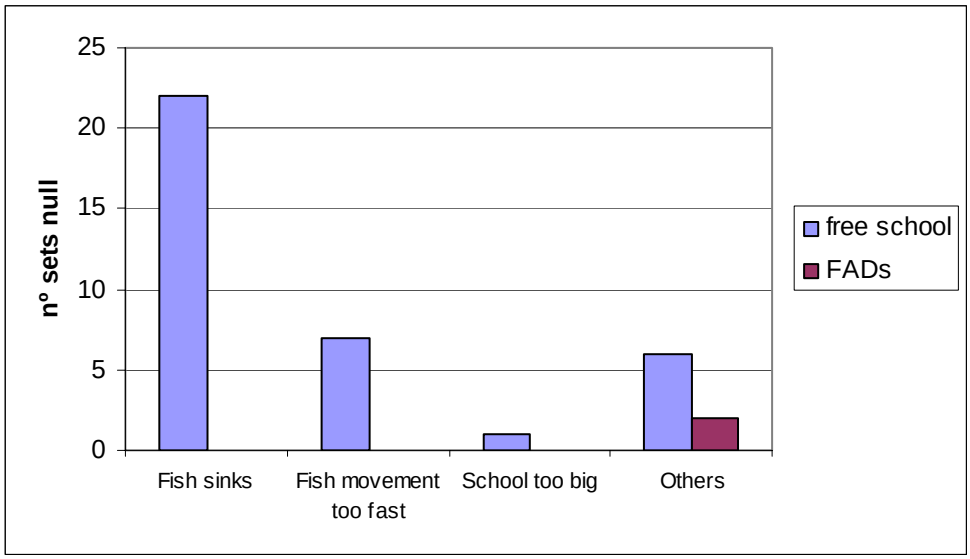


Figure 7. Reasons for null set per type of association.

