Agenda Item 2 | Review of New Information on Threats to Small Cetaceans (reporting cycle 2017 only)

Bycatch

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Action Requested

- Take note

Submitted by | UK Sea Fish Industry Authority

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The Risk Assessment for Sourcing Seafood (RASS): Empowering businesses to buy responsibly

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ABSTRACT

The RASS web-based tool has been developed by the UK Sea Fish Industry Authority to inform UK seafood businesses and retailers about four environmental risks when sourcing wild-capture seafood; fish stock status, management efficacy, bycatch, and habitat impact. These risks are scored on a five-point scale (1 – very low, 5 – very high risk) against criteria outlined in this paper. RASS allows seafood buyers to identify products that align with their corporate social responsibility commitments (CSR), but unlike other 'fish lists', it does not say "buy" or "avoid". In other words, RASS is informative rather than prescriptive, and puts decision-making back into businesses' hands. The RASS website has been designed for a range of different users, and in addition to risk scores, risk summaries, outlooks, and further evidence are also provided, all of which are freely accessible. The creation of new fishery profiles (and future developments) in RASS is guided through feedback from a seafood industry steering group composed of technical managers and buyers. Ultimately, the RASS tool will improve seafood businesses' capacity to navigate the complexities of fisheries science and management, and commercial realities, when carrying out their CSR commitments.

1. Introduction

Seafood (from wild and farmed sources) is the largest globally traded commodity by value ($148 billion in 2014) [11], and seafood businesses globally are paying increasing attention to corporate social responsibility (CSR) in their decision-making [34]. In the UK, seafood industry reputational disputes are common due to clashes of perspective and value differences between the industry and NGOs (e.g. Hugh's Fish Fight http://www.fishfight.net/story.html). National media coverage also tends to favour the publication of 'bad news stories', and in certain cases has caused public misunderstanding through sensational headlines and oversimplification of complex issues (e.g. *The Telegraph* 16/09/12[1]). This juxtaposed with wider societal concerns of overfishing and its implications [10]; i.e. biodiversity conservation (see Convention on Biological Diversity Aichi target 6), food security [20,23], supply-chain integrity (e.g. mislabelling [22], and slavery [5]) has set a strong incentive for the seafood industry to pay serious attention to their CSR policies to address these concerns (see Annex 1 of supplementary information). Public relations (PR) play an important part, with businesses requiring up-to-date science-based information to manage their exposure to the risk of reputational damage from negative PR (e.g. http://cato.greenpeaceusa.org/Carting-Away-the-Oceans-9.pdf).

Previous studies and industry forums [12,25] have identified a need from seafood businesses for structured information that can be easily assimilated into their own seafood procurement risk management systems, and ensure compliance with their CSR policies and/or their business's risk tolerance. To address these needs of commercial seafood buyers the UK Sea Fish Industry Authority[2] (Seafish herein) has developed a risk assessment tool known as the Risk Assessment for Sourcing Seafood (herein RASS www.seafish.org/rass) (see Fig. 1 for example). RASS will inform seafood businesses by providing freely available up-to-date information on a comprehensive range of fisheries whose products are in the UK supply-chain.

In this paper the conceptual basis for RASS is first outlined which includes a discussion of how the tool is positioned in relation to other seafood information and certification schemes. Following this, in section three, the risk assessment methodology is described. In section four the paper ends with a summary of how businesses have been using RASS to-date, alongside a discussion of the opportunities for improving

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[1] 100 adult cod left in the North Sea. The actual number is thought to be around 21 million.

[2] Seafish is funded through a statutory levy (Fisheries Act 1981) on point of first sale of seafood product in the UK. One of the services Seafish provides is the dissemination of fisheries sustainability information to a range of businesses, from primary/secondary processors, to merchants, retailers, and food-service. Historically this has been through a series of Responsible Sourcing Guides.

