Small-eyed ray (Raja microocellata) is found on the inner continental shelf in the east Atlantic from the south-western coasts of the British Isles to northern Morocco (Stehmann and Bürkel, 1984). It is locally abundant in the Bristol Channel and parts of the English Channel (Ellis et al., 2005). It is an inshore demersal species, inhabiting the inner continental shelf waters down to a depth of about 100 m (Ellis et al., 2005). It is usually found on sandy substrates, favouring sandy bays and sand banks, with shallow, sandy bays in the northern Bristol Channel acting as important nursery grounds (Kaiser et al., 2004; Ellis et al., 2005).

Small-eyed ray is a medium-sized skate, attaining a maximum length of 91 cm. The estimated maximum age is about 12 years. Total length at maturity is between 69 and 78 cm and they breed during the summer. They predate on shrimps and other small crustaceans when small, with the adults also feeding on sandeels and other demersal fish.

It is a locally important component of targeted skate fisheries using otter trawl or set-nets, as well as a commercial bycatch in mixed demersal trawl and set-net fisheries (ICES, 2015). Smaller individuals are usually discarded (Silva, et al., 2012).

The degree of resource competition and species interactions between skate species is poorly understood. Historically, the larger common skate (Dipturus batis) complex, was known to predate on smaller skate individuals, and earlier, longer-term declines in larger skates may have benefited populations of smaller skate species, due to a reduction in predation or competition.

ICES provides advice for two stocks, one in the Bristol Channel and another in the English Channel (ICES, 2014a,b). Insufficient information is available to present longer-term trends in species-specific landings for these stocks, although the species-specific reporting of skates is improving. The degree of connectivity between small-eyed ray in the Bristol Channel and English Channel is unknown, and they are currently treated as separate stocks. Catch rates in scientific trawl surveys in the Bristol Channel imply a recent decrease in catch rates, although the longer-term trend has shown a general increase. The status of the English Channel stock is unknown.

References


ICES (2014b). Small-eyed ray (Raja microocellata) in the English Channel (Divisions VIl, d). In: Report of the ICES Advisory Committee, 2014. ICES Advice 2014, Book 5, Section 5.3.29.8; 4pp


The status of small eyed ray stock in ICES Divisions 7f and 7g (Bristol Channel, Celtic Sea north) has been scored as very high risk. Reference points for long-term sustainability have not been defined for this stock, and therefore cannot be used to derive a risk score. The risk score was calculated using a data-limited approach where the vulnerability score for cuckoo ray (62/100; FishBase, 2015) was weighted with the stock size indicator which is below average in recent years (ICES 2016).

The management of small eyed ray stock in ICES Divisions 7f and 7g (Bristol Channel, Celtic Sea north) has been scored as a moderate risk. This is because data-derived management controls are in place, albeit under the framework of a generic TAC for all skates (Rajidae) over a broader management area, and that compliance can be patchy (e.g. misidentifications in skate species can occur). Data-limited assessments and scientific advice for these stocks are provided on a biennial basis and a comprehensive regulatory framework is in place.

The bycatch risk of this fishery is scored as high risk. This is because otter trawls have the potential to take relatively high quantities of bycatch of non-target and vulnerable species (> 30% of catch weight), including demersal elasmobranchs and protected, endangered and threatened (e.g. sharks and rays) species in certain circumstances. However, the incoming EU landings obligation is intended to reduce discarding.

The habitat risk of this fishery is scored as a moderate risk. This is because, although otter trawls are considered to have a potential to cause significant habitat damage, damage to vulnerable and sensitive marine habitats is likely to be minimised given that the footprint of the fishery is within core areas, typically historically fished ground.

Spatial management to reduce potential interactions with vulnerable habitats are being developed, but there remains uncertainties about the location of some sensitive seabed habitats and therefore some risk of further impact.

### Stock Status

<table>
<thead>
<tr>
<th>Stock</th>
<th>Current risk status</th>
<th>Outlook</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very high</td>
<td>Unknown</td>
<td>There is evidence for stock decline or at best for a stable stock in the Bristol Channel. The most recent ICES advice is for a 36% decrease in the landings of this stock.</td>
</tr>
</tbody>
</table>

The status of the English Channel stock is unknown. The most recent ICES advice was for a 20% decrease in the landings of this stock.

