Appendix 1h: Other Users

A1h.1 Introduction

The coasts and seas of the UK are intensively used for numerous activities of local, regional and national importance including coastally located power generators and process industries, port operations, shipping, oil and gas production, fishing, aggregate extraction, military practice, as a location for submarine cables and pipelines and for sailing, racing and other recreation. At a local scale, activities as diverse as saltmarsh, dune or machair grazing, seaweed harvesting or bait collection may be important.

These activities necessarily interact at the coast and offshore and spatial conflicts can potentially arise. A key consideration of this SEA is the potential for plan elements to interact with other users and material assets, the nature and location of which are described below.

A1h.2 Ports and shipping

A1h.2.1 Commercial ports

UK ports are located around the coast, with their origin based on historic considerations including, principally, advantageous geography (major and other ports are indicated in Figure A1h.1 below). In 2019 some 486.1 million tonnes (Mt) of freight traffic was handled by UK ports, which is comparable to that handled in the previous year (DfT 2020). 98% of this traffic was handled by major ports (Inwards traffic at 307.7Mt and outwards traffic of 167.7Mt). The 2008 recession had an accompanying 12% downturn in movements in major ports from a peak of 570.2Mt in 2005. Tonnage handled has been relatively stable over the past 10 years, declining just 3% since 2009 (the lowest level of tonnage handled following the 2008 recession).

Grimsby and Immingham is the UK's busiest port, handling 11.4% of the UK's traffic (equal to 54.1Mt) in 2019. Other major ports in Regional Sea 2 include London, Felixstowe and Dover, handling approximately 54, 25.3 and 23.4Mt respectively. In Regional Sea 1, the largest ports are Tees and Hartlepool (28.2Mt) and the Forth (25.2Mt), while in Regional Sea 8 the largest ports are Orkney and Sullom Voe, which handle a significant amount of crude oil, some 2.8Mt and 7.4Mt respectively in 2019. Southampton on the south coast is the largest port within Regional Sea 3, handling 33.2Mt, and within Regional Sea 4 Milford Haven handled the most traffic at 35Mt.

Regional Sea 6 includes the major ports in Northern Ireland: Belfast, which handled 18.5Mt and Larne at 2.8Mt. It also includes the major ports on the west coast of Britain, the largest of these being Liverpool (34.3Mt) and the Clyde (8.8Mt). There are few large ports in Regional Sea 7, with Glensanda being the largest. Glensanda only has export traffic almost entirely consisting of granite, amounting to 6.7Mt in 2019.

Liquid bulk traffic was the largest cargo type handled at UK ports in 2019 at 192.7Mt. The main components of this cargo are crude oil (85.5Mt) and oil products (76.2Mt). Dry bulk cargoes totalled 93.5Mt, consisting of ores (15.4Mt), agricultural (10.8Mt) and other (58.3Mt) products.

The main origins of UK cargo in 2019 were the Netherlands (51.8Mt), Norway (26.5Mt), USA (26.5Mt), France (19Mt), Belgium (15Mt), and Russia (14.2Mt), with destinations dominated by the Netherlands (26.6Mt) and France (13.2Mt).

A1h.2.2 Commercial shipping and ferry operations

As indicated above, the shipping industry continues to be the dominant carrier of goods to and from the UK, making up approximately 95% of imports and exports to the country by tonnage (DfT 2020). It is estimated that the maritime services sector which would include port and shipping related activity employed approximately 239,200 people in 2013, or 0.7% of total UK employment (Oxford Economics 2015). In terms of regional variation, this sector is particularly important in Scotland (2.6% of GDP), Northern Ireland (2%) and North East England (2%).

The North Sea (Regional Seas 1 & 2) contains some of the world's busiest shipping routes, with significant traffic generated by vessels trading between ports at either side of the North Sea and the Baltic (Figure A1h.2). North Sea oil and gas fields generate moderate vessel traffic in the form of support vessels, principally operating from Peterhead, Aberdeen, Montrose and Dundee in the north and Great Yarmouth and Lowestoft in the south (UKHO 2013), which in turn results in busy port approaches at these locations. Oil related operations to the west of Shetland bring regular traffic into Regional Sea 8.

Similarly, there is traffic associated with the gas fields of the eastern Irish Sea with supply trips operating out of ports including Liverpool, Barrow and Heysham. Within Regional Seas 6 and 7, major routes pass on either side of the Outer Hebrides and in the south, the North Channel has moderate traffic bound for the Firth of Clyde and Irish Sea. There is moderate traffic in a north-south direction through the Irish Sea between lanes which link England and Scotland with the Isle of Man, Northern Ireland and the Irish Republic. The Bristol Channel and Liverpool Bay areas are a moderate source of traffic in Regional Sea 4 and 6 as these areas contain several large ports.

Some of the highest traffic densities are located in routes from the Humber, south to the Thames Estuary (Regional Sea 1), Strait of Dover and English Channel (Regional Sea 3). The density of shipping in the Strait of Dover and eastern English Channel is also exemplified by International Maritime Organisation (IMO) routeing in this area in the form of an extensive traffic separation scheme. Under the terms of Chapter V of the Safety of Life at Sea (SOLAS) Convention, the IMO is the only organisation which establishes such measures, which are put in place to aid navigation of certain ships or ships with certain cargoes and include traffic separation schemes (e.g. Dover Strait), areas to be avoided (e.g. around Orkney and Shetland), deep water routes which are areas surveyed for obstacles (e.g. west of the Outer Hebrides). All UK routeing measures are shown on Figure A1h.2.

In relation to shipping routes and navigational safety, the Maritime and Coastguard Agency (MCA) note MGN 654[1] (replaces MGN 543) provides guidance on UK navigational practice, safety and emergency response issues with regard to Offshore Renewable Energy Installations (OREIs). The note makes a number of recommendations around the themes: considerations on site position, structures and safety zones; and navigation, collision avoidance and communications. A template for assessing the best distance between wind farm boundaries and shipping lanes is also provided. The MCA guidance indicates a number of scenarios with difference spacing of wind farms from shipping lanes, indicating the relative

[1] https://www.gov.uk/government/publications/mgn-654-mf-offshore-renewable-energy-installations-orei-safety-response

tolerability of wind farm distances from lanes. The minimum distance at which risks to shipping would be low, and therefore broadly acceptable, is recommended to be a distance greater than 3.5nm. A number of recommendations are also provided in relation to search and rescue operations, counter pollution or salvage incidents which should be borne in mind during turbine design. Reference is made to the Offshore Renewable Energy Installations, Emergency Response Co-operation Plans (ERCoP), a template for which is provided by the MCA[2], to help renewables developers and operators formulate their emergency response plans.

The availability of ship Automatic Identification System (AIS) data has been variously used to plot shipping routes around the UK (DECC 2009, MMO 2013, MMO 2014a, EMODnet 2019, EMSA 2019). Ship AIS uses Very High Frequency (VHF) transmitters which broadcast a signal at regular intervals providing vessel information which includes: location, identification number, destination, speed and bearing and a timestamp for the message. The information collected by the system is limited by range which may vary between 20nm and 350nm depending on the strength of the transmitter, atmospheric and sea state conditions, and visibility/height of receivers. An average range of 40nm may be expected (MMO 2014), though this terrestrial data may be augmented by satellite derived data (S-AIS). Two classes of AIS data are collected: AIS-A and AIS-B. These are used on larger vessels (gross 300 tonnes or more) and all passenger ships, and the fishing and recreational sailing sectors respectively. AIS data has provided a useful means of creating maps of vessel density (see Figure A1h.2), however it has a number of limitations:

- AIS data may contain errors or contain limited route information where transmissions from individual vessels are infrequent
- Not all vessels carry the AIS system or operate it in a continuous manner
- The range of the AIS system can be limited under a number of conditions, and resulting data can be limited, particularly when only terrestrial data recording methods are used. The AIS-B system has limited power compared to AIS-B to prevent overloading system bandwidth, therefore its range will generally be less than that of AIS-A and perhaps as low as 10nm.

AIS data is typically interpreted (e.g. see EMODnet 2019, EMSA 2019) and mapped as a vessel density grid, which may be by month, year and vessel type. Noting the limitations of the data provided above, the 2019 vessel density grid covering the UKCS based on EMSA (2019) is shown in Figure A1h.2 (note that 2020 is available, however, 2019 data is used to reflect the vessel density prior to the COVID-19 pandemic).

