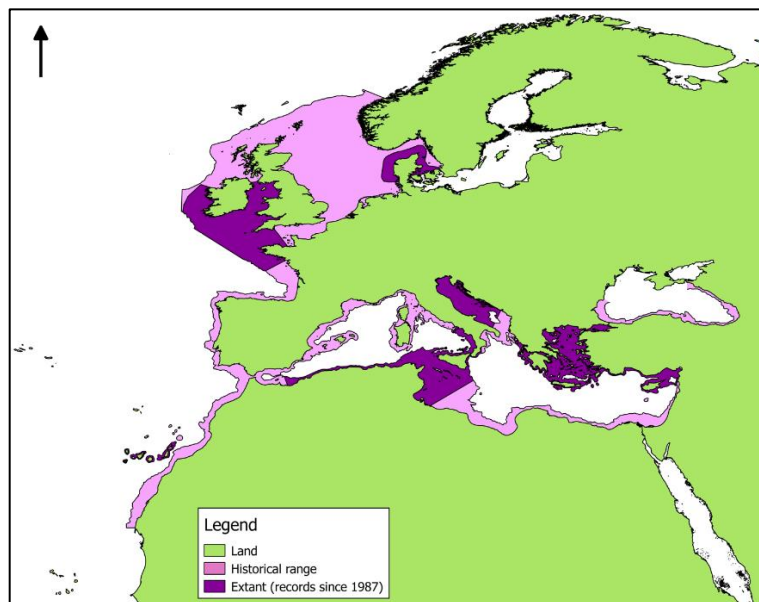


## Summary of Angelshark *Squatina squatina* distribution and migration data

### 1. Distribution

Angelshark *Squatina squatina* were historically distributed from southern Scandinavia to West Africa and the Canary Islands, throughout the Mediterranean, and into the Black Sea (Figure 1). Their population is now fragmented; Lawson et al. (in prep.) report a 49% decline in geographic range. The species is Critically Endangered (Feretti et al. 2015).

*S. squatina* are usually reported from soft sediment habitats in coastal and shelf waters at depths of 0-150m. This is one of several shark species that use warm shallow water nursery grounds to speed the development of their young and provide a refuge from predation; female angelsharks move inshore to give birth to young of 20-30cmTL in coastal nursery grounds (Myers et al. 2017). During the winter months, in the north of their range, angelsharks have been captured in deeper water, 200-300m, in a transboundary area of the Celtic Sea that may be an over-wintering ground (see Figure 2). Conversely, research in the Canary Islands has recorded the majority of shallow water sightings of adult angelsharks in winter, when water temperatures ranged between 17°C and 21°C. They are believed to inhabit deeper cooler water during the summer at this southern edge of their range.



**Figure 1. Angelshark *Squatina squatina* historical range and recent known distribution.**

Source: UNEP/CMS/COP12/Doc.26.2.5. Proposal for a Concerted Action for Angelshark. All distributions extend to the 1,000m depth contour to show potential Angelshark habitat.



**Figure 2. Suspected location of a transboundary deepwater (200-300m) over-wintering area straddling Irish, Welsh and English waters.**

Source: ICES WGEF 2018.

## 2. Movements

A high degree of population structure is described from the Canary Islands, the last remaining centre of abundance. Migrations here appear to be associated with mating and pupping activity and thermal preferences. Myers et al. (2017) report two peaks of sightings, in summer (June to July) and winter (December to February). They suggest that pregnant females move into shallow water to give birth between April and July, when neonates and females are most commonly sighted. Mature males move inshore in winter, when mating, mating scars and gravid females are reported. Myers et al. (2017) suggest that male sharks undertake horizontal or vertical migrations to different areas (deeper or offshore) during summer. Narvaez (2013) and Osaer (2009) also noted that active males were predominantly found during winter, and that the pupping season started in spring. They reported the majority of angelshark sightings during the colder months, when water temperatures ranged between 17 °C and 21°C.

