# CHONDRICHTHYAN OBSERVATIONS WITH ROV IN THE WESTERN MEDITERRANEAN AND SOUTHERN BAY OF BISCAY.

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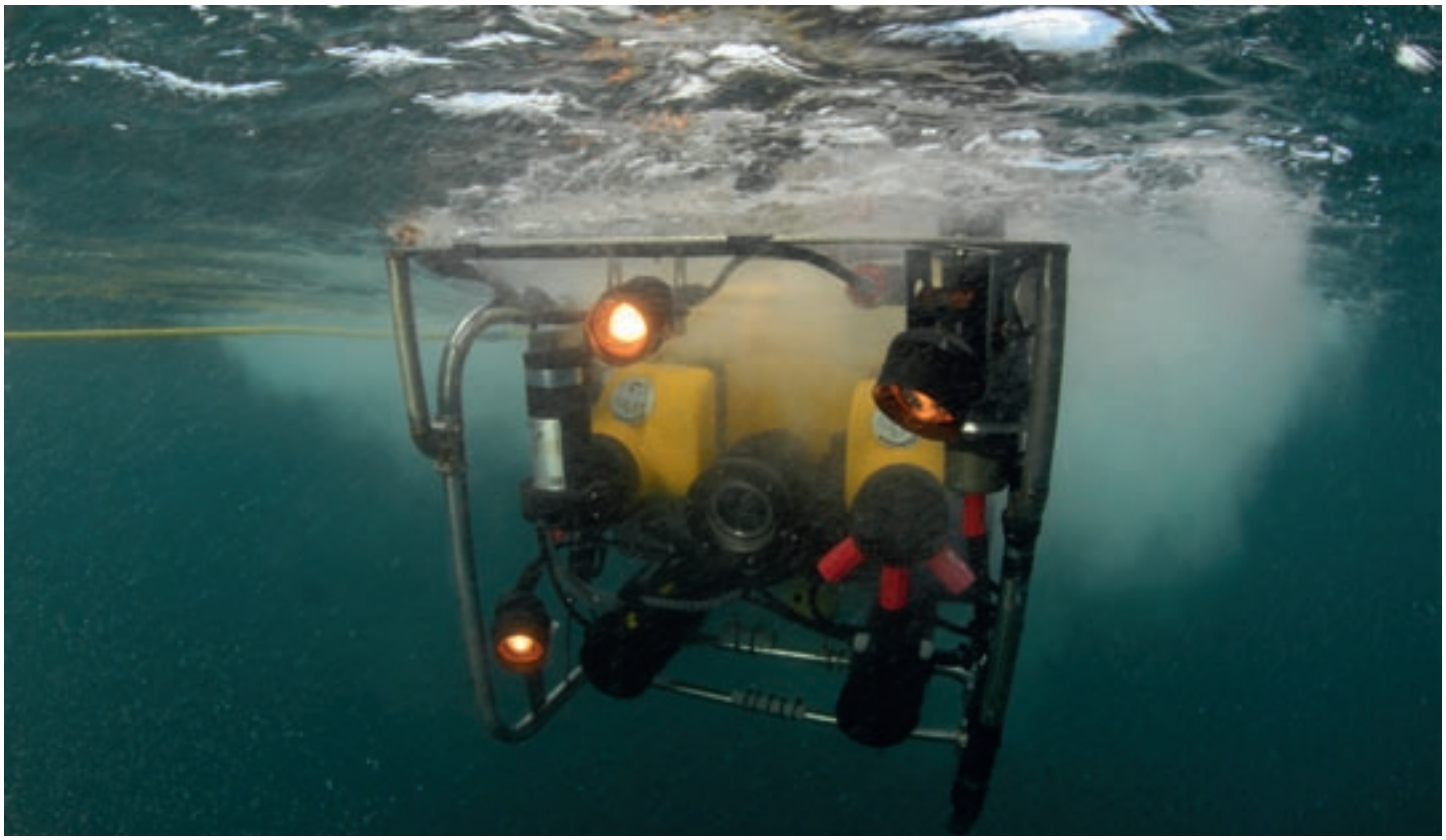