[2] https://www.gov.uk/government/publications/offshore-renewable-energy-installations-orei, https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping#further-information

Figure A1h.1: Major UK ports and relative tonnage of cargo handled, 2019

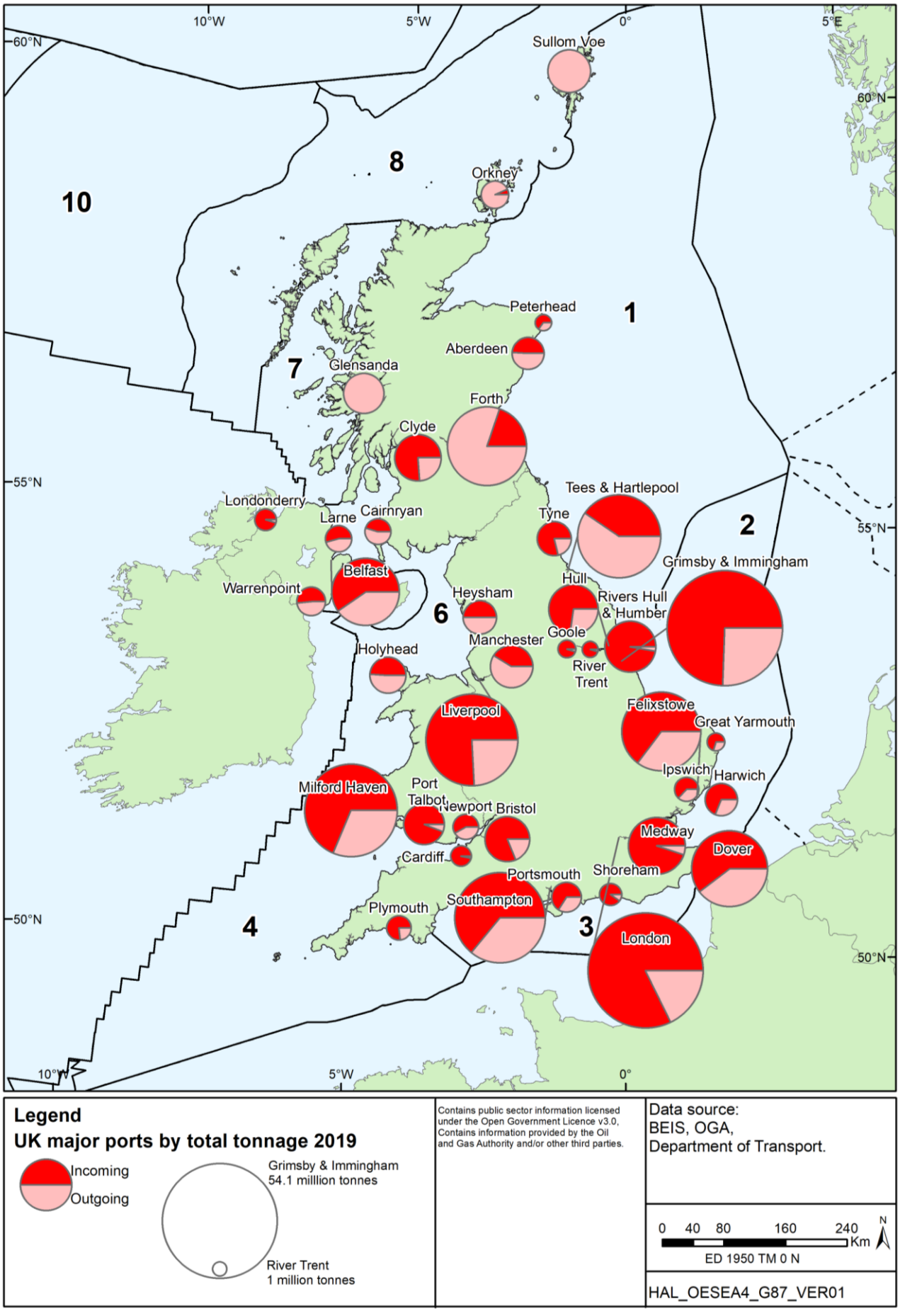


Figure A1h.2: AIS density grid, 2019

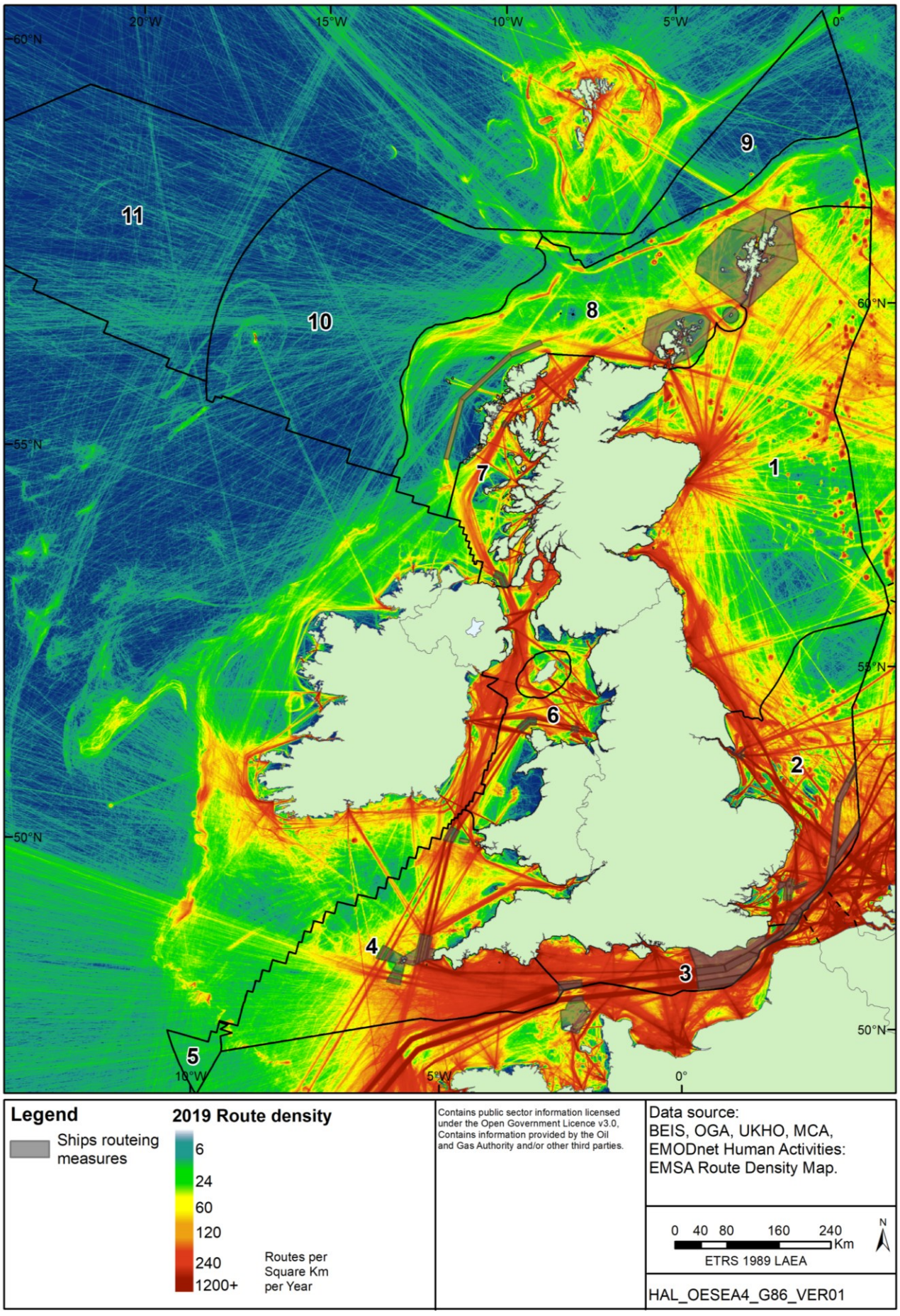
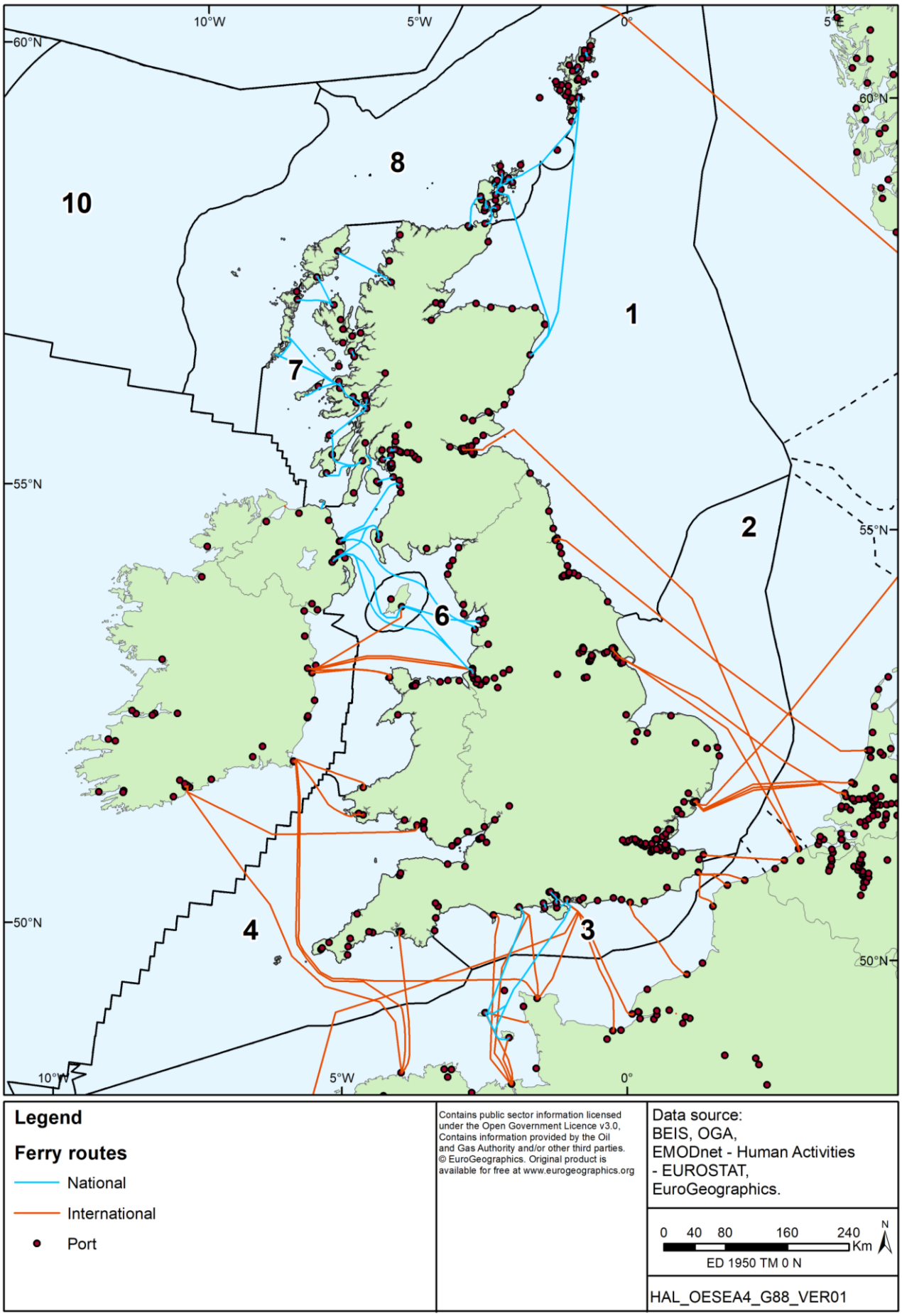


