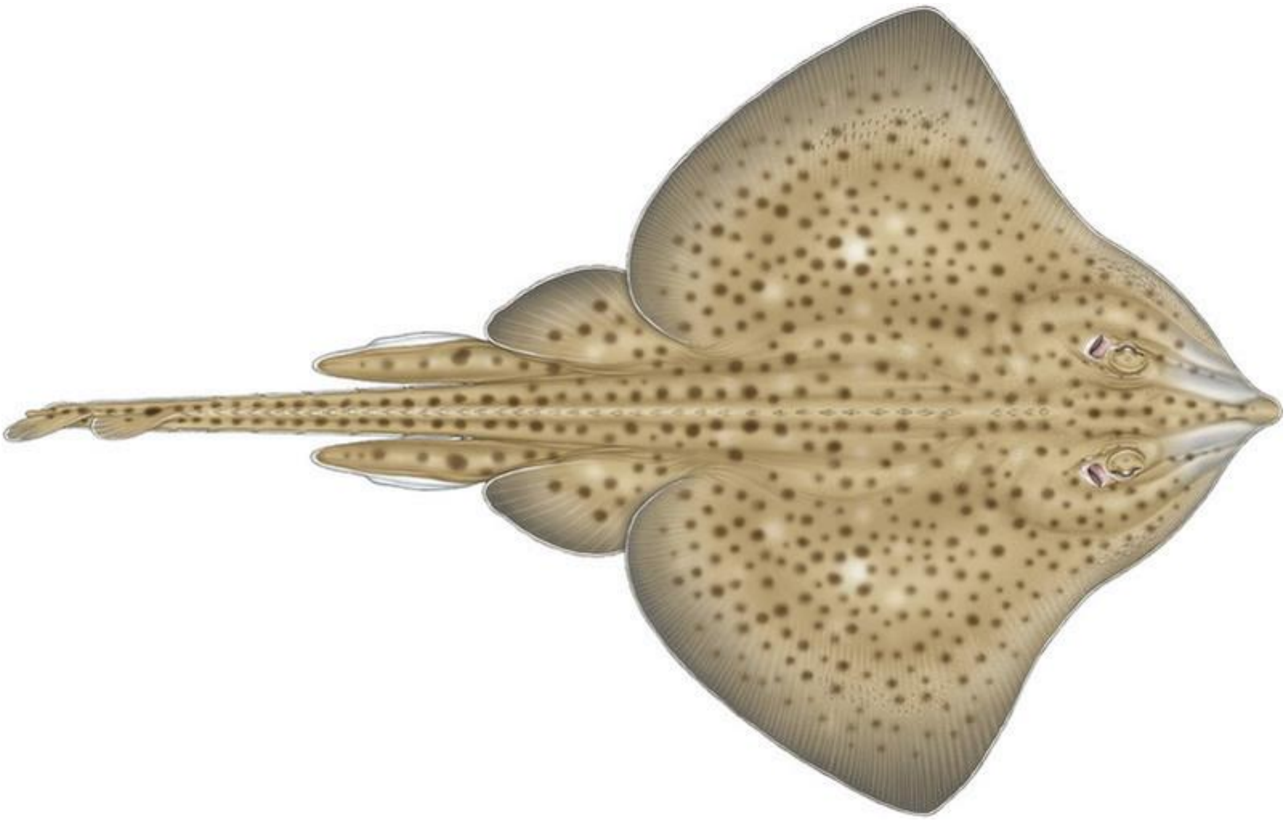
Fisheries Research & Management Plan

Skates and Rays

in the North of Devon & Severn IFCA's District



Devon & Severn IFCA Inshore Fisheries and Conservation Authority

NORTH DEVON BIOSPHERE

European Union European Structural and Investment Funds

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Cover image – Spotted ray (*R. montagui*) (Seafish, 2019b, https://seafish.assetbank-server.com/assetbank-seafish/action/viewAsset?id=12302&index [unedited]).

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Introduction

Background

In 2017, the UK fishing fleet added an estimated £1.53 billion to the UK economy and provided employment to 23,000 people in Great Britain. Globally the demand for fish is expected to rise but growth in fish catches has stalled, with some regions experiencing declines of up to 35% between 1930–2010, primarily driven by overfishing. The fishing industry is also an integral part of coastal communities' cultural heritage and fishing has been passed down through generations, making the future of the industry an emotive issue.

The North Devon fishing fleet landed just under 1,000 tonnes of documented catch in 2019, with an estimated value of £1.7 million (MMO, 2020a). Much of the commercial fishing effort in the Bristol Channel is potting for shellfish with important trawl fisheries for skates and other demersal species also operating. There are also traditional netting fisheries close to the shore for species such as herring and bass. Although these fisheries are low in financial value they carry immense cultural value to the fishers and their communities, being seen as part of their history and way of life (FRMP Interviews, 2020).

UK Government 25 Year Environment Plan

In 2018 the UK Government published a 25 Year Environment Plan (25YEP) with goals and targets for "*improving the environment within a generation and leaving it in a better state than we found it*". These goals and targets include "*ensuring that all fish stocks are recovered to and maintained at levels that can produce their maximum sustainable yield*."

To inform the development and implementation of the 25YEP the Government set up a series of pioneer projects including a Marine Pioneer in North Devon (see **Figure 1**). The pioneer projects have been created to test innovative ways of managing the environment and using a natural capital approach. The intention is that successful measures can be scaled up and applied at a national level.

As part of the Marine Pioneer the Devon and Severn Inshore Fisheries and Conservation Authority (D&S IFCA) and the North Devon Biosphere have produced a series of innovative Fisheries Research Management Plans (FRMPs) for commercially important species in the north of D&S IFCA's District (see **Figure 1**).

Fisheries Research & Management Plans

The FRMPs consider a localised and ecosystem-based fisheries management (EBFM) approach. EBFM is a holistic way of managing fisheries. It accounts for interactions between species, the overall health of the ecosystem and pressures that can affect this such as aggregate dredging, poor water quality and marine developments.

The FRMPs are different from previous work in this area because they take local and historical knowledge into account and include the cultural and heritage value of the fisheries. The plans also account for ecosystem factors that are sometimes overlooked by traditional fisheries management such as the impacts of local marine developments and the relationships marine species have with one another.

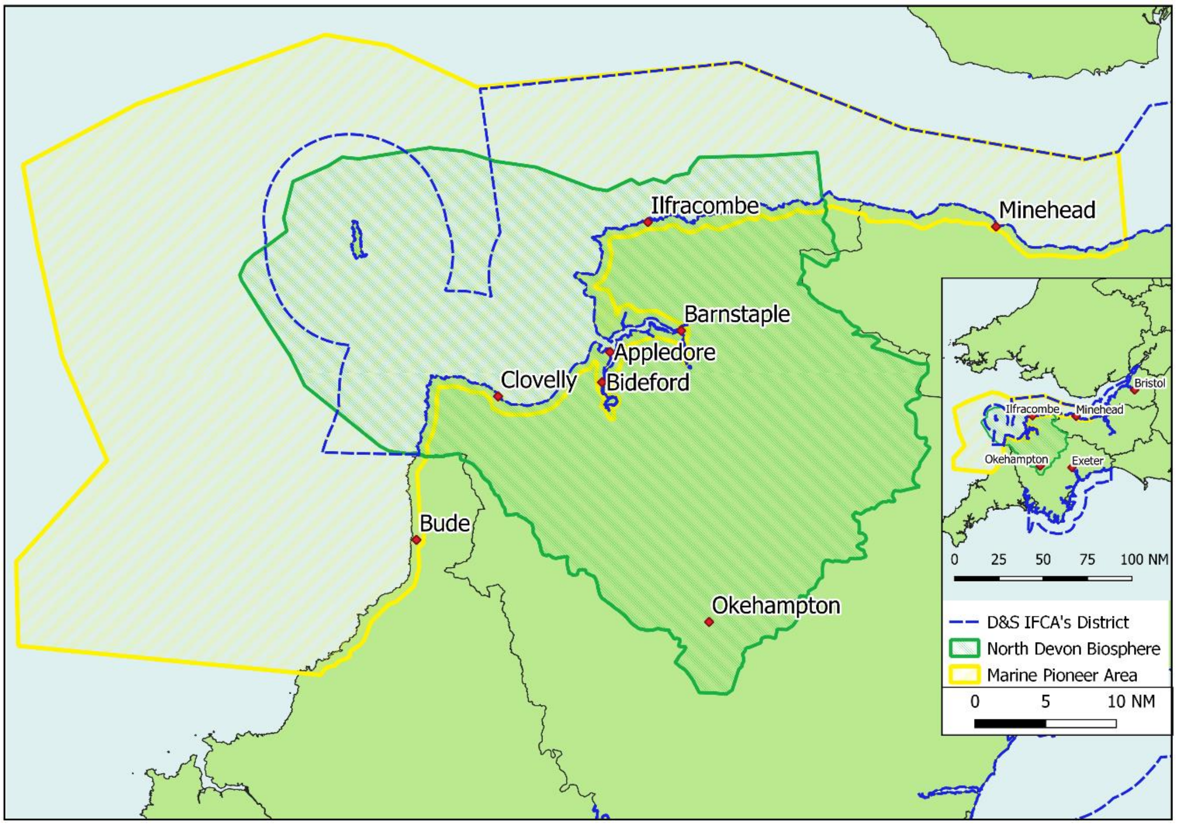

__Figure 1__ - The Marine Pioneer area, North Devon Biosphere reserve, and Devon & Severn IFCA District on the North Devon and Somerset coastline.

Methodology

Each FRMP has been developed using existing data and knowledge combined with information gathered through stakeholder engagement. There was a thorough review of the evidence available in academic journals, grey literature, regulator and industry reports and historical sources. Semi-structured interviews were held with 9 fishers who are or have been active in the north of the D&S IFCA's District, and with individuals who have fished in this area in the past and worked within the inshore fishing industry. This included commercial and recreational fishers, charter boat operators and members of the North Devon Fishermen's Association (NDFA).

Each FRMP includes:

- A full ecosystem-based review of the ecology, fisheries, and management for the focal species, which can be used by a range of stakeholders as a comprehensive source of fish and fisheries knowledge.
- An evidence base that can be used to evaluate the impact of human activity on fisheries, fish, and habitats. This can also be used to engage with other organisations in the development of national policy and implementation of Fishery Management Plans under the Fisheries Act (2020).
- Identification of current gaps in evidence so that D&S IFCA and other organisations can take a rational and prioritised approach to future research.
- Recommendations for fisheries management, making the case for local, sustainable, ecosystem-based fisheries management where realistic and appropriate.

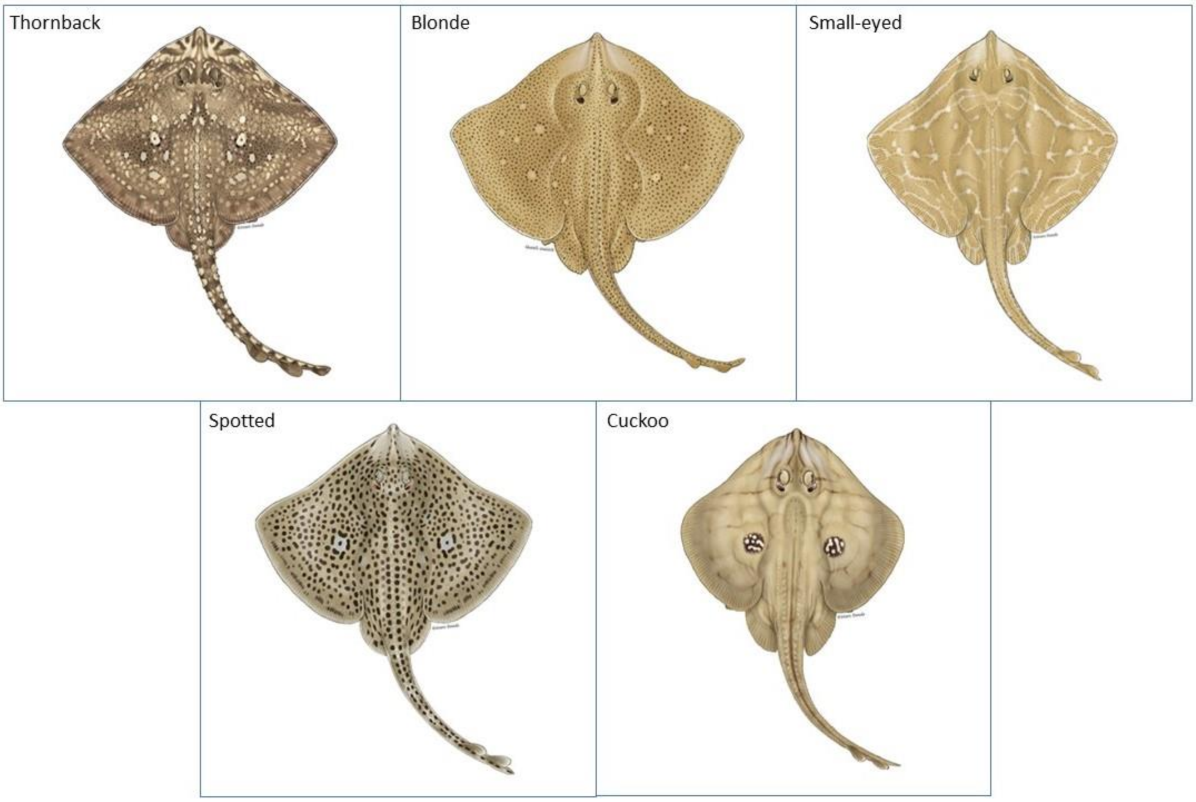

Figure 2 *- Commercially important UK skate species for the UK (Cornwall Good Seafood Guide, 2019, [https://www.cornwallgoodseafoodguide.org.uk/ [unedited]](https://www.cornwallgoodseafoodguide.org.uk/)).*

Skates & Rays

Please note: all species described in this FRMP are species of skate (Rajidae). As many of the common/English names for skate species include the term ray (for example, thornback ray, or blonde ray) they are referred to as 'skates and rays' within the fishing industry. This plan will use the term 'skates and rays' for consistency.

Over 150 skate (*Rajidae*) species have been recorded worldwide and 27 have been found around the British Isles (Heessen, Daan and Ellis, 2017). Several of these species are commonly found in waters in the north of D&S IFCA's District and this FRMP focuses on the most commercially important: thornback ray (*Raja clavata*), blonde ray (*Raja brachyura*), small-eyed ray (*Raja microocellata*), spotted ray (*Raja montagui*) and cuckoo ray (*Leucoraja naevus; see* **Figure 2**). Skates and rays support a number of important fisheries around the UK. The targeted trawl fishery in the Bristol Channel has landed up to £1 million worth of skates and rays annually in recent years. In FRMP stakeholder interviews some fishers described the skates and rays fisheries as essential for keeping their fishing viable.

Summary of Recommendations

Drawing on existing data and knowledge, and information gathered through stakeholder interviews, this plan makes a series of recommendations to facilitate the transition to a localised approach to managing skate and ray fisheries in the north of the D&S IFCA's District. Recommendations have been grouped into 'research' and 'management'. Many of the recommendations are interconnected and would need to be delivered as a whole for them to be effective.

You can find the details of each recommendation in **PART 1** of this plan.

Research

Establish detailed knowledge on the ecology, range and movements of skates and ray stocks to fill gaps in knowledge and inform management.

Involve fishers in the planning of future research to make the most of local expertise and knowledge.

Investigate reported spawning and nursery grounds off Minehead to determine its importance for local skates and rays and other species.

Management

Improve integration between fisheries management and marine planning to make sure the exploitation of the marine environment is responsible and sustainable.

Improve landings data collection for recreational and commercial fishers to discover which species are present locally and the numbers caught by commercial and recreational fishers.

Improve communication and engagement with fishers to establish stronger fisheries enforcement presence in the north of D&S IFCA's District and combat illegal fishing and non-compliance in the area.

Transition towards single species assessment and management for skates and rays to incorporate the different ecologies into management and assess the appropriate scale for management.

Introduce robust monitoring of small-eyed ray populations in the Bristol Channel to help safeguard important local fisheries and keep exploitation sustainable.

PART 1. RECOMMENDATIONS FOR MANAGEMENT TO FACILITATE A TRANSITION TO A LOCALISED, ECOSYSTEM BASED APPROACH

*This section outlines the research and management changes that are needed to adopt a local, ecosystem-based approach to skate and ray fishery management. The evidence to support the recommendations is outlined in **PART 2** of this plan. The recommendations have been categorised in terms of priority. Many of the high priority recommendations need to be addressed first to make it possible for the others to be carried out in the future. For example, many of the management recommendations can only be actioned once the research gaps have been filled.*

Summary of Current Fishery Status

Recent surveys indicate that several populations of skate and ray species in the Bristol Channel are growing. This is backed up by local fishers reporting that skate and ray catches have remained strong. Skates and rays are extremely important local fisheries for North Devon and the targeted skate and ray fishery in the Bristol Channel is one of the biggest in the UK.

Correctly assessing and sustainably managing skate and ray stocks in the Bristol Channel is an urgent priority because they are so popular with commercial and recreational fishers. Though these ecologically-similar species may be targeted together in a fishery, the status of specific populations should be assessed independently, as aggregated assessments of fishery targets can mask change at the species level (e.g., (Henly *et al.*, 2021).

Research Recommendations

The research recommendations are also available on D&S IFCA's website and will be shared periodically with interested parties to encourage collaborative research between fishers, scientists and managers that is relevant to management and policy.

Establish detailed knowledge on the ecology, range and movements of skates and ray stocks – *High Priority*

To achieve species-specific management of skates and rays it is essential to have a detailed understanding of their distributions. There is information about the distribution of skates and rays in the Bristol Channel on a multi-species level but this needs to be documented for each of the distinct commercially-important species.

To better understand where each of the distinct skates and rays species are present and in what quantities, the catch (and bycatch) of trawl fisheries in the Bristol Channel could be monitored. More detailed information on the ecology and movements of skates and rays species in the Bristol Channel could also allow for more effective monitoring of species that are important to local fisheries, e.g., small-eyed ray.

Next steps:

- Any future monitoring or research should be designed in collaboration with Cefas and ICES to ensure the data are suitable for input to stock assessments.
- Findings can help inform future Fisheries Management Plans (FMPs), and contribute to delivery of the ecosystem and scientific evidence objectives of the Fisheries Act 2020.

Involve fishers in the planning of future research – *High Priority*

Engaging with fishers through the FRMP interviews has been invaluable in investigating local skates and rays fisheries and arriving at these recommended next steps for research and management. Local fishing knowledge and fisher engagement should be used as much as possible in future to help direct research and benefit the local fishing industry.

Next steps:

- D&S IFCA is well-placed to facilitate fisher/researcher collaboration and will investigate what is needed to enable this (for example, collaborations will require standardised protocols and terms of reference, including for shared use of vessels and equipment).

Investigate reported spawning and nursery grounds off Minehead – *Medium Priority*

The possibility of spawning habitat near Minehead needs to be investigated. Fishers have reported large egg-carrying female rays and juvenile fish. This raises immediate concerns regarding aggregate dredging and coastal development activities in the area. If found, the spawning grounds must be mapped thoroughly and the implications of human activity on the habitat need to be incorporated into the management of fisheries and other activities.

Next steps:

- D&S IFCA will explore collaborative research opportunities with relevant stakeholders to investigate the reported spawning areas near Minehead.
- D&S IFCA will support appropriate investigations of essential fish habitat in under-sampled coastal and estuarine areas. This information would inform regional Marine Plans, marine licencing and permitting processes.
- Findings from this research could inform future FMPs and contribute towards delivery of the ecosystem and scientific evidence objectives of the Fisheries Act 2020.

Management Recommendations

Improve integration between fisheries management and marine planning – *High Priority*

There is widespread concern that the effects of human activity on marine organisms and environments is not being appropriately considered by planners. Detailed information about marine species and ecosystems is required to inform environmental impact assessments, Habitats Regulations Assessments, and other licensing and permitting assessments affecting marine developments. There is a strong need to realign and unify aspects of marine spatial planning, licencing, and permitting with fisheries and environmental management so that these are more accurately and reliably considered in the process. This is particularly true in the Bristol Channel and Severn estuary, where there are high levels of interest for aggregate extraction and renewable energy developments.

