



# Seafood Strategic Outlook

Spring 2016

## **Product integrity:**

An initial review of developments, implications and practical responses from industry and Seafish

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**SEAFISH**  
the authority on seafood



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# Contents

1.	Introduction and requirement .....	2
2.	UK seafood industry and product integrity .....	3
2.1	Product landscape .....	4
2.2	Framing product integrity risks (definition and dimensions) .....	6
2.3	Motivations behind product integrity risks .....	8
2.4	Supporting product integrity in the UK seafood industry .....	8
3.	Drivers and risk developments affecting seafood .....	10
	product integrity - the long view	
3.1	Food security .....	10
3.2	Climate change .....	11
4.	UK seafood product integrity - recent and anticipated .....	12
	developments, impacts and response	
4.1	Whitefish .....	12
4.2	Pelagic .....	13
4.3	Shellfish .....	13
4.4	Exotics .....	14
4.5	Salmon.....	14
4.6	Example impacts and response.....	15
5.	UK seafood product integrity - impacts and response .....	19
	to longer term developments	
	Bibliography .....	20
	Appendices	
	Appendix 1 - Locating product integrity in seafood risk landscape .....	21
	Appendix 2 - Consultees .....	21
	Appendix 3 - UK seafood industry .....	22
	- main systems, functions and activities	

## 1. Introduction and requirement

This report is focussed on the integrity of UK seafood products. It considers the major industry impacts arising from key drivers of product corruption and sets out major areas where industry and Seafish response may be required.

The Seafish mission is to secure a profitable, sustainable, and socially responsible future for the UK seafood industry. An important underlying function for Seafish in achieving this mission is to help protect the industry in the face of natural and man-made risks and challenges.

Risk developments in the macro trade landscape can present longer-term, strategic challenges for the industry (see Appendix 1). Reflecting on these developments in 2015, the Seafish Board decided *“species substitution, product adulteration and the extension of materials through water addition/retention represent the most imminent threat to food integrity since the horse meat crisis of 2013. Criminal activity in this area not only represents a threat to brand owner integrity and equity, but also a significant food safety risk to society at large”*. This review is an important part of responding to this need.

This report aims to support the UK seafood industry in understanding:

- The major product categories in UK seafood industry.
- The new and emerging developments expected to impact on product integrity.
- Industry impacts (positive and negative) likely to arise from these developments.
- Action industry (and Seafish) can take in response.

This exercise, conducted in 2015, involved desk research and consultation with Seafish staff and industry operators (see Appendix 2).

The review has limitations. The scope of consultation is not exhaustive. In addition, the review does not consider alternative future pathways (scenarios), but is based on ‘business as usual’ projections.

## 2. UK seafood industry and product integrity

This chapter provides a representation of the seafood industry landscape and the major UK product categories. This representation frames the investigation, discussion and agreement on risk developments, impacts and responses.

The UK seafood industry, being reliant on wild capture and aquaculture produced raw material, is diverse, complex and dynamic. The seafood industry is considered here to operate as many subsystems (regional, sectoral), of varying degrees of interdependence, nested within one overarching global system.

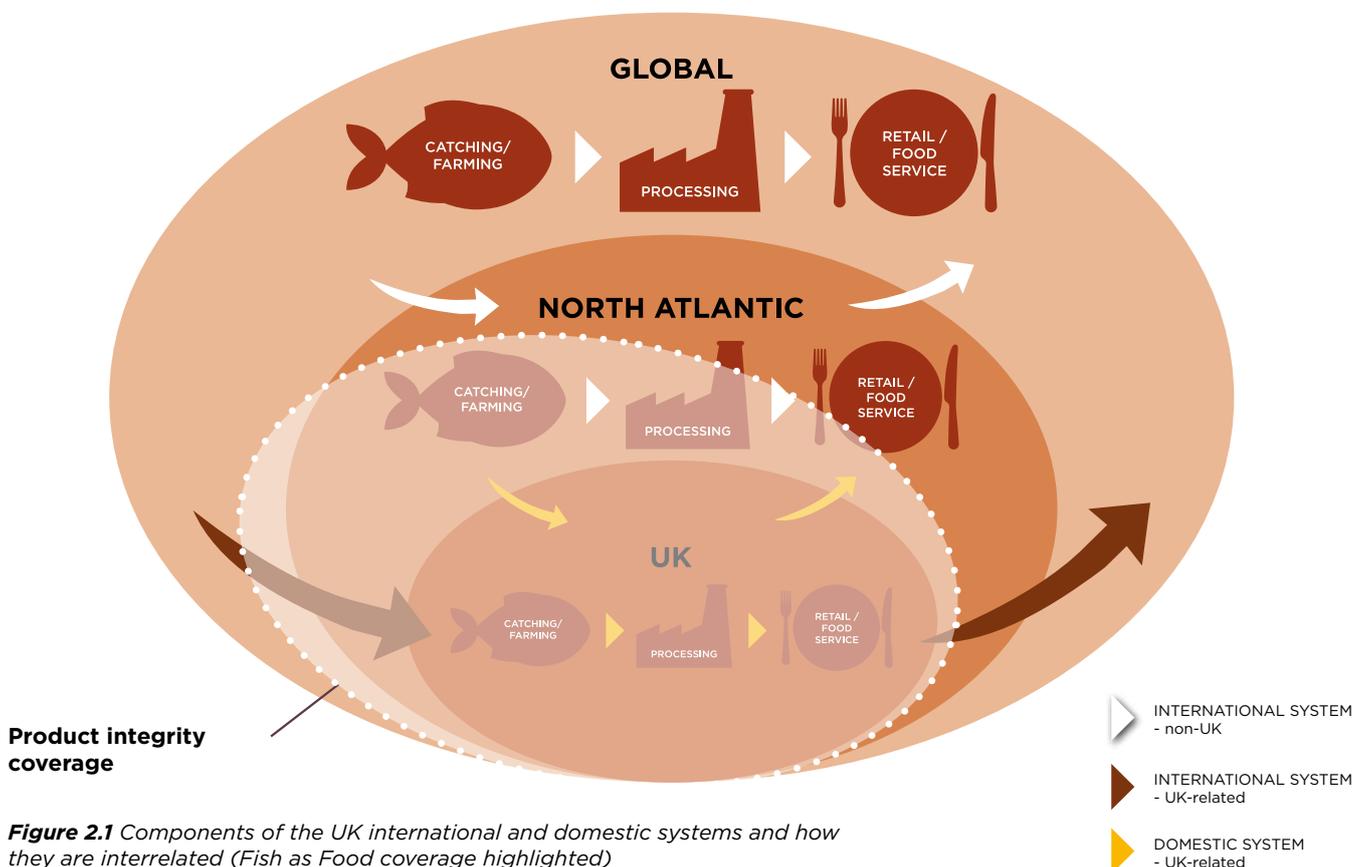
In the global context, from a UK perspective, there are at least two major seafood systems with distinct characteristics:

- A domestic system – defined as a system reliant on domestically sourced material (material caught from stocks in North Atlantic/UK waters and landed in the UK, material farmed in the UK). Within the ‘domestic system’, the key UK actors are: farmers/vessels, agents and merchants in the UK handling material landed/farmed in the UK;

UK processors of fish; and the downstream supply chain in the UK of all of the former including food service companies, retailers and exporters.

- An international system – defined as a system reliant on internationally sourced material (material caught from stocks in the North Atlantic and elsewhere landed outside the UK, material farmed outside the UK). Within the ‘international system’, the key UK actors are: agents and merchants in the UK importing fish and shellfish that is caught, landed or farmed and possibly processed outside of the UK; UK processors of imported fish; and the downstream supply chain in the UK of all of the former including food service companies, retailers and re-exporters.

It is notable that from a UK perspective, imported seafood material is largely for UK consumption, whilst material originating in the UK is generally exported for overseas consumption. The UK consumer maintains a robust preference for salmonids (farmed salmon), whitefish (cod, haddock and Alaska pollock), pelagics (tunas) and shellfish (cold-water prawn and farmed warm-water prawn). Meanwhile, UK landings volumes are dominated by mackerel and herring (pelagics), Nephrops (shellfish) and cod and haddock (whitefish).



## 2.1 Product landscape

Seafood products handled in the UK are produced in a range of product formats. This review focusses on *final product for direct consumption in the UK*.

Within the protein landscape, *products available for direct consumption in the UK*, serve specific consumer interests. In serving these interests, proteins are processed to provide convenience (incl. time saving) for those storing/preparing/cooking the product (chefs or the consumer). Products offer a spectrum of solutions to the chef or consumer:

- Customised solutions (meeting a special/novel requirement e.g. special occasion)
- Kit/component solutions (meeting a convenience requirement e.g. quick meal/protein)
- Off-the-shelf solutions (meeting a general requirement e.g. meals)

At one end of the spectrum, products provide basic proteins made available in a simple format,

to support customised and kit/component solutions. At the other end, products that involve significant transformation of the original protein, can support off-the-shelf solutions.

Primary processed material is in the main considered a fresh product (chilled never frozen, including live animal). Secondary processed products are mainly frozen (including refreshed product) and ambient products (including prepared & preserved). Tertiary or composite products (where seafood is one of a number of ingredients in the final product) could be fresh or frozen.

Primary products are relatively simple in comparison to secondary, and particularly tertiary, products. Greater product variation can be expected with the latter and in minor/specialised primary products.