## SUMMARY

In 2006, 2007 and 2008, Oceana employed an ROV to complete bionomic seabed surveys in the Mediterranean Sea and Bay of Biscay, between 50 and 350 meters depth. Information on positions, depths and times of observations was recorded, providing new data on the geographic distribution and bathymetric range of chondrichthyans. Fourteen species were found: five sharks, eight batoids and one chimaera. A total of 304 individuals were observed: 158 in the Mediterranean and 146 in the Bay of Biscay. The most widespread chondrichthyan observed was *Scyliorhinus canicula*, accounting for 69% of all observations. The densest presence of chondrichthyans in general (56.786 sightings/hr) occurred in the Aceste seamount, Italy, due to the high number of *Galeus blainvillei*. The other species observed were *Hexanchus griseus, Galeus melastomus, Galeus atlanticus, Dasyatis pastinaca, Torpedo marmorata, Raja clavata, Raja montagui, Raja miraletus, Raja naevus, Raja radula, Raja brachyura* and *Chimaera monstrosa*. *Galeus atlanticus* was recorded for the first time in the Bay of Biscay, out of its recorded distribution range of the Alboran Sea, Strait of Gibraltar and surrounding European and African Atlantic waters. The use of an ROV in underwater investigations helps us better understand the chondrichthyan populations which live at deeper depths.

**Key words:**
unmanned vehicles, chondrichthyans, Bay of Biscay, western Mediterranean, *Galeus atlanticus,* seamounts, *Scyliorhinus canicula.*

## INTRODUCTION

Studying the distribution of chondrichthyans in the oceans has always presented us with the difficulty of locating these animals in complicated, vast and rough environments. The majority of the data that we have come from fishery statistics or scientific studies employing various fishing techniques to capture individuals. However, the development of new technologies to study the marine environment, including the use of bathyscaphes, submarines and remotely operated vehicles (ROVs), has opened the doors to observing live animals in their natural environment and, thus, discovering new facets about the lives of these fish which live at deeper depths.

Some 1000 different species of chondrichthyans can be found all around the world. Closer to the area of the present study, there are approximately 118 known species in the Northeast Atlantic (Gibson *et al*., 2008) and around 80 identified in the Mediterranean Sea (Cavanagh and Gibson, 2007). Of these, only a few can be considered abundant or common in the depths and waters we surveyed, while others are seen only occasionally. It is known that many chondrychthyan populations have been severely depleted in Europe and worldwide due to fisheries overexploitation (see Cavanagh and Gibson, 2007; Gibson *et al*., 2008).

Small spotted catsharks (*Scyliorhinus canicula)* and rays (*Raja* spp.) were found to be some of the more commonly found species in the area of study. Their demersal behaviour, resting on the surface and swimming close to the bottom, makes observation during visual marine seabed sampling favourable. The additional information gained on these and other species could ultimately lead to improved fisheries management and conservation programs.

## MATERIALS AND METHODS

From June to September in 2006, 2007, and 2008, Oceana carried out marine expeditions during which a total of 126 underwater immersions were completed with an ROV in waters of the western Mediterranean (Italy and Spain) and the Bay of Biscay (Spain). The bathymetric range of these dives was between 50 and 350 metres (m) depth.

A ROV Phantom HD2+2 was used equipped with a 750 resolution line camera with an F1.2 lens and a 1:12 zoom. The ROV was kept at a distance of less than half a metre above the sea floor with the cameras slightly inclined, thus creating a field of vision 1.5-2 m wide and a vision depth of 4-5 m. The ROV moved at 0.2-0.4 knots, and between approximately 700 and 850 square metres was sampled per hour. A transect between 0.3 and 0.8 miles long was made during each dive, which allowed us to analyze between 800 and 2,500 square meters per dive.