Next steps:

- Findings from the recommended research in this FRMP should be incorporated into regional Marine Plans through discussions with D&S IFCA and the MMO.
- This would aid delivery of the Government's 25 YEP and Fisheries Act 2020 objectives, including utilising an ecosystem approach and prioritising sustainability.

Improve landings data collection for recreational and commercial fishers – *Medium Priority*

Reliable data on fish mortality is essential for the effective management of fisheries. Until recently, national management stated that smaller commercial vessels (<10 metres) were not required by law to declare their landings, but any sales of fish over 30kg to registered sellers required a sales note. It is likely that many sales from the artisanal fisheries in the north of D&S IFCA's District do not exceed 30kg in weight so they will not have been recorded. Any catches of skates and rays by recreational anglers or netters also go largely undocumented.

For managers and researchers to investigate the effects of fisheries on local skate and ray populations reliable catch data are needed from both recreational and commercial fishers. Progress has been made regarding the development of the <10 metre vessel catch recording app, and there are similar options for recording catch for recreational fishers (e.g. Cefas Sea Angling Diary), however, more detail is needed, particularly in a local context to properly understand the impacts of fishing on skate populations. One option is to trial monitoring stations with logbooks and make it mandatory for small scale commercial fishers and recreational fishers to record their skates and rays landings. For a trial like this to be successful the identification of species must be accurate. This may require training or guidance for fishers because of similarities in UK skate and ray species.

Next steps:

- The IFCAs are well-placed to facilitate improvements in landings data to help establish species-specific understanding of skate and ray distributions and abundance at local to national scales. Additional data requirements should be evaluated in collaboration with those who are best placed to use them for stock/distribution assessments (e.g. Cefas and ICES).
- When specific data needs are identified, such as mandatory species-level recording of skates and rays catch, a pilot or trial study should be undertaken in collaboration with local fishers as part of D&S IFCA's Annual Plan.

Improve communication and engagement with fishers to establish stronger fisheries enforcement presence in the north of D&S IFCA's District – *Medium Priority*

There is a strong consensus among fishers in the north of the District that a stronger enforcement presence is needed to help combat non-compliance and illegal fishing in the inshore fishing industry. D&S IFCA has one of the the largest districts of any IFCA and is the only IFCA with two separate coastlines to cover and monitor. The limited size of the enforcement team means it is not possible for IFCA officers to maintain a strong presence in every area of the District. Consequently, officers must implement an intelligence-led, risk-based approach to their work that is proportionate to the compliance requirements: officers must prioritise patrols in areas with high numbers of reports of illegal fishing activity, which is typically the south coast of the District.

To enable enforcement officers to focus more of their activities (e.g., patrols) in the north of D&S IFCA's District, there needs to be more comprehensive reporting of illegal activity from those in the area, and improved communication between officers, fishers, and other local stakeholders. Additional external funding to expand research and enforcement capabilities would also improve this situation.

Next steps:

- D&S IFCA will improve collaboration and engagement through activities such as virtual roadshows for ports, sectoral meetings and future FRMP interviews. More information about planned activities is available in the D&S IFCA's Annual Plan and Communications Strategy, accessible via the D&S IFCA website.

Transition towards single species assessment and management for skates and rays – *Low Priority*

Once detailed information about the populations and distributions of distinct skates and rays species is available they should be assessed and managed on a single species basis. At this point each species should be assessed to see whether a local approach to management is appropriate and achievable. The current approach of managing skates and rays as a multi-species on a national scale doesn't accurately capture the nature of stocks in the Bristol Channel. In the past this has led to restrictive measures being implemented for species that are locally abundant such as the temporary 2016/17 VIIf small-eyed ray ban.

Focusing on skates and rays on a species level in the Bristol Channel will also provide information on the presence and status of threatened species such as the undulate ray and common skate. It is recommended that any future FRMPs or wider stock assessments focusing on skates and rays be conducted on a species-specific basis. Work such as this on a more local and regional scale can then be used to feed into the shifting to a species-specific management basis on a national and international levels.

Next steps:

- This recommendation can only be progressed once the information on distinct species of skates and rays is available. This transition should be delivered in close collaboration with local fishers, Defra and the MMO.
- Future FRMPs, FMPs or wider Cefas and ICES stock assessments focusing on skates and rays should be conducted on a species-specific basis to meet sustainability and ecosystem objectives of the Fisheries Act 2020.

Introduce robust monitoring of small-eyed ray populations in the Bristol Channel – *Low Priority*

Robust monitoring of local populations of small-eyed ray is needed to accurately assess the stock and keep exploitation sustainable in the Bristol Channel. Small-eyed ray is an important species for fishers in the Bristol Channel and previous restrictive management at European level has been extremely damaging to the inshore fishing industry. Accurate monitoring could also be used to inform appropriate scales and methods of management and safeguard local fisheries.

Next steps:

- Effective monitoring and management would require collaboration across local fishers, D&S IFCA, Welsh Government and Defra in order to be effective, with involvement of Cefas as outlined above to achieve robust monitoring methods.

PART 2. REVIEW OF EXISTING SCIENTIFIC RESEARCH AND FINDINGS FROM STAKEHOLDER ENGAGEMENT

Species Ecology

Skates are large, flattened, cartilaginous fish that fall into the super order *Batoidea* (rays) and are closely related to sharks. Skates are broadly divided into two sub-families: hard-nosed skates – *Rajidae,* and soft-nosed skates – *Arhynchobatinae* (Heessen, Daan and Ellis, 2017). Like sharks, a large proportion of skate's bodies are covered by pointed placoid scales, similar to teeth (McEachran, De Carvalho and Carpenter, 2002). They have flat bodies with a slender, fleshy tail and large flat pectoral fins that extend the full length of their bodies; these fins are used for movement through the water. Skate jaws are located on the underside of their body and they have ventral gill slits, however, they possess dorsal spiracles (water inlets for breathing) meaning they are able to bury themselves in sand or sediment and still respire normally (Bustamante *et al.*, 2012). The majority of skates and rays spend most of their time near the ocean floor where they feed on bottom dwelling organisms (Hamlett, 1999).

Geographical Range, Migrations & Habitat

Skates are found all over the world, though tend to favour cooler, deeper water and avoid brackish and freshwater environments (apart from a single species in Australia). The geographic ranges of the skates and rays found in the Bristol Channel overlap substantially, with all five species being found in UK waters, and throughout regions of western European and Mediterranean waters (see **Figure 3**). However, each species has its own preferences for depth and habitat (see **Table 1**).

Figure 3 *- Worldwide distributions of the thornback ray (R. clavata), the blonde rays (R. brachyura), the small-eyed ray (R. microocellata), the spotted ray (R. montagui) and the cuckoo ray (L. naevus) (from IUCN, 2019, https://www.iucnredlist.org/ [unedited]).*

Engaging with fishers from North Devon and Somerset that regularly target skate further highlighted the importance of the Bristol Channel for small-eyed ray populations. Small-eyed rays (see ***Figure 4***) have a much more restricted range than other skate species, with a significant portion of their distribution being within the Bristol Channel and wider Celtic Sea region. Fishers reported that small-eyed rays comprise a significant part of their skate and ray catch in the Severn estuary and stressed the importance of the Bristol Channel for the small-eyed ray as a species, with one fisher stating that "*around 70% of all small-eyed rays caught in the UK are from the Bristol Channel and Celtic Sea* (FRMP Interviews, 2020)." Several fishers described the importance of ray stocks in keeping their fishing viable throughout the year, and that the large restrictions on small-eyed ray fishing (such as the proposed ban in 2016, see **Fishery Management**) would drive them out of the industry.

Figure 4 *- Small-eyed ray (R. microocellata) (Vanhalst, 2015,* *http://www.marinespecies.org/photogallery.php?album=730&pic=110479* *[unedited])*

Although skates are not considered a highly migratory species, adults do seasonally migrate from their deeper, offshore waters to breed and spawn inshore during the summer before returning before the winter (Hamlett, 1999). The newly hatched pups of most skate species spend a year or two in these inshore nursery grounds before travelling further offshore as they grow larger (Serena, 2005). Upon reaching maturity, they will join the rest of the adult population in their seasonal movements to and from the shore. The males and females of some skate populations have been seen to migrate to their spawning areas independently of one another with females leaving the offshore areas two or three months before the males (Hunter *et al.*, 2005a, 2005b).

Table 1 *- Ranges and distributions of skate species found in the Bristol Channel.*

Species	Depth Range	Closeness to Shore	Geographical Range	Substrate	Sources
Thornback	Down to 300 m, though most abundant between 10 and 60 m.	Mainly favour coastal waters, though migrate further inshore to breed.	Northern range extends to just shy of Arctic Circle and continues through almost all coastal Europe including the Mediterranean and Black Seas. Range extends south along the northern, western, and southern coasts of Africa. Some sightings also reported from Indian Ocean.	Favour variety of fine substrates including mud, sand, and gravel.	(Whitehead, 1984; Rousset, 1990; Stehmann, 1996; Hunter *et al.*, 2005b; Henderson, 2014)
Blonde	Down to depths of 150 m, as deep as 300 m in the Mediterranean.	Mainly favour coastal waters, though migrate further inshore to breed.	Less widespread than thornbacks, found as far north as Faroe Islands, throughout all UK waters. Range extends through Western Europe and covers western halves of the Mediterranean and North African coasts.	Favour sandbank habitats, usually dominant skate species in these environments.	(Bertrand *et al.*, 2000; Baino *et al.*, 2001; Ellis *et al.*, 2005a; Porcu *et al.*, 2015; ICES, 2018)
Small-eyed	Rarely found deeper than 100 m.	Mainly favour coastal waters, though migrate further inshore to breed.	Most limited range of UK skate species. Restricted to Atlantic coasts of Southern Britain, Ireland, and Northwest Europe. Range extends southwards from Gibraltar and along the northwest African coast. Patchier distribution than other species.	Favour sandy habitats and bottoms.	(Hureau *et al.*, 1984; IUCN, 2006; Barnes, 2019)
Spotted	Found down to 200 m though has been surveyed as deep as 530 m.	Mainly favour coastal waters, though migrate further inshore to breed.	Widely distributed in the northeast Atlantic, with their range including all British coastal waters extending up to the Shetland Islands and Southern Norway. Also found along the northwest and southern coasts of Western Europe including most of the Mediterranean, northern Africa, and the Canary Islands. Also reports of spotted rays off the coasts of Egypt and Israel.	Commonly found on sand and coarser substrates.	(Baino et al., 2001; Bauchot, 1987; IUCN, 2007; Whitehead, 1984; Williams, Helle and Aschan, 2008)
Cuckoo	Found between 20 and 500 m, though most found around 200 m depth.	Favour more offshore waters compared to other skate species, though cuckoo juveniles are found further offshore than adults.	Found in coastal waters as far north as Shetland and Southern Norway. Distribution covers all coastal western Europe including most of the Mediterranean and Adriatic Seas as well as the North African coast.	Coarse sand and gravely substrates.	(Whitehead, 1984; Bertrand *et al.*, 2000; Serena, 2005; Heessen *et al.*, 2017)

Reproduction & Life History

In general, skate species tend to have slow growth and maturation rates, with relatively low fidelity, meaning populations can take many years to grow (Whitehead, 1984). Unlike stingrays, skates are oviparous, meaning they lay their eggs. Some skate species show high spawning site fidelity, meaning they may return to the same locations to breed, with females and males sometimes journeying to these sites independent of one another (Hunter *et al.*, 2005a, 2005b). Males use structures called claspers joined to their pelvic fins to attach themselves to the female so fertilisation can occur. Egg fertilisation occurs in utero, and once fertilisation has occurred, a protective casing forms around the embryo. These fertilised, protective cases are then laid on the sea floor and are commonly known as mermaids' purses (Treloar *et al.*, 2012). These egg cases differ in size an appearance between different skate species (see **Figure 5**).

Figure 5 *– Spotted ray (R. montagui) egg cases from North Devon (BeachStuff, 2017,* *http://www.beachstuff.uk/eggs_and_egg_cases.html* *[unedited]).*

Once hatched, juvenile skates (see **Figure 6**) tend to spend a year or two living in shallow, inshore nursery areas such as lagoons or estuaries. Once they have grown larger, they begin to venture offshore and do not return to these inshore areas until they have sexually matured and begin taking part in breeding migrations with the other adults of its species (Whitehead, 1984). More detailed information on skate life histories is available in **Table 2**:

__Table 2__ - Reproductive information and life histories of skate species found in the Bristol Channel.

Species	Breeding Season	Fecundity	Juvenile Information	Sexual Maturity	Adult Size & Longevity	Sources
Thornback	March to September in shallow, inshore waters. Timing may be more restricted for individuals.	48 to 74 egg cases, can be as much as 160. Eggs hatch after ~five months (influenced by temperature).	10 to 14cm long, weigh 8 to 9 grams. Use shallow, inshore waters as nursery grounds for ~2 years before venturing further offshore. 1:1 ratio of males to females.	After six to eight years.	Females ~118cm Males ~100cm	(Chevolot et al., 2006; Ellis et al., 2005a; Gallagher, Nolan and Jeal, 2005; Hamlett, 1999; Hunter et al., 2005b)
Blonde	May to August in shallow, inshore waters avoiding more freshwater habitats.	Maximum of 44 egg cases. Hatch after six to seven months.	Use shallow, inshore waters as nursery grounds for ~2 years before venturing further offshore.	Females - five to seven years (~83cm length) Males - six to eight years (~80cm) Varies with region.	Maximum 110cm.	(Ellis et al., 2005a; Gallagher, Nolan and Jeal, 2005; Heessen, Daan and Ellis, 2017; Henderson, 2014; McCully, Scott and Ellis, 2012; Porcu et al., 2015)
Small-eyed	June to September, peaking in the summer, in shallow, inshore waters.	54 to 61 eggs per year.	Size at birth is approximately 10cm. Use shallow, inshore waters as nursery areas before moving offshore when older.	After five years, approximate length of 57.5cm for both males and females.	Tend not to exceed 91cm in length.	(Ryland and Ajayi, 1984; Dorel, 1986; Hamlett, 1999; Ellis *et al.*, 2005a, 2011)
Spotted	February to June in shallow, inshore waters.	25 to 60 eggs, hatching after five or six months.	Size at birth is between 10 and 12 cm, juveniles spend one to two years in shallow, coastal nursery areas before moving offshore when larger.	After four to six years.	Most have a length close to 60cm and live up to ten years, some older and larger individuals recorded.	(Heessen, Daan and Ellis, 2017; McCully, Scott and Ellis, 2012; Ryland and Ajayi, 1984; Van Steenbergen, 1994; Walker, 1999)
Cuckoo	Spawning peaks after winter, but egg cases are present year-round in UK.	Around 90 eggs per year, hatch after eight months.	Hatch at no longer than 10cm, juveniles favour deeper offshore waters compared to other skate species.	Varies between locations, usually between 55 and 60cm length for males and females.	Normally get no larger than 73cm and can live up to 12 years of age.	(Du Buit, 1976; Ellis, Pawson and Shackley, 1996; Ellis et al., 2005b; Heessen, Daan and Ellis, 2017; Maia et al., 2012; McCully, Scott and Ellis, 2012)

Figure 6 *– Juvenile thornback ray (R. clavata) (Jochen, 2016, http://www.marinespecies.org/photogallery.php?album=730&pic=112990).*

While being interviewed as a part of this project, fishers from Minehead spoke at length about how many of the rays they catch in their nets are large, egg-bearing females and that juvenile fish of many different species are regularly caught in the area (FRMP Interviews, 2020). Similar catches are made from angling charter vessels using rod and line gear. These fishers believe that the waters off Minehead are used as a nursery area by multiple species, including skates, and so will often return any egg-carrying female skates to the sea to let them deposit their eggs and protect local populations. Further research is required to detect key habitats used by juvenile fish in this area, confirm the presence of any breeding and nursery grounds, and identify which species use them.

Food Web & Interspecies Interactions

The diets of the Bristol Channel skate species are generally very similar with all species undergoing a shift in diet as they grow and mature (Hamlett, 1999; Moura *et al.*, 2019). As juveniles, skates predominantly feed on small crustaceans, such as shrimp, mysids, amphipods and small crabs (Ajayi, 1982; Ebert and Bizzarro, 2007). Older, larger individuals begin feeding on larger crustaceans such as prawn and crab and some fish including dragonet and sand eel (Ellis, Pawson and Shackley, 1996). Although there is a lot of overlap between the diets of UK skate species, there are some key differences. For example, studies have shown that fish make up a much larger portion of the diet of cuckoo rays (even during the juvenile stage) and small-eyed rays than for other species such as thornback and blonde rays (Ajayi, 1982; Rae and Shelton, 1982). Adult thornback rays are more generalist predators, occasionally feeding on organisms such as cephalopods, and cannibalising other thornbacks

(Šantić, Radja and Pallaoro, 2012). The majority of skate feeding occurs at a benthic level near the sea floor, however, some feeding on fish does occur slightly higher up in the water column (Ajayi, 1982; Hamlett, 1999; Follesa *et al.*, 2010).

Adult skates are not typically predated upon by many other organisms (Ebert and Bizzarro, 2007). A 2017 investigation of the roles of marine apex predators found that skates in a Northern Irish coastal ecosystem were effective in preventing crabs from heavily feeding on, and reducing coverage of, bivalves, which are important for reef formation (Barrios-O'Neill, Bertolini and Collins, 2017). It is highly likely that such relationships are present in other areas of high skate abundance such as the Bristol Channel, and that overfishing of skates and rays in these areas could lead to dramatic changes in ecosystem structures and dynamics, with knock-on effects to other organisms.

Though there is no documented evidence of this in the scientific literature, skate populations in the area could be acting as a food source for grey seals (*Halichoerus grypus;* see **Figure 7**). The largest grey seal colony in the South West is located on Lundy island, in the north western section of the NDMP area, and there are reports of small numbers of seals seen further into the Bristol Channel (ABPmer, 2014). It is possible the seals could turn to the skates as a food supply should their preferred food sources decline, e.g. cod, sand eels, herring, etc (Hammond and Wilson, 2016). Seal predation is thought to have contributed to declines of up to 98% in northwest Atlantic populations of winter skate (*Leucoraja ocellata*) (Benoît *et al.*, 2011; Swain and Benoît, 2015). Similar instances of skate predation have been observed in South African waters involving brown fur seals (*Arctocephalus pusillus*) and white skate (*Rostroraja alba*).

Figure 7 *– Lundy grey seal (H. grypus) (North Devon Biosphere, 2020,* https://www.northdevonbiosphere.org.uk/marinewildlife.html *[unedited]).*

Predation of skates during the juvenile and egg case stages of their life cycle will be more common, when the animals are far smaller and more vulnerable. For Bristol Channel skates and rays, once the egg case has been deposited by the mother, it can take five or six months for the juvenile to hatch, leaving them in an extended period of extreme vulnerability. There are numerous examples of skate egg cases being fed upon by gastropods (Cox and Koob, 1993; Lucifora and García, 2004). Off the Danish coast, egg cases of the thorny skate (*Raja radiata*) were found with boreholes consistent with those of local gastropods (Cox, Walker and Koob, 1999), which are thought to be a significant factor in influencing population abundance.

There are few reports of heavy predation of juvenile skates, but it is likely that they may be targeted by large predatory fish or sharks, such as spurdog (*Squalus acanthias*), as they often travel into inshore, shallow waters to feed on fish on or near the seabed (Avsar, 2001).

Fishery Information & Structure

Commercial fishing of skates and rays has more than doubled since 1970 with catches from the early 2000s exceeding 200,000 tonnes globally (Enever *et al.*, 2009). This intense fishing pressure has caused population declines in several species as well as local extinction of some of the larger skate species from areas of their historic ranges, e.g. common skate complex (Brander, 1981). There has been a steady increase in landings over the past few years though the market value of skate can fluctuate, meaning years with higher catch does not necessarily mean more money was earned by fishers (MMO, 2018).