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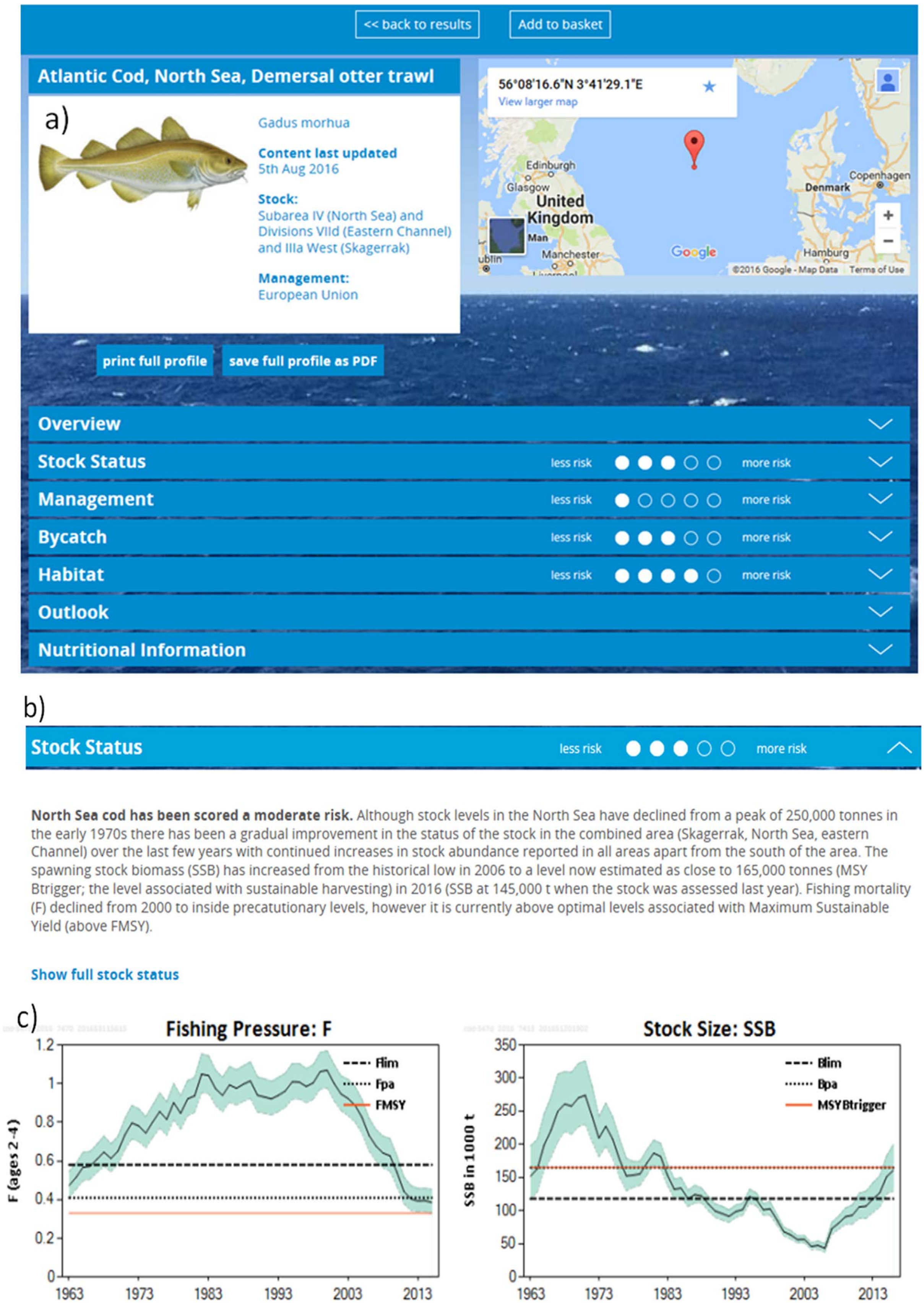

Fig. 1. The RASS website showing a North Sea cod profile [18]. A) a profile constitutes the species, stock area, and main capture method (herein a fishery), B) clicking on a tab will reveal rationale for scoring, and C) clicking on *show full stock status* will provide further evidence and context, including a narrative and time series graphs (where available). As of September 2016, there are 360 RASS profiles.

and further developing the tool.

2. Conceptual basis for RASS

In an increasingly globalised supply chain, seafood buyers face a considerable challenge in making sense of disparate pieces of complex and often contested information, while being pressured by non-governmental organisations (NGOs) not to source from certain stocks and/or fisheries they consider to be 'off-limits'. Currently, there are three ways in which buyers can respond to these challenges: (1) following a third-party certification scheme; (2) adopting the guidelines of an NGO; or (3) signing up to a partnership initiative. RASS offers a fourth alternative.

2.1. Third-party certification schemes

An advantage of following a third-party certification scheme[3] such as the Marine Stewardship Council (MSC), or Friend of the Sea, is that the business can outsource any risks associated with sourcing seafood. Certification schemes are often viewed as guarantee of sustainability by buyers. However only 20% of global seafood catch is from fisheries that are certified or in assessment [29], and globally there is a considerable market demand for non-certified products [11]. There is some evidence to suggest that such schemes have shifted consumer purchasing decisions and improved practices in producers [13]. But critics have argued that these schemes are limited in reaching a critical mass of consumers [3], and ultimately limited in effecting changes to resource health [21], in many cases certifying already well managed fisheries.

2.2. NGO guidelines

Many businesses[4] traditionally have relied on the buy/ don't buy recommendations of NGOs such as the Marine Conservation Society Good Fish Guide and the Monterey Bay Aquarium's Seafood Watch Program. However these recommendations are often underpinned by assumptions based on the NGOs environmental philosophy (rather than evidence) that may not be explicit to the buyer. Additionally, through following an NGO a commercial buyer is aligning their own CSR policy with the environmental philosophy of the NGO in question. This of course has its advantages if the business has a strong brand identity to protect and wants to minimise the potential risk of negative PR through aligning their own CSR philosophy with that of the NGO, but it may leave the business little room for manoeuvre or flexibility to exploit new commercial opportunities.