The typical protein product landscape in the UK is shown in figure 2.2. This is followed by a brief description of the key characteristics of whitefish, pelagic, shellfish and exotic products.

**Table 2.2 Types of Seafood products**

Product Format		Extent of processing			
		Live	Primary	Secondary	Tertiary
Fresh	Chilled never frozen	x	x		x
	Refresh - chilled previously frozen			x	x
Frozen	Frozen			x	x
	Prepared and preserved			x	

**Table 2.2 Example products in seafood sectors**

Primary	Secondary	Tertiary
Whole Loins Fillets - skin on Fillets - skinless Portions - skinless Meat in shell Meat	Crabsticks Fish balls Fish paste Roe Taramasalata Tuna pate	Curry Fishermen's pie Kedgeree Salmon en croute Seafood cocktail Seafood pasta Szechuan prawns with vegetables Spring rolls Prepared pre-school meals (<5yrs)

(Source: Food Standards Agency, 2008)

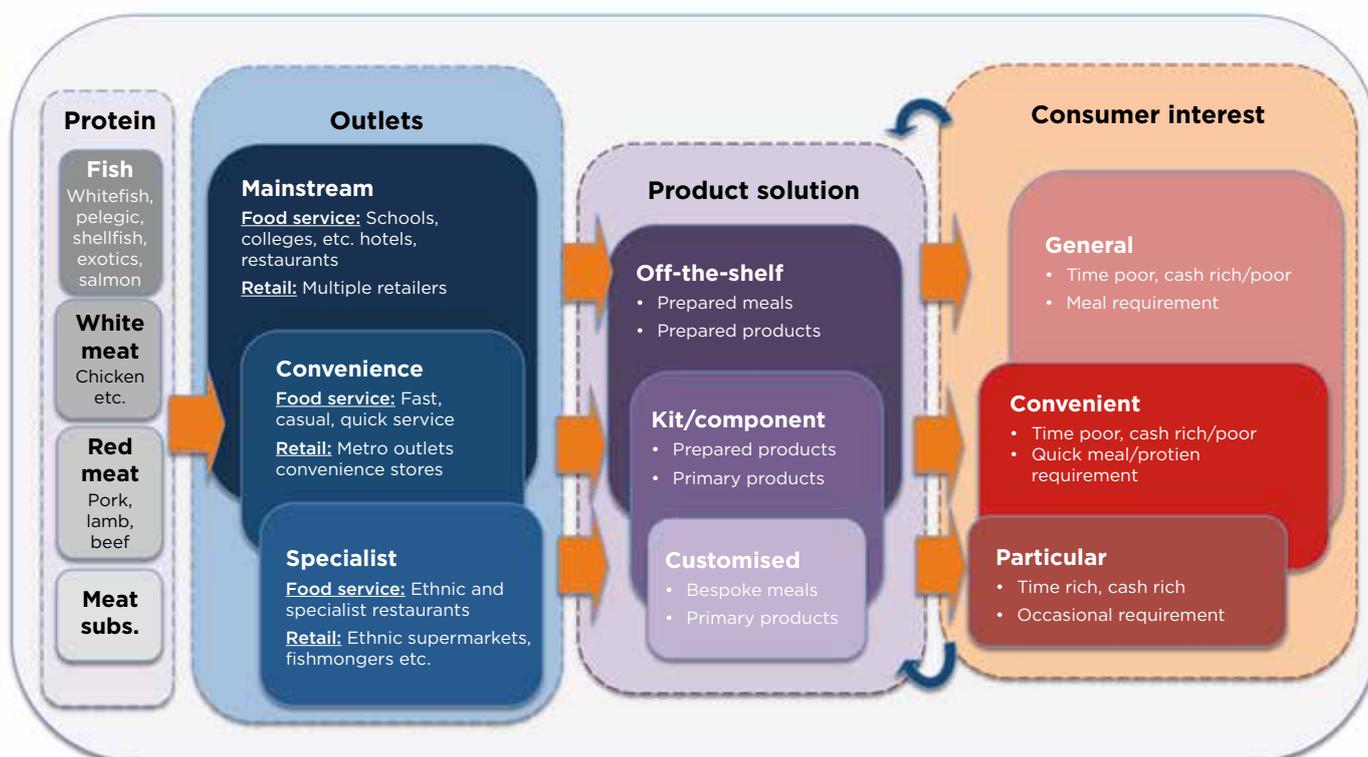


Figure 2.2 Current protein product landscape (example products listed only)

Table 2.3 Key characteristics of whitefish, pelagic, shellfish and exotic fish			
	Major supplying regions	Species and chain	UK market products
Whitefish	UK domestic sources include UK waters and NE Atlantic. International sources include Arctic/Barents Sea (Norway, Russia, Iceland) and North pacific/Bering Sea (USA).	Cod, haddock, whiting, monkfish, sole, plaice, hake, Alaska Pollock. UK domestic more fragmented than integrated chains of competitors e.g. Iceland. Fresh product sent direct by truck. Frozen product held in storage, containerised and shipped and sent by truck.	Whitefish products for the UK market include domestic sourced fresh product (lower volume and higher value (£/kg)) and internationally sourced refreshed/frozen product (higher volume and lower value (£/kg)).
Pelagic	UK domestic sources include UK waters and NE Atlantic. International sources include Eastern Atlantic (Spain, Morocco), Indian ocean, Pacific ocean, and Atlantic ocean.	Herring, mackerel, sardine/pilchard, anchovy, tunas. UK fresh product sent direct by truck, overseas fresh material sent by truck and air freight. Frozen product held in storage, containerised and shipped and sent by truck. UK domestic more fragmented than integrated chains of Iceland and Faroes.	Pelagic products for the UK market include fresh product (lower volume and higher value (£/kg)) that is either domestically sourced or internationally sourced and frozen product (higher volume and lower value (£/kg)) that is internationally sourced.
Shellfish	UK domestic sources include UK waters and NE Atlantic. International sources include North Atlantic, and farmed sources in South East Asia and Central America.	Nephrops, cold water prawn, farmed warm-water prawn. UK fresh product sent direct by truck. Frozen product held in storage, and sent by truck with international material containerised and shipped.	Shellfish products for the UK market include fresh but a sizeable volume of frozen product is also represented from UK and international sources. Fresh domestic product tends to be high value low volume, and frozen product tend to be low volume and high value (£/kg).
Exotics	UK domestic sources include UK waters. International sources include EU, Asia, Australia, and Africa.	Carp, wild and farmed bass, farmed bream, snappers, kingfish, parrotfish, and groupers.	Exotic seafood products for the UK market include fresh (including live) product, and frozen product. Both fresh and frozen product tend to be low volume and range from low to high value (£/kg).

In general, seafood products destined for the UK market can be briefly characterised as:

- **UK market products:** A diverse set of products, ranging from sale of live fish to added value seafood products.
- **Species and chain:** A diverse range of species, with product supply chains ranging from short to long (reflecting species but also the time required to cook/consume versus time required to produce seafood products). Variation in the level of control, ranging from vertically integrated chains to market based supply.
- **Major supplying regions:** Origin and main producing countries being both UK and international.

## 2.2 Framing product integrity risks

From a Seafish perspective a product has integrity if it meets market and consumer expectations and its attributes have not been corrupted by natural events or deliberate acts that undermine weight, composition, format, safety, legality, quality or provenance.

For the purposes of this exercise, product integrity is undermined when man-made or natural risks affect the supply chain, interfering with and corrupting the quality, safety and legality of seafood products. Product integrity risks can be business-to-business or business-to-

consumer generated, and can ultimately affect the reputation of seafood as a safe, healthy and nutritious product. They can also have more serious implications relating to food fraud and fraud in general.

Risks of product interference and corruption, resulting from human action or a consequence of naturally occurring risks in the general environment, are nested within a risk spectrum (shown in Fig 2.3). Human action can be both intentional and unintentional. Products intentionally interfered with are associated with 'black market' practices, products unintentionally (unknowingly) interfered with are associated with a grey market (where practices have questionable legitimacy). Products with integrity are associated with legitimate markets and practices. All products can be compromised by natural risks.

Natural risks can undermine product integrity in a number of ways. For example heavy metals could be released by earthquakes and volcanic activity, or disturbed from the seabed by weather events. Likewise human action (intended and unintended) undermines product integrity in a number of ways. Based on Seafish experience over a number of years, the major ways in which product integrity is undermined (by natural, unintended or intended risk) is shown in table 2.4.