Two vessels were used as a work station for the ROV dives: the Ranger, a ketch catamaran 21 m long and 9.75 m wide, with a 13 person crew that included a captain, three sailors, a cook, four divers, two ROV technicians and two scientists; and the MarvivaMed, an oceanographic ship 42 m long and 9.4 m wide, with a 22 person crew including a captain, two officers, seven seamen, two cooks, four divers, three ROV technicians and three scientists.

Dives were undertaken to complete ground truthing and bionomic surveys. During the dives, information on the time of day, positions and depths was collected, as well as that on the seabeds, communities, and associated species present. Video images were recorded for subsequent analysis and verification. To have a comparable parameter for every location, survey time and sightings have been taken into account to produce a clear image of chondrichthyan densities in the surveyed areas.

## RESULTS

Of the 126 immersions completed, chondrichthyans were registered in 63 of them. Fourteen different species were found: five sharks, eight batoids and one chimaera. In all, 304 individuals were observed (Table 1), with *Scyliorhinus canicula* standing out as the most commonly recorded species and making up 69% of the observations. The other species registered were *Hexanchus griseus, Squalus blainvillei, Galeus melastomus, Galeus atlanticus, Dasyatis pastinaca, Torpedo marmorata, Raja clavata, Raja montagui, Raja miraletus, Raja naevus, Raja radula, Raja brachyura* and *Chimaera monstrosa.*

The geographic distribution of the chondrichthyans observed during the investigations included Italian and Spanish waters of the western Mediterranean and Spanish waters of the Bay of Biscay, with a total of 24 different geographic locations (Table 2). In seven of the 24 locations, more than five individuals were seen. In 11 locations, only one specimen was seen. The areas where the highest number of chondrichthyans was observed were in the Basque country (122 individuals) and the Balearic Islands (97 individuals), where the most common species was *S. canicula* in both areas. The Italian waters were also noteworthy for their high presence of *S. blainville*. On the other hand, the Spanish Mediterranean waters of Murcia, Andalucia and Valencia presented the fewest chondrichthyans, with a total of only six individuals observed.

During the expeditions, 50 other locations were also sampled, accounting for 63 additional immersions, but resulted in no chondrichthyan observations. Of these areas, seven were in Italy, 19 in the Spanish Mediterranean, one in south Atlantic Spain (Doñana), and 23 in the Bay of Biscay along the coast of Galicia.

The sighting effort (the time devoted to surveying the seabed in each location) was highly variable; therefore, although a high number of sightings were registered in the Balearic Islands and especially Cabrera, the time spent surveying here was also higher than in other areas. Nevertheless, places like the Aceste seamount and the Capbreton canyon, with less time spent surveying than in the Balearic Islands, have the highest number of sightings given the effort spent.

Apart from the Aceste seamount in Italy, with an average of 56.786 individuals sighted per hour (due to the high concentration of *S. blainville*), four areas had between one and ten shark sightings an hour, and the vast majority were below one sighting per hour (Table 3).

The species with the widest general geographic range in the investigation areas was clearly *S. canicula*, which was observed in 17 of the 24 locations (71%). Seven species (*S. blainville, T. marmorata, C. monstrosa, R. brachyura, R. naveus, R. radula* and *D. pastinaca)* were observed in just one single location.

All *S. canicula* individuals were found over soft seabeds, mainly on detritic sands, muddy bottoms and, sometimes, around maërl beds. Other species also favoured sandy or muddy sea beds. For example, *S. blainvillei* was found on sandy detritic seabeds and *C. monstrosa* was seen on muddy bathyl seabeds (Figure 1). On the other hand, *H. griseus* was found over both sandy and very rocky seabeds, although always coinciding with underwater elevations. Additionally, one of the rays (*R. brachyura*) and the torpedo (*T. marmorata*) were found in areas with both soft and hard bottoms.