2.3. Signing up to a partnership initiative

Signing up to a partnership initiative enables businesses to be seen to be facilitating positive improvements and operating with due diligence, demonstrating that they are sourcing from responsible fisheries. For instance, the Sustainable Fisheries Partnership[5] (SFP) encourages this model through facilitating pre-competitive roundtable discussions between producers, processors and retailers to make fishery improvements. SFP also provides businesses with detailed fisheries sustainability information through its online database FishSource, and metrics[6] system. Many larger UK seafood businesses and retailers donate to SFP to use its bespoke services. In the UK, members of the recently established Sustainable Seafood Coalition (SSC) are obligated to improve underperforming fisheries as part of the SSC code of conduct, or if they cannot achieve this, to stop sourcing from the fishery in question. An advantage of this approach is that "avoid" or "red-listed" fisheries can still be legitimately sourced by the business provided improvements are made. Through joining such partnership initiatives smaller businesses can collaborate and pool their resources to make improvements strategically.

2.4. RASS

RASS is an information system that has been developed to address some of the above issues by providing UK seafood buyers with a source of robust and impartial information based on the best available science. RASS fulfils a similar function to the SFP Fish Source tool by providing information rather than a prescriptive rating or buy-don't-buy recommendation. However, the key difference between RASS and SFP is its risk assessment methodology (see Section 3). Given that many fisheries are too data limited to infer sustainability RASS does not make any sustainability claims, but simply states the potential risk of not achieving the four goals specified for each of the risk factors outlined in Table 1. The RASS website (Fig. 1) has been developed to cater for different users in industry, particularly time-poor seafood buyers.

The approach to scoring risk in RASS is driven by the adage of the economist John Maynard Keynes that "*it is better to be roughly right than precisely wrong*"; RASS will not score down to decimal places as other schemes (e.g. Seafood Watch http://www.seafoodwatch.org/) for two reasons: 1) for many fisheries, the evidence base is often not sufficiently robust to score to such a level and potentially gives a misleading impression of confidence, and 2) RASS assessments must be quick to undertake (1–3 days depending on accessibility of information) and keep updated. RASS has been designed to save businesses time in accessing information, and also to be intelligible to a wide range of different businesses so that they can make informed decisions.

3. Development of the RASS methodology

RASS provides scores on an integer scale of 1–5 (1 – very low, 5 – very high risk) and evidence for four individual components of a wild-capture fishery that are pertinent to seafood buyers decision-making during procurement; stock status, management efficacy, bycatch, and habitat impact. RASS does not provide a single score for a fishery, or recommend a fishery for buyers to source from. The unit of assessment for RASS is a profile (see Fig. 1a), which corresponds, in most cases, to a biological stock within a given geographical area and captured using a specific gear type. Scores for each risk component for each profile are assessed using the methodology outlined below, and colour coded according to Table 2.

The information is held by profile on a searchable database at http://www.seafish.org/rass/. When a profile is opened the interface appears as in Fig. 1a. The risk score for each component is translated into a number of dots on the interface from very low risk 1 to very high risk 5. Every risk score in RASS is substantiated by a summary, plus fully referenced narrative. Profiles are also time-stamped to inform users of when the profile was last updated (typically annually).

Expert judgement is essentially involved in all aspects of scoring profiles, though some components can be more easily defined objectively than others. For example, stock status risk is often underpinned by statistically derived reference points, whereas management, bycatch and habitat risks are more dependent on the assessor's interpretation of a patchy evidence-base. To ensure that profiles are based on the best available evidence, experts familiar with the biology and management of stocks and fisheries will collate and interpret information for their respective profiles. Risk scores will reflect expert judgement made

[3] There are currently more than 30 certified labels for fish products on the market of which the most dominant is the Marine Stewardship Council [3].

[4] Comprising of seafood processors, food service, retailers, wholesalers, distributers, and restaurants etc.

[5] Sustainable Fisheries Partnership was established in 2006 https://www.sustainablefish.org/.

[6] This software advises corporate partners about the sustainability status of the fish they are ordering. This means that constantly updated fisheries information can be fed into any company's procurement system and help staff implement sustainability policies.

Table 1
Description of risk factors in RASS.

Risk factor	Goal
Stock status	Stock harvested sustainably and within biological limits
Stock management	Stock is responsibly managed, and rules are complied with and enforced
Bycatch	Fishery minimises quantity of bycatch caught and impact on populations
Habitat	Fishery minimises adverse impact on seafloor habitats

Table 2
Key for risk matrices. Only scores will be displayed by the website, and no colour codes.

	Risk
	Very low
	Low
	Moderate
	High
	Very high

against the scoring criteria outlined in this section. When there are borderline cases to scoring (i.e. with an expert having to choose between two risk categories) a conservative stance will be taken with experts scoring the component the higher risk category. All new profiles are quality-assured by Seafish before they go live.

The risk scoring methodologically subsequently outlined will be periodically reviewed to ensure that it is aligned with developments in fisheries science.

3.1. Stock status

The goal for the first risk component, stock status, is that seafood is sourced from a stock that is harvested sustainably and within biological limits. Our definition of a stock is the biological unit defined and assessed by fisheries scientists. The majority of stocks that have been initially input into RASS are from the NE Atlantic and are assessed by ICES. A smaller proportion of stocks are found in North American waters with assessments made predominantly through USA (NOAA, e.g. Alaska Pollock), and Canadian (DFO, e.g. Northwest Atlantic cod stocks) fisheries' science institutions, and also the Regional Fisheries Management Organisations (RFMOs) (e.g. tuna and swordfish). Essentially the scoring scheme had to be developed to take into account different types of stock assessment, and the quality of information underpinning it from full assessment to data limited (see [19]. For those stocks that are not assessed in any way we resort to using the resilience and/or vulnerability of the species to fishing which is defined on Fish Base [4].

