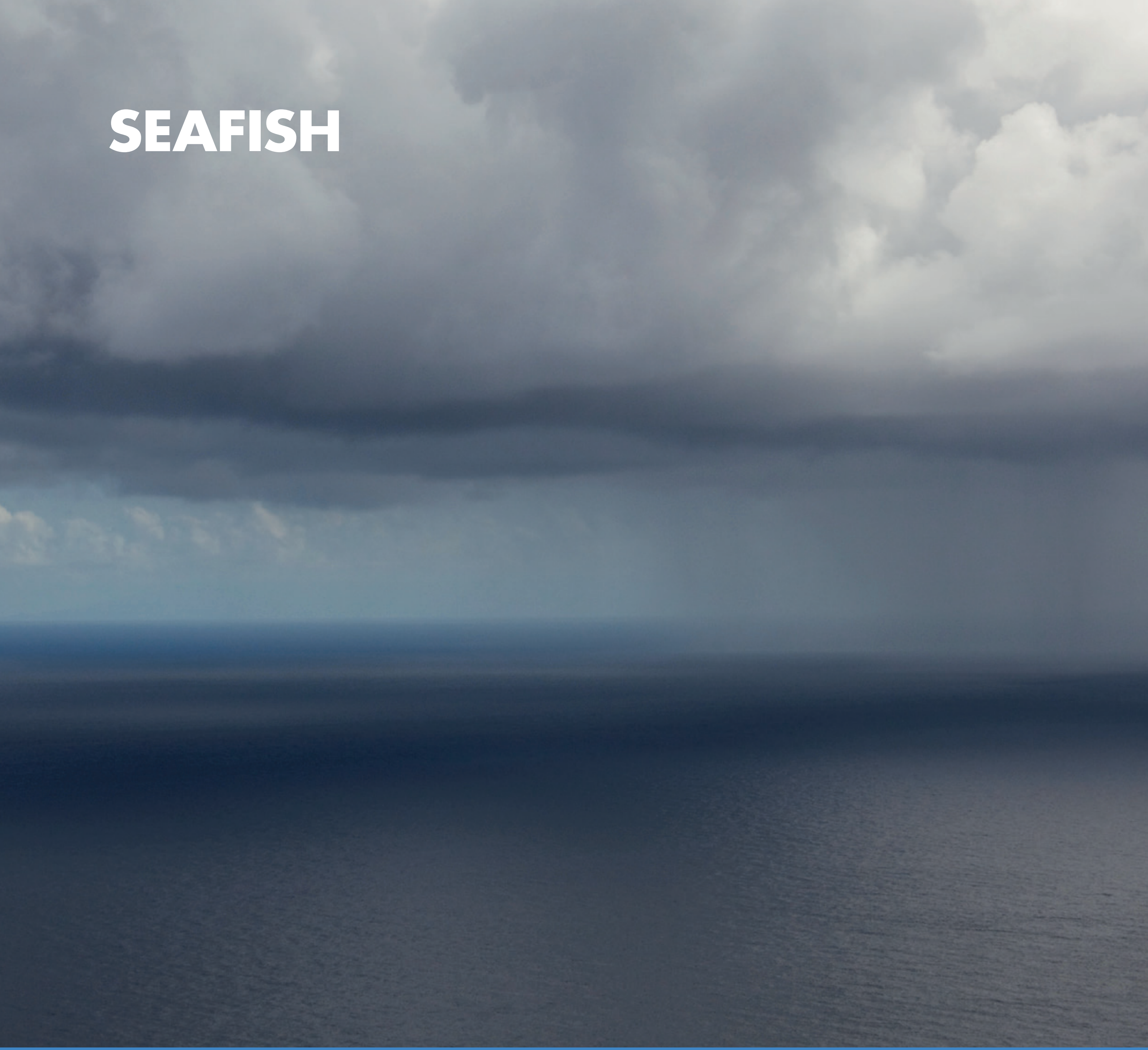



# Climate change adaptation in the UK (wild capture) seafood industry

## A Seafish/MCCIP Watching brief report

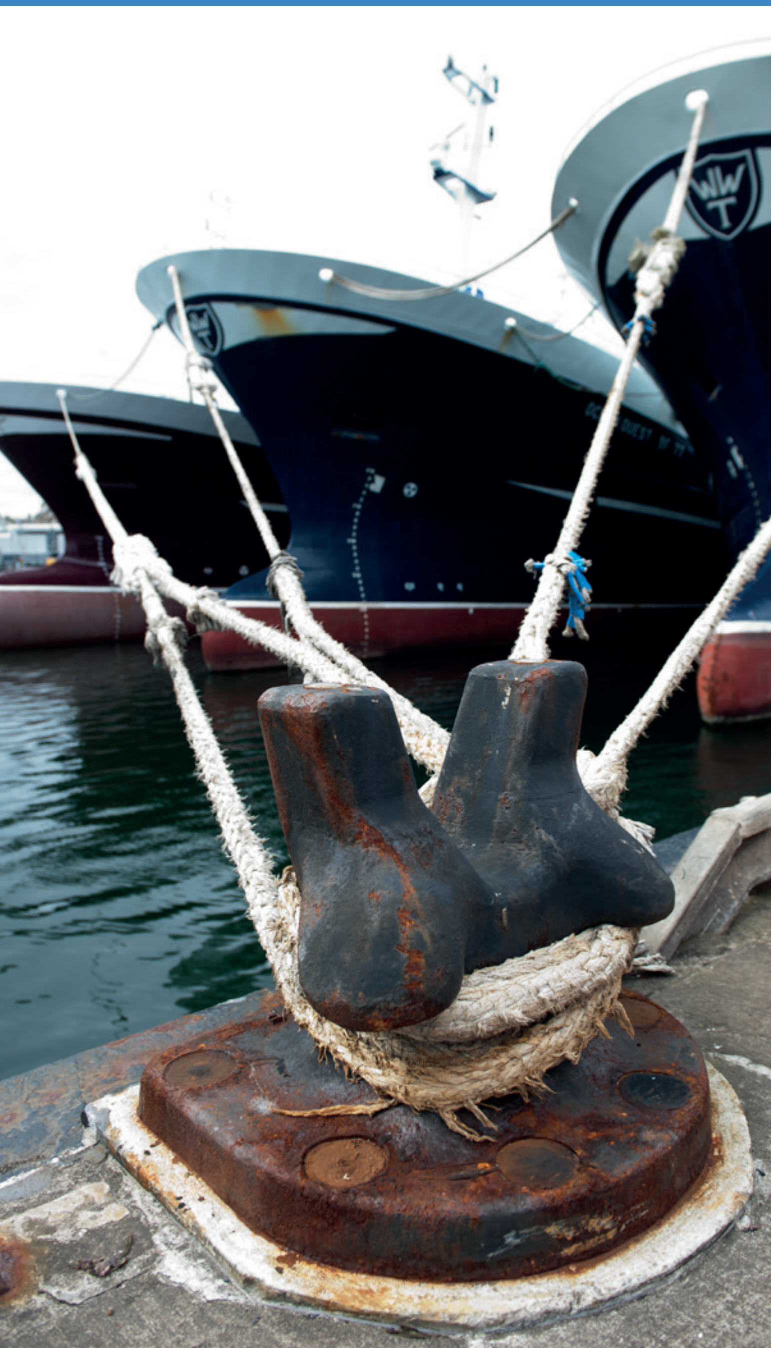
2016/17

**Authors:**
Dr Angus Garrett (Seafish), Dr John Pinnegar (CEFAS), Paul Buckley (CEFAS).

MCCIP Marine Climate Change Impacts Partnership

## Contents





# 1. Introduction

- Climate change is a strategic challenge across all UK sectors (including UK seafood). In late 2015, Seafish published a review of climate change adaptation for UK domestic and international (wild capture) seafood[1]. This also contributed to the UK Government Adaptation Reporting Requirement on climate change, conducted every five years across a number of sectors.
- The Seafish review concluded that climate change was a challenge for UK seafood, but that industry considers it a 'low priority' relative to other risks. As such a watching brief is to be maintained on climate change developments and their impacts on UK industry. Specifically, seeking regular feedback from industry stakeholders on climate change, impacts and adaptation actions. The findings to be incorporated into Seafish annual horizon reporting.
- This watching brief report considers recent advances in understanding and industry experience of climate change drivers and impacts. Advances in understanding draws on new scientific evidence collated through the MCCIP initiative[2], experience of these drivers is captured through semi-structured interviews with 15 UK industry stakeholders. Findings are provided for domestic and international seafood, and, where appropriate, by major fish species grouping concerned. This report provides a 'light touch' overview and is indicative only.

1 http://www.seafish.org/media/1476673/climate_change_report_-_lr.pdf

2 For further information see MCCIP (2017). Marine Climate Change Impacts: 10 years' experience of science to policy reporting. (Eds. Frost M, Baxter J, Buckley P, Dye S and Stoker B) Summary Report, MCCIP, Lowestoft, 12pp.

# 2. Scientific evidence – advances in understanding climate change drivers and impacts

## 2.1 Physical climate change drivers (sea level rise, temperature, storms and waves, ocean acidification and de-oxygenation, changes in terrestrial rainfall).