Seasonal migrations associated with changing sea water temperatures are described by several authors for *S. squatina* and other angel sharks (e.g. Ebert *et al.* 2013; Wheeler *et al.* 1975; Green 2007; Myers *et al.* 2017; Narvaez 2013; Osaer 2009; Eschmeyer *et al.* 1983; Kato *et al.* 1967; Natanson & Cailliet 1986; Vögler *et al.* 2008). Seasonal or spatial sexual segregation is reported for *Squatina californica* (Pittenger, 1984), *Squatina tergocellata* (Bridge, Mackay, & Newton, 1998) and *Squatina guggenheim* (Awruch, Nostro, Somoza, & Di Giacomo, 2008). *S. guggenheim* females also migrate to shallow coastal areas (< 40 m depth) to breed (Vooren & Da Silva, 1991). Vögler *et al.* 2008 propose a population strategy of spatial segregation by size for *S. guggenheim* and suggest that pupping probably requires shallow coastal areas.

Further north, off the Irish coast, significant segregation by age and sex has also been observed. Nearshore recreational angelshark catches are reported from April to October, mainly in Clew Bay and Tralee Bay. Quigley (2006) found angelsharks to be most common during June (>40% of records), with 20% of catches in July and about 17% in each of May and August. Fitzmaurice *et al.* (2003), however, identified most catches in July to August, reporting that recreational angling effort is at its peak in August. These combined observations suggest that angelsharks are most abundant inshore during June and July, when sea temperatures are 13–15°C<sup>1</sup>. Recreational catch per unit effort declines as the sharks move offshore in late summer, before surface temperatures fall to a winter low of 9–10°C<sup>1</sup>. They return the following June.

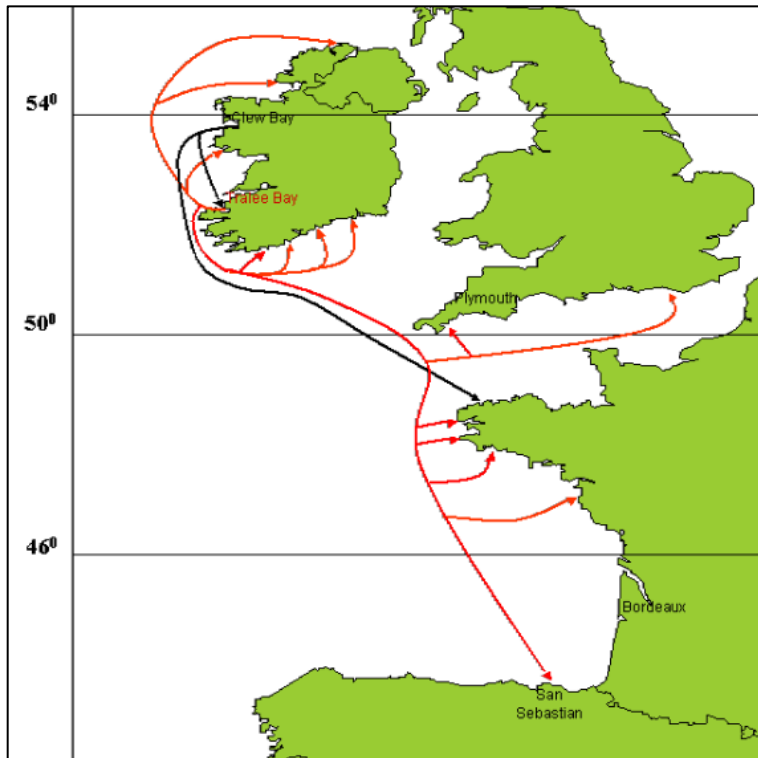
Fitzmaurice et al. 2003 reported that 100% of the angelsharks captured by two skippers in Tralee Bay between 1970 and 2002 were tagged and that catches were dominated by adult males (>80%). Some adult and sub-adult females are present, but the lack of sharks under 100cmTL (with the exception of one 85cmTL individual) suggests that there is no nursery ground in this area. These authors found that most sharks were recaptured by recreational anglers, sometimes more than once, and often close to the original tagging location even after several years (maximum 12) at liberty. This indicates a high level of philopatry (the sharks return year after year to this inshore summer location), with only one specimen tagged in Clew Bay recaptured in Tralee Bay (Figure 3). Similar philopatric behaviour occurs in other migratory sharks, e.g. white sharks (Jorgensen et al. 2010), basking shark (Doherty et al. 2017), and blacknose and blacktip sharks (Hueter et al. 2005).

Commercial tangle nets catch angelsharks entering and departing from these inshore angling grounds. Captures of tagged animals by trawlers take place further offshore. The longest movements recorded during this study were of sharks recaptured by trawlers much further south, in France and northern Spain, a maximum straight-line distance of 1,160km (Figure 3). These long-distance recaptures only took place during the winter months (Figure 4).