Types of practice

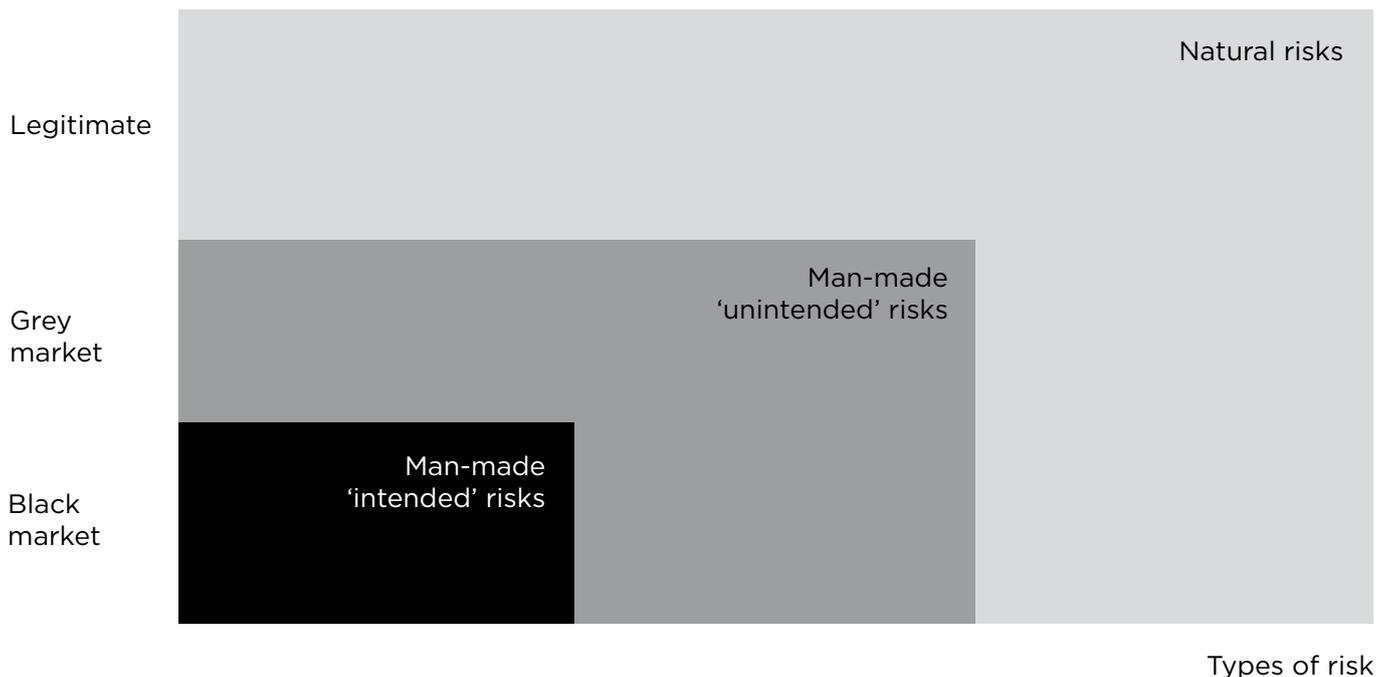


Figure 2.3 Risk spectrum for product interference and corruption

**Table 2.4 Dimensions and risk to seafood product integrity**

Dimension	Areas of specific risk	Examples
Weight	Glaze	<ul style="list-style-type: none"> <li>Water or other addition, this includes bulking up with:                             <ul style="list-style-type: none"> <li>water (this is legal if labelled as such). Present across a range of species, with higher value species typically having greater exposure.</li> <li>other agents such as agar polysaccharide (extracted from seaweed – a staple food in SE Asia). For example, if prawn still has shell on then agar can be injected between the meat and shell. Polysaccharide is a carbohydrate; protein is rarely used as a bulking agent because of its cost, however, substitutes (such as melamine) have been used in the past – in dairy – to provide a spurious reading in protein content analyses.</li> </ul> </li> <li>Short weights in glazed products. For example, product having a gross weight of 450g but with a net weight of 400g.</li> </ul>
	Added water	
Composition	Fish content	<ul style="list-style-type: none"> <li>Once onshore there are a lot of synergies with other proteins. In meat there are different materials that can be substituted, in fish there's less scope for this but there have been instances (for example injecting protein – chicken – into fish).</li> </ul>
	Nutritional profile	
	- general nutrition	
	- salt	
	Additional ingredients	
	Additives	
Product format (fresh vs frozen)	Pre-frozen, never frozen, 'fresh', chilled, 'refreshed'	<ul style="list-style-type: none"> <li>False declaration of treatment. Material sold as 'fresh' when should have been sold as 'previously frozen' and incorrectly labelled.</li> </ul>
	Contaminants	<ul style="list-style-type: none"> <li>False declaration of treatment. Material sold as 'fresh' when should have been sold as 'previously frozen' and incorrectly labelled.</li> </ul>
Veterinary medicines		
Microbiological safety		
Allergens		
Legal compliance	Safety / identification mark	<ul style="list-style-type: none"> <li>Labelling</li> <li>Does the product look like the picture on the package, does it contain a reasonable quantity of fish (given the % stated), is it as it says on the tin?</li> </ul>
Quality	Standards	<ul style="list-style-type: none"> <li>Freshness quality, eating quality, consumer acceptability (is it good to eat?)</li> </ul>
Provenance	Species	<ul style="list-style-type: none"> <li>Species substitution. For example cod for haddock, or pangasius for cod.</li> <li>Spurious 'green' attributes. For example, false claims of capture methods such as pole and line caught tuna, line caught haddock, etc.</li> <li>Spurious origin. Material purported to come from one part of the world when it actually comes from another (driven by perceived value/standards). Can occur at:                             <ul style="list-style-type: none"> <li>An establishment level (EU versus non-EU approved establishment).</li> <li>A country level (an EU approved country versus an EU embargoed country. For example, Myanmar prawns being transferred to another SE Asian country (when Myanmar was shut out of EU trade). Also Chilean salmon sold as Scottish; local/locally sourced vs sourced from further afield.</li> </ul> </li> <li>Farmed fish claimed as wild as price is superior.</li> </ul>
Market and consumer expectations	Ethical practice regarding human and animal welfare	<ul style="list-style-type: none"> <li>The integrity of perfectly legal products can be debated on the basis of whether they've been produced ethically.</li> <li>Over and above the legal requirement, and the other attributes above, integrity becomes what is morally and ethically required.</li> </ul>

Specific risks apply to domestic and international seafood but vary by seafood sector (whitefish, pelagic, etc) and on the specific location in the seafood landscape: there is wider scope for risk in secondary and tertiary stages of the supply chain. At earlier stages, risk to integrity can be lower (the fish being more identifiable, fewer actors involved etc). Risks are generally elevated on land when material has been landed. At this stage there are actors 'in the middle' making conscious decisions. The more actors involved – in any one stage, as well as 'middlemen' between stages – the greater the risk. For example, certain types of primary processed fish block for use in secondary and tertiary stages, remains relatively simple. However in secondary and tertiary stages primary inputs are beginning to mix and this complexity increases uncertainty. Furthermore, improvements in detection and forensic techniques can paradoxically heighten product integrity concerns because, as techniques improve, malpractice is easier to expose (we're better placed to find what we're looking for).

## 2.3 Motivations behind product integrity risks

Where integrity risks are man-made, product interference and corruption are motivated in a:

- grey market, by:
  - ignorance,
  - good intentions (but ill-informed)
- black market, by:
  - economic incentive.

All three motivations erode consumer trust in the supply chain, and elicit a different response from supply chain actors depending on the motivation. In a grey market, integrity problems arising from ignorance might result in acknowledging fault on the side of customer and supplier, those from good intentions (but ill-informed) might result in a sunk cost and follow up education/audit/inspection. In a black market, those arising from economic incentive, might result in a sunk cost and potential financial clawback.

Product interference and corruption can be generated by 'fraud magnets' (Steel, 2015) and 'game changers'. Fraud magnets in the product landscape include:

- Trading conditions
  - Scarcity conditions (higher demand than can be supplied). Products are valuable, popular, elite, faddish, scarce (when conditions are such that the only way to get protein to the

customer is to cheat) e.g. fixed contracts to deliver on when prices are going up or supply is constrained.

- Glut conditions. Flooding the market, for example as happened with pangasius as this can be used as a 'cheap and easy' material to substitute or dilute.
- Process weak spots. In the harvest-outlet chain where intervention is difficult to detect:
  - Complex chains present multiple opportunities to intervene
  - Storage or transport presents opportunities for substitution
  - Obscuring products so that material is no longer distinguishable, for example fillets can be re-labelled and make material more difficult to detect.

Game changers, likely to affect the product landscape itself by 'changing the rules', include:

- Technology – This includes different technologies that make interference easier (injection technologies for example), can introduce new proteins into the fish (including at a genetic level) and identifying fish species (DNA analysis is one such example).
- Regulation – may find a new law regulation leads to fraud or non-compliance – the general environment becomes more risky as a result of knowing, or not-knowing, new rules.

## 2.4 Supporting product integrity in the UK seafood industry

Product interference and corruption is a dynamic situation that responds to the ebb and flow of the various drivers. Accordingly a number of mechanisms are required to support the industry in sensing and responding to product integrity risks in the wider environment.

At present there are various levels of initiative by industry, policy, and research stakeholders. Examples are listed below.

**Industry:** Some parts of industry - for example brand owners, those in large companies or in high value markets - tend to police themselves to an extent by exposing competitor's products or by checking with peers (for example, occasionally a company may be asked by a customer to test a seafood product provided by another supplier: this may involve cooking the product, assessing the product weight according to the stated weight, estimating the weight gain and why this might be). Industry vigilance depends

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on relative damage. The legal consequences (fines) can be considered relatively paltry (e.g. £10k fine) vis-à-vis the benefits. Brand owners have much at stake and are therefore motivated to invest in mitigation. Traders may not have such an incentive. Industry initiatives have been developed on the part of brand owners (e.g. Young's 10 principles) and reputation owners (eg Seafish Integrity = people/products/animals). Industry operators tend to ask Seafish if X can be checked for compliance and if Y is within legal boundaries.