Importance & Value of Fishery

Although many skates and rays in the UK are caught as bycatch in mixed demersal fisheries, some targeted fisheries also operate in certain areas. The Bristol Channel is among some of the most important fishing grounds for skates and rays in UK waters, and is a highly important target fishery with landings being valued at over £1 million in some years (Catchpole, Enever and Doran, 2007; Ellis et al., 2010). Skates and rays are among the most popular target species in the Bristol Channel area, with most fishers interviewed as part of this project targeting local skate and ray stocks to some degree (FRMP Interviews, 2020). Skates and rays remain an important fishery in the UK, with just under 3,500 tonnes landed by the UK fleet in 2019, with a value of £4.5 million. Approximately 225 tonnes of this were landed in North Devon ports with an estimated value of £617,000 (see **North Devon Catch Data**). The Bristol Channel trawl fishery for skates and rays was previously certified as sustainable by the Marine Stewardship Council (MSC) (see **Sustainability Ecolabels**), meaning their fishing practices had been monitored and assessed to be non-damaging to the long-term health of target populations and their ecosystem. Certified fisheries such as this can market their fish as MSC standard providing additional value to their catch. Certification was awarded to the Bristol Channel skate and ray trawl fishery in 2009 but was withdrawn in 2013.

As mentioned above, the Bristol Channel skate and ray fishery is a major source of income for fishers in the NDMP Area, with hundreds of thousands of pounds being made each year in landings (MMO, 2020a). Several local fishers operating in the Bristol Channel have said they rely on skate and ray fishing to make their businesses viable (FRMP Interviews, 2020). However, large amounts of skates and rays were potentially landed and sold in North Devon and Somerset in the past without documentation. Most of the fishing fleet in the area is under 10 m in length, and until recently, there has been no statutory requirement for these smaller vessels to declare their catches. Any landings information was usually collected co-operatively using log sheets and sales notes from ports. In 2005, the UK Government introduced the First-Sale Fish Scheme, which declared that registered buyers must report their purchases of landed fish using sales notes (UK Government, 2020). However, this only applied to individual sales over 30 kilograms in weight, meaning large amounts of skates and rays landings and sales may have gone unrecorded if they were small-scale (Masters, 2014). Additionally, MMO landings data do not account for the fish caught by recreational fishers and anglers, while the exact mortality associated with catch and release angling is unknown. Progress has been made to fill these landings data gaps. Recently the MMO developed and launched the <10 metre vessel catch recording app for use by commercial fishers to aid in mandatory catch data recording, and there are similar options for recording catch for recreational fishers (e.g. Cefas Sea Angling Diary), however, more detail is needed, particularly in a local context to properly understand the impacts of fishing on bass populations.

The skates and ray fisheries in North Devon provide fishers with welcome diversity of target species, relieving pressure on their other target stocks and allowing their populations to recover from any overfishing taking place (FRMP Interviews, 2020).

Figure 8 - Skates on sale in fish market (Seafish, 2019, https://seafish.assetbank-server.com/assetbank-seafish/action/viewAsset?id=11841&index).

In addition to being commercially harvested for consumption, skates have long been popular targets of recreational fishers and anglers, particularly in the Bristol Channel. A collection of surveys conducted during the Sea Angling 2012 project (Armstrong *et al.*, 2013) highlighted the range of benefits sea angling provided for people, including important social, physical and wellbeing qualities. There are over a million sea anglers in Britain and collectively they spend £1.23 billion per year on the sport, supporting over 10,000 jobs. Being a species group regularly targeted by anglers, skates and rays contribute to this value. Additionally, the Mapping Sea Angling project led by the MMO (2020a) identified that skates and rays were amongst the most sought after species by both shore anglers and charter boat users in the South West (see **Figure 9 & Figure 10**). Popularity of species such as these can lead to heavy recreational fishing effort as fishers often compete to catch the largest animal they can and have it documented as a record with their local (or national) angling association. It is likely that the Bristol Channel attracts anglers from all over the UK to the area to specifically target skates and rays, providing business and income to local charter boats, angling shops and hospitality industries (Armstrong *et al.*, 2013).

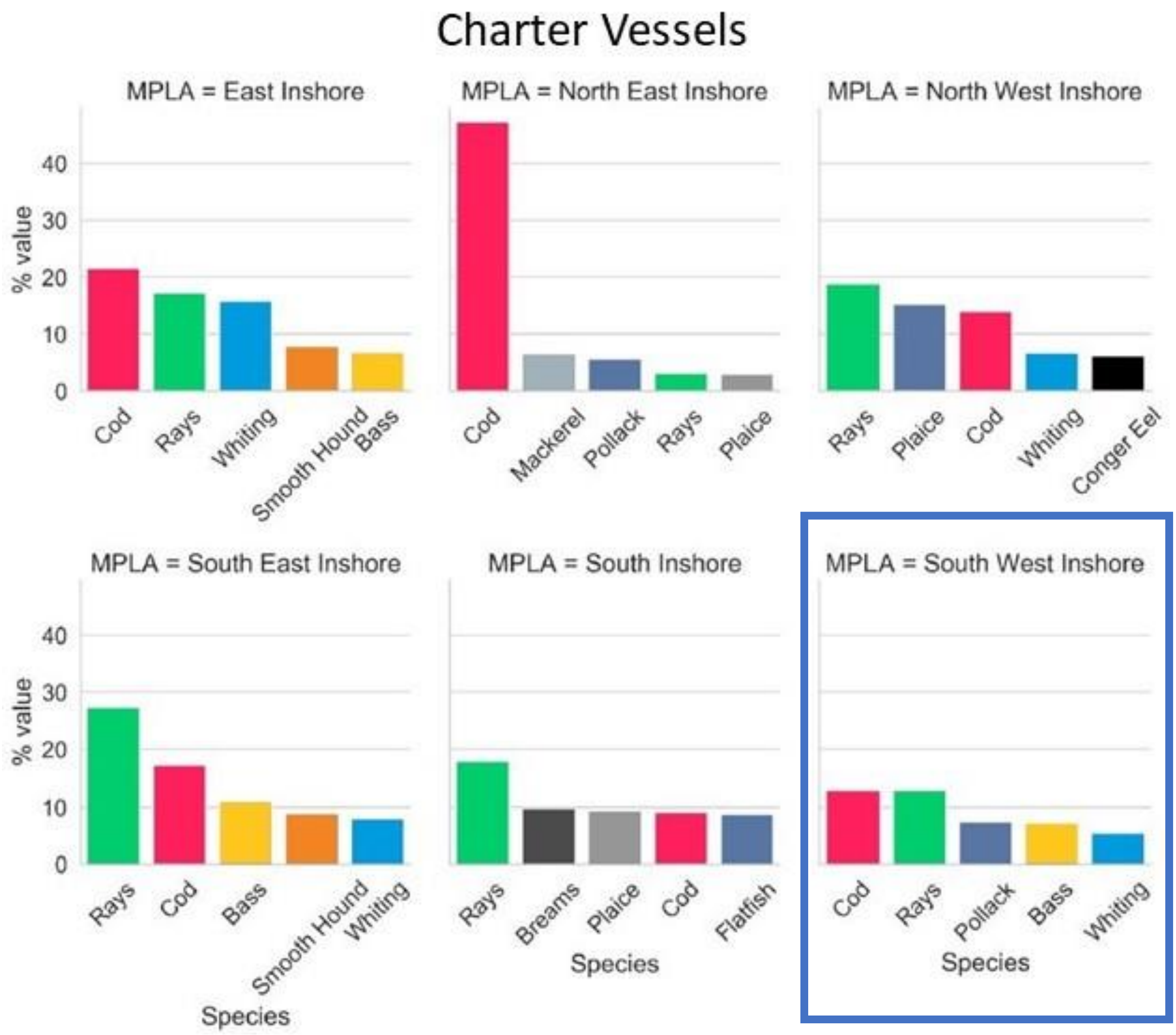

Figure 9 *- Preferred target species of charter vessel users in the UK (MMO, 2020a, https://www.gov.uk/government/publications/mapping-sea-angling-mmo1163 [unedited]).*

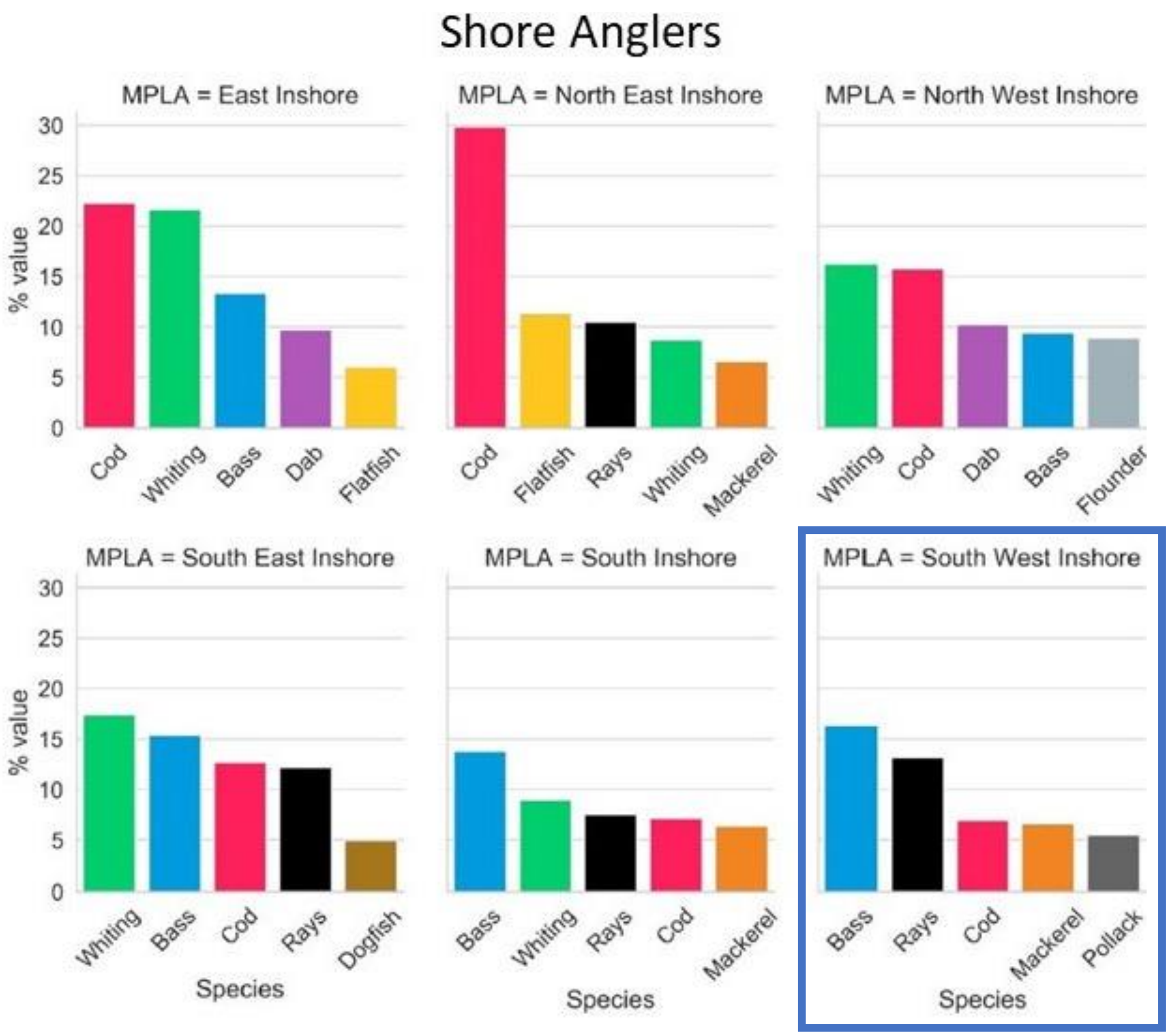

Figure 10 *- Preferred target species of shore anglers in the UK (MMO, 2020a,* *https://www.gov.uk/government/publications/mapping-sea-angling-mmo1163* *[unedited])*

Historical Landings & Changes Over Time

Evidence for fishing activity in the Bristol Channel and North Devon dates back to the Mesolithic era, including lines of stakes (thought to be the remains of fish traps) found during excavations around Westward Ho! (Preece, 2008). There are accounts of elasmobranchs, including thornback rays, being caught on long lines by fishers in North Devon as far back as the 1600s (Ashford, 2006). However, skates and rays have not always been perceived to have high market value; the majority of skates landed in the early 1800s were used as potting bait or eaten only by fishers' families (Steven, 1932). They were often referred to as "*rabble fish*" and perceived as unimportant. However, in certain areas, skates were highly sought after; larger species caught off Britain such as white skate were often sold to the French (Day, 1884). Many of the fishers in North Devon during the 1800s primarily targeted the famously abundant herring stocks along the coast, however, herring stocks declined in the 19th century following the introduction of trawling and steam power (Ibrahim, 2019). These fishers tried to maintain their productivity by increasingly directing efforts into other fisheries such as plaice and skates and rays to make up for declining herring catches. During the 1880s, the market for skates increased dramatically and they began to be regularly sold at London markets. The surge in fishing power during this time, as a result of the industrial revolution, led to steady increases in landings of many fish species, including skate, during the early 1900s.

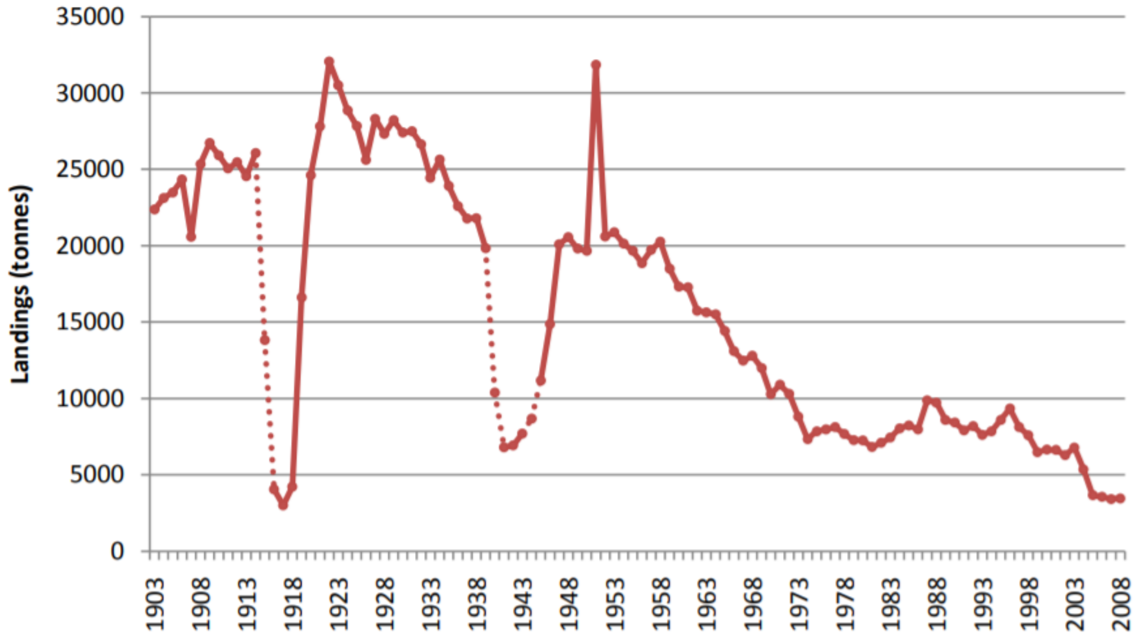

Figure 11 *- Landings of skates and rays in UK fisheries over time (Ellis et al., 2010,* *http://www.nwwac.org/_fileupload/Papers%20and%20Presentations/2016/06%20FG%20Skates%20and%20Rays/Ellis,%20Silva%20et%20al%202010_ICES%20CM%20E10.pdf* *[unedited]).*

During peacetime in the 20th Century, reported UK landings of skates and rays exceeded 20,000 tonnes per year until 1958, after which landings began to steadily decline (see **Figure 11**) (Ellis *et al.*, 2010). Since 2005, skate landings by the UK fleet have been close to 5000 tonnes per year, limited by new management measures that reduced fishing capacity via a quota system for skates and ray fisheries (ICES, 2009).

Given that skates and rays have been exploited for hundreds of years, there is a remarkable lack of historic species-specific data prior to the 1970s. The declines of large UK species such as the common and white skates was documented through the late 1800s to the early 1900s (Herdman and Dawson, 1902), though very little data on other *Rajidae* species were collected. Despite this lack of species-specific data, the dramatic declines in the numbers of skates around the British Isles was noticed by some. In 1932 one scientist noted that "*The statistics at present available show an alarming decline in the total British catches of Rays and Skates from the English Channel* (Steven, 1932)."

This lack of species-specific data persisted until very recently. Prior to 2009, all skates and rays were landed under a single identification code (SKA) in most European countries, meaning detailed information about the populations and distributions of single species could not be analysed using fisheries-dependent data. In 2009 the EU introduced new management including a TAC for skates and rays and a requirement to record skate and ray species separately (ICES, 2018). Since 2011, this has been achieved for over 90% of landings, shedding light on the population structures and distributions of some skate stocks (Ellis *et al.*, 2012).

During interviews with fishers in the north of D&S IFCA's District, many individuals spoke of observing large declines in the abundance of many species – including skates and rays – in the Bristol Channel during their time fishing (over the course of several decades for some). Several fishers attributed these declines to increases in fishing effort, especially from larger offshore vessels, catching skate and other species before they have a chance to reach coastal, inshore waters (FRMP Interviews, 2020). It is also likely that individual skate species in the Bristol Channel are subject to different levels of pressure and that their populations are reacting differently to one another.

Gear Used

Skates and rays around the UK are caught in a variety of gears, but most are caught using otter trawls, gillnets and beam trawls, with small amounts also being caught on longlines and in *Nephrops* trawls (Catchpole, Enever and Doran, 2007). Analysis of MMO landings data from North Devon ports (see **Table 3**) shows that, in the NDMP Area, currently over 96% of all skates and rays are caught using demersal trawls.

Demersal trawls are large, cone shaped nets attached to the rear of vessels that are dragged over the sea floor to catch species of fish living on and near the ocean floor (see **Figure 12**). The mouth of the trawl is usually held open by a pair of otter doors (otter trawls) or by a beam (beam trawls) (Seafish, 2020). A study on catch mortality of skates and rays in British waters found that otter trawls had an at-vessel mortality of only 0.76% (0 - 2.35%) upon capture (Ellis *et al.*, 2018). Similarly low rates of mortality were observed for longlines and tangle nets, with no mortality noted for skates caught as bycatch in drift nets. However, some species are more susceptible to damage or injury than others when caught by specific gear, for instance, thornback rays caught by longlines and tangle nets were in better condition than those caught in otter trawls and with drift nets. The same was seen for the endangered undulate ray (*R. undulata*), that is sometimes caught in UK fisheries (see **Undulate Ray**), however, EU regulations have prohibited fishing of undulates in the past, stating at the time they should be immediately released upon capture (ICES, 2018).

Table 3 *- Combined skates and rays landing data from North Devon ports in the North Devon Marine Pioneer Area from 2012 to 2016 (MMO, 2020b).*

Gear	Total Landing Weight (Tonnes)	Percentage of Landed Weight	Total Value (£)
Demersal Trawl / Seine	757.676	96.7%	£2,152,634.23
Drift & Fixed Nets	21.050	2.7%	£59,004.27
Pots & Traps	2.777	0.4%	£7,774.39
Beam Trawl	1.486	0.2%	£5,597.80
Dredge	0.416	0.1%	£1,370.00
Hooked Gear	0.061	0.0%	£183.51

There are several different types of fishing trawls, and different species of skates and rays are more susceptible to capture to some trawl types than others. Otter trawl catches in the Bristol Channel are dominated by three species, thornback, blonde and small-eyed rays, making up ~29, ~37 and ~36% of the total skate and ray catch, respectively (Silva, Ellis and Catchpole, 2012). Similar catch compositions are observed when using gillnets, but beam trawl catches are mainly composed of cuckoo and blonde rays, with small numbers of small-eyed and spotted rays also present (Silva, Ellis and Catchpole, 2012). Beam trawls usually operate further offshore than otter trawls and netters, so this difference in catch is most likely due to different habitat usage by the skates rather than gear selectivity.