Figure A1h.3: Ferry terminals and indicative ferry routes



A1h.2.3 Anchorages and places of refuge

Safe anchorages are locations around the coast which offer particularly protected environs and good holding ground in which ships can shelter during adverse conditions. UKHO sailing directions and charts provide a comprehensive account of these.

The MCA considers any location around the coast (anchorage or port) a potential place of refuge, which is defined as a location into which a ship in need of assistance can be brought to be stabilised through repair or transhipment of cargo, ultimately averting a pollution incident (see IMO Resolution A.949). Due to the unique nature of each incident, there is no ranking given to any area of refuge, and the identification of an appropriate place of refuge is based on the circumstances of a particular incident, including the prevailing weather and the potential type of threat that is posed.

A1h.2.4 Ferry routes

There are a number of regular internal and national ferry routes around the UK (Figure A1h.3).

Ferry routes within Regional Sea 1 are predominately between Aberdeen and the Northern Isles and Newcastle and Amsterdam, and as well as having routes with starting ports originating in Regional Sea 2, the southern North Sea is traversed by routes emanating from the north and travelling to mainland Europe. Ferries depart from numerous ports along the south coast of England and channel hop to the Channel Islands and several mainland European ports (Regional Seas 3 and 4). In Regional Sea 6 the North Channel is traversed by ferries travelling between Larne and Belfast to Troon or Cairnryan, while the southern half of the Irish Sea sees traffic between English ports and the Isle of Man and Ireland. The Celtic Sea has ferries travelling between Ireland and Wales and Ireland and mainland Europe. There is a complex network of ferry routes in Regional Sea 7 which connects numerous islands (e.g. Islay, Coll, Tiree, the Outer Hebrides) to the Scottish mainland.

Sea passenger statistics are reported annually for the UK by the Department for Transport[3]. The busiest international ferry routes are Dover-Calais, Dover-Dunkirk and Holyhead-Dublin, accounting for 12.7 million out of a total 18 million passengers using international short routes in 2019. The busiest domestic crossings are Cairnryan-Belfast, Cairnryan-Larne, Liverpool-Belfast, and Heysham/Liverpool-Douglas, carrying approximately 2.6 million passengers in 2019.

A1h.2.5 Recreational sailing

Recreational boating takes place ubiquitously along the coast of the UK though there are some notable areas of high usage. In response to the lack of information highlighted by the Round 2 Wind Strategic Environmental Assessment (SEA), the Royal Yachting Association (RYA), supported by the Cruising Association, began identifying cruising routes, general sailing and racing areas around the UK. This initial work published in, *Sharing the wind* (RYA & CA 2004), was based on extensive consultation and qualitative data collection from RYA and Cruising Association members. The RYA was then commissioned by the DTI (now BEIS) as part of the SEA process, to produce a report describing the recreational boating use within Regional Sea 6 (RYA 2005). The 2019 UK Coastal Atlas of Recreational Boating represents the latest version of the RYA atlas. The rotues depicted are now based on AIS data, which are accompanied by point data showing the location of RYA clubs, training centres and marinas.

[3] https://www.gov.uk/government/collections/maritime-and-shipping-statistics

A1h.2.6 Marine Environmental High Risk Areas

Following the *Braer* oil spill (5th January 1993), the Donaldson Inquiry of 1994 proposed the establishment of Marine Environmental High Risk Areas (MEHRAs) to protect marine areas of high environmental sensitivity at risk from shipping. An assessment was carried out to identify the environmental sensitivity of the UK coastline and coastal waters. Thirty-two MEHRAs have been established covering approximately 9% of the UK coastline. The location of these is indicated by markings on UK Hydrographic Office charts and through Notices to Mariners, and Marine Guidance Notices issued by the Maritime and Coastguard Agency[4].

A1h.3 Aviation

Certain civilian and military aerodromes and technical sites are officially safeguarded to ensure that their operation is not compromised by developments such as wind farms. Safeguarding maps produced for civilian sites indicate areas within which consultation is required before a development takes place (see Figure A1h.4). A 30km buffer delineates the area for which a local planning authority is required to consult the relevant aerodrome regarding any wind turbine proposal. This buffer reduces to 17km for aerodromes which are non-radar equipped and with a runway of 1,100m or more, and 5km for which are non-radar equipped and with a runway of less than 1,100m. These buffers are used to prompt discussion and do not present definitive distances within which developments will be opposed (CAA 2016). The safeguarding of military technical sites is conducted on a case-by-case basis. Similar effects can generate operational problems for air traffic services in the UK which are provided by NATS En-Route Ltd. (NERL). NERL has made available self-assessment maps[5] which indicate where turbines with blade tip heights of 20-200m would be within line of sight of at least one primary surveillance radars operated or used by NERL. The above buffers and self-assessment maps are indicative and for guidance only, and do not affect the consultation requirements for formal planning applications set out in *The Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosive Storage Areas) Direction 2002* (see Figure A1h.4).

There has been some progress in developing a technical solution to radar interference. NERL has worked with Raytheon, its radar manufacturer, to develop a commercial solution (Project RM), however applications to date have not achieved the expected levels of mitigation. Other mitigation to date has included the use of Range Azimuth Gating (RAG) and Transponder Mandatory Zones (TMZs). RAG can be used to remove radar returns from wind turbines, but also removed primary radar returns from within the “blanked” area. To further mitigate this, a TMZ can be established, so that only aircraft with a transponder, and therefore detectable to secondary radar, will be permitted to overfly the wind farm subject to RAG.

The Windfarm Mitigation for UK Air Defence programme is providing funding via BEIS’s Net Zero Innovation Portfolio through a series of commercial competitions to look at alternative technologies and solutions to interference by offshore wind on defence radar. The programme is a partnership of BEIS, the RAF, Defence Science and Technology Laboratory and the Defence and Security Accelerator.

A 9nm consultation zone exists around offshore oil and gas surface infrastructure within which wind farm developers must engage with helicopter and installation operators (CAA 2016). Development is not precluded within such areas, but consultation between the relevant parties

[4] https://www.admiralty.co.uk/AnnualNMs/26.pdf
[5] https://www.nats.aero/services-products/catalogue/n/wind-farms-self-assessment-maps/

is encouraged to avoid conflict. Helicopter final approaches are into the wind and so may be from any direction, and commence at approximately 5-6nm around installations at a height of 1000-1500ft, achieving 200ft during the day and 300ft during the night by 2nm of the destination. There are therefore potentially additional aviation related constraints associated with offshore oil and gas surface infrastructure within these distances, and the CAA have formerly indicated the need to maintain a 6nm radius obstacle-free zones around installations to ensure helicopter activities are not impacted during routine flights, Missed Approach Procedures (MAP) and in emergency evacuations (see CAA 2016). Wind turbine placement may impact on helicopter activities within 9nm of an installation in a number of ways, such as steeper and quicker descents, more complicated platform rescue operations and economic impacts and possible cessation of viable helicopter activity.