The bathymetric range of the chondrichthyans observed, shown in Table 4, was from 50 to 350 m depth. Just over half of the individuals (56%) were observed down to 200 m, will all rays occurring demersally. The sightings of *T. marmorata*, *R. miraletus, R. brachyura, R. radula* and *D. pastinaca* all occurred exclusively above 200 m. On the other hand, *G. melastomus*, *C. monstrosa* and *R. naevus* occurred exclusively below 200 m.

The majority (11 individuals) of *R. montagui* was observed below 250 m, although two individuals were observed above 200 m. Two individuals of *G. atlanticus* were observed between 200-250 m, with one individual occurring at a shallower depth between 100-150 m. These observations represent shallower depths than the usual range for this species, which is 400-600 m (Compagno, Dando and Fowler, 2005). *R. clavata* and *S. blainville* were observed in a range between 150-300 m depth, consistent with their known ranges.

*H. griseus* was observed at the deepest depths of the expedition, down to 350 m in the mesopelagic zone, although one individual was also observed in shallower epipelagic waters between 100-150 m depth. *S. canicula* was observed within the widest range of depths, from 50 down to 300 m. Some of these observations represent depths below its usual range which is down to 110 metres, although it has exceptionally been recorded down to 400 m (Compagno, Dando and Fowler, 2005).

Two other important locations for chondrichthyans were the Capbreton canyon in the Bay of Biscay (8.511 individuals sighted per hour), with mainly *S. canicula* present, and Dragonera Island to the north of Mallorca (3.429 sightings per hour), with a wider variety of species, including several rays. The Enareta seamount in Italy (1.690 sightings per hour) is also noteworthy due to the presence of *H. griseus,* as is the Les Olives sea mount to the south of Mallorca (1.253 sightings per hour) with a high presence of *R. montagui*.

In terms of species richness and diversity that was observed, the Balearic Islands stand out with a total of 7 different chondrichthyan species registered: *S. canicula*, *R. clavata*, *R. montagui*, *R. miraletus*, *R. naveus*, *R. radula*, and *D. pastinaca*, but this was also the area where the sighting effort was by far the highest.

## DISCUSSION

The use of new tools and technologies such as submarines and ROVs has allowed for in situ visual observation of fishes and habitats that can give us new insight into species distributions, behaviours and environmental conditions. The reaction behaviour of species to an approaching ROV has been the subject of various studies (see Lorance and Trenkel, 2006; Lorance, Latrouite and Séret, 2000) and has been associated with water depths and temperatures and ROV speed, among other things. In our investigations, nearly all species reacted to the approaching ROV.

Disturbed sharks were generally observed fleeing from the approaching ROV, such as *R. montagui* and *Q. monstrosa*, which actively swam away staying close to the sea bottom. Other species such as *S. blainville* showed increased activity and possible attraction out of curiosity to the ROV, displaying rapid swimming speeds and changes of direction (Figure 2). In one case in the Aceste Seamount, a *S. blainville* individual collided with the ROV. *H. griseus* also showed some attraction toward the ROV, first approaching the apparatus but later swimming away. On the other hand, *S. canicula* and *G. melastomus* presented a different reaction behaviour, remaining motionless and resting on the sea floor, possibly relying on its camouflage to go unnoticed by the new invader. *S. canicula* was also seen in a group of approximately five to ten individuals lying inmobile on the sea bottom (Figure 3), corroborating observations of this behaviour by Lorance, Latrouite and Séret (2000).

A noteworthy discovery during our investigations was the presence of *G. atlanticus* in the Bay of Biscay, which is outside of its recorded distribution area. Two sharks were observed in the Bay of Biscay, specifically in the Capbreton Canyon off the coast of the Basque Country. The registered distribution of this species is Northeast Atlantic/ Mediterranean waters of Morocco and Spain (through the Strait of Gibraltar) and with a possible extension from Mauritania to the west and Italy to the east (Compagno, Dando and Fowler, 2005). The observations of *G. atlanticus* in the Bay of Biscay (Figure 4) suggest a more northern distribution for this species than previously recorded. This is likely due to the fact that, until recently, *G. atlanticus* and *G. melastomus* were not considered or registered as separate species (Castilho *et al*., 2007).