**Policy:** Regulation will set the boundaries for what is permitted, underpinning 'integrity' by establishing what is the 'minimum required' practice. Regulation can be grouped around three core areas:

- *Consumer information.* This is focussed on protecting consumers. Much of this regulation is driven by company practice (and malpractice), and the way these practices are described. Often companies do not describe their practices clearly (either by accident or by overly keen marketing).
- *Safety.* This is focussed on protecting consumer safety. This regulation is driven by active tampering, and is difficult to see in advance. An example starting point might be Seafish receiving an enquiry about a specific practice to see if it is legal.
- *Traceability.* This is focussed on protecting fish in the water or in warehouses, centred on sustainability and supporting consumer choice. This can be driven as a result of NGO and media attention.

Government oversight in the:

- UK, includes:
  - Seafood alerts provided by Seafish Regulation team, these are:
    - Fishing related
    - Food related.
  - Defra Food Integrity team
  - FSA Food Crime Unit - when there is a change in conditions this triggers heightened scrutiny/sampling)
- EU, includes:
  - Alert services provided by the European Commission, these include:
    - EU Monitoring Service on seafood (sign-up)

- EU monitoring DODS (sign-up)
- The EU Food Fraud Network a pan-European mechanism set up '*ensure the rapid exchange of information between national authorities and the Commission in cases of suspected fraudulent practices*'.

**Research:** Product integrity related research can be driven by academic as well as industry interests, i.e. commissioned research into feasible techniques within certain boundaries (for example the Dutch cracked the 50% glaze level). Research is focussed on expanding, as well as constraining, the integrity envelope. UK research in this area is relatively limited; funding was withdrawn from this area for example funding for government research was withdrawn from the Torry Research Station in Aberdeen (fish was considered a lower priority than other sectors). University research at a UK level includes the York University 'Food integrity project', at the European level includes the 'Labelfish project' as well as research elsewhere around the world.

**NGOs and other campaign organisations:**

Product integrity issues have been raised directly and indirectly by NGOs and other campaign organisations. In the last few years for example:

- Oceana investigated seafood substitution and food labelling in the USA and found one third of seafood samples were mislabelled.
- Which? Magazine similarly investigated seafood substitution and mislabelling in the UK and identified one in six samples contained the wrong fish.

In addition a number of NGOs, such as Greenpeace, run campaigns that more indirectly highlight integrity issues arising from illegal, unreported and unregulated (IUU) fishing, although the focus is towards wider provenance concerns.

### 3. Drivers and risk developments affecting seafood product integrity – the long view

This chapter summarises the main drivers and risk developments affecting the seafood industry over the long term, with a focus on product integrity in particular. This draws on developments that are both observed (by 3rd parties) and experienced (by industry operators).

Drivers and risk developments create the conditions for ‘fraud magnets’ and ‘game changers’ that then motivate product interference (see section 2.3). For example adverse trading conditions (e.g. during an economic downturn) can draw operators towards deliberate product tampering. Table 3.1 shows the long view of drivers and risk developments affecting seafood, experienced or observed in the period 1997-2008 through to those anticipated in 2019-2029.

Systemic global risk developments, notably food security and climate change, act as multipliers to amplify the above risk developments and their impacts (threats and opportunities). Food security tensions may elevate intended (man-made) malpractice and climate change may elevate natural risks.

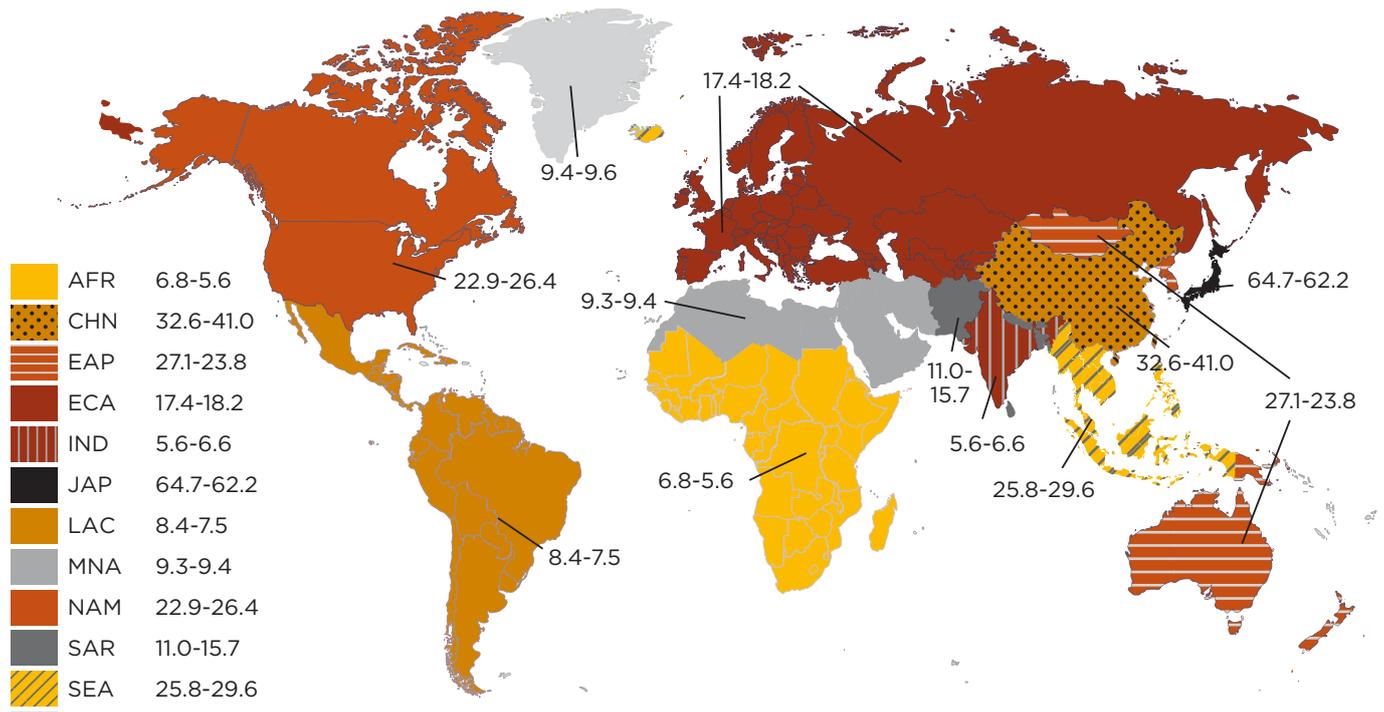
#### 3.1 Food security

The main aspects of food security are: a globalised economy; global population increase; and global availability of raw material. Projected economic growth, growth in population (and middle class income), and changing tastes and diets in regions around the world suggest:

- A world economy rebalancing towards Asia.
- An expanding global middle class (squeezed in developed countries).
- Increased protein consumption with regional differences, regions in which per capita fish consumption (Fig 3.1):
  - high and predicted to grow strongly (China, South East Asia and North America)
  - high and predicted to grow weakly (East Asia and Pacific, Europe and Central Asia, Japan)
- Global fish production expected to increase, based on:
  - wild capture having zero growth with aquaculture expanding at a declining rate.
  - concentration in Asia (particularly India, South East Asia and China) driven by species amenable to aquaculture (prawn, salmon, tilapia, carp and pangasius).

**Table 3.1 The long view: 1997/2007 – 2008/2018 – 2019/2029**

Driver	Risk developments	
	From	To
Economic developments	Economic growth, with premiumisation convenience and added value products in seafood in western markets	Limited economic growth, expanding overseas markets with greater focus on convenience and added value products
	Constrained supply in traditional supplies with opening up of new supply sources	Broadening of species and supply sources with traditional supplies potentially constrained
Trade developments	Diminishing tariffs	Free trade agreements
	Sporadic supply disruptions in producing countries	Competitive pressure to secure supply, more processing in third countries (outside UK control)
Scrutiny/regulation	Introduction/growth in scrutiny	Improved scrutiny & controls with differences in approach driving disruptions
	New regulation	Inconsistent interpretation/implementation of regulation
Safety (contaminants/residue)	Dioxins, PCBs, heavy metals	Increase in toxins (naturally occurring), pesticides, micro-plastic contamination, sediment residue contamination
Demographic/labour changes	Lack of technical knowledge (expertise = experience)	
Outliers	Improvements in testing (e.g. Biotoxins, DNA etc)	Potential new additives
	GM technology introduced in specific areas	GM creeping jurisdiction



**Figure 3.1** Projected growth in per capita fish consumption by region, 2010-2030 (kg/person/year). World Bank (2013:13,45)

### 3.2 Climate change

The main physical climate change impacts of interest to industry are:

- Sea level rise and extreme water levels
- Changes in storms and waves
- Changes in temperature
- Ocean acidification and de-oxygenation of sea water
- Changes in terrestrial rainfall (i.e. through surface flooding of land-based infrastructure, plus its role in transferring water, contaminants, and pollutants from land to sea).

The two main climate change drivers that lead to priority risk developments for wild capture seafood are *increased storminess and waves* and *air or sea temperature change*. In shellfish an additional driver is changes in rainfall/land run-off. For whitefish and pelagic fisheries, this has contributed to changing distribution of target species (as some traditional species may move away and warmer water species move in) whilst in shellfish fisheries there are changes in the prevalence of non-native species/jellyfish. In all fisheries, offshore operations will be impacted with challenges to safe working conditions and gear deployment/performance.