Consultation zones are primarily distributed in the North Sea, west of Shetland and eastern Irish Sea, coincident with oil and gas infrastructure (Figure A1h.4). Note that as decomissioning progresses, the number of consultation zones will reduce accordingly. In addition to helicopter destinations, Helicopter Main Routeing Inidicators (HMRIs, formerly Helicopter Main Routes, HMRs)[6] have been used in the North Sea and Morecambe Bay for a number years, obstacles to which could result in effects on helicopter traffic including increased flight height which might be limited by freezing levels. The CAA indicates that there should be no obstacles within 2nm of HMRIs.

Helicopter based Search and Rescue (SAR) operations are coordinated from 10 bases throughout the UK, operated by Bristow Helicopters Ltd under contract managed by the Maritime and Coastguard Agency (MCA). The service operates 21 helicopters, with Sikorsky S92 helicopters operating from Stornoway, Sumburgh, and new bases at Newquay, Caernarfon and Humberside airports. AgustaWestland AW189 helicopters operate from Lee on Solent, Prestwick airport, and new bases at St Athan, Inverness and Manston airports (Figure A1h.5). These helicopters have an operational radius of 250nm and 200nm respectively. The UK SAR also employ four fixed wing aircraft surveillance aircraft operated by 2Excel. Bristow's contract to provide SAR services is due to end in 2024, and the future provision of UK SAR capabilities is presently being reviewed through the Second generation UK search and rescue aviation programme (UKSAR2G)[7]. MCA requirements in relation to offshore renewable installations and SAR response were most recently updated in November 2021[8].

[6] As defined in the UK AIP: https://www.aurora.nats.co.uk/htmlAIP/Publications/2021-04-22-AIRAC/html/index-en-GB.html
[7] https://www.gov.uk/government/publications/second-generation-uk-search-and-rescue-aviation-programme-uksar2g
[8] https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping#offshore-renewable-energy-installation-impact-on-navigational-safety-and-emergency-response

Figure A1h.4: Possible aviation related constraints

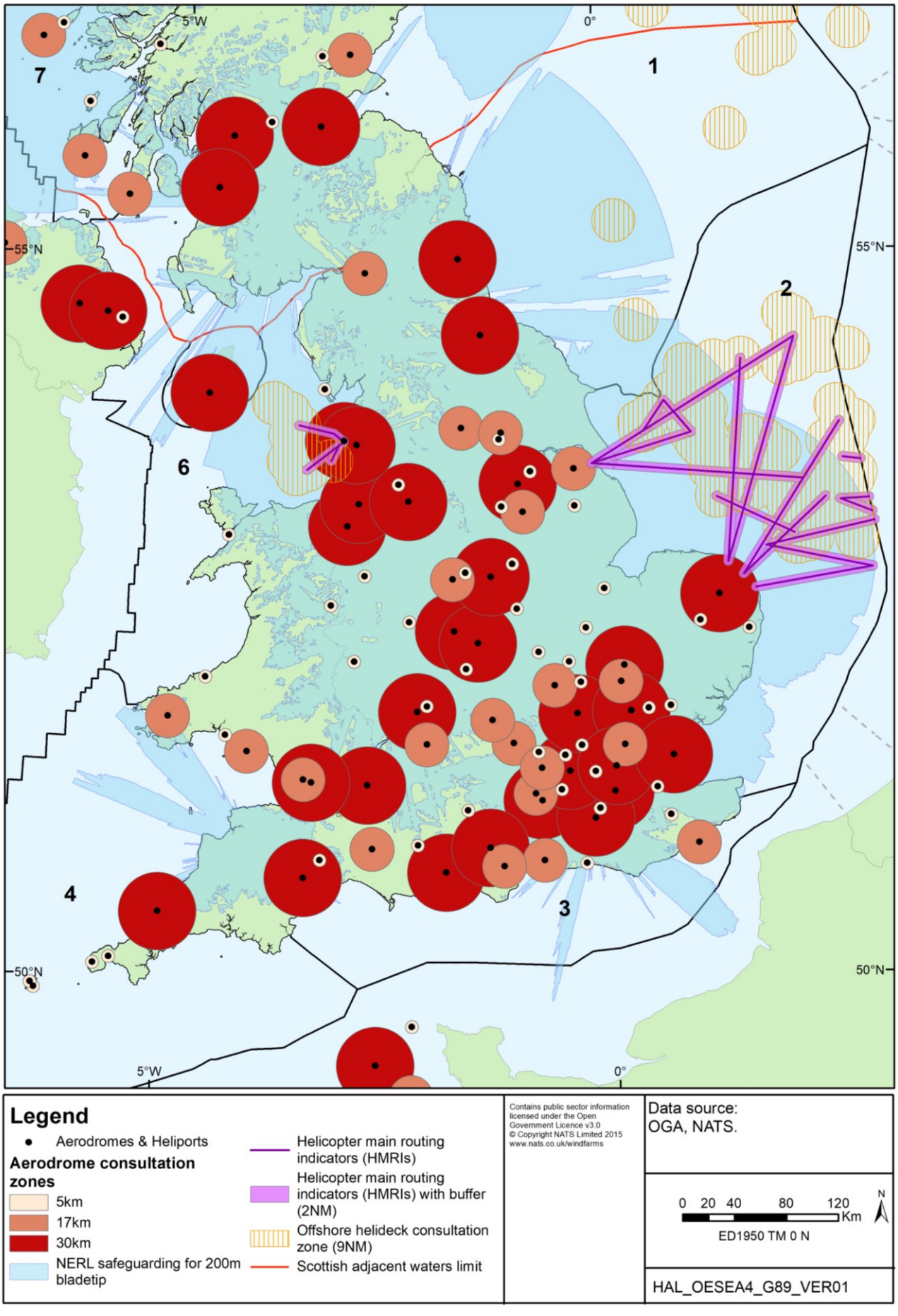
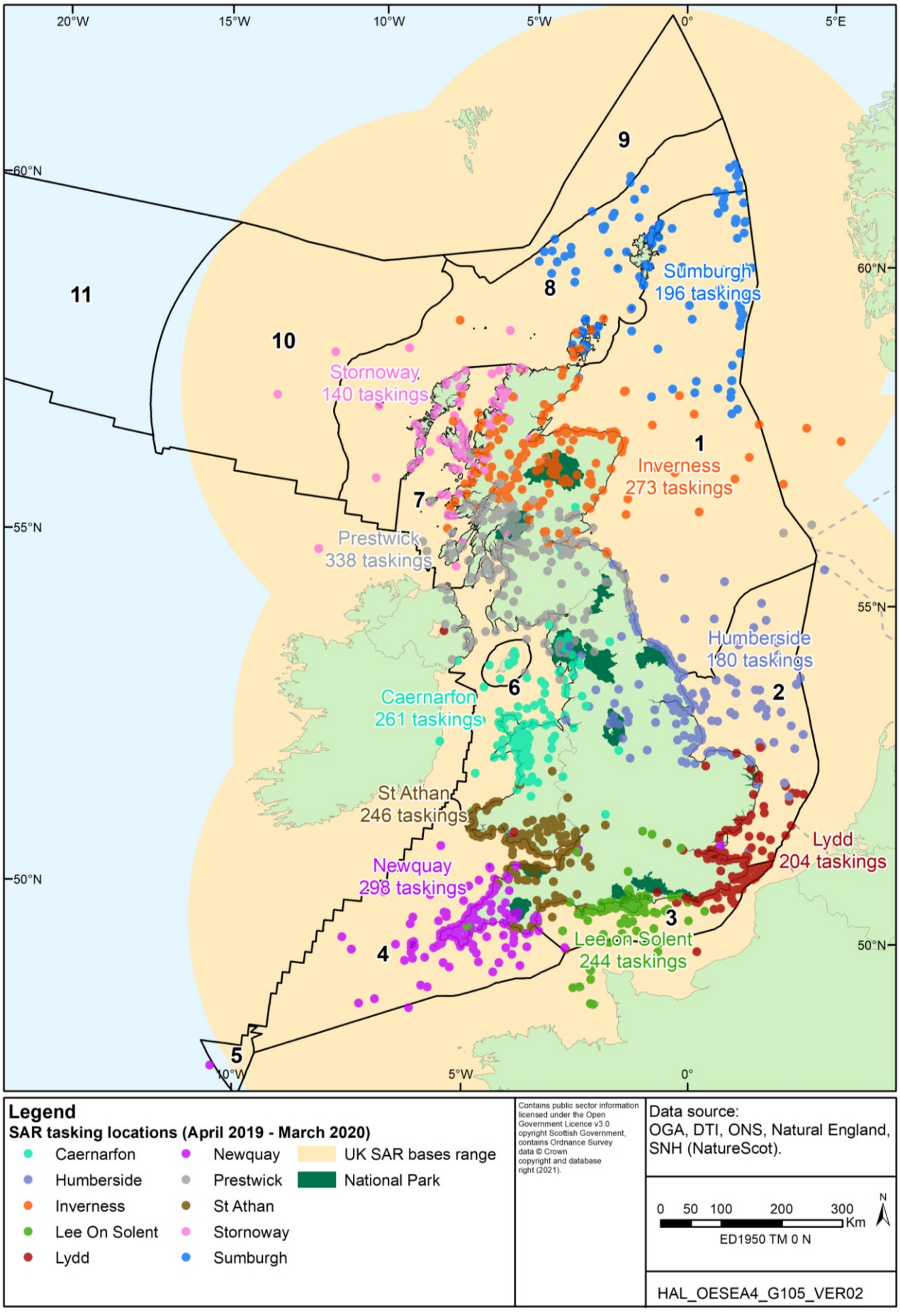


Figure A1h.5: UK Search and Rescue (SAR) helicopter response bases



A1h.4 Military activity

Practice and Exercise Area (PEXA) charts, produced by the UK Hydrographic Office, provide information relating to military activity within the UKCS. These are kept up to date through the Admiralty Notices to Mariners service and show areas which are in use, or available for use by the Ministry of Defence for military practice and exercises. PEXA designations occur in every Regional Sea with a coastline and in Regional Sea 10 (Figure A1h.6). The presence of a PEXA does not preclude other activities except for some danger areas marked with the prefix D where airspace restrictions apply and where live firing may take place (indicated on Figure A1h.6). The Marine Policy Statement indicates that marine activities must not prejudice defence and national security interests – planning and consultation between those wishing to undertake offshore activities and the MoD should help to minimise any conflicts of interest where PEXAs exist. Further guidance and information for developers is provided at the regional scale through the marine planning process.