- 2014 was a record warm year for coastal air and sea temperatures around the UK. Between 1984 and 2014 the temperature of coastal waters rose at an average rate of 0.28 °C/decade (MCCIP temperature paper).
- 2014 was the warmest year on record for mean Hadley Centre Central England Temperature (Had-CET). The HadCET dataset is the longest instrumental record of temperature in the world (Met Office).
- Collated measurements suggest a long-term decline in pH (ocean acidification) in the North Sea, whereby pH has decreased since 1984 at a rate of around 0.0035 pH units per year. The pH observations were collated by Ostle et al. (2016) from multiple sources surrounding the North Sea over the past 30 years. However, both observations and modelling show that seawater $CO_2$, pH, total alkalinity and dissolved inorganic carbon (DIC) levels all vary considerably around the UK and over the course of a seasonal cycle (Ostle et al, 2016).
- In 2014-15 the winter North Atlantic Oscillation (NAO) index was at its most positive (+3.56) since 1995 and the fourth strongest in the last 110 years. NAO was also positive for December 2015–March 2016, but weaker, than experienced in the preceding two winters (IROC report 2015)[3]. Early results for winter 2016/17 suggest a positive NAO but again, not as high as in 2014-15. Met Office Scientists announced in October 2016 that they believe they can now forecast with some accuracy, the NAO one full year in advance[4].
- The winter of 2013/14 was identified as one of the stormiest (in terms of wind speeds, wave heights, etc.) of the past 66 years (Matthews et al., 2014). This was also the wettest winter in the UK observational record[5].
- There is evidence that areas of low oxygen saturation have started to proliferate in the North Sea (Queste et al., 2012). In March 2017 Townhill et al. published a review on long-term chronic effects of low oxygen zones, especially with regard to commercially important fishes and shellfishes.

## 2.2 Implications (changing catch potential, impacts on offshore operations and assets, impacts on onshore operations and assets).

### 2.2.1 Domestic system

- A particular focus in recent years has been the spread of mackerel into Icelandic and Faroese waters, with consequences for fisheries quota allocation and governance. Many new research papers have emerged over the past few years and changes in mackerel distribution have been linked to several possible factors, including warmer seas, changes in food availability and a density-dependent expansion of the stock (see Hughes et al., 2014).
- MacKenzie et al. (2014) reported that commercial boats targeting mackerel in waters east of Greenland have started catching bluefin tuna for the first time. A parallel phenomenon has been reported off southwest England, where large schools of bluefin tuna were observed in 2015 and again in 2016, having been absent for many decades (Jeroen van der Kooij, Pers. Obs., and Mail Online, 21 August 2015).
- In the North Sea, an important summer trawl fishery targeting squid has developed, especially off eastern Scotland. A recent, high-profile Cefas paper has indicated that squid numbers have increased dramatically over the past 35-years (van der Kooij et al. 2016). Significant positive relationships were found between this increase in squid abundance and climate variables such as sea surface temperature. This phenomenon (recent increases in cephalopods) seems to be occurring throughout the World (Doubleday et al. 2016). The summer squid fishery seems to be a means of maintaining income given restrictions preventing vessels from pursuing more traditional species such as haddock and cod.
- Over the past few years, many hundreds of papers have been published focusing on the impacts of ocean acidification (OA), however, there is still a lack of conclusive evidence as to possible consequences for commercial fisheries. A recent economics study suggests that annual economic losses in the United Kingdom, the Channel Islands and the Isle of Man could amount to 97.1, 1.0 and 12.7 million US$, respectively by 2100, under a worst-case scenario, although this is based upon some very 'heroic' biological assumptions (Narita & Rehdanz 2016).

3 Also https://crudata.uea.ac.uk/~timo/datapages/naoi.htm

4 http://www.nature.com/ngeo/journal/v9/n11/full/ngeo2824.html

5 http://onlinelibrary.wiley.com/doi/10.1002/wea.2465/full

- European seabass had been held up as a 'poster child' of marine climate change in the UK. Evidence suggests that populations, did expand dramatically in the early 2000s, however in recent years fishing mortality has reached unsustainable levels and further advance of this species has been severely curtailed (ICES Advice 2015).
- For many years it has been argued that cod might not be able to persist around the UK in the future if seawater temperatures continue to rise. Despite dramatic and deliberate reductions in fishing mortality, cod stocks have continued to suffer poor recruitment related to prevailing (warm) climatic conditions. Although cod is now in recovery, the recovery of populations to above 'safe biological condition' has been very slow (ICES Advice 2015).