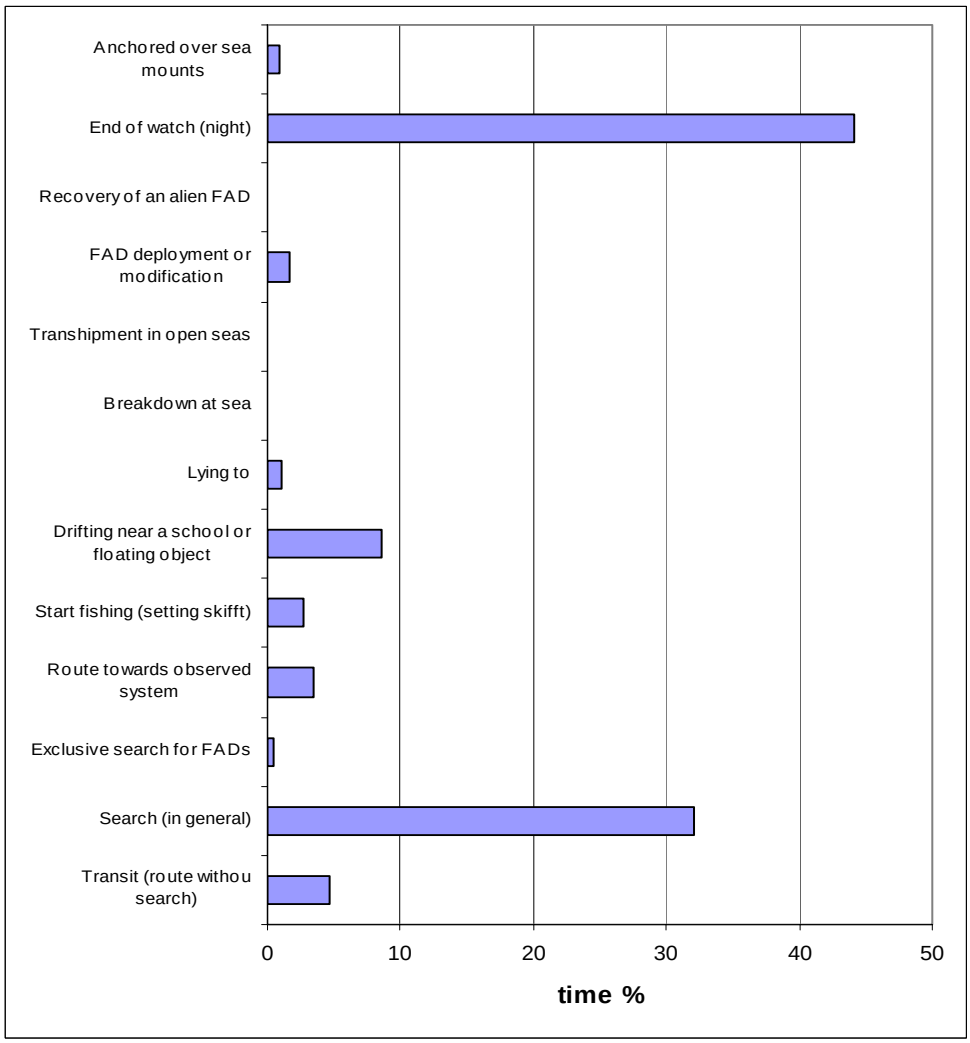


Figure 8. Purse seiner activity.

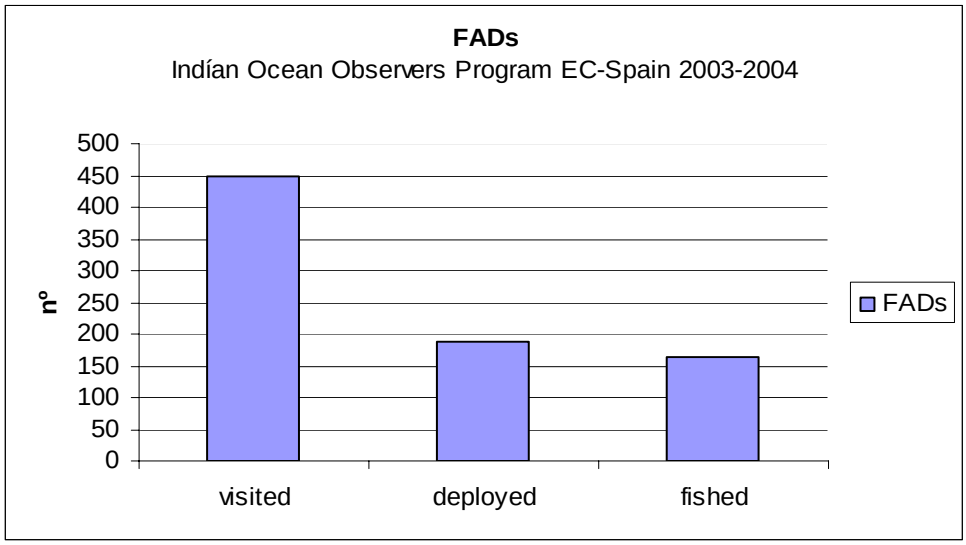


Figure 9. Number of FAD's visited, deployed and fished during 11 PNDB-IEO campaigns.

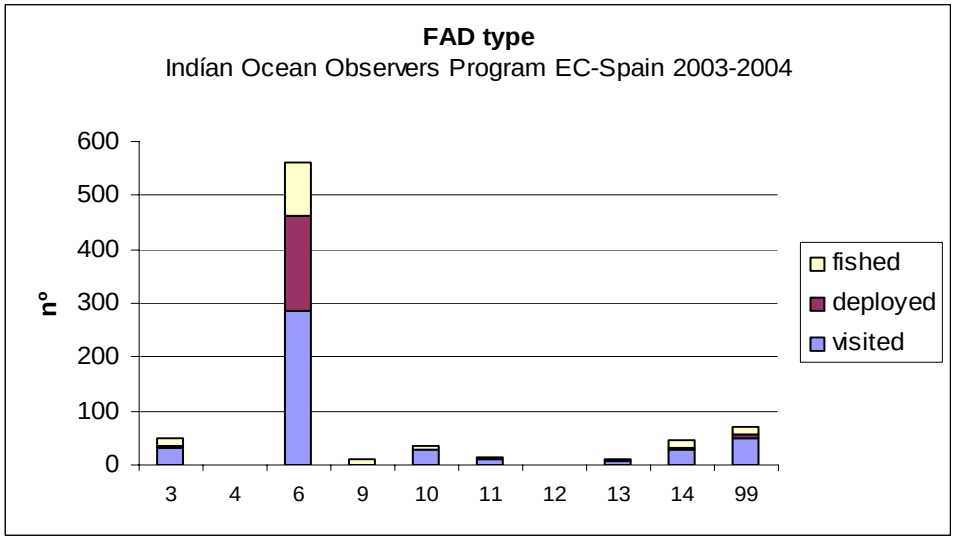


Figure 10. Type of objects fished, visited and deployed (axis *x* codes: see Table 3).