Regarding the relationships observed between the species and habitat type, of note is the association between *H. griseus* and underwater elevations. This species was observed on two seamounts: two individuals were found on the Enareta Seamount in Italy (Figure 5), at depths of 319-324 m, and one individual was observed on the Seco de Palos seamount in the Balearic Islands, between 100-150 metres depth. This species is known to be associated with seamount habitats (Foese and Sampang, 2004). These special biological communities may be favourable for *H. griseus* as preferred feeding or breeding grounds.

## ACKNOWLEDGEMENTS

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## TABLES

### Table 1. Number of individuals observed by species

| Species | Individuals |
|---|---|
| *Galeus atlanticus* | 3 |
| *Galeus melastomus* | 10 |
| *Hexanchus griseus* | 3 |
| *Squalus blainvillei* | 50 |
| *Scyliorhinus canicula* | 210 |
| *Dasyatis pastinaca* | 1 |
| *Raja clavata* | 4 |
| *Raja montagui* | 13 |
| *Raja miraletus* | 4 |
| *Raja naevus* | 1 |
| *Raja radula* | 1 |
| *Raja brachyura* | 1 |
| *Torpedo marmorata* | 1 |
| *Chimaera monstrosa* | 2 |
| **TOTAL** | **304** |

### Table 2. Species observations by location

| | | SCA | HGR | SBL | GAT | GME | TMA | RCL | CMO | RMO | RMI | RBR | RNA | RRA | DPA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Italy** | Enareta seamount | | 2 | | | | | | | | | | | | | **2** |
| | Aceste seamount | | | 50 | | | | 3 | | | | | | | | **53** |
| **Balearic Islands** | Porros Island | | | | | | | 1 | | | | | | | | **1** |
| | Menorca canyon | 4 | | | | | | | | | | | | | | **4** |
| | Les Olives | | | | | | | | | 9 | | | | | | **9** |
| | Emile Baudot | | | | | | | | | 2 | | | | | | **2** |
| | Cabrera | 65 | | | | | | | | 1 | 2 | | | 1 | 1 | **70** |
| | Dragonera | 6 | | | | | | | | 1 | 2 | | 1 | | | **10** |
| | Ausias March | 1 | | | | | | | | | | | | | | **1** |
| **Murcia** | Seco de Palos | | 1 | | | | | | | | | | | | | **1** |
| **Andalucia** | Seco de los Olivos | 1 | | | | | | | | | | | | | | **1** |
| | Alborán Sea | 1 | | | 1 | | 1 | | | | | | | | | **3** |
| **Valencia** | Barra Alta | 1 | | | | | | | | | | | | | | **1** |
| **Galicia** | Salvora | 1 | | | | | | | | | | | | | | **1** |
| | Bermeo elevation | 7 | | | | | | | | | | | | | | **7** |
| | Niebla elevation | 1 | | | | | | | | | | | | | | **1** |
| | Sisargas Islands | | | | | | | | | | | 1 | | | | **1** |
| **Asturias** | Aviles canyon | 6 | | | | | | | | | | | | | | **6** |
| | Cabo Peñas | 2 | | | | | | | | | | | | | | **2** |
| **Cantabria** | Maruca elevation | 1 | | | | | | | | | | | | | | **1** |
| | Castro elevation | 1 | | | | | | | | | | | | | | **1** |
| | Castro Verde | 1 | | | | 3 | | | | | | | | | | **4** |
| **Basque Country** | Capbreton canyon | 110 | | | 2 | 7 | | | 2 | | | | | | | **121** |
| | Arrikobajo | 1 | | | | | | | | | | | | | | **1** |