3.1.1. Quantitatively assessed stocks

Typically, the commercially most important fish stocks are fully assessed through statistical models that quantify the biomass of the stock and fishing mortality in relation to a target and/ or limit reference point(s). With ICES assessed stocks, target reference points refer to the Maximum Sustainable Yield (F_{MSY} and MSY Btrigger) or proxies, and precautionary (pa) and limit (lim) reference points relate to the likelihood that stock recruitment is being impaired. The risk can be assessed according to how stock biomass and fishing mortality reference points fall in relation to one another in the matrix shown in Fig. 2.

Reference points can differ between different assessment areas making like-for-like comparisons difficult. ICES uses the trigger level MSYBtrigger to define the level below which management action should be taken to reduce fishing mortality below F_{MSY} and rarely uses the Biomass for Maximum Sustainable Yield (B_{MSY}) target. In the USA, stock biomass reference points relate to B_{MSY} or a proportion (usually 30, 35 or 40%) of the un-fished biomass with average long-term recruitment. Limit reference points for B are undefined. Advice on sustainable exploitation is given as fishing mortality rates calculated to move stock status towards B_{MSY}, which are in turn used to determine the corresponding acceptable harvest (or range of harvests) for a given stock. The Allowable Biological Catch (ABC), and also the overfishing level (OFL – defined as any amount of fishing in excess of a prescribed maximum allowable rate).

There are five tiers used to determine ABC for US ground fish stocks based upon the status and dynamics of the stock, the quality of available information, environmental conditions and other ecological factors, and prevailing technological characteristics of the fishery (see [6].

3.1.2. Data limited stocks

Many data-limited stocks have a biomass index (B) and harvest rate (F) defined. The language in ICES stock assessment advice often relates to where B and F lay in relation to a long-term average. The various possibilities for the status of B and F (see first column Fig. 3) will be weighted by a species biological resilience defined in Fish Base [4], or Sea Life Base for invertebrates. If B and F are not defined, the default position would be to use species resilience only to score (i.e. High 3, Medium 4, Low/ very low resilience 5). For some species (e.g. brown crab, lobster) only their vulnerability has been defined, therefore this metric will be used in the absence of information on resilience. If only a population trend is known then Fig. 4 is used to score. In certain circumstances the ICES advice will only state the direction of a population trend, and if the direction is not stated, it will be inferred visually from the last five-years of the time-series. Raw catch data will not be used as a basis for scoring, though these data are sometimes included in further information for stock status.

3.2. Management

The goal for this risk component is that seafood is sourced from a stock that is responsibly managed. Here we define responsible management as reflecting the extent to which the stock harvest strategy is known to be precautionary, and secondly, what is known about the general surveillance of the fishery and extent of infringements (Fig. 5). In contrast to scoring stock status, descriptors of these two dimensions are more difficult to define objectively, because different assessors may differ in opinion on the choice of scoring criteria that best describe the same fishery. Special attention will need to be spent on quality assurance to ensure consistency in scoring.

Assessments of management will initially be made for the stock area. However, for some species (e.g. scallops, *Nephrops*) management will typically be assessed at the scale that the main capture fishery operates (e.g. scallop dredging in the Celtic Sea), and not individual beds/grounds. Generally, techniques of fisheries management in the developed world have improved considerably over the past fifty years [17], and typically it is going to be straddling/high seas stocks, and fisheries operating in the jurisdiction of developing countries where there will be more risk associated with management, I.e. where there is no agreed harvest strategy, limited surveillance, and limited law enforcement.

3.2.1. Stock harvest strategy

This dimension captures the quality of information that underpins the harvest control rules (management controls [MCs] herein), and their implementation. In reality, MCs will incorporate a combination of a total allowable catch (TAC), rules to limit fishing effort, and technical measures. Typically, in fisheries management emphasis is put on the collection of data to inform the setting of the TAC. There are however