---

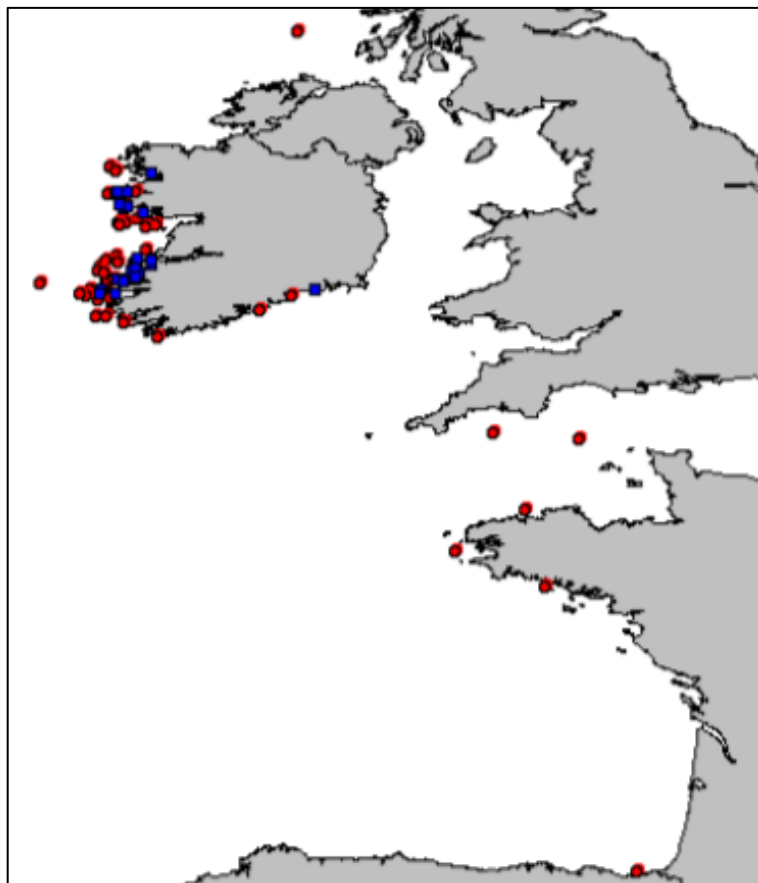
<sup>1</sup> <https://www.seatemperature.org/europe/ireland/clifden-august.htm>

ICES WGEF (2018) reported a possible nursery ground in Cardigan Bay (West Wales) and reports of angelsharks pupping in the North Sea. They also identified a possible deepwater (200-300m) transboundary wintering ground between Ireland, Wales and England (Figure 2).



**Figure 3. Angelshark *Squatina squatina* migration patterns from Clew Bay (black) and Tralee Bay, Ireland (red), from 190 tag returns 1970–2006.**

Source: ICES WGEF 2018.



**Figure 4. Seasonal distribution of Angelshark recaptures from West Ireland tagging sites.**

Blue dots are recaptures during June to September (all are close to the tagging sites). Red dots are recaptures during October to May.

Source: Fitzmaurice et al. 2003.

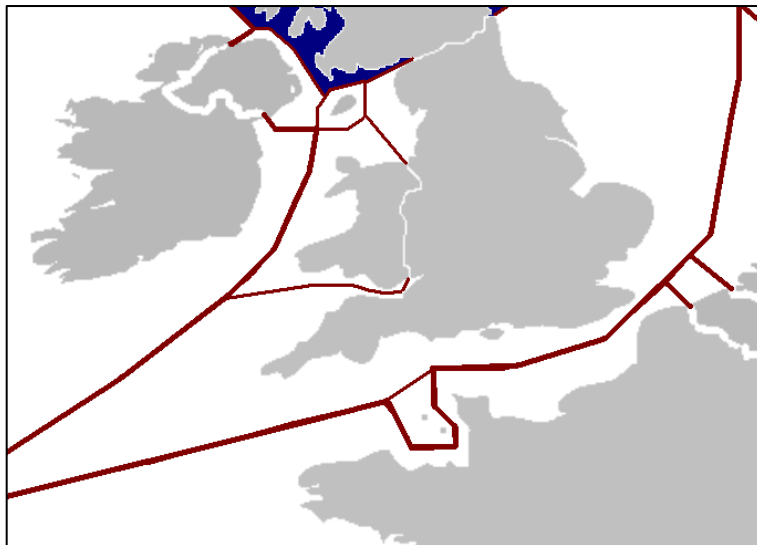
### 3. Migrations across jurisdictional boundaries