Information on gear used by fishers is available for 2012–2016 in the MMO landings underlying dataset (see **Figure 13**). These data suggest that thornback, blonde and small-eyed rays are the most susceptible to capture by demersal trawls and netting (replicating the findings of Silva *et al.*, 2012), these methods are the most common in the North Devon fishery, so these species likely make up the majority of the skate and ray catch (see **Table 3**).

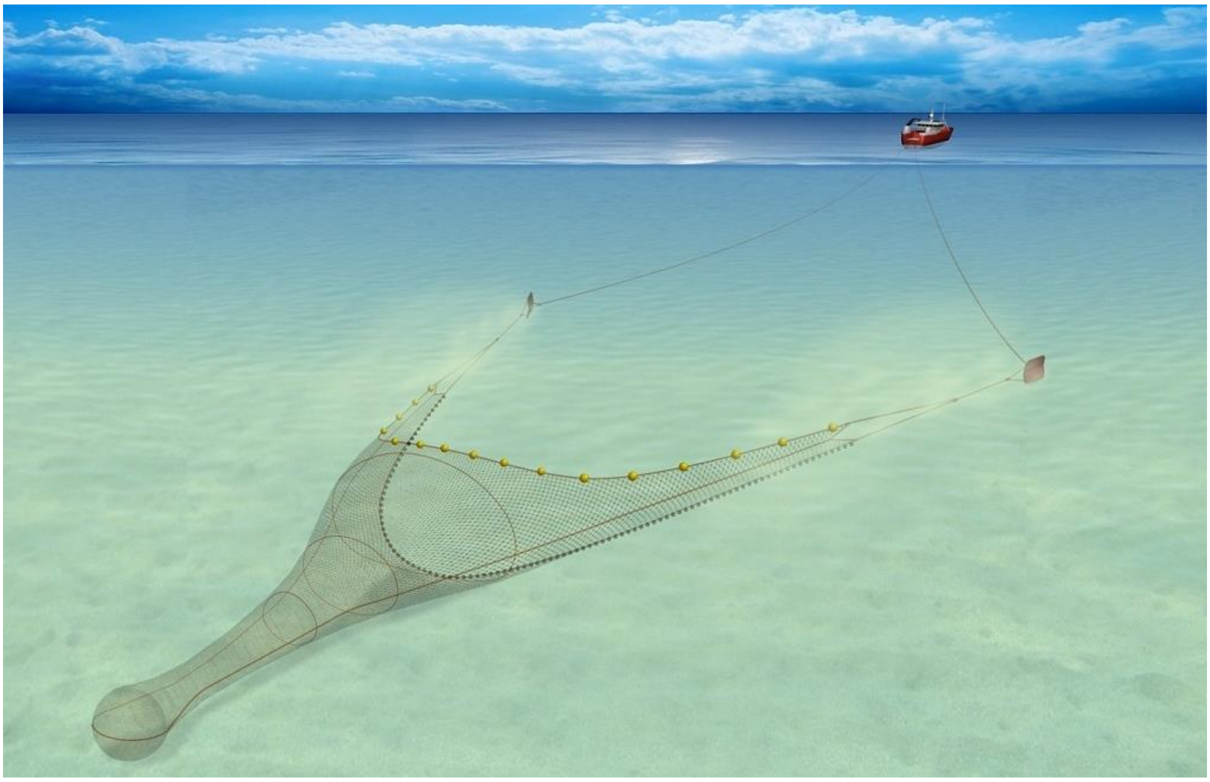

Figure 12 *- Demersal trawling (Seafish, 2015, https://seafish.assetbank-server.com/assetbank-seafish/action/viewAsset?id=4766&index [unedited]).*

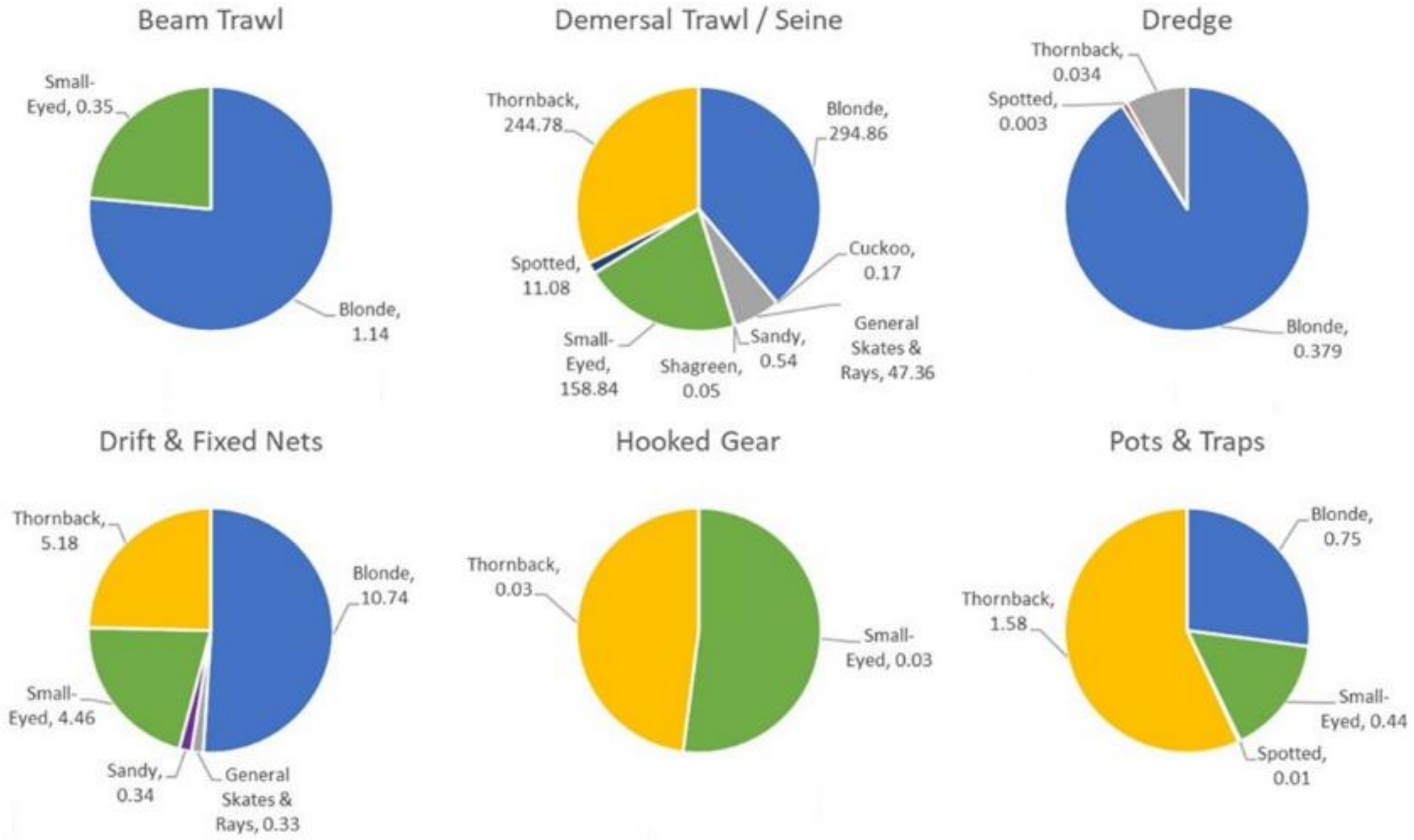

Figure 13 *– Skate and ray catch composition (tonnes) by gear type for North Devon ports (2012–2016) (MMO, 2020a).*

Current Recreational & Commercial Fishing Effort

With most mixed fisheries, including demersal trawls, it is extremely difficult to quantify fishing effort for an individual species as multiple species are targeted or caught in each haul as well as additional organisms caught as bycatch. As described in **Species Ecology**, *Rajid* species are very closely ecologically associated with one another, so much so that it is not usually possible for fishers to target one species while excluding others (Fahy, 1989). Though skippers can use fishing technology and local knowledge to increase the likelihoods of certain species being caught, there is no way to completely guarantee what is caught and in what quantities. This can be problematic for species conservation, particularly when fishing for quota species.

Fishing effort for skates and rays in British and European waters has mostly been dictated by the Total Allowable Catch (TAC) set by the European Union. Since 2009 skates and rays have been managed under a single TAC covering all species, with the exception of the small-eyed ray and the endangered undulate ray which were assigned their own TAC in 2017 and 2018 respectively (Johnston and Clarke, 2019). Additionally since 2009, species specific landings data have been mandatory and advised landings are given for all species by ICES assessments to the EU (ICES, 2018). Many of the skates and rays caught in the Bristol Channel most likely originate from, or are closely associated with, the Celtic Sea population, which has been exploited by 15 nations (though only five continue to land large quantities of skates and rays today; **Figure 14**). For skate and ray fisheries in the Celtic Sea (ICES Subareas VI and VII, excluding Division VIId), landings have been highly variable (see **Figure 15**), but have been in steady decline since 2000, in part due to the introduction of catch limits.

Since 2009, annual reported landings have stayed below 10,000 tonnes, however it is important to note that this is the year that the TAC for skates and rays was established (Ellis *et al.*, 2010), starting at 15,748 tonnes. Since 2009, the TAC was steadily reduced to 8,032 in 2016, with slight increases for 2017, 2018 and 2019 (Johnston and Clarke, 2019). These TACs have been described as restrictive or near restrictive, meaning they are dictating the fishing effort for skates and rays in the Celtic Sea.

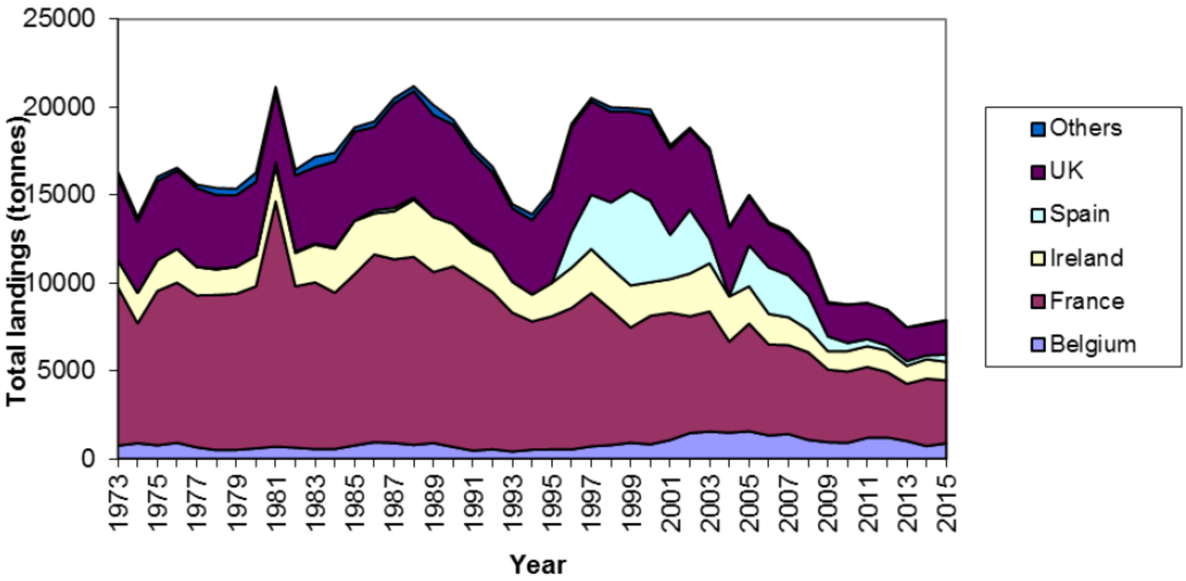

Figure 14 *- Skates and rays in the Celtic Seas. Total landings (tonnes) of skates (Rajidae) by nation in the Celtic Seas from 1973–2015 (ICES, 2018,* *http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2018/WGEF/01%20WGEF%20Report%202018.pdf* *[unedited]).*

Figure 15 *- Total annual skate and ray landings from the Celtic Sea (ICES Subareas VI and VII, excluding Division VIId) by all countries (ICES, 2018,* *http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2018/WGEF/01%20WGEF%20Report%202018.pdf* *[unedited]).*

However, landings declarations alone may not be a reliable indication of fishing effort, as the discard rate in demersal trawl fisheries can be extremely high. It has been estimated that the reported landings in elasmobranch fisheries may only represent half of what is being caught due to such high discard rates (Bonfil, 1994). In the Bristol Channel, it has been estimated that of the 3.8 million skates (3,237 tonnes) caught annually, 2.2 million (823 tonnes, 60% by number, 20% by weight) are subsequently discarded (Enever, Revill and Grant, 2007). It is likely in most skate fisheries, that further reducing TAC may result in increased discards.

In North Devon, skates and rays are targeted by fishers year-round (see **Figure 16**) but are unlikely to be under constant fishing pressure from the North Devon fleet, which seasonally target a range of other species. Additionally, North Devon fishers, in partnership with Welsh and Belgian fishers, voluntarily avoid fishing in a known skate nursery area known as The Ray Box for six months out of the year, in an effort to allow successful spawning to take place (ICES, 2018). As of July 2020, there were seven vessels with Mobile Fishing Permits (issued by D&S IFCA) in the north of D&S IFCA's District (**Table 4**). These Permits allow the of trawls, dredges, and ring nets (though currently there are no ring netting vessels operating in North Devon).

__Figure 16__ - Seasonal catch and target species of North Devon fishers (NDFA, 2020, http://www.northdevonfishermen.co.uk/our-catch [unedited]).

Table 4 - Number of fishing gear permits issued by the Devon & Severn Inshore Fisheries and Conservation Authority in or near to the North Devon Marine Pioneer Area (Devon & Severn IFCA, 2020).

Location	**Gear**						
	Commercial Netting	**Recreational Netting**	**Mobile Fishing at Sea**	**Mobile Fishing in Estuary**	**Commercial Diving**	**Commercial Potting**	**Recreational Potting**
Appledore	2	1				2	1
Barnstaple							2
Bideford		1	5			1	1
Braunton		1					1
Bridgewater							1
Bristol							2
Bude						2	
Clovelly	10	2	1			5	4
Fremington							1
Hele Bay						1	
Highbridge		1					
Ilfracombe			1			6	6
Lynmouth						2	
Minehead	4	11				2	
Padstow						2	
Taunton							1
Velator							1
Watermouth							3
Watchet		2					
Weston		1					
W.-Super-Mare		2					
Total	**16**	**22**	**7**	**0**	**0**	**23**	**24**

Recreational fishing effort for most species is difficult to quantify due to a lack of consistent catch data. Skates and rays are among the most sought after species by recreational anglers in the South West of England (see **Figure 9 & Figure 10;** MMO, 2020b). They are highly prized by both shore anglers and charter boat users, though anglers on charter vessels are more likely to catch larger, mature females with higher reproductive outputs than shore anglers due to their ability to venture further offshore. However, these species are rarely retained by anglers: estimates of retention rate have included 2.3% (data from 2016) and 7.4% (data from 2017; Radford *et al.*, 2020). The retention rate for skates and rays in the Bristol Channel may be higher than this as it is known as a UK "hotspot" for skates and rays, attracting anglers from across the country targeting these species as trophies (Seafish, 2013).

Multiple studies have shown skates to display high levels of post-release survivorship in several UK fisheries, particularly when compared to discards from trawl fisheries (Ellis et al., 2018; Catchpole, Enever and Doran, 2007; Enever et al., 2009). This suggests that, despite their popularity with anglers and assuming retention rates remain low, angling is unlikely to significantly impact skate and ray populations in the north of D&S IFCA's District. However more research is requried to confirm this.

Current Landings & Stock Status

Due to the Celtic Sea skate and ray stock being comprised of several different species living independently of one another, it is difficult to summarise the health of skates and rays in this area overall. For many species of skate in the Celtic Sea, landings have been declining in recent years (see **Figure 17**). In the Celtic Sea, much of this decline is attributable to declines in spotted ray landings (see **Figure 18**), and is likely a result of the reduced TAC. At individual species level, surveys indicate that thornback, spotted, cuckoo and small-eyed ray populations are all rising in the Celtic Sea and Bristol Channel, though the population trends of blonde ray remain unknown (see **Table 5**). This is a good indication that the reduced TAC is effectively allowing skate and ray populations in this area to recover, safeguarding the fisheries for future years. With TACs now increasing, effective surveying and monitoring of skate stocks is vital to ensure that overfishing does not resume and that stocks stay at ecologically safe levels.

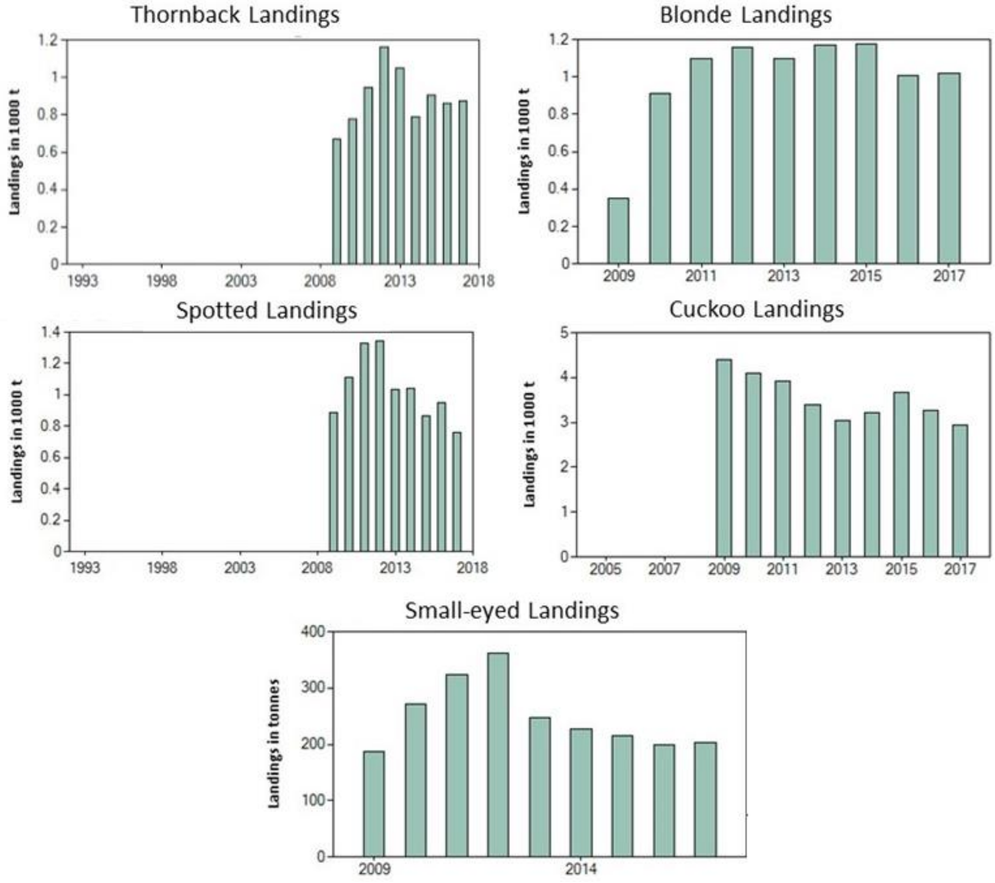

Figure 17 *- ICES landings data for Thornback ray (Raja clavata) in Divisions VII.a and VII.f-g (Irish Sea, Bristol Channel, Celtic Sea North), Blonde ray (Raja brachyura) in Divisions VII.a and VII.f–g (Irish Sea, Bristol Channel, Celtic Sea North), Small-eyed ray (Raja microocellata) in Divisions VII.f and VII.g (Bristol Channel, Celtic Sea North), Spotted ray (Raja montagui) in Divisions VII.a and VII.e–h (southern Celtic Seas and western English Channel) and Cuckoo ray (Leucoraja naevus) in Subareas VI and VII and Divisions VIII.a–b and VIII.d (West of Scotland, southern Celtic Seas, and western English Channel, Bay of Biscay) (ICES, 2020, https://www.ices.dk/data/Pages/default.aspx).*

Table 5 *- Population trends, TAC and advice for UK skate and ray stocks (Johnston and Clarke, 2019, http://www.nwwac.org/_fileupload/Papers%20and%20Presentations/2019/skates%20and%20rays/Maurice%20Clarke_ICES%20advice%20for%20skates%20and%20rays%20(002).pdf [unedited]).*

Species	Area	Status	Advice 2019/2020	TAC 2018 (t)	Notes	TAC 2019 (t)
Thornback	Irish Sea, Celtic Sea	Increasing	20%	9,699	Generic [2]	10,184
Thornback	West of Scotland	Increasing	20%	9,699	Generic [2]	10,184
Thornback	7e western Channel	Unknown	0%	9,699	Generic [2]	10,184
Spotted	Irish Sea, Celtic Sea, west Channel	Increasing	8%	9,699	Generic [2]	10,184
Spotted	West of Scotland, west of Ireland	Increasing	20%	9,699	Generic [2]	10,184
Blonde	Irish Sea, Celtic Sea	Unknown	-20%	9,699	Generic [2]	10,184
Blonde	West of Scotland	Unknown	50%	9,699	Generic [2]	10,184
Blonde	Channel 7e	Unknown	-20%	9,699	Generic [2]	10,184
Cuckoo	6,7,8	Increasing	20%	9,699	Generic [2]	10,184
Small-eye (painted)	Bristol Channel, Celtic Sea 7f,g	Increasing	25%	154	sep. TAC[1]	
Small-eye (painted)	Channel 7de	Unknown	11%		Generic[1]	10,184
L. fullonica shagreen	6,7	Unknown	-20%		Generic	10,184
L. circularis sandy	6,7	Unknown	-20%		Generic	10,184
Unduate	Channel 7d,e	Increasing	77%	161	Generic[1]	234
Common skate	All areas	Below poss. ref. pts.	Zero catch	P.S.		P.S.
Undulate	west Ireland 7b,j	Very low	Zero catch	P.S.		P.S.
White skate	All areas	Depleted	Zero catch	P.S.		P.S.