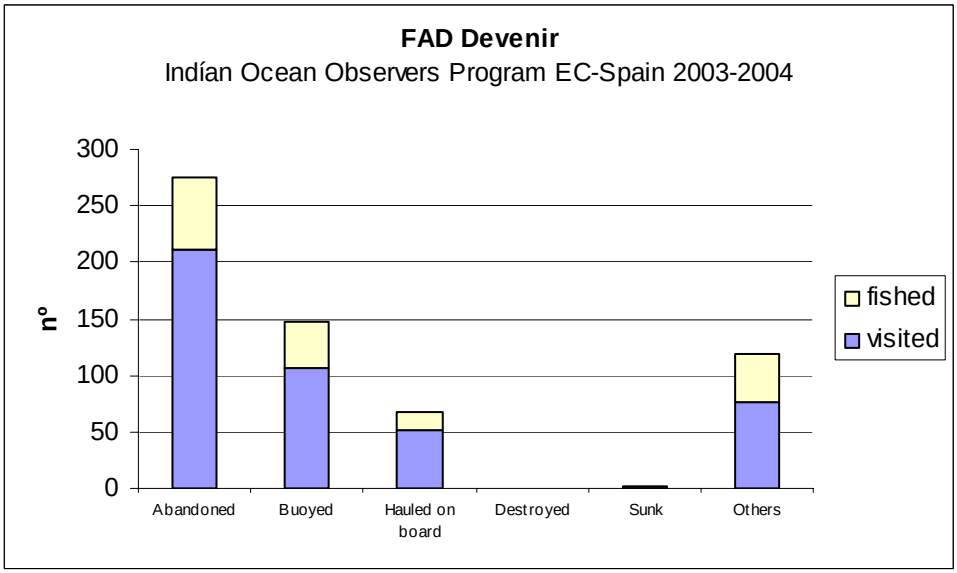
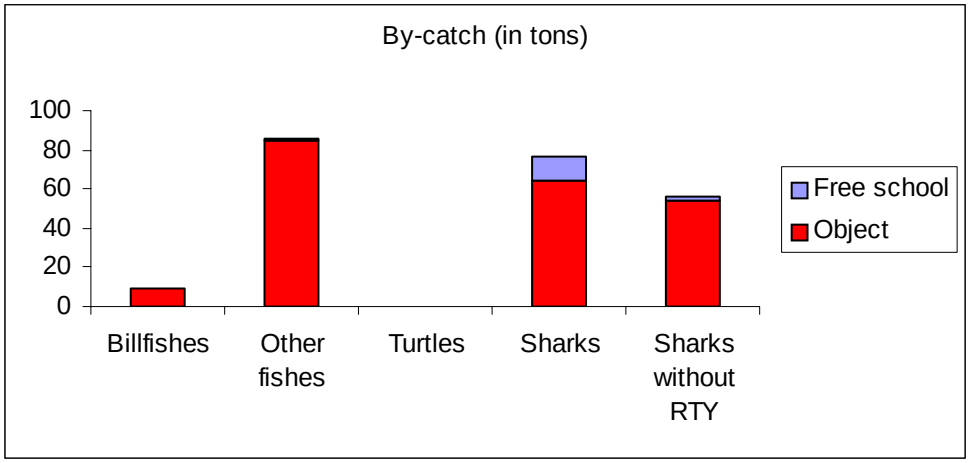
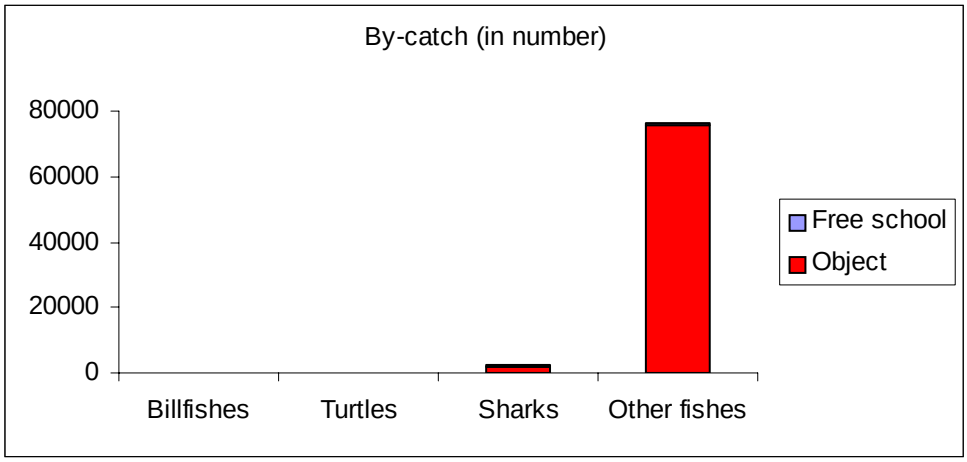