Migratory species are defined in Article 1, paragraph 1 a) of the Convention:

*"Migratory species" means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries.*

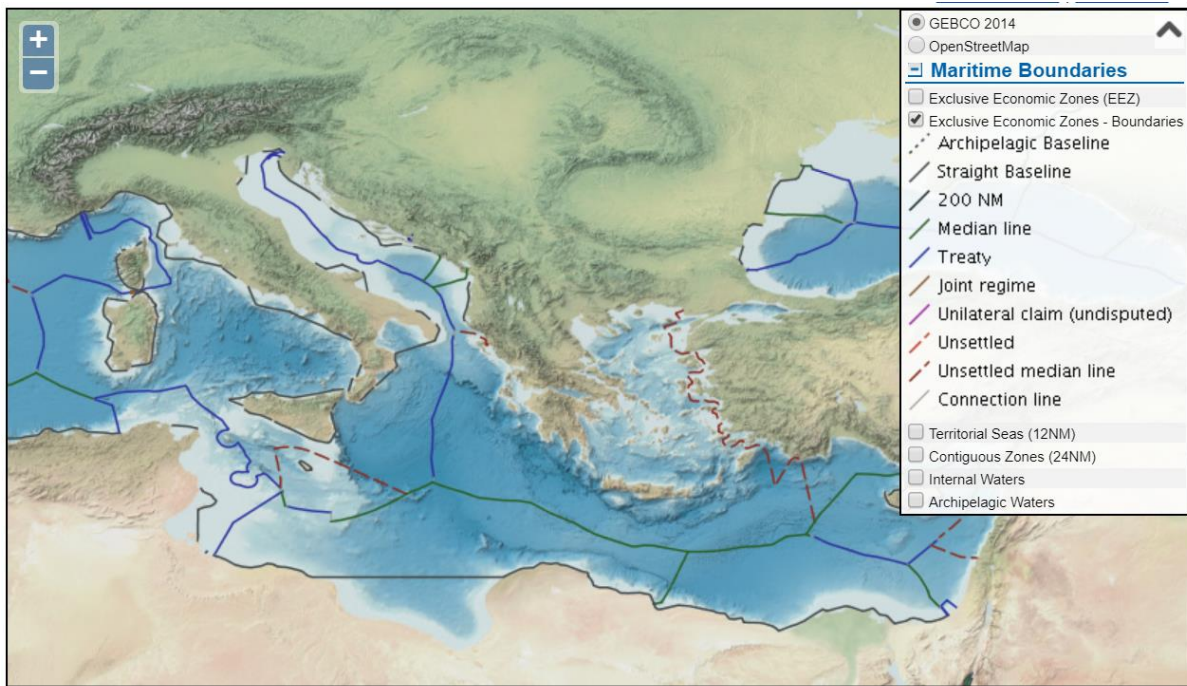
Maritime jurisdictional boundaries include the boundaries between international waters and the outer limits of Exclusive Economic Zones (EEZ, where these exist), or between international and territorial waters where EEZs have not been established, and the median lines between the territorial waters of EEZs of adjacent maritime States.

In the Northeast Atlantic, where EEZs have been established (Figure 5), the transboundary deepwater overwintering ground illustrated in Figure 2 straddles the median line between Ireland and England and Wales. A proportion of the regional angelshark population that overwinters here is likely to cross national jurisdictional boundaries during their autumn migrations from the coastal waters of Ireland, Wales and/or England to this deepwater wintering ground, and back again in spring. The proportion of the population that moves further south in winter, as illustrated by tag returns shown in Figure 4, crosses the maritime jurisdictional boundaries of Ireland, the UK, France, and in some cases also Spain.



**Figure 5. Maritime jurisdictional boundaries on the median lines between the EEZs of Ireland, the United Kingdom (Northern Ireland, Scotland, England, Isle of Man, Wales, and Channel Islands), France, Belgium and Netherlands.**

Suitable deepwater angelshark habitat occurs well inside the 200 nautical mile outer limits of Atlantic Ocean EEZs. In the Mediterranean Sea, however, very few of the 21 littoral States have exercised their right to extend national jurisdiction over a 200nm Exclusive Economic Zone (Figure 6). The majority only have jurisdiction over territorial waters, extending to 6nm or 12nm offshore. Angelsharks migrating between cooler deepwater habitat and warm shallow coastal breeding grounds in the Mediterranean will often need to migrate across the jurisdictional boundaries between international waters and the territorial seas of range States in order to reach deepwater habitat at or below 200m (Figure 7). Some may follow coastal migration routes that cross the median lines that demarcate adjacent coastal State waters.