[1] 5% can be caught in 7d

[2] 5% of 7d TAC of 1,276 t can also be caught from 7d TAC (Neth, UK, Bel, Fra only)

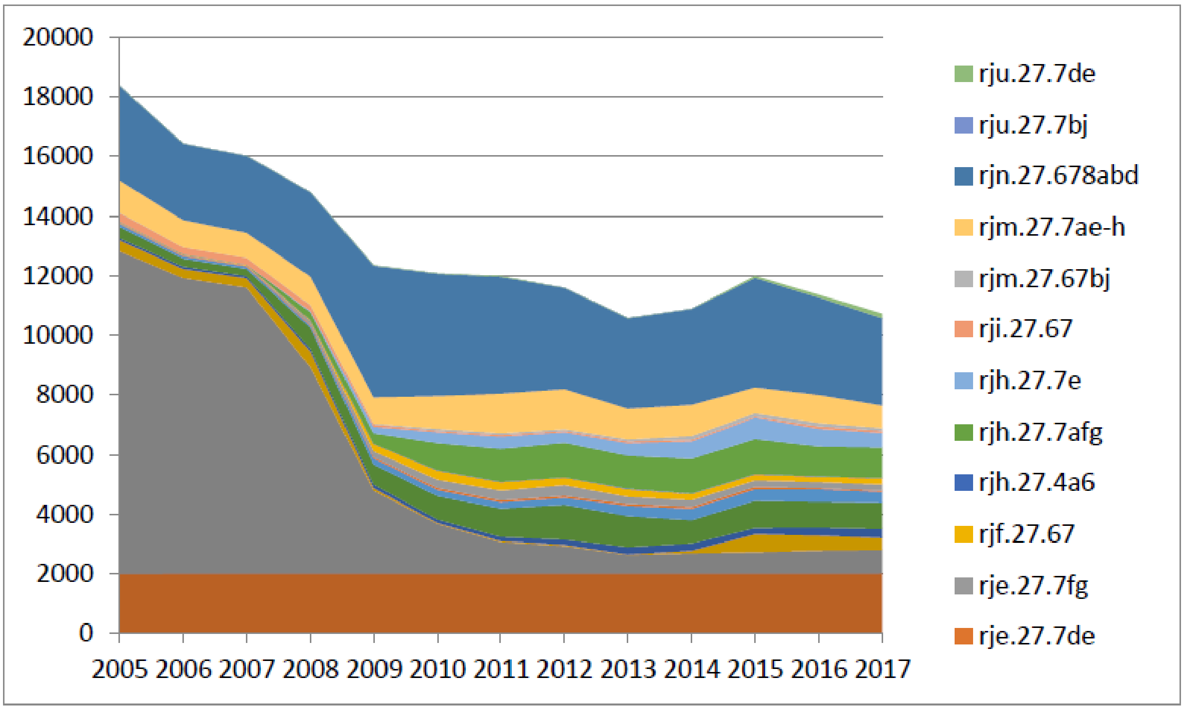

Figure 18 *- Annual total skates and rays landings (tonnes) in the Celtic Sea by stock, stock codes explained in* ***Table 6*** *(ICES, 2018, http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2018/WGEF/01%20WGEF%20Report%202018.pdf [unedited]).*

Table 6 - Skate stocks and their corresponding ICES stock codes.

Stock Code	Stock
rju.27.7de	Undulate ray *Raja undulata* Divisions VIId-e (English Channel)
rju.27.7bj	Undulate ray *Raja undulata* Divisions VIIb and VIIj
rjn.27.678abd	Cuckoo ray *Leucoraja naevus* Subareas VI-VII and Divisions VIIIa-b and VIIId
rjm.27.7ae-h	Spotted ray *Raja montagui* Divisions VIIa and VIIe-h
rjm.27.67bj	Spotted ray *Raja montagui* Subarea 6 and Divisions VIIb and VII j
rji.27.67	Sandy ray *Leucoraja circularis* Celtic Seas and adjacent areas
rjh.27.7e	Blonde ray *Raja brachyura* Division VIIe
rjh.27.7afg	Blonde ray *Raja brachyura* Divisions VIIa and VIIf-g
rjh.27.4a6	Blonde ray *Raja brachyura* Divisions IVa and VI
rjf.27.67	Shagreen ray *Leucoraja fullonica* Celtic Seas and adjacent areas
rje.27.7fg	Small-eyed ray *Raja microocellata* Bristol Channel (Divisions VIIf-g)
rje.27.7de	Small-eyed ray *Raja microocellata* English Channel (Divisions VIId-e)

Regarding the skate and ray fisheries in the north of D&S IFCA's District, the available species-specific MMO landings data (2012–2016) indicates annual landings for all species have been fluctuating slightly with sharp declines seen for small-eyed, spotted, and cuckoo rays (see **Figure 19**). It is possible this is due to a result of fewer trawlers operating in the area, or, as with the wider Celtic Sea fisheries, this may be a result of lowered TAC and quotas, as opposed to fewer skates being available to catch. Although landings at species level are not available for recent years, we can see large increases in overall skate and ray landings in North Devon during 2018 and 2019, with almost twice as many skates and rays by weight being landed in 2019 compared to 2014 (see **Table 7**). Local fishers have previously raised concerns regarding their lack of allocated skate and ray quota, despite seemingly abundant local stocks (FRMP Interviews, 2020). It is possible that despite declines in Celtic Sea skate populations, skates and rays off North Devon and in the Bristol Channel may be thriving as a result of the voluntary conservation methods put in place by local and international fishers since 2005 (Ashley, Rees and Cameron, 2019).

Alongside the rise in overall landings, there has been a significant shift in landed weight between smaller, inshore vessels (<10 metres in length) and vessels over 10 metres in length. In 2014, the smaller vessels were responsible for a third of all overall skate landings, with huge declines in landings and proportionate landings each year down to a low of 2.2 tonnes in 2018 (1.5% of all North Devon landings), with a sizeable increase to 24.3 tonnes (10.8%) for 2019 (see **Table 7**). This may be an indication of depleted inshore stocks of skates and rays or that increased fishing effort offshore, by larger vessels, is preventing skates from reaching coastal waters when migrating inshore (possibly affecting their breeding). However, as previously mentioned, North Devon fishers have reported locally abundant stocks of skates and rays despite small quota allocations (NDFA, 2020). Additionally, there is no current legal requirement for vessels under ten metres in length to record their catch, and sales under £30 in value are often undocumented, meaning the smaller, inshore fishing fleet in North Devon may be catching skate at higher levels than shown in the MMO landings data. More detailed data is needed regarding the catch of skates and rays in North Devon before any major decisions can be made regarding management of the fishery.

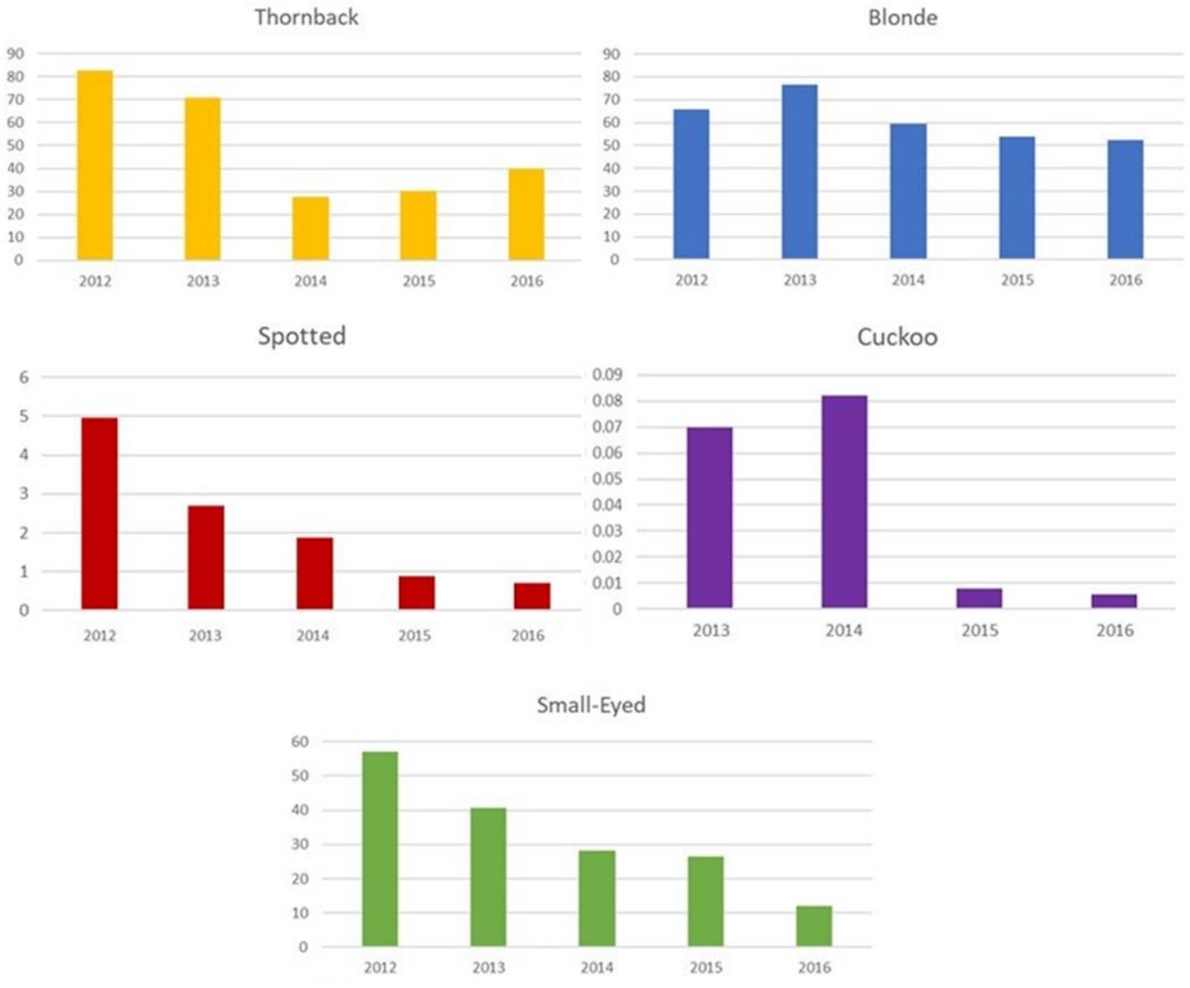

Figure 19 *- Species specific skate and ray landings (tonnes) in North Devon ports, 2012 – 2016 (MMO, 2018).*

__Table 7__ - Skates and rays landings into North Devon ports by vessel size from 2014 - 2019 (MMO, 2020b).

Year	Under 10m Landed Weight (Tonnes)	Under 10m Value	Over 10m Landed Weight (Tonnes)	Over 10m Value	Total Weight (Tonnes)	Total Value
2014	40.729	£114,342.66	77.408	£225,380.30	**118.137**	**£339,722.96**
2015	21.064	£57,114.67	99.630	£252,042.01	**120.694**	**£309,156.68**
2016	6.117	£17,069.32	136.834	£287,646.61	**142.951**	**£304,715.93**
2017	3.174	£9,009.31	144.350	£283,111.44	**147.524**	**£292,120.75**
2018	2.232	£6,184.46	144.747	£474,721.56	**146.979**	**£480,906.02**
2019	24.384	£30,461.52	200.899	£586,902.40	**225.283**	**£617,363.92**

Year	Under 10m % Weight	Under 10m % Value	Over 10m % Weight	Over 10m % Value
2014	34.5%	33.7%	65.5%	66.3%
2015	17.5%	18.5%	82.5%	81.5%
2016	4.3%	5.6%	95.7%	94.4%
2017	2.2%	3.1%	97.8%	96.9%
2018	1.5%	1.3%	98.5%	98.7%
2019	10.8%	4.9%	89.2%	95.1%

Fishery Management

The management measures laid out in the following section have been summarised for the sake of this management plan. For full details of management regulations, please seek out the original legislation at either the EU-Lex, Legislation.gov or the D&S IFCA websites.

Traditionally, skates and rays were managed as a single species group under the EU's Common Fisheries Policy (CFP) with TACs and landings being set and reported on a multispecies level, however, over the past ten years their management has evolved to take their individual species stocks under consideration. Species managed under the CFP are subject to EU fishing regulations applying to all member states and then additional management measures can be applied at a national or regional level within member countries.

Since the UK's departure from the EU, and the coming into force of the Fisheries Act and related legislation, the British fishing fleet is not subject to EU regulations while operating in British waters, though many of the regulations brought in through the European Commission are still present in UK law (e.g., the landing obligation). The EU-UK Trade and Cooperation Agreement allows the UK to establish its own regulations for fisheries, as provided for by the UK Fisheries Act, and will not be bound to the EU's CFP rules. This ability to deviate from the CFP and establish regulations that can be more responsive and specific to the situation in UK waters has long been an important issue for UK policymakers and the fishing industry.

Marine activities in England are regulated by the Marine Management Organisation (MMO), who are responsible for managing fishing fleets, quotas and fighting illegal, unregulated, and unreported fishing. English inshore and regional fisheries are managed by the Inshore Fisheries and Conservation Authorities (IFCAs); IFCAs are responsible for enforcing national and EU-derived fishing legislation as well as ensuring local fishery exploitation remains sustainable through the implementation of byelaws in their regional districts.

Past Management Measures

The first TAC for skates and rays was implemented in 1999 under the CFP, acting as a multispecies TAC with all skate and ray species included in this (Council of the European Union, 1999). The single TAC system was used until 2009, when some species specific TACs were introduced along with the requirement for species-specific landings data to be recorded in certain areas of conservation concern (Council of the European Union, 2009). Gradually, management introduced additional species-specific TACs in defined geographical regions, and prohibited landings of species from certain areas to conserve stocks (see **Table 8**).

Table 8 - *Past management measures for skates and rays in European waters at EU, National and Regional level (as of March 2020).*

Year of Implementation	Management Body	Management Measures	Areas Affected	Reasons for Implementation	Reference
1999	European Commission	Annual TAC implemented	ICES Divisions IIa & Subarea IV	Declining skate and ray stocks and lack of management keeping fisheries sustainable	Council Regulation (EC) No 48/1999
2005	North Devon Fishermen's Association (no legal legislation)	Seasonal closure of the area known as the "Ray Box" for six months of the year	300km² area north of Lundy known as the "Ray Box"	Provides skates with a sheltered area to spawn and grow without fishing pressure	North Devon Fishermen's Association
		Voluntary MLS for skates and rays of 38cm (wingtip to wingtip) Later increased to 45cm	North Devon skate and ray fisheries	Allows skates to grow and spawn before being caught and landed	North Devon Fishermen's Association
2007	European Commission	By-catch quota introduced alongside TACs, skate species cannot comprise more than 25% by live weight of the catch retained on board	ICES Divisions IIa & Subarea IV	Overfishing of skate and ray populations	Council Regulation (EC) No 41/2006
2008	European Commission	Species-specific reporting of skate and ray landings	ICES Divisions IIa & Subarea IV	Generic TAC not suitable to monitor landings of all species	Council Regulation (EC) No 40/2008
2009	European Commission	By-catch quota for vessels over 15 metres in length alongside TACs, skate species cannot comprise more than 25% by live weight of the catch retained on board Retaining of common skate is prohibited, any caught must be returned to the sea	ICES Divisions IIa, IIIa & Subarea IV	Overfishing of skate and ray populations Declining populations of common skate	Council Regulation (EC) No 43/2009

		Annual TAC implemented with species specific reporting	ICES Division VIId	Overfishing of skate and ray populations	Council Regulation (EC) No 43/2009
		Retaining of common skate is prohibited, any caught must be returned to the sea		Declining populations of common skate	
		Annual TAC implemented with species specific reporting	ICES Divisions VIa-b & VIIa-c, e-k	Declining populations of endangered skates	Council Regulation (EC) No 43/2009
		Retaining of common skate, undulate ray, Norwegian skate, and white skate is prohibited, any caught must be returned to the sea			
		Annual TAC implemented with species specific reporting	ICES Subareas VIII & IX	Declining populations of endangered skates	Council Regulation (EC) No 43/2009
		Retaining of common skate, undulate ray and white skate is prohibited, any caught must be returned to the sea			
2010	European Commission	Up to 5% of Division VIId TAC can be taken from ICES Divisions VIa, VIb, VIIa-c and VIIe-k	ICES Divisions VIa-b & VIIa-d & e-k	-	Council Regulation (EU) No 23/2010
		Up to 5% of Divisions VIa, VIb, VIIa-c and VIIe-k TAC can be taken from ICES Division VIId	ICES Divisions VIa-b & VIIa-d & e-k	-	Council Regulation (EU) No 23/2010
2014	Devon & Severn IFCA	Use of mobile gear is restricted in certain estuaries and MPAs throughout the district	Various locations throughout district, including the rivers Taw and Torridge in North Devon	Aimed to protect vulnerable fish populations and key habitats	Devon and Severn IFCA Mobile Fishing Gear Permit Byelaw

2015	European Commission	Retaining of thornback ray is prohibited, any caught must be returned to the sea	ICES Division IIIa	Declining stocks of skates and rays	Council Regulation (EU) 2015/104
2016	European Commission	Retaining of blonde and small-eyed ray is prohibited, any caught must be returned to the sea	ICES Divisions IIa & Sub-area IV	Declining stocks of skates and rays	Council Regulation (EU) 2016/72
		Retaining of small-eyed ray is prohibited, any caught must be returned to the sea	ICES Divisions VIa-b & VIIa-d & e-k	Declining stocks of skates and rays	Council Regulation (EU) 2016/72
2017	European Commission	Retaining of small-eyed ray is prohibited, any caught must be returned to the sea	ICES Divisions VIa, VIb, VIIa-c & VIIe, h-k	Declining stocks of skates and rays	Council Regulation (EU) 2017/127
		Annual TAC for small-eyed ray implemented	ICES Divisions VIIf & g	Small-eyed ray commercially important for area	Council Regulation (EU) 2017/127
2018	Devon & Severn IFCA	Netters are not authorised to use nets with mesh sizes between 71 and 89mm	Devon & Severn IFCA District	Aimed to protect vulnerable fish populations and key habitats	Devon and Severn IFCA Netting Permit Byelaw
		Netting restrictions within specified estuaries and coastal habitats, including Lundy MPA	Various locations throughout district, including the rivers Taw and Torridge in North Devon		Devon and Severn IFCA Netting Permit Byelaw