## Table 3. Sighting effort and average sightings per hour

| Western Mediterranean | | | |
|---|---|---|---|
| | | time surveying | sightings per hour |
| Italy | Enareta seamount | 1 h 11 min | 1.69 |
| | Aceste seamount | 0 h 56 min | 56.786 |
| Balearic Islands | Porros Island | 6 h 17 min | 0.159 |
| | Menorca canyon | 8 h 36 min | 0.465 |
| | Les Olives | 7 h 11 min | 1.253 |
| | Emile Baudot | 5 h 45 min | 0.348 |
| | Cabrera | 126 h 10 min | 0.555 |
| | Dragonera | 2 h 55 min | 3.429 |
| | Ausias March | 3 h 12 min | 0.312 |
| Murcia | Seco de Palos | 8 h 24 min | 0.119 |
| Andalucia | Seco de los Olivos | 15 h 09 min | 0.099 |
| | Alborán Sea | 31 h 48 min | 0.094 |
| Valencia | Barra Alta | 4 h 11 min | 0.239 |
| **TOTAL** | | **221 h 45 min** | **2.633** |

| Bay of Biscay | | | |
|---|---|---|---|
| | | time surveying | sightings per hour |
| Galicia | Salvora | 3 h 12 min | 0.312 |
| | Bermeo elevation | 7 h 20 min | 0.955 |
| | Niebla elevation | 2 h 28 min | 0.405 |
| | Sisargas Islands | 6 h 55 min | 0.145 |
| Asturias | Aviles canyon | 9 h 33 min | 0.628 |
| | Cabo Peñas | 5 h 12 min | 0.385 |
| Cantabria | Maruca elevation | 2 h 38 min | 0.380 |
| | Castro elevation | 1 h 14 min | 0.811 |
| | Castro Verde | 4 h 29 min | 0.892 |
| Basque Country | Capbreton canyon | 14 h 09 min | 8.511 |
| | Arrikobajo | 2 h 45 min | 0.364 |
| **TOTAL** | | **59 h 55 min** | **2.470** |

## Table 4. Species observations by depth (m)

| Depths (m) | Species | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SCA | HGR | SBL | GAT | GME | TMA | RCL | CMO | RMO | RMI | RBR | RNA | RRA | DPA |
| 50-100 | 58 | | | | | 1 | | | | 2 | 1 | | 1 | 1 |
| 100-150 | 23 | 1 | | 1 | | | | | 1 | | | | | |
| 150-200 | 74 | | 3 | | | | 1 | | 1 | 2 | | | | |
| 200-250 | 18 | | 30 | 2 | 6 | | 2 | | | | | 1 | | |
| 250-300 | 37 | | 17 | | 4 | | 1 | 2 | 4 | | | | | |
| 300-350 | | 2 | | | | | | | 7 | | | | | |
| **TOTALS** | **210** | **3** | **50** | **3** | **10** | **1** | **4** | **2** | **13** | **4** | **1** | **4** | **4** | **4** |

**SCA:** *Scyliorhinus canicula*; **HGR:** *Hexanchus griseus*; **SBL:** *Squalus blainvillei*; **GAT:** *Galeus atlanticus*; **GME:** *Galeus melastomus*; **TMA:** *Torpedo marmorata*; **RCL:** *Raja clavata*; **CMO:** *Chimaera monstrosa*; **RMO:** *Raja montagui*; **RMI:** *Raja miraletus*; **RBR:** *Raja brachyuran*; **RNA:** *Raja naevus*; **RRA:** *Raja radula*; **DPA:** *Dasyatis pastinaca*

## FIGURES

**Figure 1:** Two *Chimaera monstrosa* over a muddy bottom in the Capbreton Canyon, Bay of Biscay, 2008.

**Figure 2:** *Squalus blainville* reacting to ROV, Aceste seamount, Italy, 2008.

**Figure 3:** A group of *Scyliorhinus canicula*, Capbreton Canyon, Bay of Biscay, 2008.

**Figure 4:** *Galeus atlanticus* in the Capbreton Canyon, Bay of Biscay, 2008.

**Figure 5:** *Hexanchus griseus* on the Enareta seamount, Italy, at 324 m depth, 2008.