**Figure 6. Mediterranean jurisdictional and international waters.**( Marineregions.org)

#### **4. Added value provided by listing in Annex 1 of the Migratory Sharks MOU**

Table 1 lists current and former range States for Angelshark *Squatina squatina*. The majority are already Party to CMS, which lists Angelshark in Appendix I and II. They are therefore bound by the provisions of the Convention regarding the conservation and management of this species. Some range States highlighted in Table 1 are not Party to the Convention. They are not (yet) Signatories to the MOU, but upon joining they would agree to implement the Conservation Plan for all species listed in Annex 1. It is clearly desirable for Angelshark to be included in Annex 1 for this to be possible.

Turkey is the most important of these non-Party range States for Angelsharks (see Figure 1). Its coastline is over 8,000 km long (including the Mediterranean, Bosphorus Strait and Black Sea). Angelsharks recorded here are likely to cross the jurisdictional boundary of its 6 nm territorial waters when moving between shallow nursery grounds and deepwater habitat. Turkey is not Party to CMS, but became a Party to ACCOBAMS in 2018.

Lebanon is also a current range State, not a Party to CMS, but has been a Party to ACCOBAMS since 2005 and is Party to AEWa and a Signatory to the Raptors MOU.

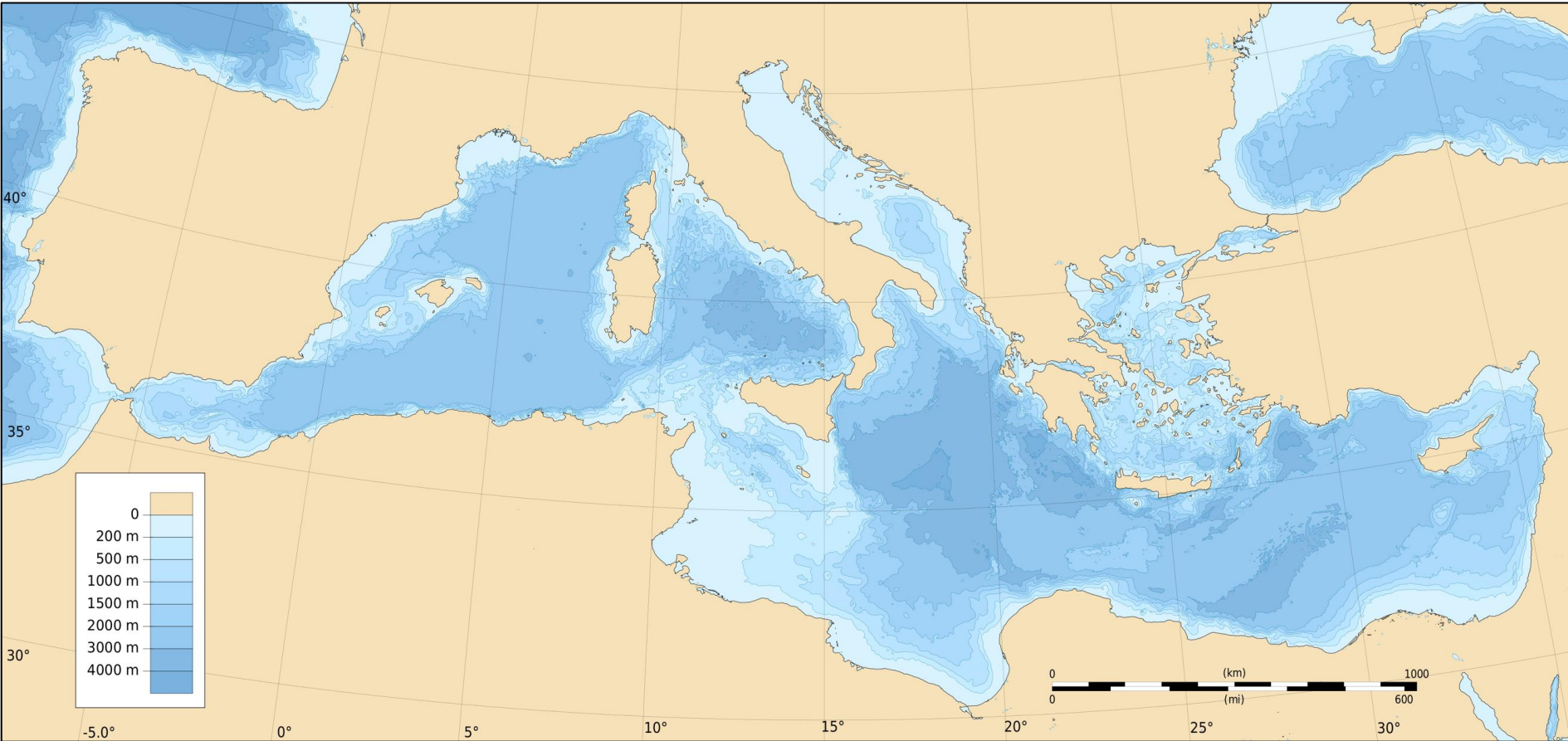
The current status of Angelshark in Russian Federation Black Sea waters is unknown. This non-Party to CMS is a Signatory to the Siberian Crane and Saiga MOUs.