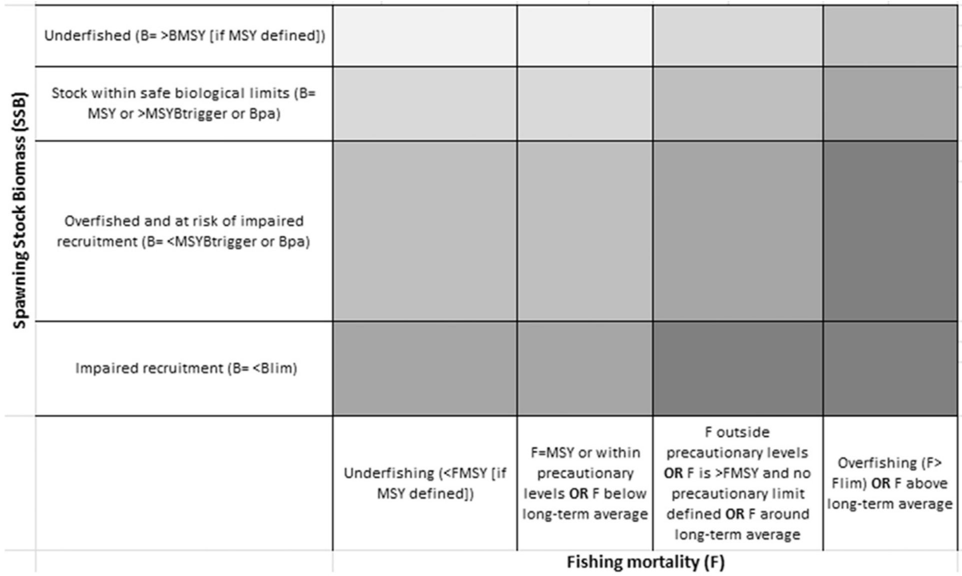

Fig. 2. Matrix for scoring quantitatively assessed stocks. Note that for some stocks, biomass reference points may be explicitly defined, whereas fishing mortality may be described as a range (see ICES advice 2015, Book 6), or more broadly in terms of where it lies in relation to a long-term average.

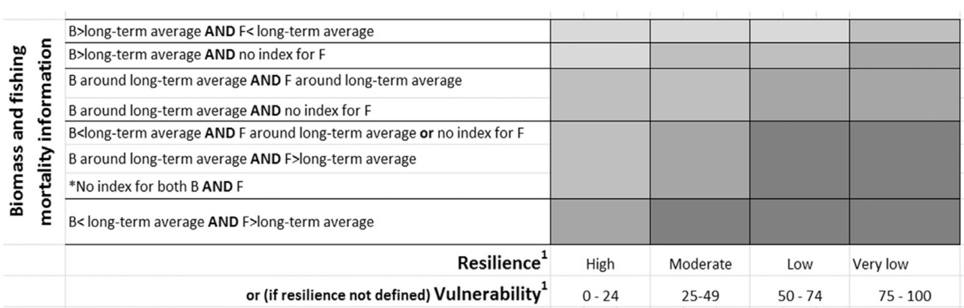

Fig. 3. Matrix for scoring data-limited stocks. *This is to be used as the default score in the absence of any information on B and F. [1] Some species may be cited as bordering two categories, we suggest being conservative in this case, and assume the lower resilience score, or higher vulnerability score.

some fisheries that are not TAC managed, for example, the Faroe Islands government's use of a effort-based management system [15].

The evidence used to score this dimension will be found in fisheries management plans and stock assessment advice, or inferred from the rules set out by the management body. Many commercially important stocks will have an agreed management plan, and it will often be explicitly stated in the stock assessment advice whether this is precautionary. However, for most fish stocks an inference will have to be made to score against the criteria shown in first column of Fig. 5. It should be noted that regardless of the quality of information underpinning the assessment, for those stocks where implementation of MCs is not consistent with advice (i.e. mismatching scales between management and stocks [e.g. *Nephrops* functional units], TACs being set higher than the range specified by the management plan, effort inadequately managed) the lowest possible score for management would be a moderate risk.

3.2.2. Surveillance and enforcement

This dimension captures the extent to which there is surveillance of a fishery to ensure that MCs are complied with, and whether infringements will compromise the stock harvest strategy. Through technological advances (i.e. satellite monitoring, electronic logbooks) the capacity of most developed countries to carry out surveillance of their fleets has increased since the turn of the century. However, infringements will continue to happen in most fisheries, therefore expert judgement should be made about the extent to which infringements (e.g. widespread misreporting of fish catches in the Baltic Sea [16]) are likely to undermine the objectives of the harvest strategy.

3.3. Bycatch

The goal for this risk component is that seafood is sourced from a fishery that minimises the quantity of bycatch caught, and the impact on populations of endangered, threatened, and protected (ETP) species. The term “bycatch” has different meanings in different jurisdictions. Bycatch is defined here as fisheries-related mortality or injury of species other than the retained catch.[7] Examples of bycatch include discards, the incidental mortality of megafauna (e.g. marine mammals, seabirds, turtles), pre-catch mortality and ghost fishing. All discards, including those released alive, are considered bycatch unless there is robust scientific evidence of high post-release survival. Here, an assessment of bycatch risk will be made for two dimensions[8] that will be scored independently of each other; the percentage quantity of bycatch in weight, and the impact on ETP species populations. The final risk will reflect the dimension that is scored highest.

3.3.1. Quantity

Typically, the quantity of bycatch caught will depend on the gear and fishery (i.e. pelagic vs mixed demersal), marketability of species

[7] This is consistent with the MSC definition of bycatch as “organisms that have been taken incidentally and are not retained (usually because they have no commercial value)”.

[8] Ghost-fishing and pre-capture mortality are considered to be beyond the scope of RASS assessments.