Whilst species-specific landings data are improving, estimates of dead discards are not available, and some landings data are generic. Hence, recent trends in the catches of small-eyed ray cannot be fully quantified.
Ongoing collection of species-specific landings data should improve understanding of stock dynamics.

Management

Moderate

Improving

Management decisions for this data-limited No individual TAC is set for this stock at present and only a data-limited assessment has been produced to provide fisheries advice. No reference points for long-term sustainability have been defined, and no management plans are currently in place. Increasing the quantity and quality of species-specific data will help to improve targeted management techniques.

Bycatch

High

Improving

Bycatch of non-target species in this fishery is relatively high with poor selectivity. However, with technical and spatial management measures continuously under development and the incoming EU landings obligation intended to reduce discarding of target species, the bycatch risk is likely to reduce in the future.

Habitat

Moderate

Improving

Otter trawls disturb seabed habitats, but a range of Marine Protected Areas have been established and are under development to help minimise damage to vulnerable marine habitats.

<table>
<thead>
<tr>
<th>Type</th>
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<th>Outlook</th>
<th>Reason</th>
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<tr>
<td>Stock</td>
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<td>Whilst ICES describes the small eyed ray stock in the Bristol Channel as below the historic average, recent trends suggests that the stock is increasing.</td>
</tr>
<tr>
<td>Management</td>
<td>Moderate</td>
<td>Improving</td>
<td>Management decisions for this data-limited No individual TAC is set for this stock at present and only a data-limited assessment has been produced to provide fisheries advice. No reference points for long-term sustainability have been defined, and no management plans are currently in place. Increasing the quantity and quality of species-specific data will help to improve targeted management techniques.</td>
</tr>
<tr>
<td>Bycatch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitat</td>
<td></td>
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<td></td>
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</tbody>
</table>
Time-trends

The ICES framework for category 3 stocks was applied (ICES, 2012). The UK (E&W)-BTS-Q3 was used as the index of stock size. The advice is based on a comparison of the two latest index values (index A) with the five preceding values (index B), multiplied by the recent advised landings (ICES, 2016).

Scientific trawl surveys provide the longest time-series of species-specific data (ICES, 2015). The survey of the Bristol Channel (Figure 1) has indicated that the average of the abundance indicator in 2012–2013 was 27% lower than the average of the five previous years (2007–2011). Consequently, ICES (2014a) advised that landings should be reduced by 36% in 2015.

Figure 1. Small-eyed ray in divisions 7.f and 7.g. Left: ICES estimated landings (in tonnes). Right: Mean numbers per hour of R.microocellata derived from the UK (E&W)-BTS-Q3 survey in the Bristol Channel. Dashed lines indicate the mean annual CPUE for 2009–2013 and 2014–2015.

Stock structure and recruitment

For management purposes, ICES currently provide advice for two stocks of small-eyed ray: Divisions VIIf, g (Bristol Channel and northern Celtic Sea) and Divisions VIId-e (English Channel). The degree of connectivity between these stocks is unknown. No reference points are defined for either stock and their statuses are unknown.

No explicit information on recruitment has been presented for this stock, although the survey data used is comprised largely of juvenile fish.

Data gaps and research priorities

More information on stock structure and status is required, including the degree of connectivity between the Bristol Channel and English Channel. Whereas current trawl surveys in the Bristol Channel have been used to provide an abundance index, this is based largely on juveniles, and there are less data on adult fish. Data are more limited for the English Channel.

An improved delineation of spawning and nursery grounds is required to identify important reproductive areas for cuckoo ray. Updated data on the length at maturity are available (McCully et al., 2012), but updated age and growth parameters and fecundity data could usefully be collected.

• Historically, small-eyed ray was landed and reported under the generic ‘skates and rays’ landing category, and a longer-term series of species-specific catch information is required. Since the introduction of legal obligations to declare more demersal elasmobranchs to species level, a greater proportion of data are reported to this level (Ellis et al., 2010; Silva et al., 2012). This information currently covers a relatively short time period to aid assessments. Whilst there have been great efforts to improve species identification in commercial data, further studies to evaluate the quality of species-specific landings data are required.