The UK low flying system (LFS) allows training within the whole of the UK airspace and seas out to 3nm from the shore, and encompasses a vertical distance from ground level to 2,000ft. No designated Tactical Training Areas are present over the sea, these being restricted to areas of central Wales, northern Scotland and the Borders, and within which fixed wing aircraft may travel at between 100 and 150ft depending on their size.

The MoD (2014), updated in 2020[9], have provided guidance on the lighting of offshore wind farms, however CAA (i.e. CAP764), MCA (MGN 654) and Trinity House requirements exceed the guidance provided in most cases, which is a combination of visible and infrared (IR) lighting.

Military radar, like civilian radar, may suffer from degraded performance due to wind farm operations (see sections above). It was previously MoD policy not to let any wind farm development take place within 74km of Air Surveillance and Control Systems (ASACS) if it would be in the direct field of view (Figure A1h.7), however, in June 2011 an agreement between the MoD and wind developers led to the procurement of a TPS-77 radar that provided mitigation from the effects of wind farms located at Remote Radar Head (RRH) Trimingham. Following on from this, two further upgrades were installed at RRH Saxton Wold (now moved to Saxa Vord, Shetland), RRH Brizlee Wood, and RRH Buchan in Scotland. Concerns raised by the MoD in recent consent applications are noted, and there is a continued need for additional technical mitigation measures. The Windfarm Mitigation for UK Air Defence programme [10] is presently in its second phase and has awarded contracts to develop some of the radar mitigation solutions developed in its first phase, which will be applicable to both military and civilian radar.

[9] https://www.renewableuk.com/resource/collection/0B792CF1-8B8A-474B-95B6-17886BF724A7/20190002-Windfarm_lighting_review__002_.pdf

[10] https://www.gov.uk/government/publications/air-defence-and-offshore-wind-working-together-towards-net-zero/air-defence-and-offshore-wind-working-together-towards-net-zero, https://www.thecrownestate.co.uk/en-gb/media-and-insights/news/2021-government-and-industry-led-taskforce-unlocks-new-opportunities-for-offshore-wind/

Figure A1h.6: PEXAs in UK waters

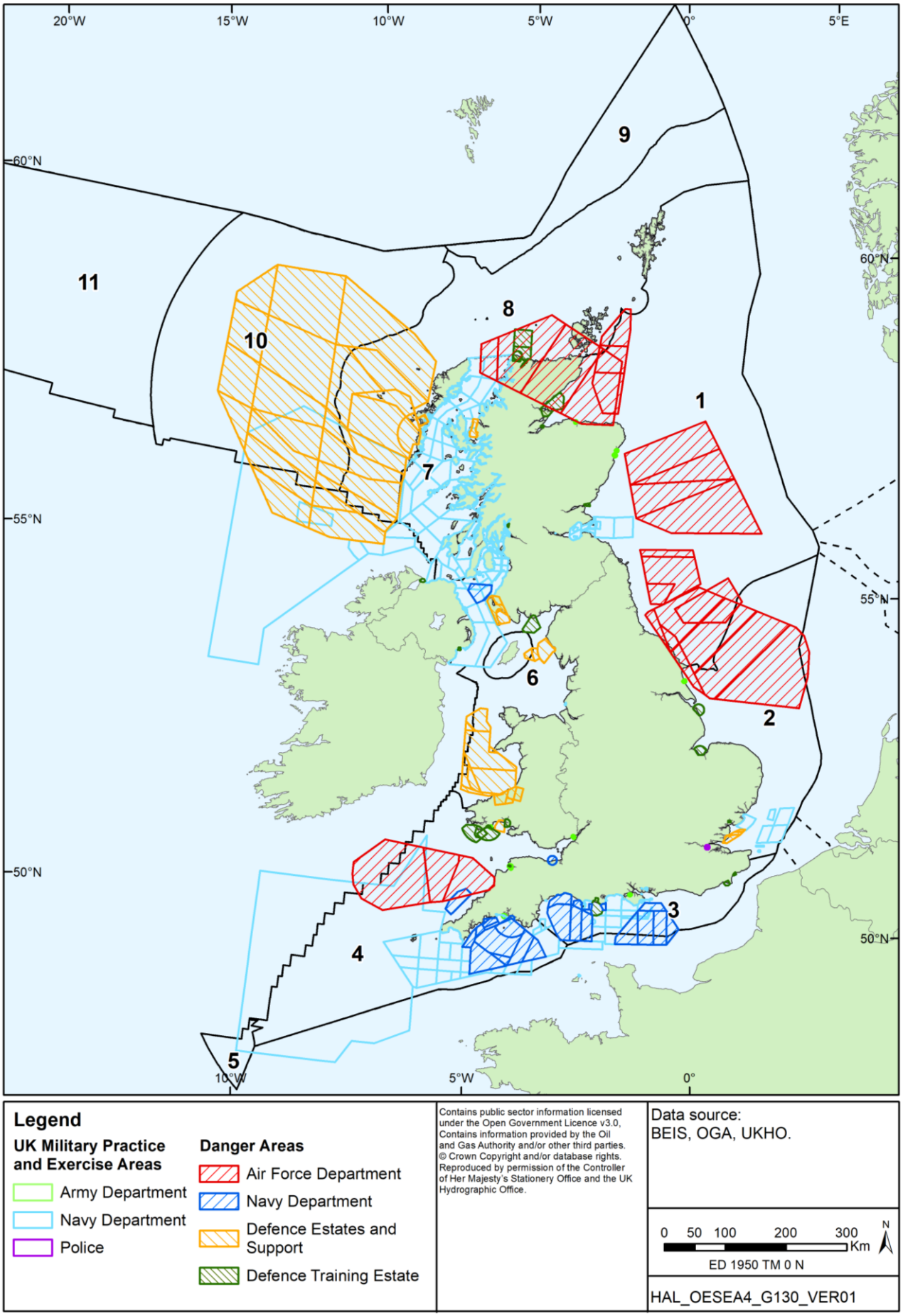
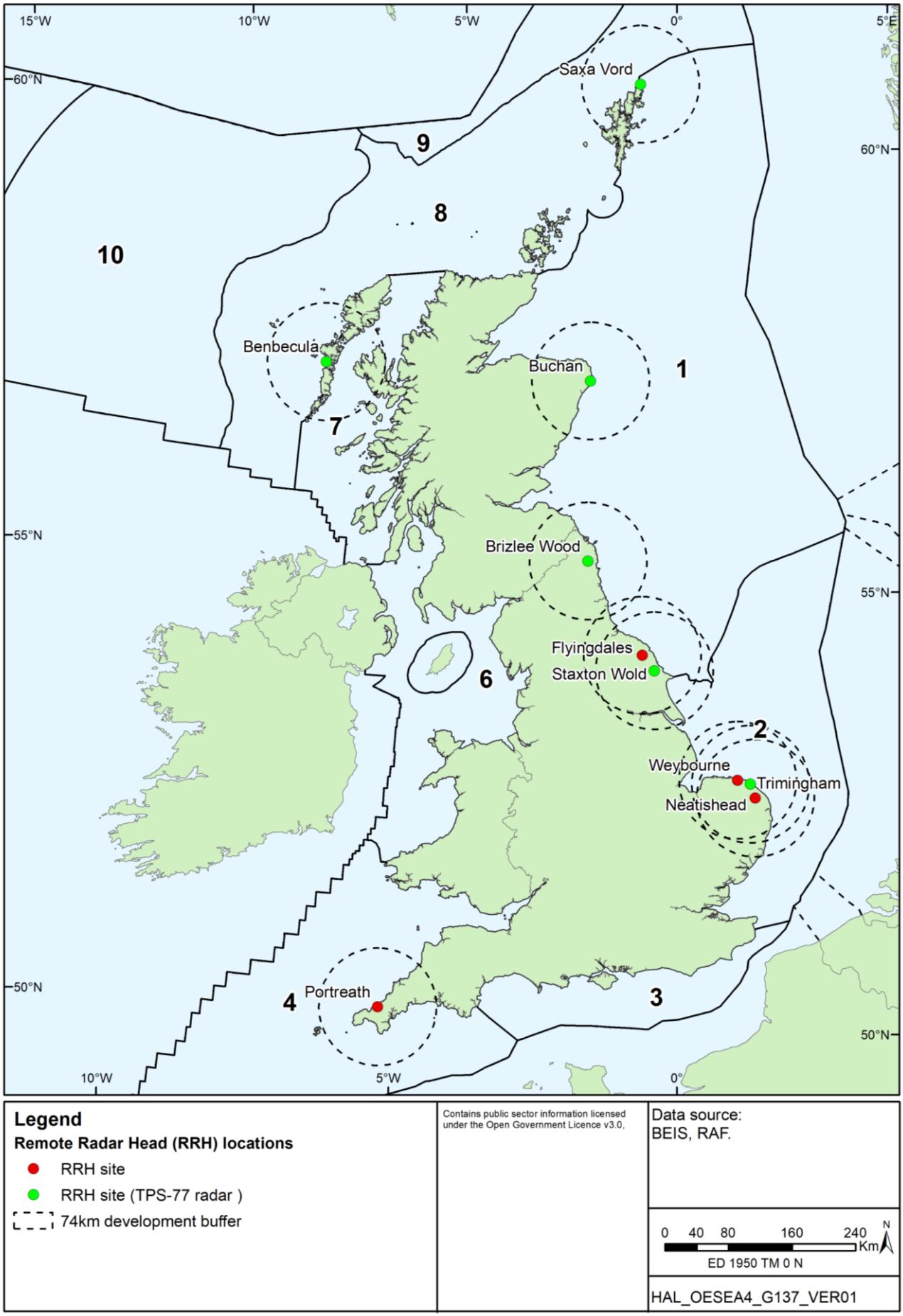