**Table 1. *Squatina squatina* range States and their CMS status**

Country	Range State	CMS Party	CMS Agreement Signatory	Sharks MOU Signatory
Albania	yes	yes		no
Algeria	yes	yes		no
Belgium	extinct?	yes		yes
Bosnia & Herzegovina	yes	yes		no
Bulgaria	uncertain	yes		no
Croatia	yes	yes		no
Cyprus	yes	yes		no
Denmark	uncertain	yes		yes
Egypt	yes	yes		yes
European Union	yes	yes		yes
France	yes	yes		no
Gambia	yes	yes		no
Georgia	uncertain	yes		no
Germany	extinct?	yes		yes
Greece	yes	yes		no
Guinea	extinct?	yes		yes
Guinea-Bissau	extinct?	yes		no
Ireland	yes	yes		no
Israel	yes	yes		no
Italy	yes	yes		no
Lebanon	yes	no	ACCOBAMS	no
Liberia	yes	yes		yes
Libya	yes	yes		yes
Malta	yes	yes		no
Mauritania	extinct?	yes		yes
Monaco	extinct?	yes		yes
Montenegro	extinct?	yes		no
Morocco	yes	yes		no
Netherlands	extinct?	yes		yes
Norway	extinct?	yes		no
Portugal	yes	yes		yes
Romania	uncertain	yes		yes
Russian Federation	uncertain. Black Sea	no	Crane, Saiga	no
Senegal	yes	yes		yes
Slovenia	yes	yes		no
Spain	yes	yes		no
Sweden	extinct?	yes		yes
Syrian Arab Republic	yes	yes		yes
Tunisia	yes	yes		no
Turkey	yes	no	ACCOBAMS	no
Ukraine	uncertain. Black Sea	yes		no
United Kingdom	yes	yes		Yes
Western Sahara	yes	no	no	no