Discards are known to take place but have not been quantified. Discard survival of various skates is approximately 55% in otter trawl fisheries in the Bristol Channel (Catchpole et al., 2007; Enever et al., 2009), but the survival of small-eyed ray in other gears has not been estimated. Quantitative estimates of (dead) discarding are required to improve estimates of total fishing mortality.

The potential effects of other human activities (e.g. aggregate extraction) on this species have not been evaluated. The distribution of the juveniles of this species covers large areas of Carmarthen Bay (7.f). These grounds are often fished by whelk potters, and the presence of such static gear may limit the impacts of trawling on the nursery grounds (ICES 2016).

References


ICES (2014b). Small-eyed ray (Raja microcellata) in Divisions VIIIf, g (Bristol Channel). In: Report of the ICES Advisory Committee, 2014. ICES Advice 2014, Book 5, Section 5.3.29.7; 5pp.


ICES (2016). Small-eyed ray (Raja microcellata) in Divisions 7f and 7g (Bristol Channel, Celtic Sea north). In: Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 5, Section 5.3.20; 5pp.


The management of small eyed ray stock in ICES Divisions 7f and 7g (Bristol Channel, Celtic Sea north) has been scored as a moderate risk. This is because data-derived management controls are in place, albeit under the framework of a generic TAC for all skates (Rajidae) over a broader management area, and that compliance can be patchy (e.g. misidentifications in skate species can occur). Data-limited assessments and scientific advice for these stocks are provided on a biennial basis and a comprehensive regulatory framework is in place.

Advised and agreed catches

The recent advised landings for 2015 and 2016 were originally derived using landings statistics from 2011-2013. In 2016, a review of the landing statistics of elasmobranchs (ICES, 2016a) was conducted. As a result, the basis which was used to provide advice in 2014 for 2015 and 2016 has been adjusted to account for the update in the landing statistics in the period 2011-2013.

The index is estimated to have decreased by more than 20% (29%) and thus the uncertainty cap was applied. The precautionary buffer was applied previously (ICES, 2014) and has not been applied again. This corresponds to landings of no more than 153 t in each of the years 2017 and 2018 (ICES 2016).

Stock Harvest strategy

Small-eyed ray is taken in targeted skate fisheries using otter trawl or set-nets in areas of higher abundance (e.g. Bristol Channel). Elsewhere, this species is a commercial bycatch in mixed demersal fisheries for roundfish and flatfish, mainly by beam and otter trawls. Smaller fish (< 40 cm length) are usually discarded (Silva et al., 2012).

Management of this stock is by Total Allowable Catch (TAC; combined for all skates and rays) in Subareas and Divisions VI, VII, and VIIIa,b,d. ICES do not provide advice on the overall skate TAC, but provide advice on appropriate landings/catches for individual species. No quantitative stock assessments have been undertaken for this species. ICES (2014a) advised on the basis of the data-limited approach that landings of small-eyed ray in the Bristol Channel should be reduced by 36%, which implied landings of 188 t in each of 2015 and 2016. On the basis of the data-limited approach, ICES (2014b) also advised that landings of small-eyed ray in the English Channel should be reduced by 20%, which implied landings of 43 t in each of 2015 and 2016.

Total catches have not been estimated. Discards are known to take place but they have not been quantified and there may be some discard survival (ICES, 2015).

Some vessels operating in the Bristol Channel have switched from beam trawl to outrigger trawl. This allows these vessels to fish closer to shore (as beam trawls were excluded from inshore grounds) and outrigger trawls are effective at catching skates and rays. The potential impact of this change in the fishery to the stock of small-eyed ray has not been evaluated.

Given its small geographical distribution and localised abundance, populations may be vulnerable to declines caused by localised overfishing, habitat degradation and other anthropogenic disturbance.