Figure A1h.7: Military radar sites contributing to UK ASACS



A1h.5 Met office radar

The Met Office uses a number of radio communication and remote sensing techniques to inform the public weather service and to provide meteorological information to a range of other stakeholders including to aviation, road, rail and maritime users, defence, civil contingency services and utilities. Like other radar, impositions from structures, particularly wind farms, can generate potential interference (Met Office 2012). The Met Office engages in the consultation process of planning applications to ensure proposals are appropriately assessed and mitigated against, with weather radio and meteorological stations being safeguarded[11]. For the types of radar operated by the Met Office (C-Band) it was recommended by the Operational Programme for the Exchange of weather RAdar information (OPERA), see Met Office (2012), that turbines should not be located within 5km of a radar antenna, and that an impact study should be undertaken for proposals within 20km, recommendations were adopted by the Met Office (see Figure A1h.8) – also see Hall *et al.* (2016) who note the potential for impacts at greater distance. Additional meteorological stations are also safeguarded but the distance from these for which there is concern related to the siting of wind farms is variable (also shown on Figure A1h.8). These concerns are primarily in relation to onshore development, however, some consultation zones reach the coast or overlap small areas of nearshore waters and are noted here for completeness.

A1h.6 Oil and gas activity

Oil and gas related activities are chiefly centred on the southern, central and northern North Seas (Regional Seas 1, 2 and 8), west of Shetland (Regional Seas 8, 9 and 10), and the eastern Irish Sea (Regional Sea 6) – Figures A1h.9 and 10.

In the central and northern North Sea (Regional Sea 1 but also eastern parts of Regional Sea 8, see Figure A1h.9), oil is the dominant hydrocarbon resource produced. Production in Regional Sea 1 is primarily located on a north-south axis along the median line from quadrants 29-30 in the south to 11 in the west (Moray Firth), reaching quadrant 211 in the far north and east of Shetland. Quadrants 204, 205 and 206 in Regional Sea 8 include the Foinaven, Schiehallion, Lancaster, Solan and Clair oil fields as well as the Laggan and Tormore gas condensate fields in quadrants 205 and 206 on the boundary with Regional Sea 9. In Regional Sea 2, gas developments predominate with a comprehensive network of installations and pipelines in quadrants 43, 44 and 47-49. In Regional Sea 6, gas is the predominant hydrocarbon resource produced from the East Irish Sea basin from quadrants 110 and 113 (see Figure A1h.10). Oil is currently only produced from the Douglas Field in Quadrant 110.

A substantial array of fixed surface infrastructure is associated with oil and gas production which includes production and accommodation platforms and numerous FPSOs. Pipelines carrying oil, gas, condensate and other chemicals connect these fields to coastal infrastructure (see Figures A1h.9 and A1h.10). Major pipeline landfalls in Regional Sea 1 include those at Sullom Voe, Shetland and the Flotta terminal, Orkney. St Fergus gas terminal in north-east Scotland is one of the largest in the UK and is supplied from installations in the central and northern North Sea, including the East Shetland Basin, and also from the Norwegian Sector. The Ineos-owned Forties Pipeline System extends from the Forties Charlie platform, via the Forties Unity Platform, to Cruden Bay in Aberdeenshire, and constitutes one of the most

[11] https://www.metoffice.gov.uk/services/business-industry/energy/safeguarding

substantial pipeline systems in the North Sea. Gas pipelines serving the platforms of the southern North Sea connect to terminals at Bacton and Easington/Dimlington (Regional Sea 2). In Regional Sea 6, gas pipelines connect to Barrow-in-Furness and Point of Ayr gas terminals with oil sent to an offshore storage installation.

The oil and gas fields of the UKCS are at a mature stage of development, many fields having been discovered in the 1960s and 1970s. Hydrocarbon resources in UK waters are steadily declining and decommissioning of infrastructure is an area of growing importance. In the 1990s, the UK changed from an energy net importer to a net exporter, with government policy designed to maximise production from domestic reserves. To achieve this end, the licensing system was reformed with the introduction of two new licences: i) the 'promote' licence and ii) the 'frontier' licence. UK oil & gas production peaked in 1999 with an overall decline thereafter resulting in the UK becoming a net importer of gas in 2003 and of oil in 2004. Reductions in production levels and exploration activities on the UKCS in the early 2000s led to the Wood Review in 2013 which set out a number of recommendations that were accepted by government, including maximising economic recovery, and the creation of the Oil & Gas Authority (OGA). Net imports of crude oil have generally declined since 2012, with the exception of 2017 which saw an increase. The UK became a net exporter of crude oil again in 2020, for the first time since 2014, following a sharp decline in demand and also in crude oil imports (see Figure A1h.11). Government revenues from UK oil and gas production were £248 million in the tax year 2020 to 2021, a drop of 71% on the previous year which was largely related to average oil prices being at their lowest levels since 2004-2005[12]. Figures for 2020 are anomalous due to the economic impacts of the COVID-19 pandemic.

[12] https://www.gov.uk/government/statistics/government-revenues-from-uk-oil-and-gas-production--2/statistics-of-government-revenues-from-uk-oil-and-gas-production-july-2021