### 2.2.2. International system

- According to a detailed global analysis[6] from the World Meteorological Organization (WMO), 2016 was not only the warmest year on record (globally), but it saw atmospheric CO2 rise to a new high, while Arctic sea ice recorded a new winter low. WMO says that the "extreme and unusual" conditions have continued into 2017. Compared with the 1961-1990 reference period, 2016 was 0.83 °C warmer than the average. It was around 1.1°C above the pre-industrial period, and at 0.06 °C just a fraction warmer than the previous warmest year record in 2015.
- In the Arctic, temperatures were about 3 °C above the 1961-1990 average. In Svalbard (from where the UK imports cod), the yearly average was 6.5 °C above the long-term mark. Warmer temperatures in the Barents Sea region (around Svalbard) are usually associated with enhanced cod populations (Drinkwater 2005).
- El Niño is a climate cycle in the Pacific Ocean with a global impact on weather patterns and fish distributions. The cycle begins when warm water in the western tropical Pacific Ocean periodically shifts eastward along the equator toward the coast of South America. There is a direct impact on the UK seafood industry as we import large quantities of tuna from the Pacific and Indian oceans (consumed by UK citizens) as well as anchoveta from Peru, that are used as feed for UK aquaculture. Both of these fish types are known to be very heavily influenced by El Nino. El Nino tends to lead to dramatic declines in Peruvian anchoveta populations, with major consequences for global fishmeal markets (and prices).
- The 2015/2016 El Niño was one of the strongest events in history, and this strong event was preceded by a weak El Niño in 2014 (Lian et al. 2017). NOAA reported that the 3 month average of the Oceanic El Niño Index from November 2015 to January 2016 peaked at 2.3 °C (4.1 °F), which meant that the 2014-16 event was tied with the 1997-98 event for the strongest values on record. During the event, tuna schools migrated away from their traditional waters near Papua New Guinea, to waters surrounding the island nation of Kiribati. As a result of this over 700,000 tonnes of Tuna was caught in waters surrounding Kiribati during 2014, and the island nation was able to sell access rights to international fishing firms at over $15,000 a day. Similar large-scale re-distribution of tuna fisheries was observed during previous El Niño events (see Miller 2007; Marine Policy 31: 56–70).
- NOAA's Global Climate Prediction Centre issues regular El Niño forecasts for the year ahead. On 13 April 2017, the latest advice suggests that *"ENSO-neutral conditions are favoured to continue through at least the Northern Hemisphere spring 2017, with increasing chances for El Niño development by late summer and fall".*
- 2015 and 2016 also witnessed coral bleaching on a massive scale throughout the World. Corals bleach (lose their symbiotic algae) whenever water temperatures are elevated temporarily above the normal summer maximum for longer than about two weeks. Climate change has caused global sea surface temperatures to rise by about 1°C over the past century, pushing corals closer to their bleaching threshold. A strong El Niño, as well as other weather phenomena, also raised the temperature further this year. About 93% of the reefs on Australia's Great Barrier Reef are known to have been affected. NOAA has identified 2015/15 as one only three "global coral bleaching events" (the others were in 1998 and 2010). Bleaching events often impact fish communities and the human communities that depend on coral reefs and associated fisheries for livelihoods and wellbeing.

6 https://public.wmo.int/en/media/press-release/climate-breaks-multiple-records-2016-global-impacts

# 3. Industry experience of climate change impacts and relevant responses

Industry experience of climate change within domestic and international systems is described by major fish species grouping. **Note:** *Stakeholders urged* ***caution*** *in attributing impacts directly to climate change drivers. Other drivers of relevance include social (e.g. fisheries management) and environmental (biological and oceanic cycles) drivers, so the link between climate change drivers and impact should be considered indicative only.*

## 3.1 Domestic (see tables 3.1 and 3.2 in Annex 1)

### Whitefish

Notable drivers experienced include:

- *'Increased storminess and waves':*
  - Contributing to poor **weather conditions** in small inshore fisheries in the South West, particularly those targeting bass and Pollock (those using fixed nets and lines).
  - Had a severe effect on **road logistics** in lowland Scotland with the closure of the Forth Road bridge (storminess undermined the soundness of the existing bridge and caused delay in building the new crossing).
- *'Temperature change'* affecting **fish stocks** with:
  - The continued growth of the hake stock (towards becoming a choke stock under the landings obligation) and the continuing growth of the UK market for this species.

### Pelagic

Notable drivers experienced include:

- *'Increased storminess and waves':*
  - Affecting **catchability** - seven new pelagic vessels on order, all of which will be pumping from aft, and an extra deck fitted in the forward area.
- *'Temperature change':*
  - Affecting the variability and unpredictability of **fish migration**. For example, the 2015 autumn mackerel fishery was much later in the year, the 2016 winter mackerel fishery was also late, and the 2016 summer herring fishery was late.

### Shellfish

Notable drivers experienced include:

- *'Increased storminess and waves':*
  - Contributing to poor **weather conditions** in small inshore fisheries in the South West, particularly those targeting crab and lobsters and also landings from dive scallops.
- *'Temperature change':*
  - Contributing to the reduced **prevalence of algal blooms** in summer (damp/windy/cold weather followed later by warmer temperatures avoided de-oxygenation and the danger of mussels/scallops being unable to feed/cleanse).
  - The shortage of squid (a worldwide shortage coinciding with El Nino) which has dramatically raised quayside prices.

### Progress against adaptation responses

Notable responses include:

- *Developing much closer science-industry collaboration:*
  - Closer collaboration through a number of initiatives: SPFA have employed an in-house scientist with expertise in the ecosystem approach to fisheries, and will work with partners in Netherlands and the Rep. of Ireland to produce estimates for minimum herring biomass; NFFO collaboration with Cefas to produce a science strategy for industry generated data; Fishing into the future / Celtic Seas Partnership 'fishing for data' initiative to develop protocols for industry data collection.
  - Problematic collaboration, with partnership working in scientific advice and data collection showing a continued disconnect between assessments and the reality of fish on the grounds.
- **Building port resilience**. In response to storm damage and disruption during the winter of 2013/14 the MMO launched a "Storm Damage Gear Replacement Scheme" supported by the European Fisheries Fund (EFF) whilst Cefas have conducted a preliminary analysis of fishery disruption in southwest England (Brixham, Newlyn, Plymouth, Penzance) using satellite-derived vessel monitoring data, to characterise the scale of the problem [to be presented at the Seafish Common Language Group on Thursday 22 June 2017].