ICES (2012) noted that additional measures to regulate exploitation of these stocks (e.g. seasonal and/or area closures, technical measures, and tailored measures for target fisheries) should be identified and developed with stakeholder consultations, considering the overall mixed fisheries context.

Small-eyed ray in ICES Divisions VII-g and VIII-e are assessed biennially to estimate temporal trends in population abundance. No reference points for long-term sustainability have been defined for this species and currently no analytical assessments can be presented due to data limitations. The data-limited stock assessment (ICES, 2012b) is based on a time-series of trends of population abundance from standardised research trawl surveys in the Bristol Channel and commercial landings data.

Standardised research trawl surveys provide the longest time-series of species-specific abundance information to assess stock status (ICES, 2015), although these surveys do not sample all the size classes and habitats for the various species. It has not yet been possible to generate an appropriate survey index for the English Channel stock.

Fisheries for small-eyed ray stocks are managed under the EU Common Fisheries Policy (CFP), which aims to set annual TACs that will help achieve FMSY targets for an increasing number of stocks (Council Regulation (EC) 1380/2013). At present, skate fisheries are managed by means of a generic, multi-species TAC combined for several divisions, along with prohibitions for severely depleted species. ICES (2012) suggested that a suite of species- and fishery-specific measures should be developed to manage the fisheries on commercial species and achieve recovery of depleted species.

No management plan is currently in place for this stock, and no specific management objectives are known to ICES.
Surveillance activities to record compliance with national and international fishery control measures are primarily the responsibility of the competent fishery inspection authorities in each country. In addition, the European Fisheries Control Agency (EFCA), established in 2005, organises operational coordination of fisheries control and inspection activities by the Member States as well as cooperation with third countries and other Regional Fishery Management Organisations.

The requirements for surveillance and sanctions for infringements are laid down in the EU Control Regulation (EC) No 1224/2009. Surveillance activities on fisheries taking small-eyed ray include the use of vessel monitoring systems (VMS) on board vessels over 12 m overall length; direct observation by patrol vessels and aerial patrols; inspections of vessels, gear, catches at sea and on shore, verification of EU logbook data against sales documents. The EU Control Regulation specifies that Member States should set up electronic databases containing the inspection and surveillance reports of their officials as well as records of infringements.

Direct control of fishing effort for fleets catching small-eyed ray was introduced in 2003 (Council Regulation (EC) 1954/2003) and modified in 2008 (Council Regulation (EC) 1342/2008). Both these council regulations require Member States to allocate effort in kW-days to different groups of vessels, depending on gear, mesh size and area.

No official minimum landing size (MLS) for small-eyed ray is in existence outside the 6 nautical mile limit in European waters. Nevertheless, local bylaws apply in some districts of England and Wales that stipulate a MLS (typically 40–45 cm disc width) for skates caught in inshore waters to reduce mortality on juveniles. This will afford some protection to small-eyed ray.

Under EU Regulation 850/98 a minimum mesh size of 22cm is required for gillnets targeting rays and skates (those catching <70% skates and rays) in the Celtic Sea (Subareas VI and VII).

This species was traditionally landed under a general category of ‘skate and rays’. However, formal requirements to record species-specific data for the main skate species were introduced in 2008 (Council Regulation (EC) No 40/2008) and have continued to help build a more accurate picture of the different stocks.

References


ICES (2014b). Small-eyed ray (Raja microocellata) in Divisions VIIIf, g (Bristol Channel). In: Report of the ICES Advisory Committee, 2014. ICES Advice 2014, Book 5, Section 5.3.29.7; 5pp.


ICES (2016). Small-eyed ray (Raja microcellata) in Divisions 7f and 7g (Bristol Channel, Celtic Sea north). In: Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 5, Section 5.3.20; 5pp.


Targeting and behaviour

Demersal otter trawls operating in the Celtic Seas, West of Scotland and North East Atlantic are towed by a single boat as a single or multiple rig. The trawl doors create sand clouds that herd the fish into the net. Otter trawls can be rigged with different types of ground gear depending on seabed topography and the species targeted (Løkkeborg, 2005).