Figure A1h.8: UK weather radar stations and related consultation zones

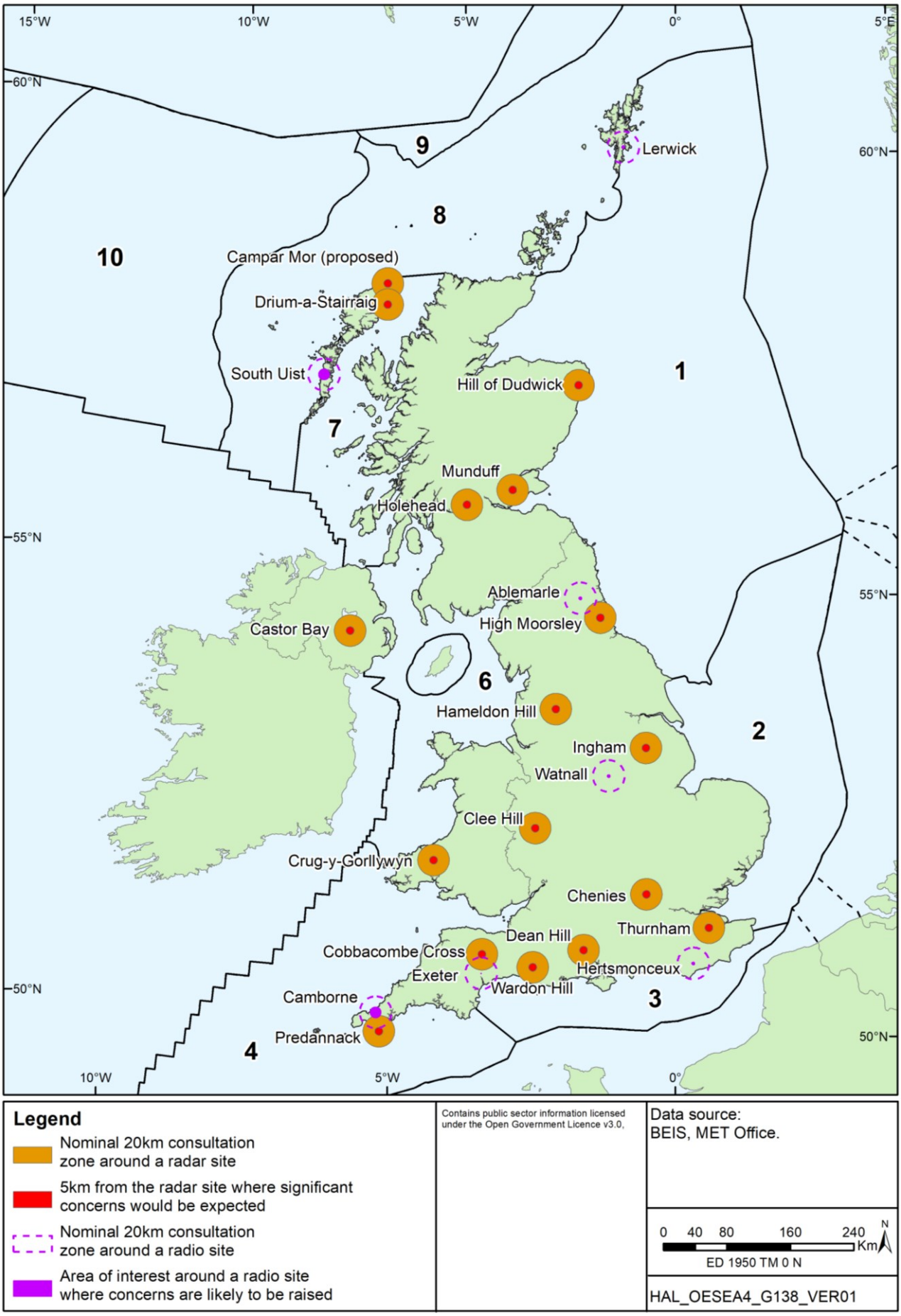


Figure A1h.9: Oil and gas infrastructure (north)

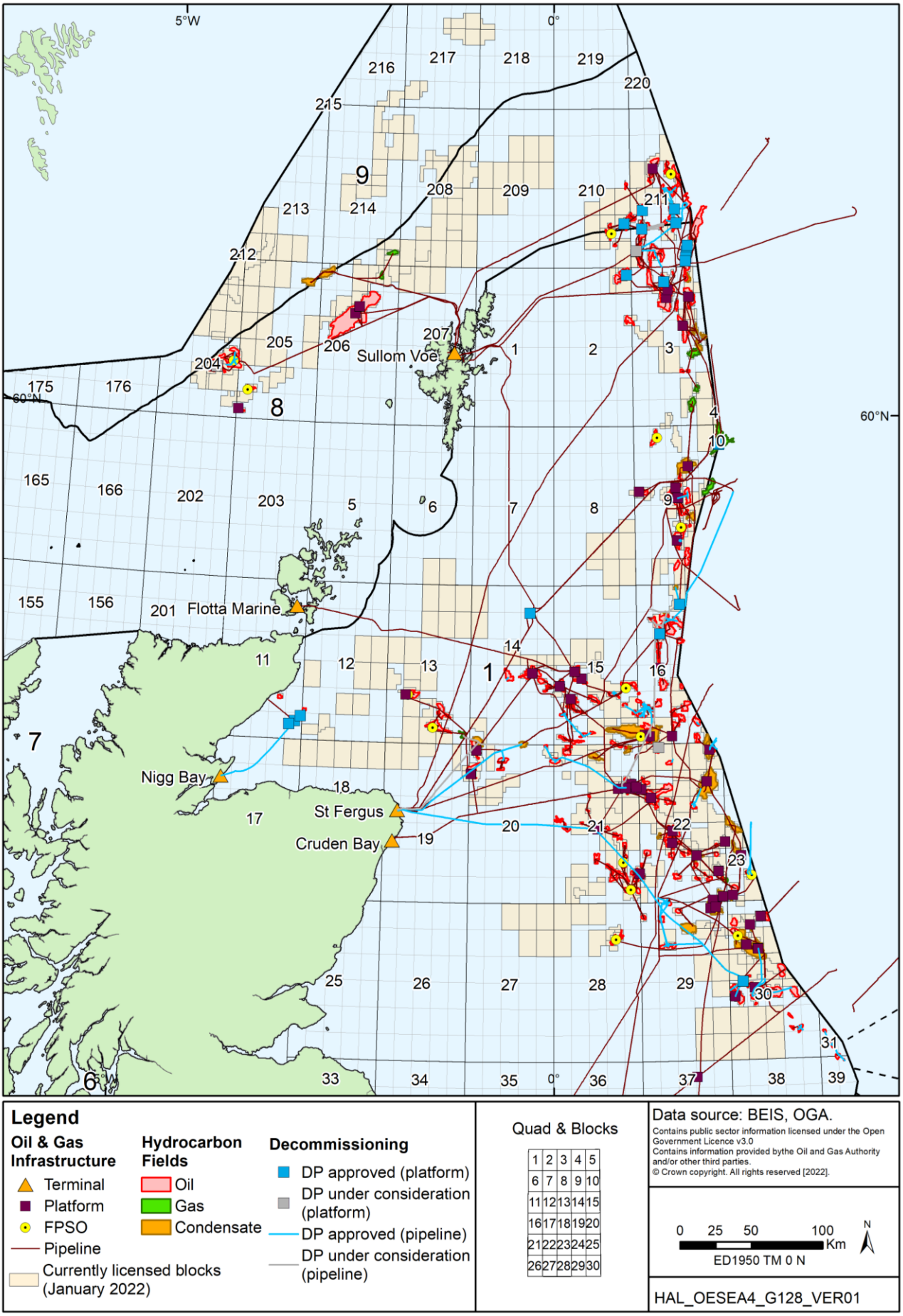


Figure A1h.10: Oil and gas infrastructure (south)