- Communicating **domestic fish availability**. An apparent weakening of industry representation and a noticeably lower profile marketing of seafood from Scotland. The 'Consumption 2040' initiative in England and Wales is contributing to the consumer eating available seafood i.e. when it's there.
- Brexit developments mean a lot of existing arrangements are currently 'on the table' and should be easier to develop. For example adapting domestic quota allocation/ relative stability/ vulnerability is likely to be advanced in the Brexit process.

## 3.2 International (see tables 3.3 and 3.4 in Annex 1)

### Whitefish

Notable drivers experienced include:

- *'Temperature change':*
  - Affecting **catch potential of target species** in the Arctic/North Atlantic fisheries with newly opened waters resulting from melting ice. Currently this impact is focussed on reputational impact rather than food supply impact.
  - Affecting **catch potential of target species** in the North Pacific (Alaska and Bering Sea) fisheries with Pollock fish size being noticeably smaller (suggesting less food availability). This, together with changes in the periods of fish availability, has impacted fishing (fishing activity has had to change - more uncertainty in forecasts) and markets (with smaller fish size more material is driven into block production, getting pushed into lower value markets).

### Pelagic

Notable drivers experienced include:

- *'Temperature change':*
  - Affecting fish distribution and, alongside issues of stock health and inadequate management, impacts on the availability of handline tuna in the Maldives and The Philippines.
- *'Sea level rise':*
  - Anxiety in the Maldives ranges from 'fairly' to 'extremely' concerned.

### Shellfish

Notable drivers experienced include:

- *'Temperature change':*
  - Affecting **catch potential of target species** in the cold water prawn North Atlantic fishery/East coast of Greenland inshore fishery with prawns moving north and under the ice and generally more difficult to access. Coupled with the recovery of West Atlantic cod stock, this has an impact on quota availability (contributing, in turn, to a number of Canadian operating plants being shut down).

### Progress against adaptation responses

Notable responses include:

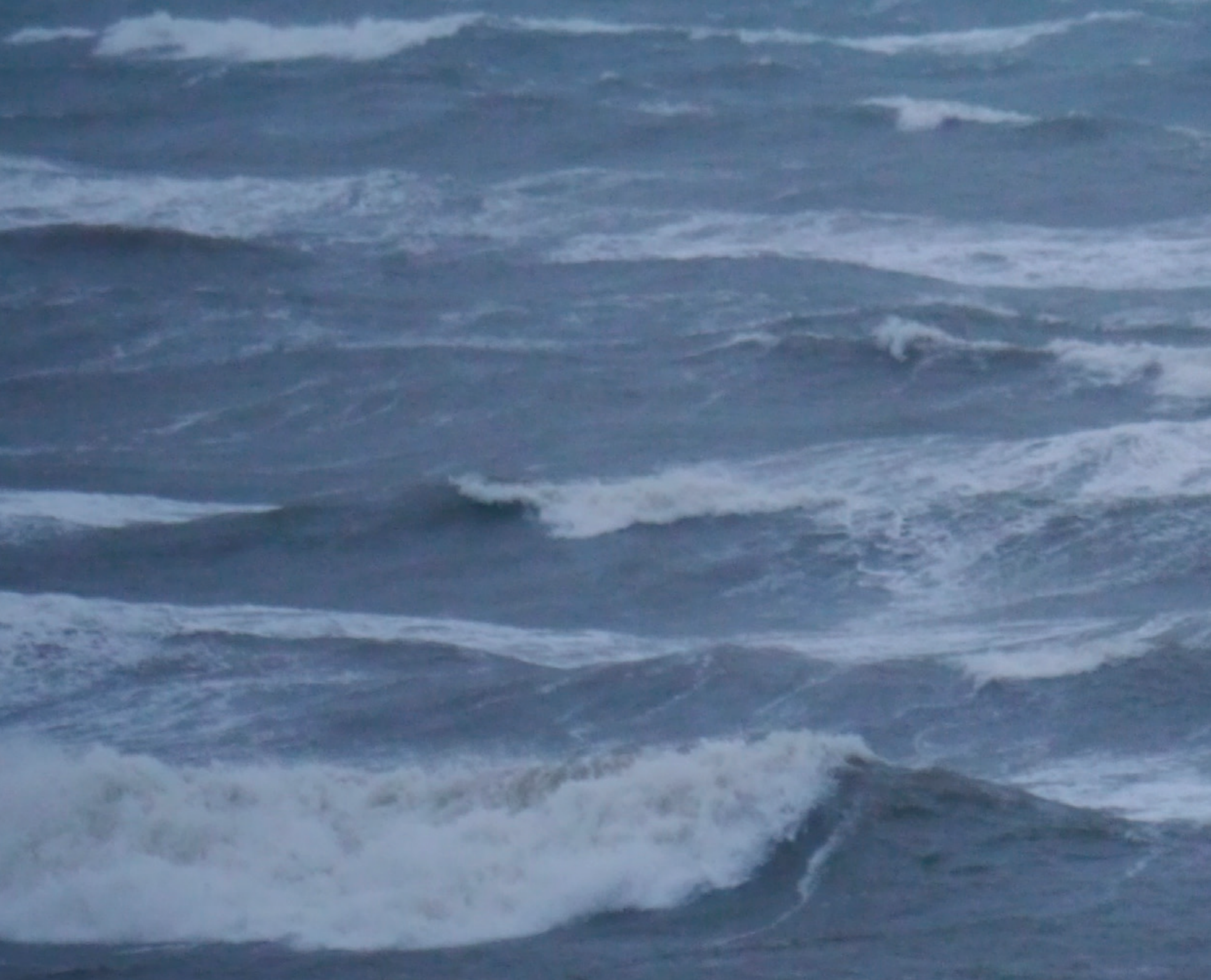
- **Management regimes embracing the concept of climate change adaptation;**
  - Large scale NGO activity (Greenpeace) in the Arctic highlighting concern over international access and governance rights. Government/industry/NGO collaboration to ensure the footprint is fixed now and that access does not aggravate this. There has been agreement with Norwegian and Russian fleets that they won't go outside traditional fishing grounds. It has also been agreed that for the new areas opening up, the Norwegian government will be mapping the ecosystem and seabed before decisions are made on whether the ecosystems are pristine, can be fished etc.
  - This response can be challenging for many regional management arrangements due to near term imperatives. For example at RFMO level, particularly within tuna fisheries, problems of governance can supersede discussions of wider impacts such as climate change (usually consigned to 'talk about this problem tomorrow'). In the North Pacific, wider economic conditions and cutbacks can challenge investment of additional resources into fisheries management science/evidence.