Demersal otter trawling is not a well-targeted fishing activity given that a wide variety of non-target species can be caught. This fishery catches a wide variety of mixed demersal finfish, such as sole, lemon sole, plaice, monkfish, John dory and skates and rays and these mixed catches means that the minimum cod end mesh size of 80 mm and other aspects of the management regimes and markets are not optimal for all the species caught. Other fish targeted may include important gadoid species such as Atlantic cod (Gadus morhua) and haddock (Melanogrammus aeglefinus). Fish may be discarded because they are smaller than the Minimum Conservation Landing Size, or the size and/or species are not marketable. Discarding due to the vessel being short of quota for the managed species also occurs.

Evidence of bycatch risk

Discard rates have been estimated from surveys at around 30-40% of total catch weight in European demersal otter trawl fisheries (European Commission, 2011) whilst Rochet et al (2014) estimate discards as high as 70% in some areas, such as Biscay and Iberian waters. According to the Discard Atlas for North West waters (Anon, 2014) the main managed species discarded (2010 -2012) are species such as: cod (49%), haddock (47%), plaice (38%) and whiting (33%) by weight.

Smaller, demersal sharks are occasionally taken as bycatch in otter trawl fisheries such as Starry smooth-hound (Mustelus asterias) and spurdog (Squalus spp.). In addition, common skate (Dipturus batis) and spurdog (Squalus acanthias) can be taken as bycatch in offshore otter trawl fisheries. Currently landing of these species is prohibited and fishermen are required to return them to the sea where they have a chance of survival.

Other species bycatch and respective discards by the demersal otter trawl fishery in the Celtic Sea targeting plaice were made up primarily (60%) of four species: red gurnard, horse mackerel, boar fish and grey gurnard (Rochet et al., 2002; Enever et al., 2007).

However, catch composition and discard rates vary according to regional variations in species composition, the design of the trawl, the cod-end mesh size and other selectivity devices used (see mitigation measures). The fisheries are known to provide a diverse catch, in terms of species numbers, so inevitably some of the less valuable species are likely to be discarded.

Most of the risk resulting from discarding in this fishery relates to the relatively poor understanding of the population dynamics of the species discarded; the data on catches are unreliable and/or they are subject to data limited or no assessments. Bycatches of skates, rays and sharks (elasmobranchs) take place in most European otter trawl fisheries. Elasmobranchs have to reach a relatively large size before maturing into adults and produce low numbers of young (low fecundity). Consequently, these species are considered more vulnerable to fishing activities than the more fecund 'teleost' stocks such as Atlantic cod and haddock.

For further discussion of the relative risks fishing to the various species caught in this fishery see Cotter et al., (2015) and Seafish (2014).

Mitigation measures

A wide variety of non-target species are caught in European mixed otter trawl fisheries. Optimising gear selectivity in mixed fisheries is challenging given that different species have different selectivity requirements. Many mitigation measures have been designed and tested to increase selectivity in demersal otter trawls. In this fishery, using 100 mm instead of 80 mm cod ends, both as conventional diamond and as a square configuration (so called T90 or mesh turned through 90o), can substantially reduce discards (around 70%) without loss of commercial catch (Enever et al., 2010). Also mortality of discarded rays has been shown to be reduced through the use of cod end = 100 mm mesh and T90 because that results in a lower bulk of the catch causing less pressure on the fish in the cod end (Enever et al., 2009; 2010). However, the permitted minimum cod end mesh size for this fishery is 80 mm and so the use of the above gears would be an individual initiative by Skippers.

To actually be effective in controlling bycatch levels in fisheries, these measures have to be operationally viable, enforceable and used within an incentive scheme which encourages fishers to use them. The introduction of the landings obligation or ‘discard ban’ under the EU Common fisheries policy (EU 1380/2013) is intended to take place over the period 2016 – 2019 in this fishery. This landings obligation will ultimately apply to all species managed by TAC; it will not apply to non-TAC species, however many of these are likely to benefit from improved selectivity.
Defra has begun a research project (MF 1232) to use applied science to support the industry in delivering an end to discards and has promised to provide the research and development needed to underpin the implementation of the landings obligation.