Population trend (over 5 years)				
Increasing				
Stable				
Declining/ unknown				
Resilience[1]	High	Moderate	Low	Very low
or (if resilience not defined) Vulnerability[1]	0 -24	25 - 49	50 -74	75 - 100

Fig. 4. Matrix for scoring data-limited stocks if only a population trend is known. If catch (or landings) data is only available assume that the population trend is unknown.

and or/size groups within species' catch, and regulations in place for example EU regulatory discarding of undersized and/or over-quota catch [31]). All these factors mean that for a given gear type, bycatch can vary significantly between different regions. In the EU, a discard ban (Commission Delegated Regulations (EU) No 1392-6/2014) is in the process of being implemented that is expected to reduce the amount of bycatch caught by fishermen. The quantity of bycatch caught in some fisheries has been directly documented (e.g. European Discards Atlases 2014), or in many cases a general inference will have to be made drawing on evidence from similar fisheries operating elsewhere (Fig. 6a). When an inference cannot be made from existing evidence, a default stance on the potential bycatch risk will be taken for the given category of gear.

3.3.2. Endangered, threatened, and protected (ETP) species

A species will be categorised as ETP if it is legally protected in conservation law, or the population is known to be below safe biological levels. Preferably, the risk will take into account evidence on the potential biological removal (PBR) rate [14], or the population status of the ETP species. If there is no information on this, an inference will be made on whether there is mitigation in place across the fishery that will likely reduce the impact of the fishery on the ETP species/population in question. If there is ambiguity over the extent to which mitigation is taking place in the fishery, a precautionary stance will be taken, with this dimension being scored a high risk (Fig. 6b).

3.4. Habitat

The goal for this risk component is that seafood is sourced from a fishery that has minimal adverse impact on seafloor habitats. Typically, mobile bottom gears have the greatest impact on the seafloor [33], but effects can vary considerably between gear types and according to the

Stock harvest strategy (Decreasing monitoring of stock, and risky harvest strategy)	**Surveillance and enforcement**: Management controls (MCs) are routinely enforced and independently verified through surveillance of fishing activities (e.g. VMS, logbooks, dockside monitoring, vessel inspections). Infringements happen only very occasionally and unlikely to compromise harvest objectives.	Compliance can be patchy (i.e. misreporting of catches officially stated to be a problem), and infringements may compromise harvest objectives.	Lack of surveillance prevents confirmation of whether fishing vessels are complying with MCs; **OR** there is widespread non-compliance and no capacity to enforce regulations, harvest objectives (if they exist) will likely be compromised.
Management controls[1] (MCs) are derived from analytical stock assessments and known to be precautionary; **AND** Actual MCs are within the range specified by science advice.			
MCs are advised using analytical stock assessments though found not to be precautionary (OR tested without implementation error); **OR** Simpler data-limited approaches (e.g. ICES data-limited methods) are used for setting MCs, and which are based on knowledge of the fisheries and the biology of the stock, but unknown whether they are precautionary; **AND** A fishery has implemented MCs for the stock that are consistent with science advice, though may be set higher for an operational reason (e.g. to avoid discards in a mixed fishery).			
MCs are derived from data, though compromised by mismatching scale of assessment unit and management (e.g. some *Nephrops* functional units, and where there is a combined TAC for overlapping stocks); **OR** catches or effort too high (i.e. outside range specified by science advice) and may not lead to a sustainable pattern of exploitation.			
A fishery has implemented MCs that are rational in relation to the life-history of the species/ stock, but lack of monitoring means efficacy is not verifiable.			
Data are too limited to develop any form of MCs to adjust fishing opportunities on the stock **BUT** there are management measures in place to control effort in the fishery.			
Data are too limited to develop any form of MCs to adjust fishing opportunities on the stock **AND** no effort control.			

Fig. 5. Matrix for scoring management at stock (parent) level. [1]Adequate management controls lead to an exploitation pattern in line with advice.

a) Total quantity (by weight of total catch)	**Risk**
<1% discards **OR (in the absence of discard rate)** Fishing gear very unlikely to catch bycatch (e.g. hand gathering).	
1%≤ <10% discards **OR** Bycatch low % level of the catch (e.g. pelagic fisheries, rod and line).	
10%≤ <30% discards **OR** Bycatch potentially moderate % weight of the catch (e.g. gillnetting). **OR** High discarding though likely to be high post-release survival of the majority of the bycatch (e.g. rays (Enever et al. 2009))	
30%≤ <50% discards **OR** Bycatch potentially high % weight of the catch (e.g., bottom trawling in a mixed fishery).	
50%< discards **OR** Bycatch potentially very high % weight of the catch (e.g. some shrimp trawl fisheries).	

b) ETP species	**Risk**
Capture of ETP species over the course of a fishing season is very unlikely.	
Capture of ETP species is likely (≥1 per year). Impact on the population is unlikely to be significant because: Population status of ETP species is healthy **OR** Removal < PBR[1] rate.	
Capture of ETP species is likely and population status is unknown or declining. However, mitigation (including high post-release survival) in fishery is likely to significantly reduce impact.	
Capture of ETP species is likely. Impact on the population may be significant because: Population status of ETP species is declining **OR** Removal > PBR[1] rate **AND** Effect of any mitigation is questionable or not well documented.	
Capture of ETP species likely and population status is critical. Removals very likely to be having a significant impact on the population.	