Suggested additional requirements include:

- **Predictive modelling to support adaptation**. Currently fisheries managers are focussed on the current position, however there is a need to move towards *'what if..?'* analyses (more challenging as, in capture fisheries, this has to be done at a macro level).

## 4. Conclusion

- A range of small scale impacts experienced, with the exception of the Arctic fisheries where there has been large scale NGO activity.
- In general, the main development in the last 12-15 months has been greater awareness of climate change and wild capture fisheries. Higher awareness is demonstrated in NGO activity, for example; the Greenpeace campaign focussed on Arctic fishing, stakeholder discussions held by The Prince of Wales International Sustainability Unit, and Oceans Day at the recent UN Climate Change Conference of the Parties (COP) in Paris.
- Greater awareness has the potential to force a heightened speed of response. For example, collaborative action in the Arctic arguably transformed the requirement to *“Ensure management regimes embrace the concept of climate change adaptation”* from a short-term response (of 2-5 years) into an immediate response (< 2 years).



# Annex 1 – Tables

| OFFSHORE | Sea level rise, extreme water levels | Increased storminess and waves | Air or sea temperature change | Ocean acidification and deoxygenation | Changes in rainfall / run off |
|---|---|---|---|---|---|
| **WHITEFISH** | | | | | |
| **a) Fishery resources** | | | | | |
| i. Alterations in species phenology | | | 🔴 | | |
| ii. Impacts on choke species (linked to landing obligations) | | | 🔴 🟢 | | |
| iii. Changes to growth rate of target species | | | 🔴 🟢 | | |
| iv. Changes to the distribution of target species | | | 🔴 🟢 | | |
| v. Changes to year-class strength (including larval survival) | | | 🔴 🟢 | | |
| vi. Migration patterns of target species (timing and routes) | | | 🔴 🟢 | | |
| **b) Offshore operations** | | | | | |
| i. Staff physical working conditions | | 🔴 | | | |
| ii. Gear deployment / performance | | 🔴 | | | |
| iii. Damage to fleet | | 🔴 | | | |
| **PELAGIC** | | | | | |
| **a) Fishery resources** | | | | | |
| i. Migration patterns of target species (timing and routes) | | | 🔴 | | |
| ii. Alterations in species phenology | | | 🔴 | | |
| iii. Changes to the catchability of target species | | 🔴 | 🔴 | | |
| iv. Changes to growth rate of target species | | | 🔴 🟢 | | |
| v. Changes to the distribution of target species | | | 🔴 🟢 | | |
| vi. Changes to year-class strength (including larval survival) | | | 🔴 🟢 | | |
| **b) Offshore operations** | | | | | |
| i. Staff physical working conditions | | 🔴 | | | |
| ii. Gear deployment / performance | | 🔴 | | | |
| **SHELLFISH** | | | | | |
| **a) Fishery resources** | | | | | |
| i. Presence of HABs | | 🔴 | 🔴 | | 🔴 |
| ii. Presence of pests and diseases | | | | | 🔴 |
| iii. Changes to year-class strength (including spatfall) | | | 🔴 🟢 | | |
| iv. Presence of non-natives / jellyfish | | | 🔴 🟢 | | |
| v. Changes to the distribution of target species (including squid) | | | 🟢 | | |
| vi. Changes to growth rates of target species | | | 🔴 🟢 | | |
| ***b) Offshore operations*** | | | | | |
| i. Staff physical working conditions | | 🔴 | | | |
| ii. Gear deployment / performance | | 🔴 | | | |
| iii. Damage to fleet | | 🔴 | | | |
| **ONSHORE** | | | | | |
| **a) Ports and harbours** | | | | | |
| i. Damage to site infrastructure | 🔴 | 🔴 | | | 🔴 |
| ii. Boat damage in ports / harbours | | 🔴 | | | |
| iii. Integrity of electricity supply | | | | | 🔴 |
| **b) Employment and fishing communities** | | | | | |
| i. Integrity of housing and local amenities | 🔴 | 🔴 | | | |
| ii. Days at sea | | 🔴 | | | |
| **c) Transportation of catch** | | | | | |
| i. Disruption to ferry service | | 🔴 | | | |
| **d) Processing of catch** | | | | | |
| i. Damage to site infrastructure | 🔴 | 🔴 | | | 🔴 |
| ii. Integrity of electricity supply | | | | | 🔴 |