Figure 11. Future of objects fished and visited according to type (in %)





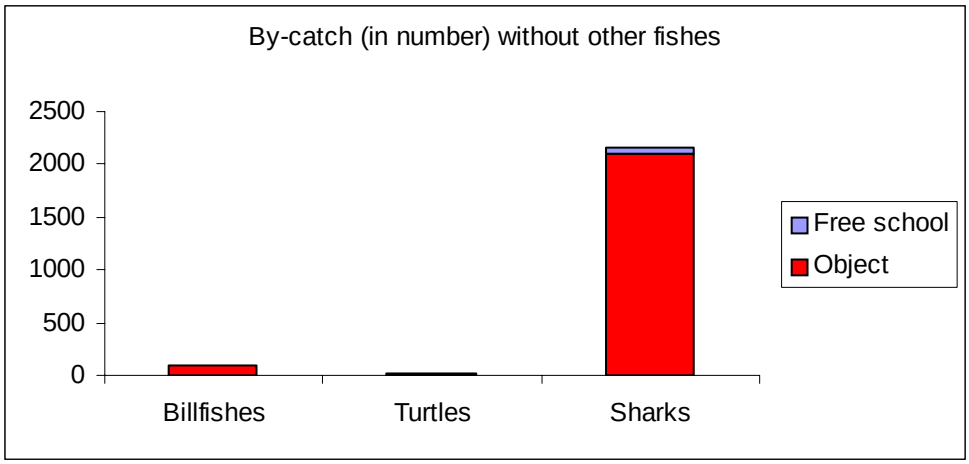


Figure 12. Catch of different groups of accessory fauna in tonnes and number, and over object and free school. Included above is a column of sharks—except whale-shark—and below the various groups of other fish have been considered.