There are prohibitions on landing vulnerable marine species with depleted population abundance. For example, landings of the following elasmobranchs are prohibited: common skate, black (Norwegian) skate, white skate, undulate ray, spurdog and angel shark. Prohibitions on landing on vulnerable marine species deter fishers from targeting species with low population resilience to fishing activities and helps conserve stocks such as skates and rays that have a relatively high probability of surviving after being discarded.

A Fisheries Science Partnership study on the survival of skates discarded from a commercial trawl fishery showed that two out of three discarded skates survived for at least three days and up to 45 days, but that survival rates decrease with increasing length of tow and total catch/cod end weight (Catchpole et al. 2007; Enever et al., 2009). The use of larger, square mesh panels in trawls may reduce the catch of abrasive material in the cod-end, and so enhance potential survivorship of fish to be discarded (Enever et al., 2010).

There are a number of other ray species caught in trawl fisheries but the amount varies between fleets and areas. Most of these are assessed and managed under the European Common Fisheries Policy and there are active efforts by the EU, ICES, Defra and others to find improved assessment and management strategies for these stocks.

References


Gear effects, targeting and behaviour

Fishermen use their knowledge of seasonal fish aggregations and seabed types together with information from the vessel's echosounder to make informed decisions on where to trawl. Gears are adapted to the substrate type and the species targeted, with a relatively narrow range of conditions in which they can operate. Most otter trawling occurs within core areas where yields are high and it is safe to trawl, typically historically fished grounds (Jennings and Lee, 2011).

This fishery dominated by smaller vessels, has core areas on inshore grounds around the South West peninsula of the UK, with similar fisheries off France and Ireland.

Evidence of habitat risk

Otter trawls impact seabed habitats by modifying bottom topography and disturbing biogenic features. Biological communities can potentially be disturbed both directly and indirectly by changes in the physical attributes of the areas being fished. Trawl doors have the most pronounced impacts on seabed habitats by creating scouring marks and furrows up to 20 cm deep (Løkkeborg, 2005).

The habitat risks are related to the types of seabed communities and other sources of seabed disturbance such as wave and tidal action. A number of theoretical and field studies have focused on the effects of towed gears, which show that areas outside the core areas fished tend to be more sensitive to fishing (Gray et al., 2006; Jennings et al. 2012). Consequently, habitats that have not traditionally been disturbed by fishing activities are relatively more sensitive to the effects of otter trawling.

Understanding the nature of these differences is important in the management of the effects of otter trawling. Communities that inhabit areas where there is more disturbance by wave and tidal action are less likely to be affected by trawling, whereas communities inhabiting deeper waters unaffected by disturbance from wave and tidal action or on harder more gravely substrate are relatively more sensitive to trawling (Bolam et al., 2014). However, there are some habitats such as ross worm (or sabellaria) which inhabit shallower areas and are considered relatively sensitive, but such areas are traditionally avoided by TR2 fisheries.

Mitigation measures

Where the fishery targets relatively shallow core areas, expected to be subject to wave and tidal action and hence relatively resilient to the effects of fishing and fishing has been occurring for many years, the seabed ecosystem is likely to be adapted to fishing. However, there are sensitive areas, mostly outside the core areas of the fishery which may be vulnerable and there has been substantial work over recent years to map and protect these areas. For further discussion of the relative risks of the various habitats affected by this fishery see Cotter et al., (2015) and Seafish 2014.

Under the Marine Strategy Framework Directive (MSFD) from the European Union (Council Directive 56/2008), Member States have committed to aim towards ‘good environmental status’ (GES) for the seabed habitats by 2020. The Convention for the Protection of the Marine Environment of the North-East Atlantic (the ‘OSPAR Convention’), which was signed up to by 15 nations plus the European Union, is developing a coherent network of Marine Protected Areas to protect vulnerable marine habitats in the North-East Atlantic.


These initiatives have resulted in improvements in habitat mapping and risk assessment of the effects of trawling on the seabed and the UK Marine Management Organisation (MMO) is engaging in a programme designed to assess the effects of fisheries and implement management measures where sites are considered at risk. Similar initiatives are taking place in other European countries.

References