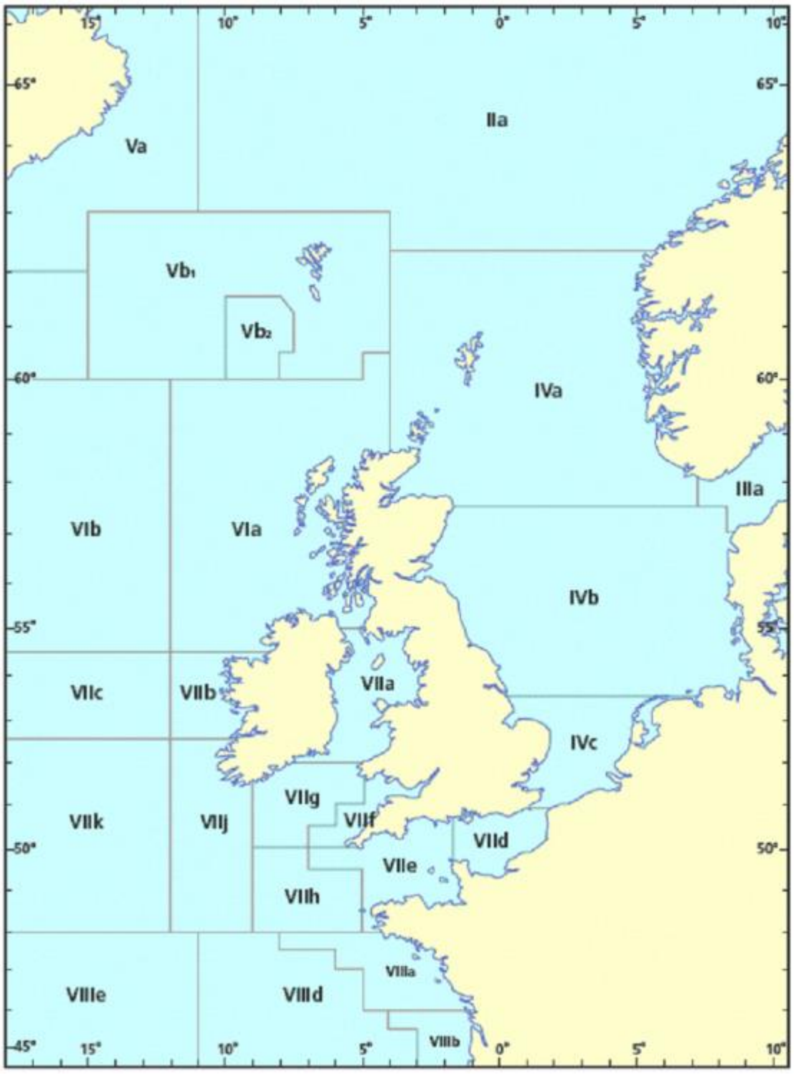

Figure 20 - ICES Divisions surrounding the British Isles with Division VIIf containing the Bristol Channel and NDMP area (Devon & Severn IFCA, 2016).

Management Measures Currently in Place

Skate fisheries are currently managed by various mixed or species-specific quotas, with TACs often covering large geographic areas. Under EU (and retained EU) legislation there are prohibitions on catching certain skates and rays in certain areas (**Table 9**).

EU TACs are set based upon scientific advice from ICES and are distributed out amongst member states. **Table 10** shows the TACs set for skate and ray fisheries for 2020. The EU-UK Trade and Cooperation Agreement (2020) sets out a framework for the two parties to agree on TACs for each stock by 10th December each year. The agreement also sets out the process should there be no agreement on TACs (Article FISH.7): each party will set a provisional TAC in line with ICES advice (though the agreement does not specify which reference points should be used), and its share of the TAC is based on the agreed quota shares.

Table 9 - Current EU prohibitions on skate and ray fishing.

Species	Areas Prohibited
Thornback ray (*R. clavata*)	ICES Division IIIa
Undulate ray (*R. undulata*)	ICES Subareas VI, IX & X
Blonde Ray (*R. brachyura*)	ICES Division IIa
Small-eyed ray (*R. microocellata*)	ICES Subarea IV & Divisions IIa, VIa-b, VIIa-c & VIIe, VIIh-k
Starry ray (*A. radiata*)	ICES Divisions IIa, IIIa, VIId & Subarea IV
Common skate (*D. batis*) & complex (*D. flossada* & *D. intermedia*)	ICES Division IIa & Sub-areas III, IV, VI, VII, VIII, IX and X

Table 10 - EU TACs set for skate and ray fisheries for 2020.

Area	Species	TAC (Tonnes)	UK Share of TAC (Tonnes)
ICES Division IIa & Subarea IV	Skates & rays	1,737	1,125
ICES Division IIIa	Skates & rays	47	0
ICES Divisions Via-b, VIIa-c & VIIe-k	Skates & rays	10,184	2,632
ICES Division VIId	Skates & rays	1,474	222
ICES Divisions VIId & e	Undulate ray (*R. undulata*)	234	58
ICES Divisions VIIf & g	Small-eyed ray (*R. microocellata*)	192	50
ICES Divisions VIII & IX	Skates & rays	4,759	10
ICES Division VIII	Undulate ray (*R. undulata*)	33	0
ICES Division IX	Undulate ray (*R. undulata*)	50	0

Alongside these TACs, fishers must report their landings on a species-specific basis wherever possible in order to improve understanding of stocks (Council of the European Union, 2020).

In December 2016, new management measures introduced by the EU included a ban on landing small-eyed ray caught in ICES Divisions VIIf & g (and other Divisions around the UK). This was a devastating change for North Devon fishers, some of whom rely heavily on landings of small-eyed rays in order to make their businesses viable (Devon & Severn IFCA, 2016). Consequently, the North Devon Fishermen's Association worked closely with Defra to provide evidence of the economic importance of small-eyed ray to the area, as they felt this had been overlooked by the EU when deciding on the new management measures. Defra submitted an in-year amendment to the European Commission requesting the ban on small-eyed ray fishing be lifted in ICES Divisions VIId-k. The Commission accepted some of Defra's proposals, allowing the fishery to reopen in Divisions VIIf and g in April 2017 with a new TAC implemented based on scientific advice from ICES (Devon & Severn IFCA, 2016).

During the 2012 reformation of the Common Fisheries Policy, one of the main changes made was to reduce the amount of discarding (the practice of throwing unwanted catch over the side while at sea). Previously, vessels that caught undersized fish or fish for which they held no quota would discard them before returning to port as landing them would be illegal. The minimum landing size (MLS) system, previously used to define undersized fish, has been replaced with the Minimum Conservation Reference Size (MCRS). Fish below MCRS cannot be sold for direct human consumption (at higher prices); this incentivises fishers to catch in-size fish, while also ensuring undersized fish are not wasted or discarded. As of January 2019, all catches of regulated species must be landed, though with some exceptions, one of which is skates and rays. Studies have shown that skates and rays have a higher likelihood of survival once caught and retruned to sea (Enever, Revill and Grant, 2007; Catchpole, Enever and Doran, 2007; Enever et al., 2009). Skates and rays have high levels of discards (ranging from 30 to 70%) as they are difficult to avoid catching using netted fishing gear and have trouble escaping once captured because of their unusual shape and size.

In addition to these EU and national regulations, fishers targeting skates and rays in the north of D&S IFCA's District must also comply with D&S IFCA byelaws, specifically the Netting Permit Byelaw and Mobile Fishing Permit Byelaw, most recently revised in 2018. These byelaws regulate inshore fishing throughout the District by placing catch, gear, temporal, and spatial restrictions on fishers (outlined in **Table 11**) to manage fisheries effectively and sustainably. As well as these gear-specific byelaws, D&S IFCA has additional byelaws in place that were inherited from Devon Sea Fisheries and the Environment agency, described in the IFCA 'byelaw booklet', available at: https://www.devonandsevernifca.gov.uk/Enforcement-Legislation/D-S-IFCA-Byelaw-Book-and-Minimum-Conservation-Reference-Size-List

There are no official minimum conservation reference sizes (MCRS) in place for skates and rays under EU or national law. Therefore, some IFCAs have MCRSs in place for their districts, which range between 40 and 45cm for skates and rays (Southern IFCA, 2020). In North Devon, fishers have introduced a voluntary minimum landing size for all skate species in the Bristol Channel of 45cm (increased from a previous 38cm; NDFA, 2020). In 2005, North Devon fishers, in partnership with Welsh and Belgian fishers, also voluntarily avoid trawling in a large area of the Channel north of Lundy for six months of the year (NDFA, 2019). This voluntary closure was implemented in an effort to relieve fishing pressure on skate stocks during spawning and to safeguard local populations for future commercial exploitation.

Currently there is little to no regulation of recreational angling for skates and rays at a regional, national, or international level. With no EU MCRS in place, anglers are free to catch and take rays of any size, however, several angling associations have their own voluntary minimum sizes for ray species in place of~40cm to prevent capture of juvenile fish that have not yet sexually matured (NFSA, 2020).

Table 11 - Fishing restrictions currently in place affecting skate and ray fisheries as part of D&S IFCA Permit Byelaws. References to Annexes here relate to the Annexes of the relevant Permit Byelaws

Regulation Type	Gear	Restrictions	Permit Byelaws
Gear	Netting	Nets must be marked with floating markers displaying port, vessel and permit details as well as fixed with tags when required by the authority	Netting
		Nets with mesh sizes 71– 89mm are prohibited	Netting
	Seine netting	When using authorised seine nets, permit holders must remain with the net for the full time of deployment as well as deploy and haul the net in one continuous action	Netting
	Drift netting	When using authorised drift nets, permit holders must remain within 100 metres of the net for the full time of deployment	Netting
	-	The storing of crabs, lobsters, scallops, or bass in containers in the sea or estuaries is prohibited	Netting
Spatial	Netting	In the North Devon estuaries (defined in Annex 2), fishers are not permitted to use any nets other than seine and also providing that they are no longer than 20 metres in length, all species other than sand eel are returned to the water and that the mesh size is no greater than 20mm	Netting, netting Annex 2
	Netting	Only a single net, no longer than 25 metres may be used by recreational permit holders in the seaward areas defined in Annex 2	Netting, netting Annex 2
	Netting	In the Annex 3 coastal areas, use of a net is only authorised when the headline of the fixed net is set at least 3 metres below the water's surface, and if the net used is a drift or seine net	Netting, netting Annex 3
	Netting	In the areas off Lundy Island (defined in Annex 4) no netting of any kind is authorised	Netting, netting Annex 4
	Netting	The use of fixed nets is prohibited in the Somerset areas (defined in Annex 5) unless in accordance with temporal restrictions in the netting byelaw	Netting, netting Annex 5
	Demersal mobile gear	In the Lundy SAC and MCZ (defined in Annex 1) the use of demersal fishing gear is prohibited except for authorised use of demersal trawl gear in areas outlined in Annex 1a and the authorised use of demersal scallop gear in areas defined in Annex 1b	Mobile fishing, mobile fishing Annexes 1, 1a and 1b
	Demersal mobile gear	In the Severn Estuary SAC (defined in Annex 5) the use of demersal mobile fishing gear is prohibited	Mobile fishing, mobile fishing Annex 5
Temporal	Fixed nets	The use of fixed nets is authorised in the Somerset areas (defined in Annex 5) between 30th September and 1st April	Netting, netting Annex 5

Risks & Threats

Conservation Status

The conservation statuses of the described skate species are summarised in Table 12. Though none of the north Devon species are currently listed as endangered or vulnerable, their extended life histories (late age-at-maturity, low reproductive output, slow growth) and the heavy fishing pressure they experience make them prone to large, rapid population drops that they are unable to quickly recover from.

Table 12 *- Conservation status and threats to thornback, blonde, small-eyed, spotted and cuckoo rays (IUCN, 2019, https://www.iucnredlist.org/).*

Species	Conservation Status	Population Status	Threats
Thornback ray *Raja clavata*	Near threatened	Decreasing	Heavy commercial fishing pressure, including as bycatch by trawlers. Extremely difficult to quantify this fishing pressure as skates and rays are combined into one stock in fishing records. Also regularly caught by recreational fishers, targeting of the larger skates as trophies may prevent population recovery due to the late ages of maturity for skates.
Blonde ray *Raja brachyura*	Near threatened	Decreasing	Heavy commercial fishing pressure including trawling and bycatch by both commercial and artisanal fishers, especially in the Mediterranean. Trawling fishing effort in the Mediterranean has been steadily increasing for 50 years and a lot of the area is now heavily exploited.
Small-eyed ray *Raja microocellata*	Near threatened	Decreasing	Caught as bycatch in trawl and set net fisheries mostly within the Bristol Channel. Commercially important to the area. Sand bank habitats favoured by small-eyed rays are regularly dredged with unknown effects on the skates.
Spotted ray *Raja montagui*	Least concern	Stable	The smaller body size of the spotted skate means it has greater resilience to fishing impacts compared to larger skate species. However, larger spotted skates tend to be landed as bycatch in demersal fisheries. Also extensively caught in Mediterranean trawling fisheries causing fluctuations in populations and abundance.
Cuckoo ray *Leucoraja naevus*	Least concern	Unknown	Heavy commercial fishing as well as being caught as bycatch in trawls and scallop dredges in the north west Atlantic. High levels of discard due to skates' smaller size. Under similar fishing pressures in the Mediterranean with many areas currently being heavily exploited by trawlers. The cuckoo's smaller size and offshore range means it is rarely targeted by recreational fishers and anglers.

It is extremely difficult to quantify the effects of overfishing on populations of skates and rays as the stocks were assessed on an aggregate basis without species-specific information (Johnston and Clarke, 2019). However, increasing knowledge and data reporting at a species level has allowed for differentiation into separate species-specific stocks (Ulrich, Martín and Vrgoc, 2018), and subsequent specific management for some species, providing more effective protection from overexploitation.

Threats to Species & Ecosystem

Overfishing

It is well documented that elasmobranchs are highly vulnerable to rapid population declines and extinctions due to overfishing. Studies have shown that large, flat-bodied coastal species, such as skates and rays, are the most vulnerable to large declines such as these, and there are multiple examples of large skates becoming some of the most highly threatened marine species in UK waters, e.g. white skate and the flapper skate (Neat *et al.*, 2015). Much like other elasmobranch species, skates and rays are vulnerable to population declines because they are slow growing, late to mature, produce few young with long pregnancies, may not reproduce every year, and their body shape makes them vulnerable to capture by most fishing gears (Enever *et al.*, 2009). High levels of fishing pressure have been seen to affect life history traits of skates, namely the size at maturity (Dulvy *et al.*, 2000). For example, thornback rays in the North Sea have been observed to undergo an increase in growth rates and sexually mature at smaller sizes due to higher fishing mortality (Walker and Hislop, 1998). It is thought that these changes are a result of changing population densities resulting from fishing pressure (Dulvy *et al.*, 2000).

Overfishing is perhaps the most urgent threat facing skate and ray stocks in Europe. Skates become vulnerable to capture in trawler nets from a very early age, meaning fishing mortality can prevent large numbers of young skate from reaching sexual maturity and breeding (Catchpole, Enever and Doran, 2007). In the Bristol Channel, a study investigating the growth and ages of rays off the southern coast of Wales found that the majority of thornback, blonde and small-eyed rays caught were juveniles in the first few years of their lives (Ryland and Ajayi, 1984). A lack of species-specific assessment and quotas in the past management of skates and rays is likely a key contributor to the overfishing of skate and ray stocks. This style of management ignored the varying distributions and populations of different ray species. Even after the implementation of TAC-based management, concerns remain about fishing mortality. Any large reductions in TAC may be cause for concern as this will limit landings of skates and rays but not limit catch as skates and rays are part of a mixed catch in demersal fisheries. This would result in increased discards, meaning loss of potential revenue to the fishing industry as well as imposing uncertain levels of mortality on skate stocks (Lart, 2014).

Demersal Fishing

Most of the rays caught in the Bristol Channel are caught in trawl fisheries, which tend to have high levels of discards and low selectivity between species. Demersal trawls can be damaging to some marine environments, particularly when the area is trawled often (Jennings *et al.*, 2002). Contact between the trawls and the seabed can damage benthic habitats, reduce the abundance of target and non-target species and truncate age and size distributions (Kaiser *et al.*, 2006; Jorgensen *et al.*, 2007). A vast amount of research has shown that trawling can greatly alter the dynamics of ecosystems, for example, by reducing the abundance of large predators, trawling can increase the abundance of small and fast-growing species that can recover quickly from disturbance (Tillin *et al.*, 2006). Trawling can also increase the availability of organic matter (in the form of more dead or injured animals) to scavengers and bottom feeders and decrease the feeding efficiency of filter feeders by resuspending sediment from the sea floor (Bradshaw, Collins and Brand, 2003; Howarth et al., 2018).

Spatial and seasonal restrictions on trawl fisheries are often used by fisheries managers to help protect vulnerable fish stocks and prevent damage to habitats with rich benthic communities. It is important to note that demersal trawling mostly takes place over sand, mud and shingle beds that are already subject to regular disturbance through natural tides and water movement (Seafish, 2020). However, there is a vast amount of scientific evidence showing regular trawling can be damaging even in these habitats, especially if occuring on or near spawning grounds, and that these ecosystems can take years to recover post-disturbance (Hiddink *et al.*, 2017; Sciberras *et al.*, 2018)

Bycatch & Discards

Incidental capture or bycatch is thought to be one of the most dangerous threats to elasmobranch species today and is one of the reasons these species tend to be overfished (Oliver *et al.*, 2015). There are only several targeted skate fisheries around the UK (including the Bristol Channel), meaning the majority of skates are caught and landed as bycatch in demersal fisheries. The unaccounted fishing mortality of elasmobranchs is recognised as a global problem, and it has been estimated that up to 50% of elasmobranch catches are taken as bycatch without being included in fishery statistics or subjected to management measures (Stevens *et al.*, 2000). As with many fisheries, there are potential issues regarding discards when fishing for skates and rays, particularly due to the mixed nature and high bycatch rates of the fishery. Discards are the portion of catch that are not retained on board for landing in port, and are instead returned to the sea. Discards can be made up of the target species as well as bycatch meaning both skate populations and those of other marine species are affected by skate and ray fisheries. Fish are discarded when they are unmarketable, below MCRS, or are species which fishers are not authorised to land. The health and survival of fish discarded back to the sea varies greatly based on what fishing gear was used to catch them, for example, hook and line fisheries can return unwanted fish back to the sea immediately after capture with relatively little injury, which is one of the reasons these fisheries are so sustainable (Rush and Caslake, 2009). Conversely, fish caught in demersal trawls can often be severely injured or killed during the trawl, meaning mostly dead fish are returned to the sea, adding additional mortality to the stock (Wade *et al.*, 2009). As of 2019, the EU Landing Obligation has been in full effect meaning the discarding of certain catches of fish at sea is banned (MMO, 2020c). With many fish species, most discarded fish die during capture or shortly after being discarded back to the sea, however this is not the case for skates and rays. Skates and rays are exempt from the Landing Obligation as studies have shown they demonstrate high survival rates post-discard compared to many other species (Catchpole, Enever and Doran, 2007; Ellis et al., 2012). The total amounts of skates and rays that are currently discarded in fisheries is unknown, however, it has been reported that the global catches of sharks and skates may only represent half of what is actually being caught, with the rest being discarded before being landed and declared (Bonfil, 1994).