**Figure 7. Bathymetry of the Mediterranean Sea.**



## Bibliography

- Awruch, C. A., Nostro, F. L., Somoza, G. M., & Di Giacomo, E. (2008). Reproductive biology of the angular angel shark *Squatina guggenheim* (Chondrichthyes: Squatinidae) off Patagonia (Argentina, southwestern Atlantic). *Ciencias Marinas*, 34, 17–28.
- Bridge, N. F., Mackay, D., and Newton, G. 1998. Biology of the ornate angel shark (*Squatina tergocellata*) from the Great Australian Bight. *Marine and Freshwater Research*, 49: 679–686.
- Cinnirella, S., March, D., et al. 2012. A multidisciplinary Spatial Data Infrastructure for the Mediterranean to support implementation of the Marine Strategy Framework Directive. *International Journal of Spatial Data Infrastructures Research*, 7:300-322.
- Doherty, P.D., Baxter, J.M., Godley, B.J., Graham, R.T., Hall, G., Hall, J. Hawkes, L.A. Hawkes, Henderson, S.M., Johnson, L., Speedie, C., & Witt, M.J. (2017). Testing the boundaries: Seasonal residency and inter-annual site fidelity of basking sharks in a proposed Marine Protected Area. *Biological Conservation* 209 (2017) 68–75
- Ebert, D.A., Fowler, S.L. & Compagno, L.J.V. (2013). *Sharks of the World – A fully illustrated guide*. Wild Nature Press. UK.
- Eschmeyer, W. H., Herald, E. S., & Hammann, H. (1983). *A field guide to the Pacific coast fishes of North America from the Gulf of Alaska to Baja California*. Boston, MA: Houghton Mifflin.
- Ferretti, F., Morey, G, Serena, F., Mancusi, C., Fowler, S.L., Dipper, F. & Ellis, J. 2015. *Squatina squatina*. The IUCN Red List of Threatened Species 2015: e.T39332A48933059. <http://dx.doi.org/10.2305/IUCN.UK.2015-1.RLTS.T39332A48933059.en>. Downloaded on 12 December 2018.
- Fitzmaurice, P., Keirse, G., Green, P., and Clarke, M. 2003. Angel shark tagging in Irish waters. Central Fisheries Board, Dublin, Ireland. 19 pp.
- Green, P. (2007). CFB marine sportfish tagging programme 1970–2006. Working Document to ICES WGEF 2007.
- Hueter, R. E., M. R. Heupel, E. J. Heist, and D. B. Keeney. 2005. Evidence of Philopatry in Sharks and Implications for the Management of Shark Fisheries. *J. Northw. Atl. Fish. Sci.*, 35: 239-247. doi:10.2960/J.v35.m493
- ICES WGEF 2018. Section 22, Angel shark *Squatina squatina* in the Northeast Atlantic. Pp.585-606 in the Report of the Working Group on Elasmobranch Fishes. 19–28 June 2018, Lisbon, Portugal. ICES CM 2018/ACOM:16; 1306 pp.
- Jorgensen SJ, Reeb CA, Chapple TK, Anderson S, Perle C, et al. (2010) Philopatry and migration of Pacific white sharks. *Proc R Soc B* 277: 679–688. doi:10.1098/rspb.2009.1155
- Kato, S., Springer, S., & Wagner, M. H. (1967). *Field guide to eastern Pacific and Hawaiian sharks*. United States Fish and Wildlife Service, 271, 1–47
- Lawson et al. (in prep.) Fallen Angels: Extinction risk and conservation of Critically Endangered angel sharks in the Eastern Atlantic and Mediterranean Sea.
- Myers, E. K. M., Tuya, F., Barker, J., Jiménez Alvarado, D., Castro-Hernández, J. J., Haroun, R., and Rödder, D. 2017. Population structure, distribution and habitat use of the Critically Endangered Angelshark, *Squatina squatina*, in the Canary Islands. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 27: 1133–1144.
- Narvaez, K. (2013). Aspectos biológicos y ecológicos del tiburón ángel *Squatina squatina* (Linnaeus 1758) en la isla de Gran Canaria (PhD thesis). University of Las Palmas de Gran Canaria, Spain.
- Natanson, L.J., & Caillet, G.M., 1986. Reproduction and Development of the Pacific Angel Shark, *Squatina californica*, off Santa Barbara, California. *Copeia*, 4, 987-994.
- Osaer, F., Narváez, K., Pajuelo, J., and Lorenzo, J. 2015. Sexual development and maturity scale for the angel shark *Squatina squatina* (Elasmobranchii: Squatinidae), with comments on the adequacy of general maturity scales. *Sexuality and Early Development in Aquatic Organisms*, 1: 117–132
- Pittenger, G. G. (1984). Movements, distribution, feeding, and growth of the Pacific angel shark, *Squatina californica*, at Catalina Island, California (MS thesis). California State University, Long Beach.
- Quigley, D. 2006. Angelshark (*Squatina squatina*) in Irish Waters. *Sherkin Comment*, 41.
- Vögler, R., Milessi, A. C., and Quiñones, R. A. 2008. Influence of environmental variables on the distribution of *Squatina guggenheim* (Chondrichthyes, Squatinidae) in the Argentine–Uruguayan Common Fishing Zone. *Fisheries Research*, 91: 212–221.
- Vooren, C. M., & Da Silva, K. G. (1991). On the taxonomy of the angel sharks from southern Brazil, with the description of *Squatina occulta* sp. n. *Revista Brasileira de Biologia*, 51, 589–602.



Wheeler, A., Blacker, R. W., & Pirie, S. F. (1975). Rare and little-known fishes in British seas in 1970 and 1971. *Journal of Fish Biology*, 7, 183–201.