Climate change may also have implications for aquaculture supplies, especially those originating in estuarine areas<sup>1</sup>. In a UK context, there may be impacts from *increased storminess and waves* (e.g. the integrity of salmon cages and mussel beds), *air or sea temperature change* (e.g. the presence of nuisance species causing fish kills and fouling of structures as well as the emergence, translocation and virulence of disease), *changes in rainfall/land run-off* (e.g. sewage related bacterial and viral pathogens in shellfish harvesting waters), and *acidification*.

Onshore, the above risk developments are compounded by *sea level rise and extreme water levels*. This can give rise to impacts affecting onshore operators:

- Damage to site infrastructure (port & processors).
- Integrity of electricity supplies.
- Transport distribution (including ferries).
- Integrity of housing and reduced employment.

## 4. UK seafood product integrity – recent and anticipated developments, impacts and response

Given the drivers and longer term developments set out in the previous section, this chapter identifies the recent and anticipated risk developments and impacts for industry. These are described as they relate to whitefish, pelagic, shellfish, exotic, and salmon trades. The chapter concludes with examples of industry impacts and a list of action areas suggested by way of response to anticipated developments.

All sectors (whitefish, pelagics, shellfish, exotics and salmon) share a common exposure to product interference and corruption. These include integrity concerns relating to:

- **Product format.** Specifically the false declaration of how products have been treated, for example product sold as fresh without reference to previous freezing.
- **Product safety.** Specifically the risk of pesticides in imported seafood material.
- **Product quality.** Specifically standards relating to freshness and eating quality.
- **Provenance.** Specifically the seemingly constant low level malpractice in species substitution (grey market) alongside material - of spurious origin - flowing between countries and through establishments (both inside and outside the EU). Also spurious claims regarding the merits and impacts of specific fishing methods that are not proven e.g. trawling/electric stunning (pulse fishing). Also claims as they relate to green attributes and certification; including the spurious claims on supply practices. For example claiming another fishing method is used rather than the actual. There is also growing concern in the use of certifications, with the selling of uncertified fish as certified.
- **Market/consumer expectations.** Specifically that fish products are safe, natural, and healthy with ethical practices in the supply chain concerning labour and animal welfare.

Whilst the UK seafood industry may share these concerns, individual sectors have exposure to particular practices that interfere and corrupt products. This exposure is briefly explored in the next few sections.

## 4.1 Whitefish

### 4.1.1 Recent developments

- **UK market products:** Whitefish products from domestic sources have suffered concerns in retail over *fish provenance* (examples in flatfish include dab or plaice sold as lemon sole). Internationally sourced refreshed/frozen product has also suffered concerns over *fish provenance* in retail (the mislabelling of Atlantic and Pacific cod) and in food service (particularly in the fish and chip sector where cod, haddock and pangasius from domestic and international sources have been used interchangeably).
- **Species and chain:** Internationally sourced material has suffered concerns over *fish weight*; specifically added water (across all whitefish species but especially in high value species such as cod) and glaze problems, for example in pangasius, particularly in individually quick frozen (IQF) products (less so in frozen fillet block). There have also been concerns over *fish provenance*, with instances of species substitution (exchanging Alaska pollock for cod where processing has been outsourced) and exploiting the various common names for fish (for example cods, pollocks, halibuts). There are concerns over *legal compliance* in processed products (where there are inconsistent proportions of fish in particular products, in fish pie for example).
- **Major supplying regions:** In UK domestic sources there have been concerns over *fish quality* with variations in taste and other attributes potentially resulting from different catch methods (line caught, trawl caught, pulse fishing) and from the effect of other marine sectors on fish (debris, heat, oil leaks etc). Internationally sourced material has seen concerns raised over *fish composition* (with additives being used to emphasise fish whiteness in Iceland for example), *provenance/legal compliance* (mislabelling of Icelandic sea bass for example and spurious claims regarding catch method such as haddock supposedly line caught) and *fish safety* (pangasius supply recently suffering from contaminants).

### 4.1.2 Anticipated in next five years

- **UK market products:** Whitefish products for UK market from domestic sources could suffer problems with *fish provenance*. For example, as retail product labelling does not specify product origin this can mislead the consumer looking to buy domestic product. In the food service sector, there is continued

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scope for species substitution (fish and chip shops do not need to specify what fish is being sold, other outlets may use lower value species for higher value species such as monkfish). Internationally sourced refreshed/frozen product could suffer problems with *fish composition* (the continued push on health benefits and omega 3 in particular, coupled with the erosion of volume and quality of oils, could mean product expectations are not met).

- **Species and chain:** Domestic sourced material may be undermined by concerns over *fish provenance*. The Landing Obligation may generate species substitution, for example whiting for haddock, coley for cod, and vice versa. International material may suffer *fish weight* problems (difficulties testing for added water means this will continue unabated) and unmet *market/consumer expectations* particularly over ethical labour practices in the EU (with malpractice in processing potentially growing as national authorities reduce their duty of care over workers' social conditions).
- **Major supplying regions:** In UK domestic sources there are concerns over *fish provenance* specifically in flatfish fisheries where there are potentially spurious claims over the attributes of pulse trawling for Dover sole and other flatfish species. International sources may also suffer problems of *fish provenance* (as the environmental integrity of deep water fishing is questioned) and unmet *market/consumer expectations* particularly over animal welfare and standards in slaughtering fish.

## 4.2 Pelagic

### 4.2.1 Recent developments

- **UK market products:** No product integrity issues were raised in this initial review.
- **Species and chain:** Internationally sourced material has suffered concerns over *fish provenance*; specifically species substitution in tuna trades at the primary processing stage (once product is in steak format), for example skipjack for yellowfin tuna.
- **Major supplying regions:** In UK domestic sources there have been historical concerns over *fish provenance* with some species, in some quarters, associated with spurious fishery origin ('blackfish' or out-of-quota catch). Internationally sourced material has seen concerns raised over *fish safety*. Some oily fish have a tendency to accumulate contaminants e.g. PCBs, dioxins, mercury etc, particularly larger pelagics such as tunas, as well as

harbouring histamine risks if not properly handled.

### 4.2.2 Anticipated in next five years

- **UK market products:** No expected product integrity concerns were raised in this initial review.
- **Species and chain:** Domestic sourced material may be undermined by concerns over *fish provenance*. The Landing Obligation may generate species substitution and the risk of illegal landings. Domestic and internationally sourced product could suffer problems with *fish composition* (the continued push on health benefits and omega 3 in particular, coupled with the erosion of volume and quality of oils, could mean product expectations are not met).
- **Major supplying regions:** International sources may also suffer problems of *fish quality* specifically spurious claims regarding catch method where the supply base cannot meet demand, for example pole and line caught tuna.

## 4.3 Shellfish

### 4.3.1 Recent developments

- **UK market products:** Shellfish products from domestic sources have suffered concerns in food service over *provenance*, exploiting the various common names for shellfish (examples include smaller queen scallops being sold in place of larger king scallops), *composition* (for example brown crab meat being mixed with meat from other crab species, and lobster sold without claws being of uncertain size) and *safety* (where bivalve molluscs have contained algal toxin or norovirus has been present in the mollusc or – in the case of norovirus - introduced through handling).
- **Species and chain:** Domestically sourced material has suffered concerns over *shellfish provenance* (with products sold as having spurious 'green' attributes, for example dredged scallops claimed to be hand dived, and dredged mussels claimed to be rope-grown), *shellfish weight* (specifically glazing, overglazing, and drip-loss practices in scallops and Nephrops), and shellfish safety (use of metabisulphite in Nephrops). Internationally sourced material, particularly warm water prawn, has suffered concerns over *shellfish weight*; (specifically added water and glaze in order to meet customer volumes) and *provenance* (for example prawns purportedly coming from higher value sources such as Madagascar, or lower value for higher

value species – whiteleg for tiger prawn for example).

- **Major supplying regions:** In UK domestic sources there have been concerns over shellfish safety, specifically problems arising from naturally occurring heavy metals (for example cadmium (Cd) in brown crab and silver (Ag) in mussels, man-made contaminants (pesticide residues and heavy metals) in seabed sediments, and algal toxins affecting bivalve molluscs. Internationally sourced material, particularly warm water prawn, has seen concerns raised over shellfish composition (additives in particular).

#### 4.3.2 Anticipated in next five years

- **UK market products:** Shellfish products for the UK market from domestic sources, especially those destined for food service, are expected to see continued exposure to shellfish provenance and shellfish safety problems.
- **Species and chain:** Domestic sourced material may be undermined by concerns over fish provenance, with species substitution a potential consequence of the Landings Obligation. International material, particularly scallops and warm water prawns, may suffer problems of shellfish composition (the risk of additives where the UK switches producing countries) and shellfish weight (where difficulties testing for added water means this will continue unabated) and unmet market/consumer expectations particularly over animal welfare and standards in transport and slaughtering of live shellfish.
- **Major supplying regions:** In UK domestic sources there are expected to be continued concerns over shellfish safety (arising from the continued presence of naturally occurring or man-made contaminants) with additional concerns potentially raised by hepatitis where this is present in bivalve molluscs. International sources may also suffer problems of shellfish safety (arising from natural and man-made contaminants, for example those arising as a result of the recent Chilean earthquake). Shellfish provenance, and species substitution in particular, is expected to be a concern arising from the EU/Canada free trade agreement, where American lobster may be substituted for domestic UK lobster for example.