Misrepresentation in Management

Although management has slowly shifted to incorporate the multispecies and multi-stock nature of skate fisheries, there is still some concern over the accuracy of survey and catch data on which present management is based (Simpson and Sims, 2016; Ulrich, Martín and Vrgoc, 2018). For example, it was long thought that the common skate was a single species, however, research has shown that the 'Common Skate complex' consists of two species, the Blue Skate (*Dipturus batis*) and Flapper Skate (*Dipturus intermedius*), both of which are highly endangered and are listed as prohibited species under EU law (Council of the European Union, 2009). Due to the range of morphologically similar skate species found in UK and European waters, there is a high likelihood of incorrect identification between species in survey and catch data, particularly if the animals are caught in trawls where they might be damaged. It is unclear if this occurs at a rate which would undermine current distribution and landings data, though it is essential that up-to-date information is collected regarding the distributions and ranges of skate species in the UK to ensure effective management.

Marine Development & Resource Extraction

The Severn Estuary and Bristol Channel are the focus of several plans for marine development and resource extraction, each representing a number of pressures on fish populations. Skates and rays spend much of their time near the sea floor with female skates depositing their egg cases on the seabed after breeding, often favouring gravely and sandy substrates (see **Species Ecology**). These substrates are amongst those targeted most often for aggregate dredging and extraction, meaning skates and ray habitats will be subject to continuous disturbance in areas with high levels of anthropogenic activities affecting the seabed or coastal development. Currently there are seven aggregate dredging licenses operating within the Severn Estuary area, removing ~2.7 million tonnes of marine aggregate each year, with two more applications pending approval (The Crown Estate, 2020). One of the largest sites for aggregate extraction is found near Minehead (see **Figure 21**), in the same region as reported multispecies (including ray) spawning and nursery grounds. This demonstrates the importance of identifying and mapping spawning sites to feed into management and spatial planning in marine environments.

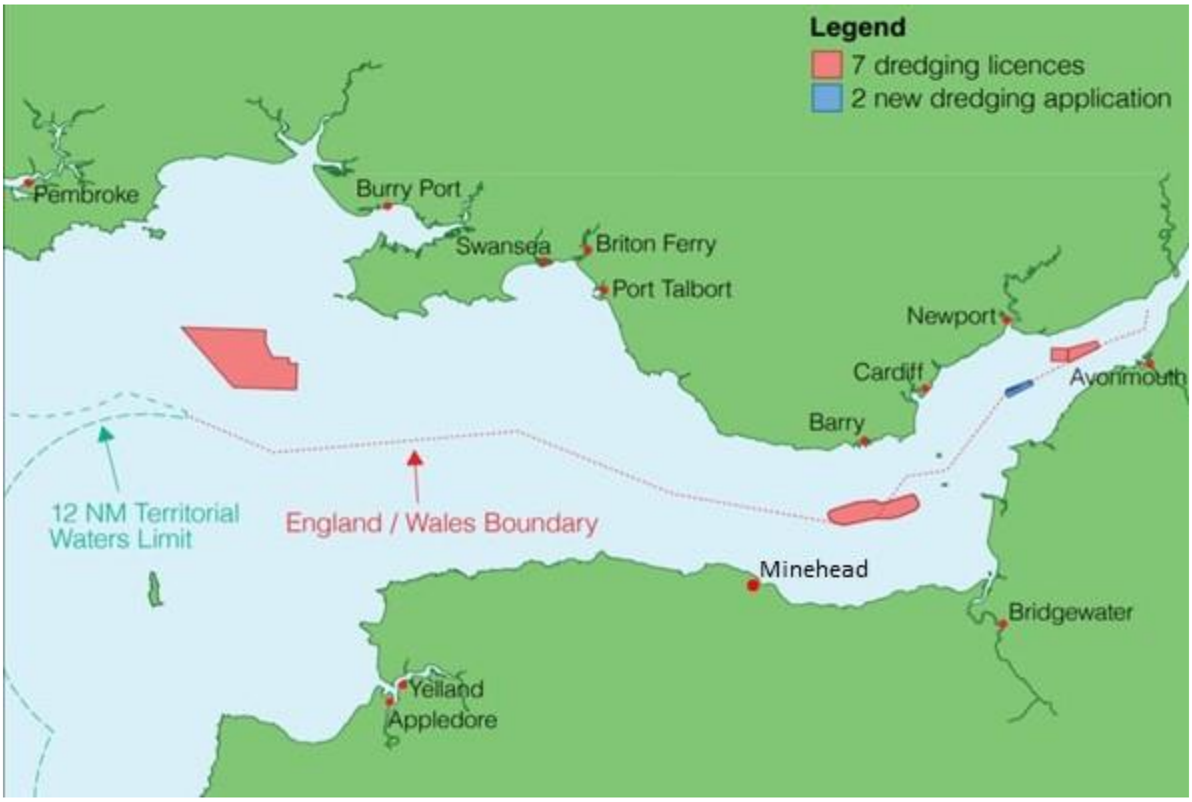

Figure 21 *- Active and potential aggregate extraction sites within the Bristol Channel (The Crown Estate, 2020, https://www.thecrownestate.co.uk/media/3634/2020-capability-portfolio-report.pdf).*

The Severn Estuary is designated as a European Marine Site (EMS), with several large cities and industrial areas surrounding it. There are currently several existing or planned development projects within the EMS in various stages of development that could potentially negatively impact marine species and ecosystems. The importance of the Bristol Channel for skates and rays, as well as the possibility of spawning grounds and nursery areas off Minehead has added to these concerns regarding local conservation of marine life, particularly near Hinkley Point Nuclear Power Station. Hinkley Point C (HPC) is an ongoing project to construct a 3,200 MWe nuclear power station next to Hinkley Point A (decommissioned) and Hinkley Point B nuclear power stations in Somerset. This project includes plans to abstract 132 cumecs of water directly from the Severn Estuary (over 11 million cubic metres per day) in order to cool the two reactors at HPC. The extraction of this quantity of water, from intake heads situated on the seabed 3.3 km offshore, has raised significant concerns regarding impacts on the marine environment, including the assemblage of fish species (Devon & Severn IFCA, 2018, 2019, 2020b; Environment Agency, 2020b). The various permits and licences necessary for HPC to extract large quantities of cooling water from the Severn Estuary were conditionally granted in 2013 on the understanding that three mitigation measures would be implemented to reduce any impacts on the fish assemblage. The developers have sought to remove the requirement to install Acoustic Fish Deterrents (AFDs), which were the central part of the three mitigation measures. The Environment Agency have estimated that, without the AFD, the cooling water system of HPC would be responsible for 4% annual losses from the ICES VIIf thornback ray population (Environment Agency, 2020a). This is a significant fish kill, and it is important to note that the other skate species present in the Bristol Channel were not included in this assessment, including the small-eyed ray, which is highly important to local fisheries and has a much more limited range than the other skate species. D&S IFCA are concerned about the effects of these fish kills on local skate and ray populations, which are vulnerable to rapid decline and subject to regular fishing pressure.

The fish assemblage, including skates and rays, is protected in the Severn Estuary as part of the Severn Estuary SAC and Ramsar site. It is only on this basis that the effects of HPC and other marine developments on fish can be considered in a regulatory and licencing context. In turn, this highlights the regulatory gaps for fish protection in other locations (e.g., the rest of the Bristol Channel) that do not fall within designated sites, or that fall within designated sites that do not include designations for fish or the fish assemblage.

Due in part to its funnel-like shape, the Severn Estuary has one of the largest tidal ranges in the world, around 14 metres (Xia, Falconer and Lin, 2010). There is increasing interest in harnessing this large tidal range for tidal power projects, especially after the Government's commitment to increase the usage of renewable energy sources. Although there is a strong desire and environmental justification to shift away from the usage of fossil fuels, tidal power developments can be damaging to marine life and greatly alter their habitats. In 2013, plans for a tidal barrage across the mouth of the Severn were rejected by MPs due to several economic and environmental problems (Harvey, 2013). Among these were concerns of fish mortality when passing through turbines, delays or prevention of reproduction/migrations and loss of habitat (House of Commons Energy & Climate Change Committee, 2013). Since then, smaller scale tidal lagoon projects have been proposed in the Severn estuary, such as the Swansea, Cardiff, and Newport tidal lagoon projects, however, these projects still carry similar threats to marine populations on a more localised scale. Though some tidal energy proposals focus on Welsh waters of the Severn Estuary and Bristol Channel, these waters form part of a large and connected ecosystem. The movement of these waters and the fish within them transcends administrative boundaries; consequently, effects of tidal energy developments have the potential to impact ecosystems in the jurisdiction of D&S IFCA.

In addition to tidal energy generation, interest in offshore wind farms for energy generation has increased greatly in the last two decades, particularly in the Bristol Channel. In 2007, proposals were set out for the development of a 240 turbine offshore windfarm just off the island of Lundy (Quilter, 2013). However, the project met considerable resistance due to environmental concerns and the plans were eventually scrapped due to "technical and financial reasons". The development of offshore wind farms can trigger a variety of potentially damaging effects to marine life (Hiscock, Tyler-Walters and Jones, 2002). Damage to the seabed and benthic communities can be partly mitigated through the use of floating turbines, however, these farms can still negatively impact wildlife, particularly birds and marine mammals (Bailey, Brookes and Thompson, 2014; Bergström et al., 2014). Despite this, the development of offshore wind farms is expected to increase with some experts stating that the development of a wind farm in the Bristol Channel is most likely inevitable, e.g. project Erebus off south Wales (Cooper, 2019; BBC, 2020).

Climate Change

After overfishing, one of the most pressing threats to marine life and the fishing industry is climate change (Stewart and Wentworth, 2019). Climate change is predicted to affect the oceans in many ways, including warming waters, changes in oscillations and currents, increases in dissolved carbon dioxide concentrations and rising sea levels (Petitgas *et al.*, 2013; Stewart and Wentworth, 2019). Changes in water temperature are expected to dramatically affect many fish species, especially those whose development, behaviour, and physiological processes are influenced by temperature, including skates and rays (Gervais and Johnson, 2020). For example, a study investigating the effects of temperature on small-eyed ray embryonic development found that increases in temperature (consistent with those predicted due to climate change) led to substantially smaller offspring developing at a faster rate than at non-elevated temperatures, showing the potential ways climate change can alter the life history characteristics of Bristol Channel skates (Hume, 2019). In contrast to this, some species of estuarine and benthic sharks have been seen to demonstrate a tolerance for changes in sea temperature and adapt well to temperature changes in their environments. For example, a population of winter skate (*Leucoraja ocellata*) in Canada is endemic to a region with water 10°C warmer than the rest of its range, demonstrating that some skate species are capable of rapid (in evolutionary terms) adaption to changes in temperature. The skates found in the warmer waters have much smaller body sizes compared to the rest of its species as well as other life history and physiology adaptations (Lighten *et al.*, 2016). Studies investigating the effects of increased ocean acidity have found no major impacts on the embryonic and juvenile survival of skate species, however there is much room for further investigation as it is likely responses to acidity and temperature changes vary between species.

In addition to altering the behaviour and biology of marine organisms, changes in water temperature are expected to alter the ranges and distributions of many marine organisms, including skates and rays, with some changes in distribution for some species observable today (Perry *et al.*, 2005). Again, this phenomenon has not been as well-studied for elasmobranchs as in other fish species, however, one study demonstrated a shift in the distribution of cuckoo rays in the North Sea as a result of changes in ocean temperature (Perry *et al.*, 2005). Cuckoo rays were seen to respond to climatic variation through local movements, moving to pockets of deeper water or further offshore. If similar responses are seen for the other skate species found in the Bristol Channel, it is possible that there will be major declines in the inshore skate and ray fisheries as a result of climate change, with the skates and rays moving further offshore, out of range of the small, inshore fishing fleet.

In addition to warming waters, the increasing frequency of hypoxic (very low oxygen) ocean "dead zones" have been attributed to climate change and the runoff of fertilisers into rivers (Diaz and Rosenberg, 2008). Dead zones have significant consequences for the functioning of marine ecosystems and the services they provide to society, including fisheries production, water filtration, and nutrient cycling (Altieri and Gedan, 2015). Fertiliser used on farmland will often run off into rivers and be transported downstream to estuaries. The increase in nutrients such as phosphorus and nitrogen in these environments (known as eutrophication) can cause blooms of marine algae (Joyce, 2000). As the algae dies, it sinks to the bottom, where oxygen in the water is consumed by microbes as part of the decomposition process, lowering the oxygen concentrations in the water. Stratification, or layering, of the water column prevents mixing between these low-oxygen waters and surface waters. Stratification is linked to temperature and salinity concentration gradients in the water and is projected to increase due to warming waters, particularly in more northerly latitudes (Keeling, Körtzinger and Gruber, 2010). This process continues until the area has transformed into an oxygen-deficient or oxygen-free zone, devastating marine life in the area, particularly in benthic communities (Diaz and Rosenberg, 2008). The frequency at which these "dead zones" are occurring is increasing, and they are common across much of the range of European skate species (see **Figure 22**). Changes in EU legislation regarding fertiliser usage has led to improvements in oxygen conditions in the North Sea, though hypoxic zones are still present throughout areas of Europe (Townhill *et al.*, 2017).

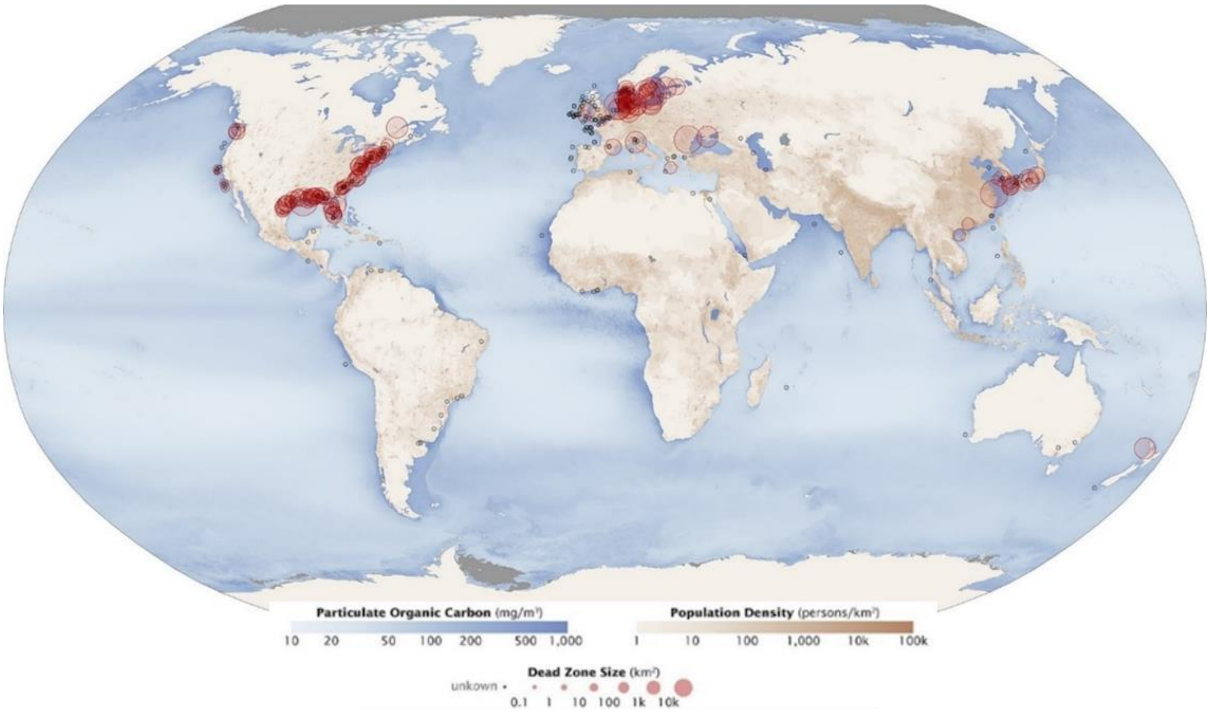

Figure 22 *- Locations of hypoxic and anoxic dead zones. Red circles on this map show the location and size of many of our planet's dead zones. Black dots show where dead zones have been observed, but their size is unknown (Allen, 2010, https://commons.wikimedia.org/wiki/File:Aquatic_Dead_Zones.jpg).*

Although hypoxic dead zones can pose a threat to all nearby inshore marine life, they are potentially devastating for fish species that use inshore and estuarine habitats as spawning areas and nurseries, such as skates, as these are the areas where dead zones are most likely to occur (Altieri and Gedan, 2015). Increases in the frequency of dead zones in or near skate spawning and nursery areas could cause further damage to the reproductive output of populations and hinder any recovery of any damaged stocks.

Climate Change: Coastal Squeeze & Flooding

With sea levels across the world rising due to climate change, a phenomenon known as coastal squeeze is an increasing concern to conservationists. As sea level slowly rises, the sea encroaches upon coastal areas causing terrestrial erosion and loss of habitat. In the marine environment, organisms and ecosystems "migrate" towards the shore to maintain their positions relative to the water level (Torio and Chmura, 2013). However, to combat rising seas, humans have installed flood defence systems such as sea walls and groynes to protect coastal areas from the rising water. Barrier defences such as sea walls prevent coastal marine life from migrating to maintain their position in preferred habitats, and thus reduce the availability of coastal habitat (Pontee, 2013). This is a very slow process but poses a significant threat to coastal ecosystems, particularly for benthic organisms.

Figure 23 *- Flood defence sea wall on Chesil Cove Beach, Dorset (BennH, 2014,* *https://commons.wikimedia.org/wiki/File:Chesil_Cove_flood_defences.png* *[unedited]).*

As weather patterns get more extreme and less predictable due to the effects of climate change, the potential for flooding within the Bristol Channel increases. There are many major cities and built-up areas surrounding the Severn that are at risk of flooding, with flood defences installed in such areas. The effects of coastal squeeze will be most severe in these developed and defended areas compared to the more rural coastal zones of the estuary, as the lack of flood defences and developments allow marine communities to retreat inland as the sea rises. In addition to causing coastal squeeze, there is concern that the construction of new flood defence installations could be damaging to fish populations in the Severn Estuary.

Threats to Fishery & Industry

One of the major issues inshore fishers have with management is that they feel fisheries and fish stocks are not assessed or considered at the correct scale when new management measures are written. One of the largest concerns of inshore fishers targeting skates and rays in the Bristol Channel is increases in restrictions leading to fisheries becoming unviable (FRMP Interviews, 2020). As part of the 2017 management measures for skate and ray fisheries, the European Commission initially decided upon a prohibition of landing small-eyed ray across several ICES Divisions, including VIIf, the Bristol Channel (see **Fishery Management).** For many fishers in the Bristol Channel, this would have resulted in their fishing becoming unviable, due to heavy reliance on skate and ray catch through the year. Following an appeal put together by the NDFA and Defra, the ban was lifted and a TAC on small-eyed ray in Divisions VIIf and g was implemented. Several of the fishers interviewed as part of this project raised the issue of the potential ray bans, with some describing it as "*a complete and total disgrace*" (FRMP Interviews, 2020). There is concern among fishers that future restrictions may be put in place without considering the economic importance of fisheries to local fishing industries, simultaneously causing loss in revenue for fishers and shifting fishing pressure on to other species.

One issue seen in most inshore fishing areas is that of illegal, unreported, and unregulated fishing. This issue was raised by almost all fishers during interviews as part of this project, with one fisher commenting "*there is a lot of fishing going on up here you don't know about…*" when discussing illegal fishing in North Devon and Somerset (FRMP Interviews, 2020). This problem is thought to be most common in sea bass fisheries, though given the importance and popularity of skate and ray fisheries to the area, it is likely that landing of illegally caught skates is common also (FRMP Interviews, 2020). Even if ray is not often targeted for these activities, their large size and susceptibility to capture in most fishing gears means illegal fishing can still impact local ray populations. There was a strong consensus between commercial and recreational fishers that there was a need for a stronger enforcement presence from D&S IFCA to discourage illegal fishing and ensure fishing regulations are followed by both commercial and recreational fishers (FRMP Interviews, 2020). The large size of D&S IFCA's District, and a small enforcement team made up of only four officers, means patrols are limited to areas with higher numbers of reports of illegal fishing, which is primarily the south coast. Engagement with fishers from the north of the District has highlighted a sense of mistrust towards the IFCA from the inshore fishing industry and shown some fishers have no confidence in the IFCA, which may contribute to illegal fishing activity remaining unreported (FRMP Interviews, 2020). It is important to work to rebuild this trust and engage with fishers as much as possible, including to encourage the reporting of illegal activity.