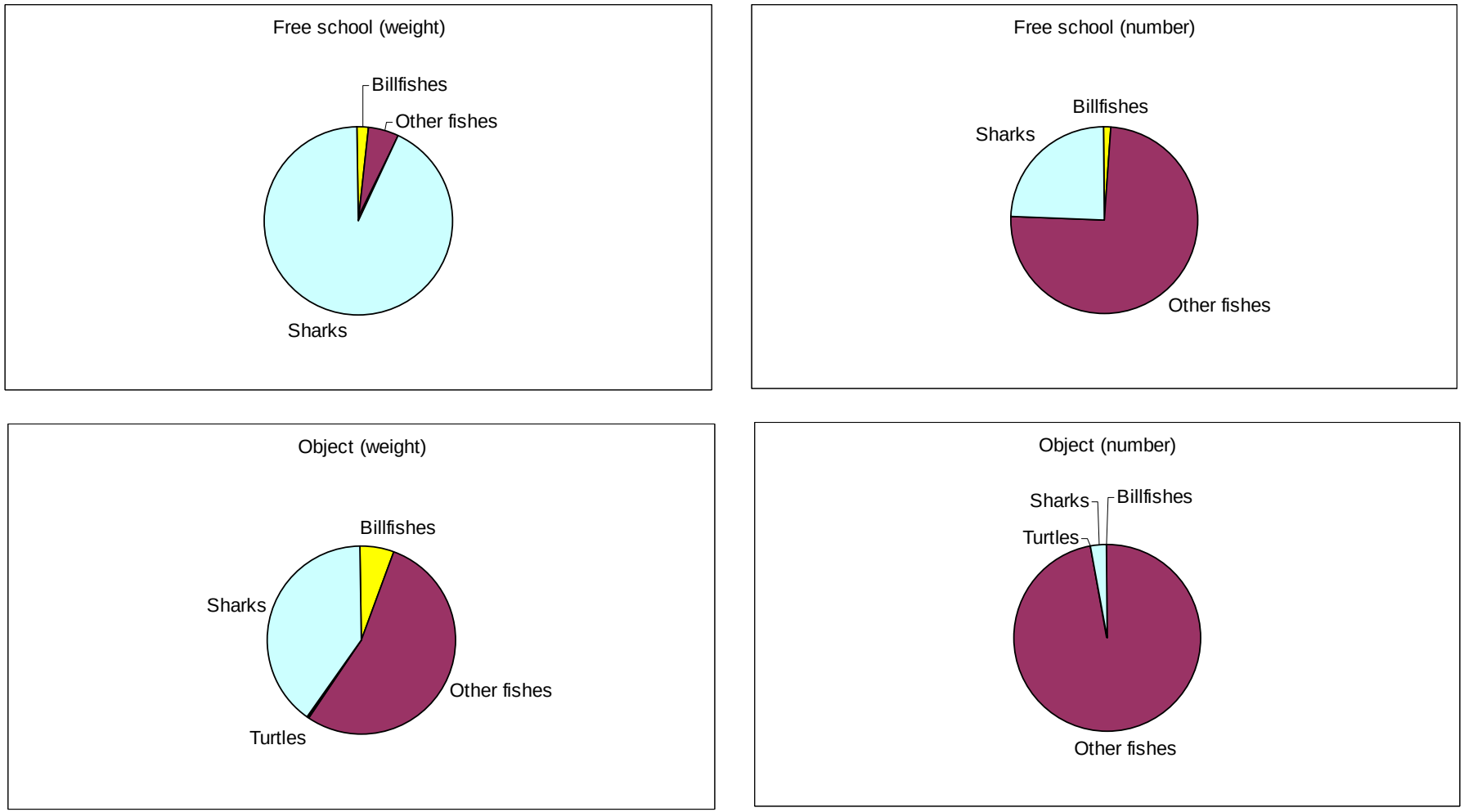


Figure 13. Weight ratio and number of various groups of accessory fauna caught over object and free school.