Table 3.1 Summary of key domestic offshore and onshore threats (red dots) and opportunities (green dots)

| | | System | Adaptation response | Owner | Scale of resource | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Minor | Moderate | Significant | Major |
| **Speed of response** (inertia) | **Underway** | **Fishery** | Scientific advice and data collection through partnership working | Fisheries Science Partnerships | | | | |
| | | **Fishery** | Development of training and education modules for fishermen | Fishing into the Future (with Seafish) | | | | |
| | | **Operations** | Enhance operational safety (raised decks) | Industry | | | | |
| | | **Operations** | Enhance operational safety (Personal Flotation Devices) | The Fishing Industry Safety Group | | | | |
| | | **Operations** | Enhance operational safety (Safety at Sea training) | Seafish-approved training providers | | | | |
| | | **Ports** | Build port resilience | Port / harbour authorities / Department of Transport | | | | |
| | | **Processing** | Develop markets for available domestic seafood | Seafood Scotland | | | | |
| | **Immediate** (<2 years) | **Ports** | Ensure berth allocations for vulnerable vessels | Port / harbour authorities | | ■ | | |
| | | **Processing** | Develop marketing strategies for seafood in rest of UK | Industry trade organisations | | ■ | | |
| | **Short term** (2-5 years) | **Fishery** | Develop close science-industry collaboration and engaged research | Industry trade associations / scientists | | ■ | ■ | |
| | | **Fishery** | Ensure quota swaps / transfers | Industry | | ■ | | |
| | | **Operations** | Keep a watching brief on climate change and potential responses | Industry trade associations | ■ | | | |
| | | **Ports** | Improving port risk management | Port / harbour authorities | ■ | ■ | | |
| | | **Transport** | Assess vulnerability of freight ferries | Government | | | ■ | |
| | | **Processing** | Establish specific seafood marketing organisations for rest of UK | Industry trade organisations (e.g. Fishmongers Hall) | | | ■ | |
| | **Medium term** (5-15 years) | **Fishery** | Developing a more robust, strategic fisheries knowledge base. | Scientists / industry / Govt | | | ■ | |
| | | **Fishery** | Review of domestic quota allocation | EU / UK Govt / Fisheries scientists / industry | | | ■ | ■ |
| | | **Operations** | Review of fishing seasons in response to disruptions | Industry / Government | | | ■ | |
| | **Long term** (>15 years) | **Fishery** | Review 'Relative stability' (Governance) arrangements | EU / UK Govt / Fisheries scientists / industry | | | | ■ |
| | | **Operations** | Assess vulnerability of fleets across the EU | EU research | | | | ■ |
| | | **Processing** | Re-locate processing sites inland | Processors and planning inspectorate | | | | ■ |