D&S IFCA is seeking to rectify this, including the improvement of collaboration and engagement through activities such as virtual roadshows for ports, sectoral meetings and future FRMP interviews. More information about planned engagement activities is available in the D&S IFCA's Annual Plan and Communications Strategy, accessible via the D&S IFCA website. It is hoped that this will improve stakeholder engagement with D&S IFCA's intelligence-led, risk-based approach to enforcement and compliance work, which is prioritised to areas with high numbers of reports of illegal fishing activity.

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Appendices

Electric Organ

Some skate and ray species possess the ability to generate (electrogenic) and detect (electroreceptive) electric fields using a structure called the electric organ (Kalmijn, 1988). While other species with this ability use these electric fields in hunting, navigation, defence from predators and sometimes prey incapacitation, research suggests that the weak electric fields generates by skate species may be used as a form of communication for reproduction purposes (Koester, 2003)

Undulate Ray

Undulate rays (*R. undulata*) are one of the larger skate species in UK waters and do not become sexually mature till later in life compared to smaller skate species (Henderson, 2014) and many other elasmobranchs. Males become sexually mature at ~7.5 years and females at ~9 years (IUCN, 2009). There are few studies focusing on the breeding seasons of undulates; in coastal Portuguese waters undulates lay their eggs in the winter and sometimes as early as late autumn (Coelho and Erzini, 2002), however, undulates in the north-eastern Atlantic have been recorded to lay eggs from March to September, much like other UK skates (Hureau *et al.*, 1984). It is thought that these differences in breeding time may be a result of water temperature, with breeding being restricted to periods of colder water (Coelho and Erzini, 2002). Females (see **Figure 24**) in Portuguese waters lay on average just short of 70 eggs in shallow, inshore waters (Serra-Pereira, Erzini and Figueiredo, 2015); however, the fecundity of undulates in more northern waters may vary. Again, much like other skate species, the young hatch and spend several years inshore before moving offshore as they grow older and larger. The oldest undulate ray ever recorded was 13 years of age, however, it is believed that they can reach ages of close to 20 years and reach lengths of 110cm (Coelho and Erzini, 2002).

Figure 24 *- Undulate ray, (R. undulata) (Merelo, 2009, https://commons.wikimedia.org/wiki/File:Raja_undulata.jpg [unedited]).*

Undulate rays share much of their range with blonde rays, but are more limited in the northern extent of their range: undulates are not found much further north than the Bristol Channel (Heessen, Daan and Ellis, 2017). Their range has been described as patchy but there may be discrete areas where undulates are locally common, especially in the Mediterranean (Coelho and Erzini, 2002). Undulates have been recorded as far east as the coastal waters of Israel and Turkey and, like other skates, are common along the north western coastline of Africa as well as the Canary Islands (Coelho *et al.*, 2002; Serena, 2005).

North Devon Catch Data

Table 13 - Skates and rays catch data from ports within the North Devon Marine Pioneer Area (MMO, 2020a).

Year	Port Landed	Gear	Live Weight (Tonnes)	Landed Weight (Tonnes)	Value
2008	Appledore	Demersal Trawl / Seine	177.150	88.147	£246,258.52
2008	Appledore	Drift & Fixed Nets	1.402	1.022	£2,954.30
2008	Appledore	Hooked Gear	0.004	0.004	£11.42
2008	Bideford	Demersal Trawl / Seine	1.645	0.794	£4,332.30
2008	Bideford	Drift & Fixed Nets	1.134	0.554	£1,654.80
2008	Bude	Demersal Trawl / Seine	0.008	0.004	£11.15
2008	Bude	Drift & Fixed Nets	0.327	0.183	£567.60
2008	Clovelly	Demersal Trawl / Seine	1.142	0.590	£1,441.37
2008	Ilfracombe	Demersal Trawl / Seine	276.722	137.652	£296,034.30
2008	Lynmouth	Drift & Fixed Nets	0.006	0.003	£4.49
2008	**North Devon Total**	**All Gear**	**459.540**	**228.952**	**£553,270.25**
2009	Appledore	Demersal Trawl / Seine	153.611	74.239	£212,361.55
2009	Appledore	Drift & Fixed Nets	3.284	1.852	£6,694.43
2009	Appledore	Hooked Gear	1.192	0.836	£2,250.66
2009	Bideford	Demersal Trawl / Seine	9.293	4.748	£16,542.40
2009	Bideford	Drift & Fixed Nets	2.263	1.573	£4,960.27
2009	Bideford	Hooked Gear	0.151	0.087	£292.44
2009	Bude	Demersal Trawl / Seine	0.046	0.022	£66.00
2009	Bude	Drift & Fixed Nets	0.198	0.095	£264.88
2009	Ilfracombe	Demersal Trawl / Seine	168.539	80.637	£217,956.45
2009	Lynmouth	Drift & Fixed Nets	0.034	0.017	£20.90
2009	**North Devon Total**	**All Gear**	**338.610**	**164.103**	**£461,409.98**
2010	Appledore	Demersal Trawl / Seine	110.839	74.445	£178,374.22
2010	Appledore	Drift & Fixed Nets	0.266	0.128	£518.95
2010	Appledore	Pots & Traps	0.008	0.004	£13.88
2010	Bideford	Demersal Trawl / Seine	103.742	67.183	£162,204.82
2010	Bideford	Drift & Fixed Nets	0.989	0.474	£1,508.00
2010	Ilfracombe	Demersal Trawl / Seine	235.074	138.734	£366,448.74
2010	**North Devon Total**	**All Gear**	**450.918**	**280.967**	**£709,068.61**
2011	Appledore	Demersal Trawl / Seine	46.097	22.128	£78,364.34
2011	Appledore	Dredge	0.063	0.031	£102.36

2011	Bideford	Demersal Trawl / Seine	137.342	71.569	£229,065.29
2011	Bideford	Drift & Fixed Nets	3.667	2.160	£7,437.20
2011	Bideford	Hooked Gear	0.005	0.003	£10.50
2011	Ilfracombe	Demersal Trawl / Seine	280.941	140.726	£460,277.18
2011	**North Devon Total**	**All Gear**	**468.115**	**236.616**	**£775,256.87**
2012	Appledore	Demersal Trawl / Seine	53.665	25.755	£88,539.62
2012	Appledore	Drift & Fixed Nets	0.527	0.252	£845.00
2012	Bideford	Demersal Trawl / Seine	70.534	33.995	£103,558.06
2012	Bideford	Drift & Fixed Nets	2.316	1.278	£4,207.69
2012	Bideford	Hooked Gear	0.079	0.038	£134.13
2012	Bude	Drift & Fixed Nets	0.065	0.057	£237.63
2012	Clovelly	Demersal Trawl / Seine	0.359	0.174	£551.14
2012	Ilfracombe	Demersal Trawl / Seine	305.732	146.350	£479,626.74
2012	Ilfracombe	Drift & Fixed Nets	0.042	0.020	£3.00
2012	Ilfracombe	Pots & Traps	4.647	2.224	£6,034.95
2012	**North Devon Total**	**All Gear**	**437.964**	**210.142**	**£683,737.96**
2013	Appledore	Demersal Trawl / Seine	125.218	60.004	£180,563.23
2013	Appledore	Dredge	0.065	0.031	£100.80
2013	Appledore	Drift & Fixed Nets	0.409	0.197	£573.70
2013	Appledore	Pots & Traps	0.009	0.004	£15.84
2013	Bideford	Demersal Trawl / Seine	13.515	6.466	£17,978.95
2013	Bideford	Drift & Fixed Nets	0.420	0.201	£298.31
2013	Bude	Drift & Fixed Nets	NA	0.074	£220.77
2013	Ilfracombe	Demersal Trawl / Seine	258.378	123.695	£386,489.20
2013	Ilfracombe	Dredge	0.777	0.372	£1,269.20
2013	**North Devon Total**	**All Gear**	**398.791**	**191.044**	**£587,510.00**
2014	Appledore	Demersal Trawl / Seine	3.135	1.501	£4,899.46
2014	Appledore	Drift & Fixed Nets	0.121	0.058	£171.64
2014	Bideford	Beam Trawl	3.105	1.486	£5,597.80
2014	Bideford	Demersal Trawl / Seine	103.436	50.133	£140,708.73
2014	Bideford	Drift & Fixed Nets	25.197	12.149	£33,818.13
2014	Ilfracombe	Demersal Trawl / Seine	110.359	52.816	£154,527.20
2014	**North Devon Total**	**All Gear**	**245.353**	**118.143**	**£339,722.96**
2015	Bideford	Demersal Trawl / Seine	86.150	50.318	£118,916.36
2015	Bideford	Drift & Fixed Nets	5.411	2.603	£6,704.68

2015	Clovelly	Demersal Trawl / Seine	NA	0.004	£14.62
2015	Clovelly	Drift & Fixed Nets	NA	0.027	£93.50
2015	Ilfracombe	Demersal Trawl / Seine	140.229	67.390	£182,512.27
2015	**North Devon Total**	**All Gear**	**231.790**	**120.342**	**£308,241.43**
2016	Bideford	Demersal Trawl / Seine	7.315	3.516	£9,152.24
2016	Bideford	Drift & Fixed Nets	8.376	4.056	£11,556.58
2016	Bideford	Pots & Traps	0.543	0.260	£802.00
2016	Bude	Drift & Fixed Nets	0.160	0.077	£273.64
2016	Bude	Hooked Gear	0.066	0.032	£59.00
2016	Ilfracombe	Demersal Trawl / Seine	200.934	134.818	£282,283.51
2016	Ilfracombe	Dredge	0.027	0.013	£0.00
2016	Ilfracombe	Pots & Traps	0.602	0.288	£921.60
2016	**North Devon Total**	**All Gear**	**218.022**	**143.059**	**£305,048.57**
2017	Appledore	All Gear	3.511	2.836	£5,130.00
2017	Bideford	All Gear	6.424	3.075	£8,673.29
2017	Bude	All Gear	0.443	0.231	£494.00
2017	Clovelly	All Gear	NA	0.023	£90.02
2017	Ilfracombe	All Gear	190.162	141.514	£277,929.62
2017	**North Devon Total**	**All Gear**	**200.540**	**147.679**	**£292,316.93**
2018	Bideford	All Gear	21.013	12.220	£37,971.35
2018	Bude	All Gear	0.1394	0.0668	£2,011.36
2018	Clovelly	All Gear	NA	0.020	£80.40
2018	Ilfracombe	All Gear	281.624	134.739	£442,854.27
2018	**North Devon Total**	**All Gear**	**302.776**	**147.046**	**£482,917.38**
2019	Appledore	All Gear	NA	12.050	£1,891.00
2019	Bideford	All Gear	76.566	41.407	£112,924.00
2019	Bude	All Gear	0.080	0.066	£55.88
2019	Clovelly	All Gear	0.018	0.013	£101.40
2019	Ilfracombe	All Gear	358.239	171.812	£502,447.52
2019	**North Devon Total**	**All Gear**	**434.904**	**225.349**	**£617,419.80**

Table 14 – Species-specific skate and ray landings data for ports within the North Devon Marine Pioneer Area (MMO, 2020a).

Year	Port Landed	Gear	Species	Live Weight (Tonnes)	Landed Weight (Tonnes)	Value
2012	Appledore	Demersal Trawl / Seine	Thornback	18.350	8.782	£30,650.41
			Blonde	18.762	8.982	£31,665.46
			Small-Eyed	15.764	7.546	£24,823.02
			Spotted	0.789	0.379	£1,169.50
			General Skates & Rays	0.000	0.071	£231.23
		Drift & Fixed Nets	Thornback	0.470	0.225	£764.50
			Small-Eyed	0.056	0.027	£80.50
	Bideford	Demersal Trawl / Seine	Thornback	31.360	15.047	£45,446.63
			Blonde	20.617	9.867	£30,130.02
			Small-Eyed	16.888	8.098	£25,042.59
			Spotted	1.670	0.799	£2,352.10
			General Skates & Rays	0.000	0.185	£586.72
		Drift & Fixed Nets	Thornback	1.602	0.770	£2,808.42
			Blonde	0.535	0.256	£971.15
			Small-Eyed	0.179	0.086	£304.48
			General Skates & Rays	0.000	0.168	£123.64
		Hooked Gear	Thornback	0.060	0.029	£107.93
			Small-Eyed	0.019	0.009	£26.20
	Bude	Drift & Fixed Nets	General Skates & Rays	0.065	0.057	£237.63
	Clovelly	Demersal Trawl / Seine	Thornback	0.157	0.075	£238.50
			Blonde	0.119	0.057	£184.56
			Small-Eyed	0.063	0.030	£93.00
			Spotted	0.021	0.010	£29.00
			General Skates & Rays	0.000	0.002	£6.08
	Ilfracombe	Demersal Trawl / Seine	Thornback	118.593	56.785	£178,849.26
			Blonde	95.447	45.679	£160,901.88
			Small-Eyed	85.102	40.727	£130,602.92

			Spotted	7.867	3.770	£11,543.08
			General Skates & Rays	0.120	0.124	£42.50
		Drift & Fixed Nets	Blonde	0.042	0.020	£3.00
		Pots & Traps	Thornback	2.147	1.028	£2,886.90
			Blonde	1.570	0.752	£1,893.35
			Small-Eyed	0.914	0.438	£1,235.10
			Spotted	0.015	0.007	£19.60
					Total -	**£686,050.86**
2013	Appledore	Demersal Trawl / Seine	Thornback	51.336	24.568	£75,084.66
			Blonde	41.559	19.941	£61,656.37
			Small-Eyed	30.525	14.634	£41,426.90
			Spotted	1.798	0.861	£2,395.30
		Dredge	Thornback	0.065	0.031	£100.80
		Drift & Fixed Nets	Thornback	0.409	0.197	£573.70
		Pots & Traps	Thornback	0.009	0.004	£15.84
	Bideford	Demersal Trawl / Seine	Thornback	4.255	2.037	£5,787.92
			Blonde	5.917	2.830	£8,069.61
			Small-Eyed	3.343	1.599	£4,121.42
		Drift & Fixed Nets	Thornback	0.420	0.201	£298.31
	Bude	Drift & Fixed Nets	General Skates & Rays	NA	0.074	£220.77
	Ilfracombe	Demersal Trawl / Seine	Thornback	91.831	43.947	£135,393.05
			Blonde	111.683	53.443	£171,407.91
			Small-Eyed	50.667	24.295	£74,179.10
			Spotted	3.806	1.823	£5,012.07
			Cuckoo	0.147	0.070	£123.57
			Sandy	0.244	0.117	£373.50
		Dredge	Blonde	0.777	0.372	£1,269.20
					Total -	**£587,510.00**
2014	Appledore	Demersal Trawl / Seine	Thornback	0.827	0.396	£1,270.82
			Blonde	1.021	0.489	£1,647.63
			Small-Eyed	1.266	0.606	£1,946.01
			Spotted	0.021	0.010	£35.00

		Drift & Fixed Nets	Thornback	0.121	0.058	£171.64
	Bideford	Beam Trawl	Blonde	2.374	1.136	£4,439.60
			Small-Eyed	0.731	0.350	£1,158.20
		Demersal Trawl / Seine	Thornback	21.548	10.329	£27,796.54
			Blonde	59.302	28.813	£81,343.59
			Small-Eyed	21.391	10.419	£30,011.30
			Spotted	0.146	0.070	£196.50
			Cuckoo	0.171	0.082	£203.60
			Sandy	0.878	0.420	£1,157.20
		Drift & Fixed Nets	Thornback	2.321	1.114	£2,922.97
			Blonde	15.720	7.523	£21,307.06
			Small-Eyed	6.445	3.172	£8,719.10
			Sandy	0.711	0.340	£869.00
	Ilfracombe	Demersal Trawl / Seine	Thornback	33.312	15.940	£44,676.48
			Blonde	44.864	21.474	£67,950.88
			Small-Eyed	28.458	13.618	£37,415.75
			Spotted	3.725	1.784	£4,484.09
					Total -	**£339,722.96**
2015	Bideford	Demersal Trawl / Seine	Thornback	23.673	11.425	£31,425.21
			Blonde	40.673	19.563	£57,184.91
			Small-Eyed	21.750	10.457	£28,903.82
			Shagreen	0.054	0.048	£14.40
			General Skates & Rays	NA	8.825	£1,388.02
		Drift & Fixed Nets	Thornback	1.990	0.954	£2,369.68
			Blonde	2.610	1.261	£3,337.50
			Small-Eyed	0.811	0.388	£997.50
	Clovelly	Demersal Trawl / Seine	General Skates & Rays	NA	0.004	£14.62
		Drift & Fixed Nets	General Skates & Rays	NA	0.027	£93.50
	Ilfracombe	Demersal Trawl / Seine	Thornback	37.339	17.872	£48,042.29
			Blonde	68.534	32.976	£90,635.75
			Small-Eyed	32.525	15.660	£42,047.15

			Spotted	1.814	0.869	£1,784.78
			Cuckoo	0.017	0.008	£2.30
			General Skates & Rays	NA	0.005	£0.00
					Total -	**£308,241.43**
2016	Bideford	Demersal Trawl / Seine	Thornback	2.849	1.379	£3,575.48
			Blonde	3.048	1.459	£3,922.06
			Small-Eyed	1.419	0.679	£1,654.70
		Drift & Fixed Nets	Thornback	3.405	1.666	£5,007.14
			Blonde	3.390	1.634	£4,615.80
			Small-Eyed	1.581	0.757	£1,933.64
		Pots & Traps	Thornback	0.543	0.260	£802.00
	Bude	Drift & Fixed Nets	Blonde	0.090	0.043	£130.56
			Small-Eyed	0.070	0.034	£143.08
		Hooked Gear	Small-Eyed	0.047	0.023	£49.38
	Ilfracombe	Demersal Trawl / Seine	Thornback	75.646	36.199	£100,640.76
			Blonde	101.961	49.291	£146,481.23
			Small-Eyed	21.836	10.468	£27,425.85
			Spotted	1.480	0.709	£1,715.04
			Cuckoo	0.012	0.006	£5.50
			General Skates & Rays	NA	38.146	£6,015.13
		Dredge	Thornback	0.007	0.003	£0.00
			Blonde	0.014	0.007	£0.00
			Spotted	0.006	0.003	£0.00
		Pots & Traps	Thornback	0.602	0.288	£921.60
					Total -	**£283,205.11**

Sustainability Ecolabels

The concept of sustainably sourced seafood has been receiving more attention from consumers over recent years. More than ever, people are showing concern over the environmental implications of their actions, including where and how their food is sourced (Kaiser and Edwards-Jones, 2006). One way to encourage the sustainability of commercial fisheries, as well as the purchasing of sustainably sourced products, is through the use of ecolabels. In essence, these are labels or marks found on seafood packaging that assure consumers the seafood in question has been caught in accordance with certain principles or practices, namely the fishery has been formally assessed and found to be non-damaging to non-target marine species and habitats (Gudmundsson and Roheim, 2000). These ecolabelled products are usually sold at a higher price than similar non-labelled products. In principle, this price premium serves to recompense producers for the extra effort required to uphold the ecolabel standards during production as well as serve as an incentive to continue to uphold these standards and practices (Kaiser and Edwards-Jones, 2006).

The most well-known ecolabel in the seafood industry is the MSC (Marine Stewardship Council), who have been assessing and certifying fisheries on their sustainability since 1997, allowing their catch to carry the MSC ecolabel and be sold as sustainably sourced (Ponte, 2012). In 2009, the Bristol Channel ray trawl fishery sought sustainability accreditation from the MSC, however, sustainable status was not granted (MSC, 2009). Generally, only larger, high-catch commercial fisheries strive for MSC accreditation, as smaller fisheries are often at a disadvantage due to issues with remoteness, data availability and management. Ironically, it is these small-scale, inshore fisheries, that are more likely to be sustainable in practice compared to the larger, offshore operations (Jacquet and Pauly, 2008).