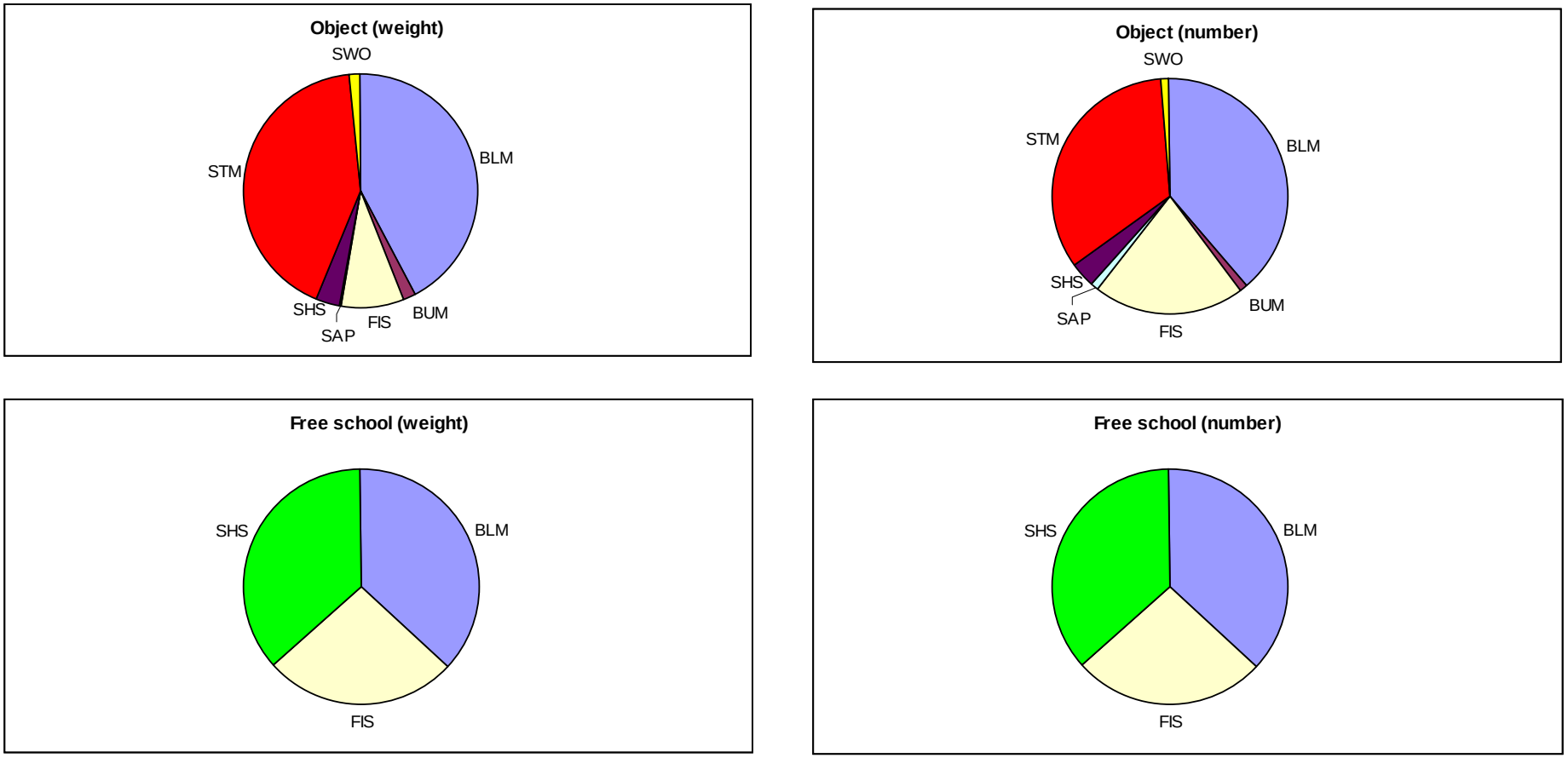


Figure 14. Weight ratio and number of main species of billfishes caught over objects and free school.