Table 3.2 Adaptation responses for the domestic system

| OFFSHORE | | | | | |
|---|---|---|---|---|---|
| | Sea level rise, extreme water levels | Increased storminess and waves | Air or sea temperature change | Ocean acidification and deoxygenation | Changes in rainfall / run off |
| **Wild capture (general)** | | | | | |
| i. Changes in species distribution and fisheries productivity (+ve and -ve effects) | | | ● (red) ● (green) | | |
| ii. Loss of fisheries production at lower latitudes | | | ● (red) | | |
| iii. Enhanced fisheries production at high latitudes | | | ● (green) | | |
| iv. Impact on international fisheries governance and access rights | | | ● (red) | | |
| **WHITEFISH** | | | | | |
| **a) Fishery resources** | | | | | |
| i. Changes in distribution or catch potential of target of species (general) | | | ● (red) ● (green) | | |
| - Arctic fisheries | | | ● (red) ● (green) | | |
| - North Atlantic Fisheries | | | ● (red) ● (green) | | |
| - North Pacific (Alaska and Bering Sea) fisheries | | | ● (red) ● (green) | | |
| - Mid Atlantic – offshore Senegal, The Gambia, Sierra Leone, Ghana | | | ● (red) | | |
| **b) Offshore operations** | | | | | |
| i. Gear deployment / performance | | ● (red) | | | |
| **PELAGIC** | | | | | |
| **a) Fishery resources** | | | | | |
| i. Changes in distribution or catch potential of target species (general) | | | ● (red) | | |
| - Tuna fisheries | | | ● (red) | | |
| - Pacific Ocean anchoveta and sardine fisheries | | | ● (red) | | |
| **SHELLFISH** | | | | | |
| **a) Fishery resources** | | | | | |
| i. Changes in distribution or catch potential of target species | | | | ● (red) | |
| ii. Introduction of non-native species | | | ● (red) | | |
| **b) Offshore operations** | | | | | |
| i. Staff physical working conditions | | ● (red) | | | |
| **ONSHORE** | | | | | |
| **a) Ports and harbours** | | | | | |
| i. Damage to site infrastructure | ● (red) | ● (red) | | | ● (red) |
| ii. Vessels / gear damage in ports / harbours | | ● (red) | | | |
| **c) Onshore processing** | | | | | |
| i. Disruption or damage to coastal processing facilities | ● (red) | ● (red) | | | ● (red) |
| **SOCIO-ECONOMIC CONDITIONS** | | | | | |
| i. Impact on national economies of changes in fisheries | | | ● (red) ● (green) | ● (red) | |
| ii. Impact on food security of changes in fisheries | | | ● (red) | ● (red) | |

Table 3.3 Summary of key international offshore and onshore threats (red dots) and opportunities (green dots)

| Speed of response (inertia) | | System | Adaptation response | Owner | Scale of resource | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Minor | Moderate | Significant | Major |
| | **Underway** | **Offshore** | IMO convention on standards of training and certification of 'watchkeepers' (fishing sector) | IMO | | | | |
| | **Immediate** (<2 years) | **Fishery** | Review of key sources of existing supply and available options | UK Industry - especially integrated supply chains / UK Govt / scientists | | | | |
| | **Short term** (2-5 years) | **Fishery** | Monitoring and assessing the impact of changes in specific regional supplies | UK industry bodies / Support organisations / Govts / scientists | | | | |
| | | **Fishery** | Promoting an awareness of climate change in the North Atlantic pelagic fishery | UK Industry / UK Govt / scientists | | | | |
| | | **Fishery** | Ensure management regimes embrace the concept of climate change adaptation | International industry bodies / Govts / scientists | | | | |
| | | **Fishery** | Ensuring international fisheries management regimes provide early resolution on 'rights to fish' | Industry bodies / RFMOs / scientists / Govts. | | | | |
| | | **Offshore** | Maintain ability to catch | UK and international industry / marine engineers and designers | | | | |
| | | **Offshore** | Ensure capacity for enhanced productivity of whitefish fisheries at higher latitude | UK and international industry / scientists | | | | |
| | | **Processing** | Improve resilience and capacity of overseas facilities | UK and international industry / Govt / RFMOs / scientists | | | | |
| | **Medium term** (5-15 years) | **Fishery** | Assessing the viability of enhanced regional productivity | UK industry / Govt / scientists | | | | |
| | | **Fishery** | Developing much closer science-industry links to understand climate driven regional changes | UK industry / Govt / scientists | | | | |
| | | **Offshore** | Engagement with overseas stakeholders to support climate change adaptation | UK industry / industry bodies / investors / RFMOs / scientists / Govts | | | | |
| | | **Processing** | Maintain a watching brief on climate change and potential responses overseas | UK industry / Govt / scientists | | | | |
| | **Long term** (>15 years) | | - | | | | | |

Table 3.4 Adaptation responses for the international system

## Consultees

1. Lucy Blow, New England Seafood Ltd.
2. Will Clark, Wilsea Ltd.
3. Ally Dingwall, Sainsburys.
4. Karen Galloway, Xenosophy Ltd.
5. Ian Gatt, Scottish Pelagic Fishermen's Association.
6. Jon Harman, Alaska Seafood Marketing Institute.
7. Malcolm Morrison, Scottish Fishermen's Federation.
8. Steve Norton, Grimsby Fish Merchants Association Ltd.
9. Alex Olsen, Espersen.
10. Dale Rodmell, National Federation of Fishermen's Organisations.
11. John Rutherford, Frozen At Sea Fillets Association.
12. Robert Stevenson, Lunar Fish Producers Organisation Ltd.
13. Huw Thomas, Morrisons.
14. Brian Young, British Frozen Foods Federation.
15. Laky Zervudachi, Direct Seafoods Ltd.

MCCIP Marine Climate Change Impacts Partnership

**SEAFISH**

18 Logie Mill
Logie Green Road,
Edinburgh UK
EH7 4HS

t: +44 (0) 131 524 8697
f: +44 (0) 131 558 1442
e: seafish@seafish.co.uk
w: www.seafish.org

*Supporting a profitable, sustainable and socially responsible future for the seafood industry.*