## 4.4 Exotics

### 4.4.1. Recent developments

- **UK market products:** Exotic products from domestic and international sources have suffered concerns over provenance/legal compliance in the retail sector with poorly labelled (and at worst non-labelled) fish in ethnic supermarkets. Products in food service have also suffered in terms of fish provenance with fish poorly represented on menus (for example the term ‘line caught’ added alongside turbot ‘because chefs like the sound of it’).
- **Species and chain:** Domestic and internationally sourced material suffer concerns over fish composition; with unknown levels of water addition, and fish provenance with instances of species substitution, for example the use of Japanese sea bass as ordinary sea bass, and the substitution of wild bass for farmed bass. There are also fish safety concerns surrounding toxins in some tropical fish (toxic reef fish and escolar for example) which can lead to severe adverse reactions for the consumer.
- **Major supplying regions:** With diverse supply routes the extent of product interference in exotic trades is highly uncertain.

### 4.4.2. Anticipated in next five years

- **UK market products:** Largely unknown but concerns over provenance and legal compliance expected to continue.
- **Species and chain:** Domestic and international sourced material may be undermined by concerns over fish provenance, specifically difficulties establishing fish origin, and problems with fish composition given the risk of additives in obscure supply routes.
- **Major supplying regions:** Unknown.

## 4.5 Salmon

Recent developments include safety and provenance of salmon. In safety, concerns relate to problems with listeria in ‘ready to eat’ products, whilst in salmon supply there are specific concerns over the supply of farmed salmon as wild salmon in both domestic and international supply.

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Expected developments concern standards, provenance and composition in salmon products. With growing concern in the use of certification, and the selling of salmon as certified, when it isn't, it is expected that standards will be compromised. With continued difficulties confirming fish origin, and the recent USFDA approval for GM modified salmon, the future provenance of salmon will be challenged. Finally, with GM content going into feed, GM is expected to become more widespread (Chile could potentially incorporate next, with Norway open to greater exposure) the composition of salmon products could be corrupted.

## 4.6 Example impacts and response

The interference and corruption of seafood products has direct impact on seafood businesses, supply chains and industry as a whole. Example impacts by dimension are provided below.

**Product weight.** Interference in the product, by adding water for example, effectively lowers the product selling cost. Suppliers engaged in this practice gain from additional weight and don't have to pay the due diligence costs – such as testing – allowing them to charge a product price that is the same or lower than the market price. This threatens credible businesses who take integrity seriously; having to compete in the market with relatively higher cost and product price, it erodes their competitiveness and customers are lost. When customers discover product interference, credible businesses can secure the short term opportunities of re-directed sales, but suffer the longer term threat of industry reputation being undermined (*“people don't remember brand differences - only the problem e.g. selling pangasius for cod”*).

**Product composition.** Interference in the product, by introducing new material, effectively changes the product so that a higher price can be extracted than would be achieved otherwise. Additives, for example, can mask product attributes: age, colour, bulk, etc. In an industry with tight margins, testing is costly, and suppliers engaged in this practice gain from avoiding these costs particularly if sales losses resulting from discovery are relatively small. Some businesses are more exposed to this practice than others: businesses drawing on processed material from suppliers further back in the chain are more exposed than those largely processing the material themselves. Some businesses are more exposed to the impact of this practice than others: brand owners (large seafood processors and multiple retailers) can suffer substantially

from loss of sales in a way smaller, non-brand owners, may not. With an ongoing push to develop new additives, there are uncertainties over fish composition and safety (see next), providing fertile ground for scandal. In salmon there are unresolved questions regarding feed composition, with uncertainty over whether fish are being fed GM soya. If this uncertainty is not addressed then there could be scope for a major scandal.

**Product safety.** To the extent that natural and man-made (unintended and intended) risks challenge product integrity in ways that create a food safety risk, this will compromise public health and create opportunities for scandal. For example journalists will revisit bio-toxin risks occasionally and highlight these in the media. In some respects the effect of existing and emerging fish additives are unknown (*“do they cause cancers for example?”*) and this should be of direct concern for the health of the general public but also a concern in terms of damage from unfounded speculation.

**Legal compliance.** The misnaming of fish has the immediate effect of hoodwinking the unwitting customer into paying a higher price, creating a non-level playing field, and also eroding the product value in the market in the longer term. For those suppliers engaging in this practice, the legal penalties are relatively low compared to the gains. Indeed some feel that *“food crime is more profitable than drugs because the sentencing is so low”*.

**Product standards.** Spurious claims over product standards/certification/attributes etc effectively secure the higher price of the authentic product whilst undermining the reputation of the sector as a whole. This threatens credible businesses that take these matters seriously who can see others blatantly cheating and not comparing like-with-like. Identifying this practice is easier for some than others; brand owners, for example, can see where their products are on a menu and it's clearly not from them (because the supplier is not registered with them). Spurious claims can give rise to very public scandals in the media.

With the onus on the whole supply chain, the requirements for integrity testing to meet current UK market requirements is raising the issue of who will pay, and increasingly, the issue of who will supply. From an international perspective, suppliers from non-EU countries are now saying *“No, you get but a small percentage of our volume but you are asking us to do an enormous amount of checking and verification to meet your standards”*.

Electronic data capture affords the opportunity to develop more comprehensive traceability systems, which are more effective and cost efficient. With much of the evidence currently held in paper form; systems are limited to one-up/one-down traceability. Electronic data capture provides an opportunity to have an overview of the whole supply chain, looking at issues by exception. With increased transparency, the economic incentive for malpractice should reduce.

**Product provenance.** Spurious claims over product species/origin/catch method etc can also secure a higher price whilst undermining the reputation of the sector as a whole. Credible businesses can be undermined by claims that are entirely spurious (passing one species off as another) or entirely unjustified (for example the unproven merits of one catching method over another). Both can give rise to public scandal. Recent species substitution in the F&C shop sector, for example, led to high profile media exposure headlined “*A fishy tale as chip shops are caught selling cheaper species.*” Current claims over pulse fishing in whitefish (the impact of which is not well understood), could encourage endorsement and industry take-up before the full effects (negative or otherwise) are known – risking the reputation of the sector. Finally, the Landings Obligation could lead to illegality in upstream EU supply chains through

an economic incentive to discard illegally (policy driven potential for the criminalisation of fishing vessel operators). This could lead to future market disruption and negative media portrayal of seafood.

**Market and consumer expectations.** Products and practice falling short of market and consumer expectations has the potential to bring businesses, supply chains and the industry into disrepute. Powerful imagery and dominant narratives, transmitted via the media, play an important role in shaping consumer perceptions that are then picked up by brand owners (particularly multiple retailers). Examples in 2015 include the negative coverage of processed meats, and growing attention to animal welfare (including seal culling by fish farms and the welfare standards around killing farmed fish) that could be extended to affect capture fisheries.

The response to product integrity risks includes highlighting intentional malpractice (black market practices) and protecting those engaged in unintended malpractice (the grey market - operators who believe they’re legitimate but aren’t). In terms of a specific response to the anticipated problems confronting product integrity in the next few years, a number of suggested actions have been highlighted. These are shown in Table 4.1.

**Table 4.1 Suggested actions in response to anticipated product integrity risks**

Dimension	Anticipated integrity risk	Sector	Suggested action	Owner*
Weight	Added water	Whitefish	Industry self-justice with fair businesses collaborating to ‘point fingers at perpetrators’. Establish a system that alerts fair businesses to malpractice, including a warning letter from fair businesses to perpetrators, ‘we’ve seen your product, this is what we think, change your practices or we’ll refer you to the authorities’.	
Composition	Additives	Whitefish Pelagic Shellfish Exotics	Normalise testing by providing a facility to support those who suspect malpractice. Establish a centralised fish content (including nutritional content) database for a number of species, populated with anonymised data and supported through regular fish content market surveys. Requires a fish testing facility (infra-red spectrometry, protein testing, DNA testing). Undertake in collaboration with retailers, enforcement agencies (food standards), voluntary industry, and others.	
		Whitefish	Ensure supply contracts stipulate that additives are not wanted and ensuring suppliers sign a declaration to this effect. Set up operations in source location to supply the UK operation, to guarantee product integrity.	
		Whitefish	For industry, individual operators (including retail and food service customers) need to undertake due diligence on their products. Customers should ask: why is this competitor product 20% cheaper, why is this meat so white?	