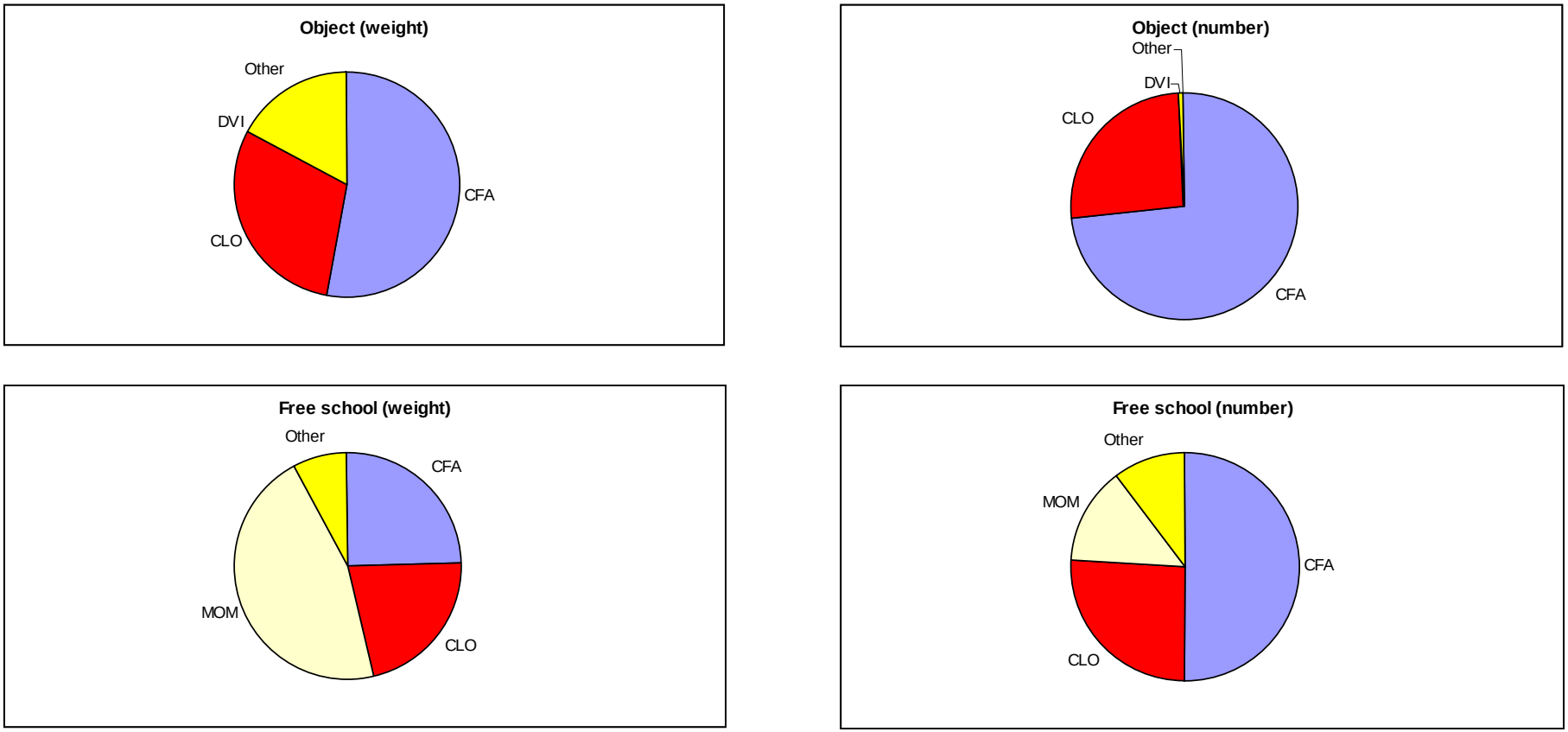
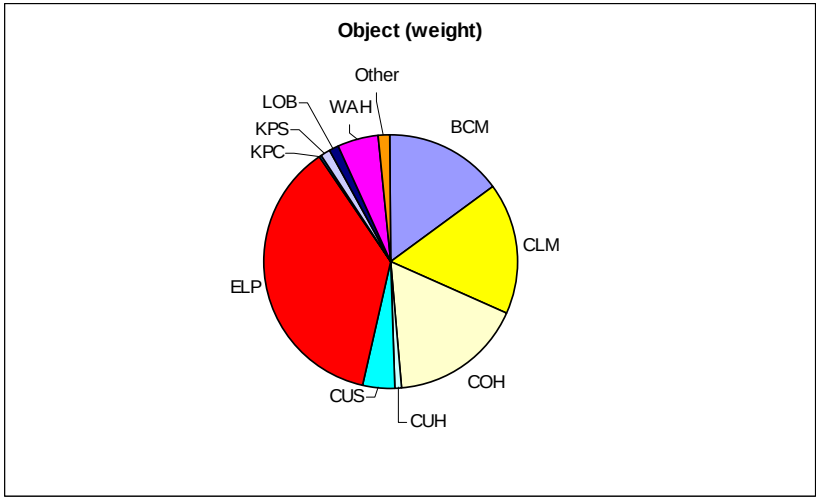
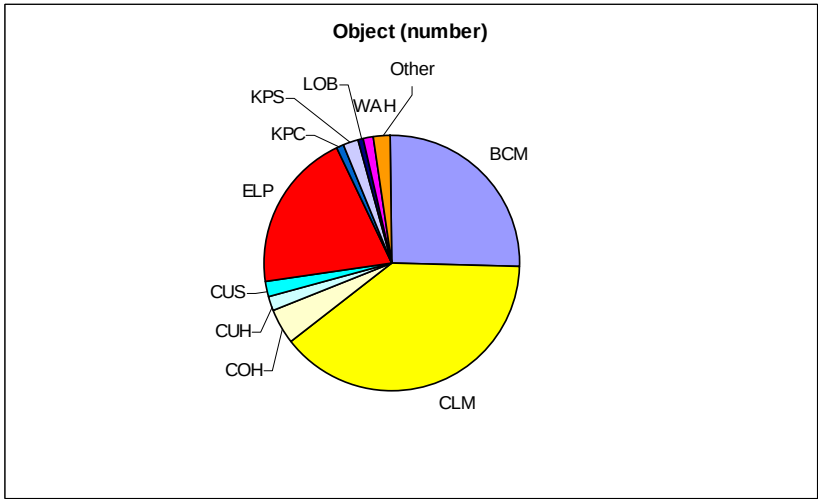
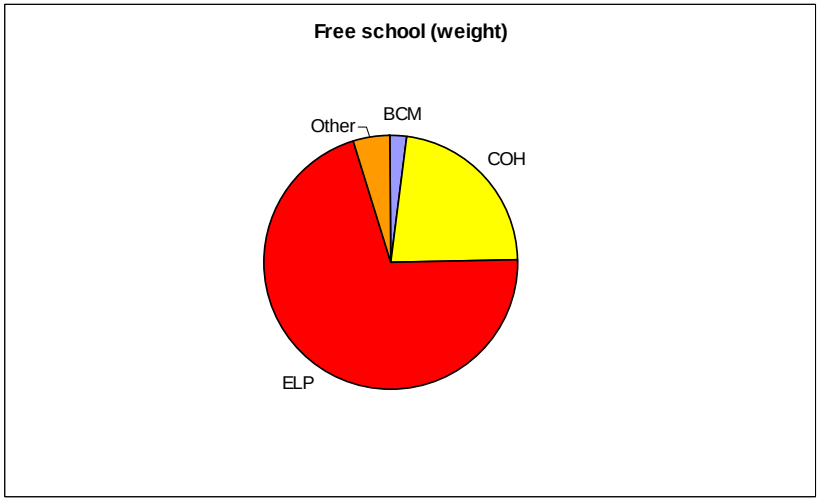