Fig. 6. Quantity of discards (a), and threat to ETP species (b). The risk scored in RASS will be the dimension that is scored the highest. [1]Potential biological removal rate [14].

environmental context in which they are fished [24]. The effects of mobile bottom gear impacts can be less in some habitats where the biological traits of key organisms and environmental conditions such as sediment type and natural disturbance render the habitats less vulnerable to fishing. In contrast, for habitats which contain species whose biological traits render them vulnerable to fishing, effects are potentially more severe and longer-lasting [7] especially in biogenic habitats such as shellfish reefs, and sponge communities [1]. The latter we define as vulnerable habitats, using sources such as OSPAR for information.

To make a completely objective assessment of the impact of a given fishery would ideally require high resolution information on where fishing is taking place in relation to vulnerable seafloor habitats. However, fishing footprints have been comprehensively mapped to this resolution for only a few sea regions. In the absence of this level of evidence, generalisations will have to be made on the impact of a gear category (Fig. 7).

4. Discussion

RASS was launched in September 2014. As of September 2016 there are 360 fishery profiles in RASS (see www.seafish.org/rass for scores and evidence), and there have been around 8000 annual visits to the website. RASS is being used by a range of businesses (e.g. processors, food service, retailers, and restaurants) to inform their procurement and/or their customer base of the impacts associated with a given fishery. In this section two issues are discussed: the added value of risk assessment beyond existing schemes, and the applicability of RASS across the entire supply-chain.

4.1. The added value of risk assessment to seafood sourcing

Risk assessment adds a significant dimension to the tools available to businesses that are used to inform their procurement. Due to strong market demand by other European countries, a high proportion of the high value seafood that is landed into the UK (mainly shellfish) is exported to markets on the continent. UK consumer preferences for traditional whitefish species and canned tuna mean that around 70% of seafood consumed in the UK is imported. Whilst the bulk of UK whitefish supply mainly comes from low risk stocks,[9] there are controversies; e.g. the provenance of tuna from the Indian Ocean. From a global perspective, there are comparatively few stocks and fisheries where there is sufficient knowledge to measure and monitor sustainability [11]. Those that are typically commercially important and found mainly in the seas of developed countries [17]. Whilst some major retailers and seafood brands are demanding sustainability through certification schemes such as the MSC, it is unrealistic to think this model could be applied to all fisheries and stocks, partly because of the heavy information requirements involved, and partly because of the lack of financial incentives for many fisheries to enter these (expensive) schemes [3]. Globalisation and further integration of developing nations into the global economy [27], including the rise of demand for seafood in less sustainably aware countries [9], suggests that product from non-certified fisheries will continue to have several routes to market in the foreseeable future.

Given that the sustainability status of many fisheries is either not

[9] Mainly NE Arctic and Icelandic cod stocks.

Impact criteria	Risk
No interaction of the gear with seafloor habitats (e.g. pelagic seining longlines and handlines, pelagic gillnets, pelagic trawling [e.g. mackerel, herring])	
Gear touches the seafloor, though significant interaction with vulnerable habitats is very unlikely Pelagic trawling [e.g. Alaska pollock], demersal longlines, pots and traps, demersal gillnets (though see caveat for moderate risk category where static gear is used over biogenic habitats)	
Potential interaction with vulnerable habitats (marginal overlap of the fishery's footprint with vulnerable habitats) An argument can be made that the footprint of mobile bottom gears is adequately managed to significantly reduce damage to vulnerable habitats. I.e. MPAs limit the interaction of a mobile bottom gear with vulnerable marine habitats. **OR** Static bottom gears/ demersal longlines are being used over biogenic reef habitats where possible entanglement can occur. **OR** Bottom trawling/ dredging/ seining known known to occur mainly on habitats resilient to disturbance, such as mobile sediments.	
Likely interaction with vulnerable habitats (significant overlap of the fishery's footprint with vulnerable habitats) Bottom trawling/ dredging/ seining known to occur on vulnerable marine habitats, such as deep-water muds **AND** no MPAs to restrict footprint.	
Highly likely interaction with vulnerable habitats over a large proportion of the fishery's footprint. Bottom trawling off continental shelf/ deep-sea areas that may be previously untrawled.	

Fig. 7. Habitat scoring criteria. [1] Use these statements where high resolution mapping data is present.

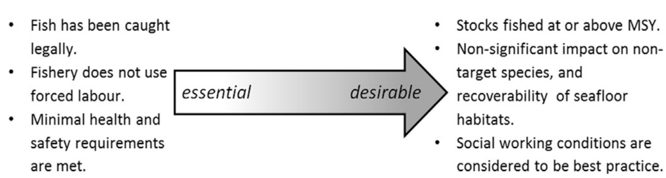

Fig. 8. The spectrum of requirements that responsible sourcing of seafood entails. Certification schemes are defining what is considered best practice with regards to

known or failing in certain aspects [11] it is clear that additional sourcing tools are required to inform buyers of the risks associated with these fisheries [23], and what actions they may take to reduce these risks. At a minimum, risk assessment in responsible sourcing means ensuring that the fish has been caught legally (both environmentally and socially), though this would not fulfil many businesses' criteria of best practice as part of their CSR commitments (Fig. 8, also Annex 1). RASS will help business take initiative to; 1) become more aware of key risks associated with sustainability, and 2) reduce risks that are contrary to their sourcing policy. Currently, as far as the authors are aware, RASS is being mainly used by technical managers to advise internal buyers of the suitability of product for purchase, and identify potential reputational risks for the business's executive. Additionally, many of these businesses will also undertake audits of their suppliers to ensure that they are operating responsibly mitigating risks as far as it is reasonable,[10] and essentially practicing due diligence.