\*to be agreed

**Table 4.1 Suggested actions in response to anticipated product integrity risks (Cont.)**

Dimension	Anticipated integrity risk	Sector	Suggested action	Owner*
Composition	Additives	Whitefish	Identify the 'bulking' agents and 'whiting' agents in use and establish the long term effects, on health for example.	
		Whitefish, Shellfish	Monitor research activity developing new additives/ techniques (what scientists, working in what areas). Monitor companies selling the chemicals (i.e. review the food related chemical sector).	
	Fish content	Salmon	Establish, and monitor, which salmon is being fed with GM soya	
Product format (fresh vs frozen)	None identified			
Safety	Micro-biological safety	Shellfish	If scientific evidence judges hepatitis to be a risk, fund and project manage an initiative that explores whether standard depuration methods can eliminate the hepatitis risk.	
	Contaminants	Shellfish	Requires active reputation and crisis management with advance preparation of briefing papers containing key expert spokespersons, Frequently Asked Questions, and technical evidence	
Legal compliance	Labelling	Whitefish	Ensure additives are included on labelling and this is enforced (Seafish should have a role in this)	
		All	Investigate the proportion of fish mislabelled in the UK context (retail and food service) to establish the scale of the labelling integrity problem and avoid misuse of earlier research conducted outside UK.	
		All	Ensure decision-makers in retail and food service understand their legal obligations under the legal fish names regulation.	
		All	Conduct a regular survey of menus across the UK food service sector to identify illegal names commonly used. Produce a regularly updated briefing for chefs on illegal fish names and associated malpractice.	
		All	Produce a list of legal fish names in a friendly format (drawn from the cumbersome FSA web database) and provide to chefs	
Quality	Standards	All	Benchmark the range of production and sustainability standards (akin to the GSSI exercise) to avoid multiple and costly standards for each part of the supply chain.	
		All	Incorporating a chain of custody into the Responsible Fishing Scheme was intended to send a clear message around misuse of certification (selling fish as certified when it isn't).	
		All	Educate decision-makers in the retail sector (category managers and one level up) to understand the implications of their seafood business decisions.	
		All	Educate decision-makers in the food service sector (chefs and new chefs at college) to understand the implications of their seafood choices. "How sure are you, as a chef, that what you're selling is what it is?" Build on Good Fish Guide and produce a chef guide to fish around the UK as a first step.	

\*to be agreed

**Table 4.1 Suggested actions in response to anticipated product integrity risks (Cont.)**

Dimension	Anticipated integrity risk	Sector	Suggested action	Owner*
Provenance	Spurious origin	All	Ensure transparent measures and appropriate policy levers are developed to address the economic incentive to discard illegally (particularly a consistent Europe-wide approach to monitoring and enforcement in the first instance).	
			Integrity issues arising from IUU regulation can be picked up by monitoring: <ul style="list-style-type: none"> <li>• yellow flagged countries (as these are higher risk i.e. candidate red flagged countries).</li> <li>• international trade statistics to identify instances of 'stop-start'.</li> </ul>	
	Species substitution	All	Monitor market data to help with anticipating gluts and shortages. For example there is concern at the moment that the low harvest of olive oil might suggest integrity issues with extra virgin olive oil.	
		Whitefish Pelagic Shellfish Exotics	For domestic caught and processed seafood in UK regions, establish clear regional branding. Use existing market mechanics to support a brand. Collect evidence to support claims (stock condition, method of capture, fish handling, nutritional value, environmental impact). Replicate success seen elsewhere. For example, Norwegian Skrei cod (spawny fish), branded and promoted to influential chefs.	
			Require supply chain transparency (transparency of transactions at UK and EU ports has to improve). In the UK, platforms are required for improved accountability through mass balance, traceability, and self-audit. The opportunity to do this through the Seafish Responsible Fishing Port Standard (RFPS) should be explored. In Europe, Buyer led initiatives may be required (either private market-led traceability systems, or franchising RPS).	
	Catch methods	Whitefish	Investigate the long term threats from pulse trawling. Specifically: <ul style="list-style-type: none"> <li>• What voltage is being used, and how is this decided?</li> <li>• What is the effect of an electric pulse going through the water?</li> <li>• How does it affect the target species, e.g. bloodspots, burning, blistering.</li> <li>• How does it affect other species e.g. effect on the reproductive organs, breaking the spine etc?</li> <li>• Are there wider effects, e.g. fish washed up on the beach, increased by-catch, etc?</li> </ul>	
		Whitefish	Provide review of environmental integrity of catch methods, particularly deep water fishing	
Market and consumer expectations	Ethical labour	All	Responsible Fishing Scheme module for ethical labour.	
	Animal welfare	Whitefish Shellfish	None suggested	

\*to be agreed

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## 5. UK seafood product integrity – impacts and response to longer term developments

The impact of longer term developments on UK seafood product integrity is multiplied by food security and climate change challenges:

- The challenge of food security, a growing world population and middle class offers opportunities for protein suppliers in an enlarged global market but also the considerable challenge of intensified competition. Although seafood could potentially play an important role in supplying this protein, from a UK perspective the industry is not as integrated as other protein sectors opening avenues for product interference. This presents a credibility challenge, particularly to international seafood supply.
- The challenge of climate change brings additional uncertainties to the seafood industry. The industry may be directly impacted by disruptions to the fish resource, as well as the catching/harvesting, onshore handling and distribution activities. However, there may be indirect impact if other protein sectors are disrupted.

With longer term food security pressure, increasingly fierce fish trading is expected to drive risks to product integrity across all areas. With stronger prices and competition with other proteins making trade more difficult, profits for some operators will be further squeezed. Small and medium sized companies may be particularly vulnerable (being unable to afford testing and/or committed to supply large volume amid heightened uncertainty).

In response, particularly in *product weight and composition*, some operators will focus on new ways of interfering with the product, whilst other operators will collaborate with each other and the authorities to detect product malpractice and ensure a more widespread adoption of integrity controls. Whilst there will always be some intentional malpractice (black market) a squeeze in profits may push operators towards unintentional malpractice (grey market) with potential to expand the black market (particularly if the legal consequences continue to be relatively paltry).

It is expected that industry will polarise with consolidation at either end of the spectrum: large volume operators (providing products for mass consumption) and smaller companies

with specialist products and supply chains. Both groups will be sensitive to product interference or corruption:

- large companies will wish to protect their brand from large scale damage, and
- small companies have an interest in protecting/ demonstrating their product authenticity.

For those operators with an interest in product integrity, much stiffer competition for material will force closer collaboration to ensure *product standards*. The cost, and the time involved, in meeting UK market requirements is increasing and this is happening at a time when the size of middle class markets in Asian countries and their demand for seafood is increasing. Recognising that “*We can’t be 40 companies doing 40 different things*” may drive existing platforms (MSC, RFS etc) to provide the required chain of custody. As more operators join, improving technology, tracking, and traceability tools, will reduce some product integrity risks.

There is a concern that *market and consumer expectations* may be undermined if working conditions in Europe continue to deteriorate (particularly as national governments, under austerity conditions, retreat from providing a social safety net). Should this play out, operators may have to adopt the social and ethical enquiries (currently conducted in other parts of the world) in EU operations in order to meet market and consumer expectations. This may push the price of authentic products higher, and with it, further incentive to cheat.

Specific risks arising from longer term climate change pressure are difficult to foresee at present. However, speculative concerns include climate change elevating levels of natural risks and that climate change might combine with food security to place further pressure on the global protein system. For example there may be a limit on how much red meat can be produced. With rising prices there will be greater incentive for malpractice in red meat, and an incentive to look at seafood. With further pressure on seafood, prices would rise – resulting in a greater incentive to cheat.

The industry and Seafish have a choice as to whether or not to respond to this emergent landscape at this stage. Responding could involve a range of defensive or offensive actions, *initiated in advance*. Deciding not to respond at this stage would mean industry and Seafish are subject to events as they unfold, the experience with the ‘horsegate’ affair is illustrative of this, requiring strong capabilities to react quickly.

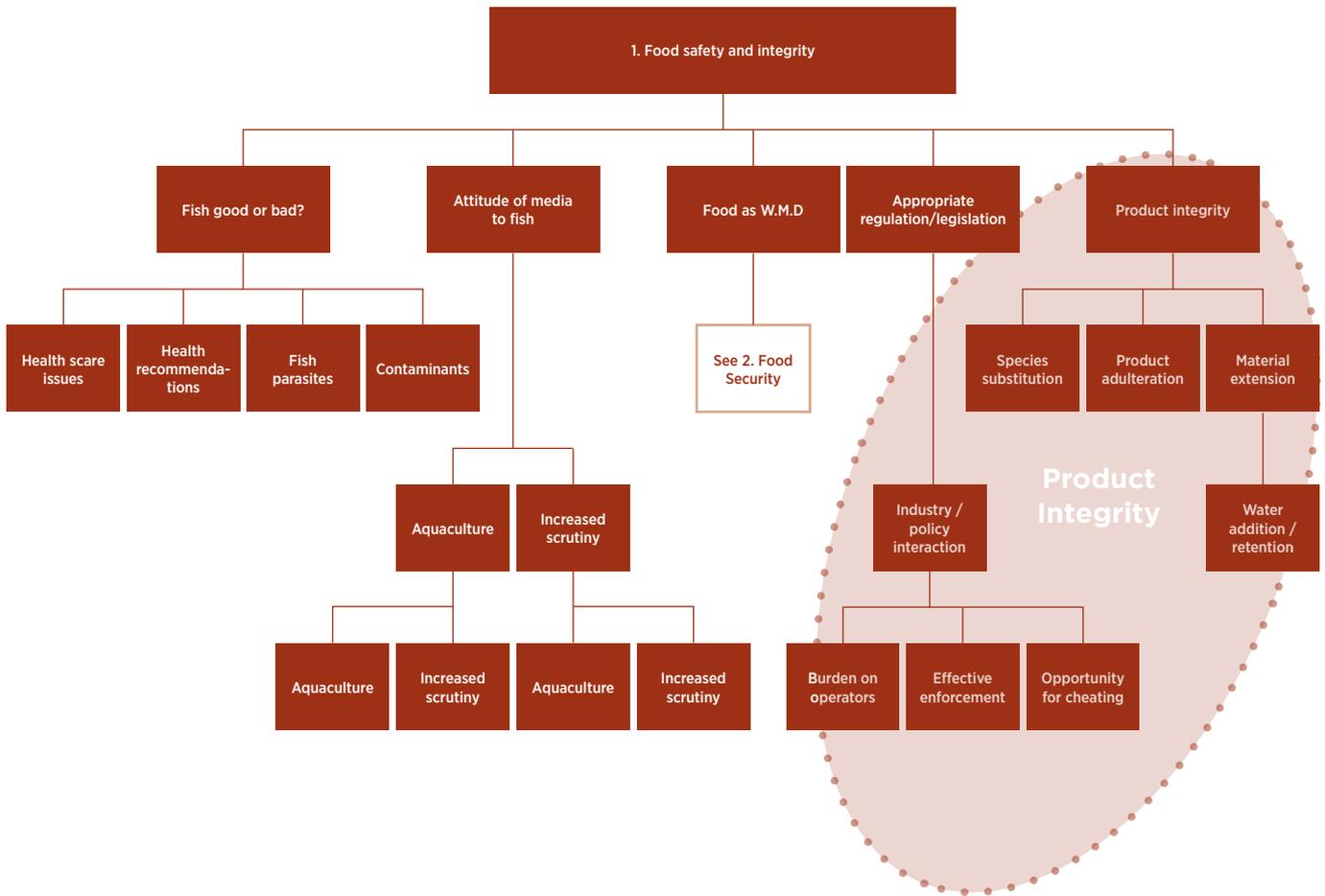
If there is an appetite to respond at this stage, this review exercise has highlighted the following conclusions and requirement regarding man-made risks:

- **The integrity of seafood products is not a new area of risk, but the risks and impacts are intensifying.** Food and seafood products have been undermined by product interference for many years. As a result, when product interference is discovered, it can have a dramatic impact: reputations are damaged, operations have closed, with hundreds finding themselves out of a job. Ultimately, with product interference potentially injurious to consumers, this risk becomes a food safety concern to the general public.
- **Whilst individual operators have taken action where they can, an industry response has been elusive with Seafish having played a less than effective role.** The industry has not had the required relationship with standards bodies that might have enabled some protection against malpractice. Although integrity issues have been raised with Seafish in industry forums, such as the Common Language Group, to date the emphasis has been on information rather than action (*“Guides and information sheets are brilliant but there’s no action”*). The Seafish role has been largely ‘hands-off’; there to *‘flag the issue’* with an expectation that *‘it’s industry who has to act’*. With an industry suffering from illegal operators, and a broadly passive Seafish position, the weak response in recent years is unsurprising.
- **A strong response to product integrity risks is required.** On the part of industry, a clear – and public – commitment to product integrity is required from leading industry operators. There is a danger that some operators will want to *‘watch what’s going on (rather than taking action)’*. Therefore this commitment should be substantiated with meaningful collaboration on key initiatives that will address product integrity risks (see section 4 for suggested actions). In support of this, a much more assertive response is required from Seafish. The organisation should:
  - Be more active: demonstrating greater application in engaging with industry to highlight issues to those buying fish (buyers and end customers).
  - Support companies to engage meaningfully with product integrity initiatives. This includes leading industry operators certainly, but also specific support to at-risk groups (particularly smaller and mid-sized operators in the UK and beyond).

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## Appendix 1 - Locating product integrity in seafood risk landscape



## Appendix 2 - Consultees

1. **Michaela Archer**  
*Seafish*
2. **Fiona Wright**  
*Seafish*
3. **Craig Burton**  
*Seafood Scotland*
4. **Ivan Bartolo**  
*Seafish*
5. **Jess Sparks**  
*Seafood Scotland*
6. **Mandy Pyke**  
*Seafish (Shellfish hygiene and safety)*
7. **Peter Wilson**  
*Seafish*
8. **Richard Stansfield**  
*Flatfish Ltd*
9. **Simon Derrick**  
*Icelandic*
10. **Huw Thomas**  
*Morrison's*
11. **Mike Mitchell**  
*Young's Seafood*
12. **Alex Olsen**  
*Espersen*
13. **Peter Hajipieris**  
*Birds-Eye*
14. **Will Clark**  
*Wilsea Ltd*
15. **Laky Zervudachi**  
*Direct Seafood*
16. **Mike Berthet**  
*M&J Seafood*

## Appendix 3 – UK seafood industry – main systems, functions and activities

Source: Seafish, Defra

System	Species distribution (and main producing countries)	Source method	Capture method
Domestic	UK waters/NE Atlantic (UK)	Capture	Whitefish & flatfish (bottom trawl)
Domestic	UK waters/NE Atlantic (UK)	Capture	Whitefish (gillnets) Whitefish (minority line-caught)
Domestic	UK waters/NE Atlantic (UK)	Capture	Flatfish & rays (beam trawl)
International	NE Atlantic/Barents sea (Norway, Russia, Iceland)	Capture	Demersal fish (bottom trawl)
International	North Pacific/Bering sea (USA)	Capture	Whitefish (pelagic trawl)
International	South East Asia (Vietnam)	Aquaculture	Freshwater pond culture
Domestic	UK waters/NE Atlantic (UK)	Capture	Small pelagic (purse seine & mid-water trawl)
Domestic	UK waters/NE Atlantic (UK)	Capture	Small pelagic (line caught)
International	Eastern Atlantic (Spain, Morocco) Eastern Pacific (Peru)	Capture	Small-pelagics (purse seine)
International	Indian ocean (Spain/France/Sri Lanka) Pacific ocean (Philippines/ Mexico) Atlantic ocean (Spain/France/ Ghana)	Capture	Tunas (long line) Tunas (purse seine) Tunas (pole & line / handline)
Domestic	UK waters/Eastern Atlantic (UK)	Capture	Crustaceans (pots)
Domestic	UK waters/NE Atlantic (UK)	Capture	Prawn (trawl)
Domestic	UK waters/Eastern Atlantic (UK)	Capture	Molluscs (dredged)
Domestic	UK waters/NE Atlantic (UK)	Aquaculture	Molluscs (rope grown/longlines) Molluscs (bottom grown)
International	North Atlantic (Denmark/ Greenland/ Iceland/ Norway/ Canada)	Capture	Prawn (trawl)
International	Mixed (Eastern Pacific, Mediterranean, North & South Atlantic, Indian ocean)	Capture	Cephalopods (jigging, trawl in North Atlantic)
International	South East Asia (Indonesia/ India/ Thailand), Central America (Ecuador/ Honduras)	Aquaculture	Shrimp farming (intensive > extensive)
Domestic	UK		
International	Asia, Africa		
International	Pacific ocean (USA / Canada / Russia)	Capture	Salmon (nets)
Domestic	UK waters/NE Atlantic (UK)	Aquaculture	Marine cage farming Freshwater ponds/raceways

Transportation	Format and process form	Species	Broad species grouping
Road, container	Fresh - Whole, fillets/loins, smoked, prepared	Cod, haddock, whiting, monkfish, sole, plaice	Whitefish
Road, container	Fresh - Whole, fillets/loins, smoked, prepared Whole, fillets/loins, smoked, prepared	Cod, haddock, Pollock	Whitefish
Road, container	Fresh - Whole, fillets/loins, prepared	Sole, plaice, rays	Whitefish
Road, container, Air freight	Fresh/Frozen - fillets/loins, smoked, prepared	Cod, haddock, hake, halibut, plaice	Whitefish
Road, container	Frozen - fillets/loins, smoked, prepared	Alaska Pollock	Whitefish
Road, container	Frozen - Whole, fillets/loins, prepared	Pangasius	Whitefish
Road, container	Fresh/frozen (including frozen at sea) - Whole, fillets/loins, smoked, fishmeal, preserved, aqua feed	Herring, mackerel, sardine/pilchard, blue whiting	Pelagic
Road, container	Fresh - Whole, fillets/loins, smoked, prepared	Mackerel	Pelagic
Road, container	Fishmeal, fish oil, canned, aqua feed	Anchovy, sardine/pilchard	Pelagic
Air freight, Container	Fresh/frozen - Whole, fillets/loins, preserved Preserved Whole, fillets/loins, preserved	Tunas (yellowfin, albacore, skipjack, swordfish)	Pelagic
Road, Air freight	Live Fresh/frozen - Whole, prepared	Crabs, lobsters, Nephrops, whelks	Shellfish
Road	Live Fresh/frozen - Whole, shelled, preserved	Nephrops	Shellfish
Road, Air freight	Live Fresh/frozen - preserved	Mussels, scallops	Shellfish
Road, container, Air freight	Live Fresh - preserved	Mussels, oysters	Shellfish
Road, container	Frozen - Whole, shelled, preserved	Northern/cold-water prawn	Shellfish
Road, container	Frozen - prepared, brined	Squid, octopus, cuttlefish	Cephalopods
Road, container	Frozen - Whole, shelled, preserved	Warm-water prawn	Shellfish
		Carp, bream	Exotics
		Kingfish, Parrotfish, Groupers, Snappers	Exotics
Road, container	Frozen - Whole fillets/loins, smoked, prepared	Pacific salmon	Salmonids
Road, container, Air freight	Fresh/frozen - Whole, fillets/loins, prepared, smoked Fresh/frozen - Fillets/loins smoked, prepared	Atlantic salmon, Rainbow trout (NE Atlantic small pelagic, waste and some imported fisheries (anchovy, sardine) input as feed in stage 2)	Salmonids



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