Figure 15. Weight ratio and number of main species of sharks caught over objects and free school.







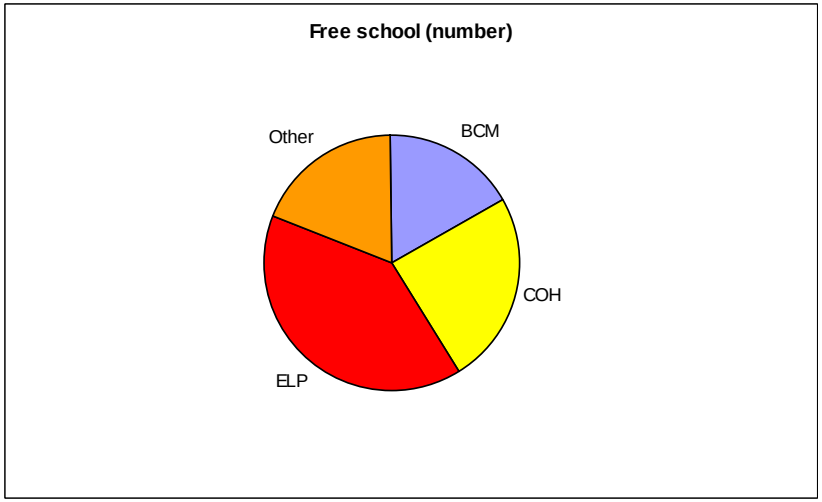


Figure 16. Weight ratio and number of main species of other fish caught over objects and free school.

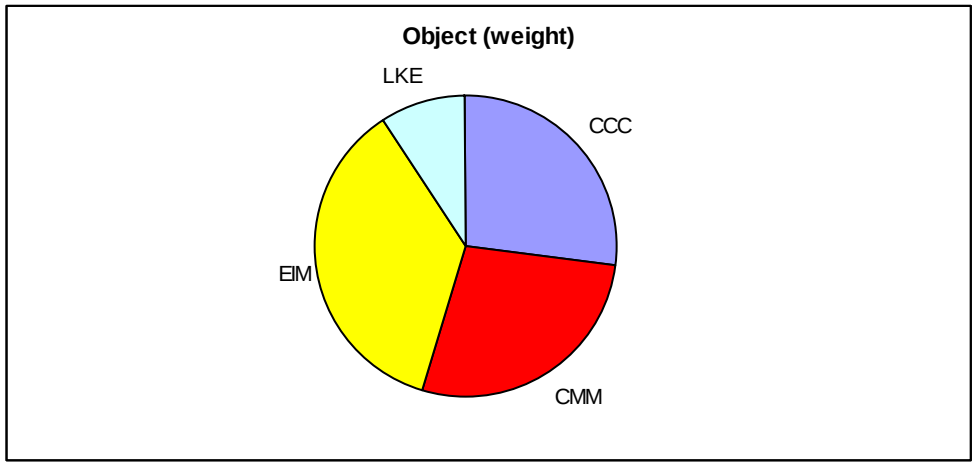


Figure 17. Weight ratio and number of main species of turtles caught over objects.