The ultimate goal for many seafood businesses is sourcing from a fishery which will yield long term resource so that the business can continue to thrive (Head of CSR, Young's Seafood, pers comm). This means that poorly performing fisheries can still be considered a sourcing option by some businesses if improvements can be made. To this end, many seafood businesses are now sponsoring Fisheries Improvement Projects (FIPs),[11] though it should be noted that this is not without controversy, because there is doubt whether some FIPs actually lead to improved environmental performance, with concerns around the transparency and independence of the FIP process [30]. RASS alongside existing tools (e.g. MSCs benchmarking and tracking tool [28]) can potentially play a role in this process, particularly in data deficient fisheries by 1) collating all available data, and producing an assessment of risk of the performance of the four risk components (stock, management, bycatch, and habitat) not meeting the businesses' required standard (which may place them at risk of negative PR), 2) providing a gap analysis to facilitate targeted data collection for the fishery to potentially reduce risk scores, and show where improvements can be made to management, and 3) by providing the fishery with a platform to demonstrate the efficacy of improvements to seafood buyers.

RASS also provides a tool for communication of fisheries science to the wider range of stakeholders that may influence businesses procurement decisions. Risk communication has been described as an interactive process involving the exchange of information and opinion between individuals, groups, and institutions [2]. Because individuals (and businesses) have different risk perceptions and tolerances [32],

[10] Sometimes in may not be possible for a supplier to mitigate certain risks. E.g. a small-scale low impact fishery may be catching a very small proportion of a stock that is being unsustainably overexploited by other vessels.

[11] See https://www.sustainablefish.org/fisheries-improvement for overview.

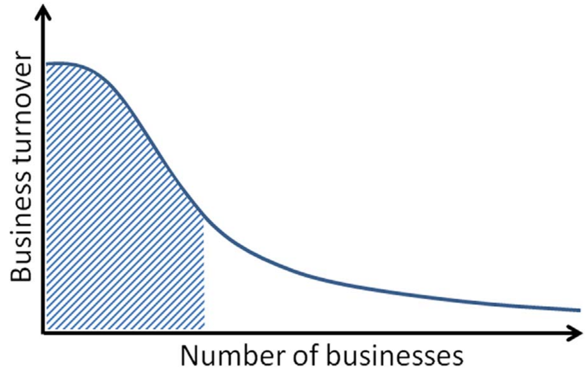

Fig. 9. Schematic graph showing relationship between number of seafood businesses and turnover. The shaded area represents where engagement has focused to-date.

forging a common understanding of a problem and potential solutions (e.g. mitigation of seabed impact of bottom trawling) between different stakeholders is a major area of work that Seafish undertakes [12]. A UK industry stakeholder steering group has been setup to provide oversight to the RASS project, and is a valuable forum to discuss new developments, make recommendations for prioritising new profiles, and provide industry and NGOs with the latest insight on changes to profiles and contentious issues.

Some stakeholders have questioned the need for yet another seafood information tool and scoring methodology, when there are currently several existing already (Section 2). However, a key challenge and cost for many seafood businesses (including major retailers) is collating and understanding *all* information relevant to their sourcing policies so that they can make informed decisions. Collectively, the UK seafood industry has requested RASS to be developed as a tool to meet this business need.

4.2. One sourcing tool for the UK supply-chain

To-date, most engagement with the supply-chain has been with the larger primary and secondary processors, food service companies and retailers. Strategically, these businesses account for the bulk of UK seafood supply, however there is a tail of several hundred smaller businesses that RASS could potentially benefit (Fig. 9). In order to increase engagement with smaller businesses, RASS will host the outcomes of the risk assessment that members of the Sustainable Seafood Coalition (see Section 2.3) will have to comply with as part of their codes of conduct.[12]

The significance of the tail-end of the supply-chain for the industry's collective reputation is that many businesses currently have limited/if any sourcing policies in place. Businesses in this tail may also be more likely to source seafood as a commodity rather than as a differentiated product, potentially leading to increased risk of seafood fraud [26]. Whilst RASS might be a useful awareness-raising tool for such businesses, the information within it may be moot if the business cannot trace seafood products back to their source fisheries. Further research is needed to improve understanding of how different seafood businesses are operating to enable future developments in RASS to have benefits across the entire supply-chain.

5. Conclusion

Commercial seafood buyers require up-to-date science based information to allow them to source from fisheries that align with their CSR policies. RASS does not provide a single score for a fishery, or recommend a fishery for buyers to source from, it simply provides risk scores and evidence for users to make up their own mind. RASS is envisioned to become the go-to sourcing tool for the UK seafood industry, and to achieve this aquaculture profiles, and a human rights risk tool are currently in development. Moreover, although RASS is being tailored for the UK seafood supply-chain, it offers a model for science communication that could be replicated in other countries, and may even by applicable to other areas of natural resource management.

[12] http://www.sustainableseafoodcoalition.org/ssc/codes-of-conduct/.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2016.10.005.

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