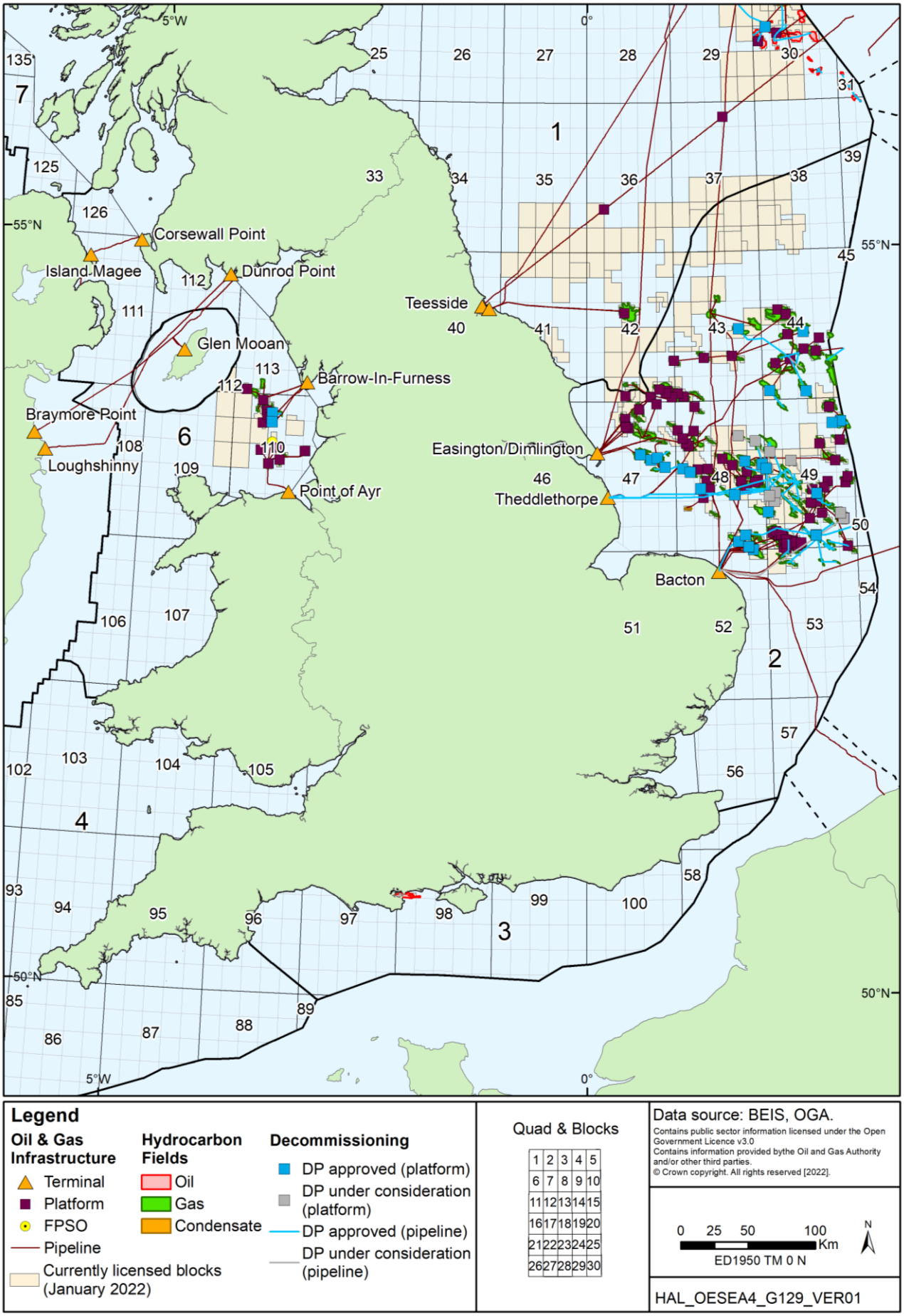
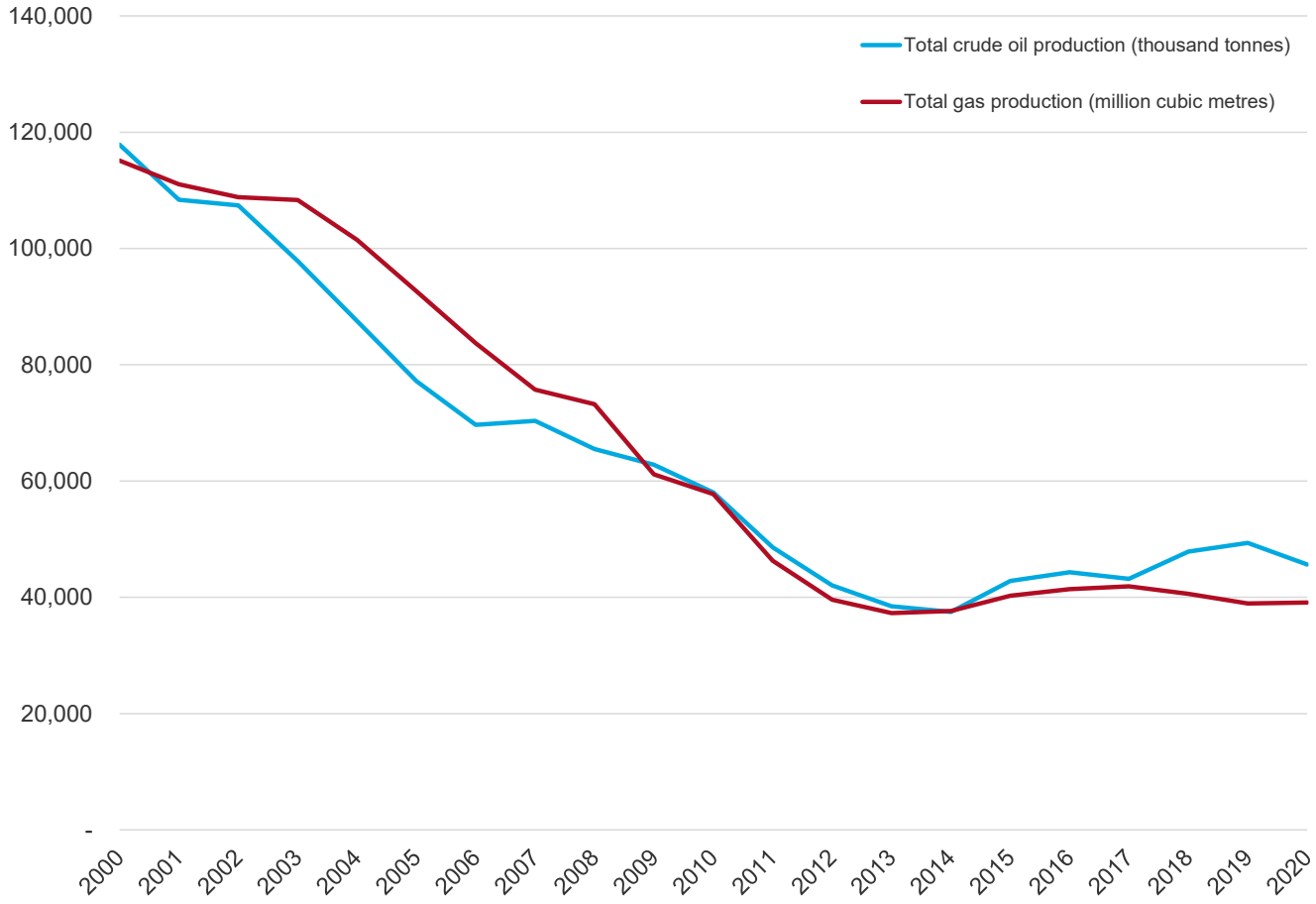


Figure A1h.11: Total crude oil and gas production from the UKCS, 2000-2020



Note: Total crude oil production includes offshore production, total terminal receipts and extended well tests and does not include natural gas liquids. Total gas production includes dry gas and associated gas.
Source: DUKES F.1 Crude oil and Natural Gas Liquids production (https://www.gov.uk/government/statistics/petroleum-chapter-3-digest-of-united-kingdom-energy-statistics-dukes) and DUKES F.2 Gas production (https://www.gov.uk/government/statistics/natural-gas-chapter-4-digest-of-united-kingdom-energy-statistics-dukes).

A1h.6.1 Drilling activity on the UKCS

Exploration and appraisal (E&A) drilling has been declining since the beginning of the financial crisis in 2008 (see Figures A1h.12 and A1h.13), with development drilling (Figure A1h.14) similar declining over the same period. The majority of E&A wells drilled in the period 2000-2020 were in the central North Sea (Regional Sea 1).

Figure A1h.12: Exploration drilling on the UKCS, 2000-2020

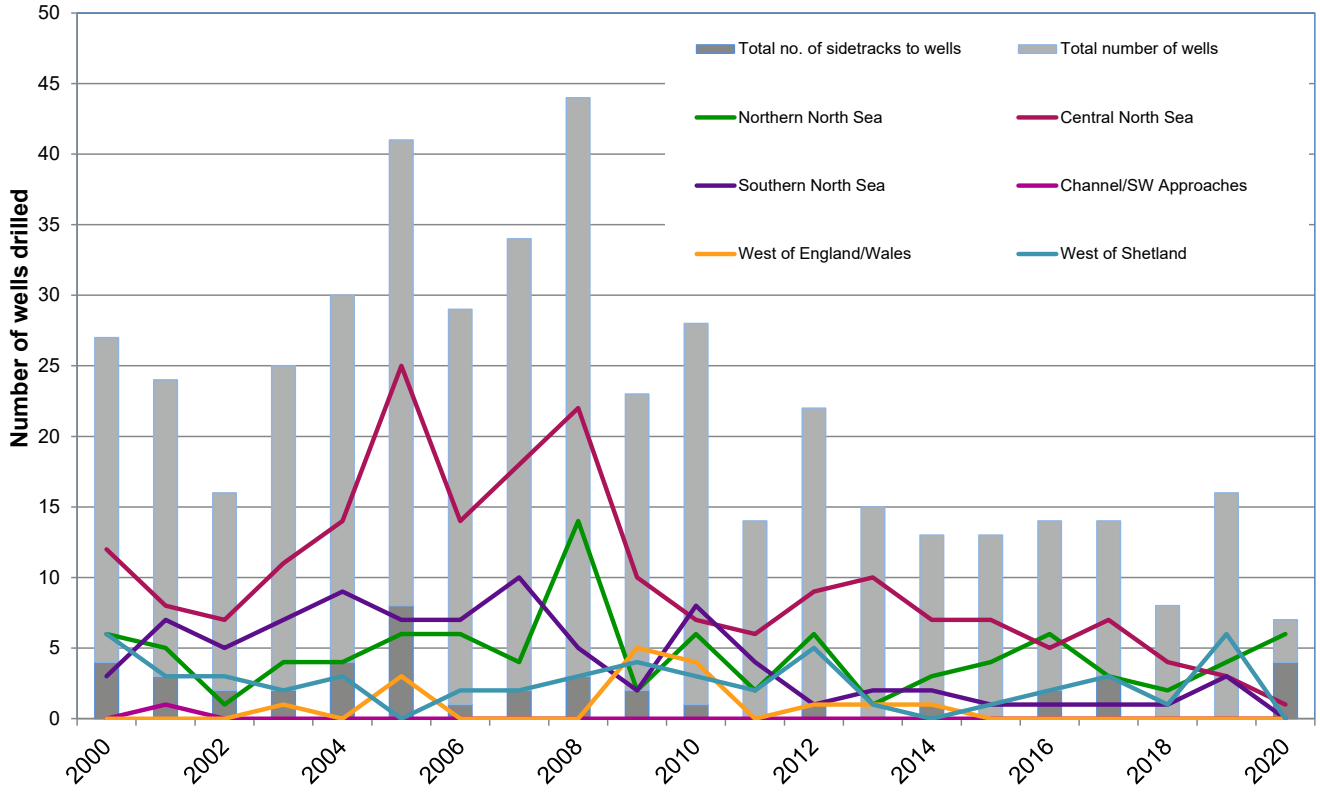


Figure A1h.13: Appraisal drilling on the UKCS, 2000-2020

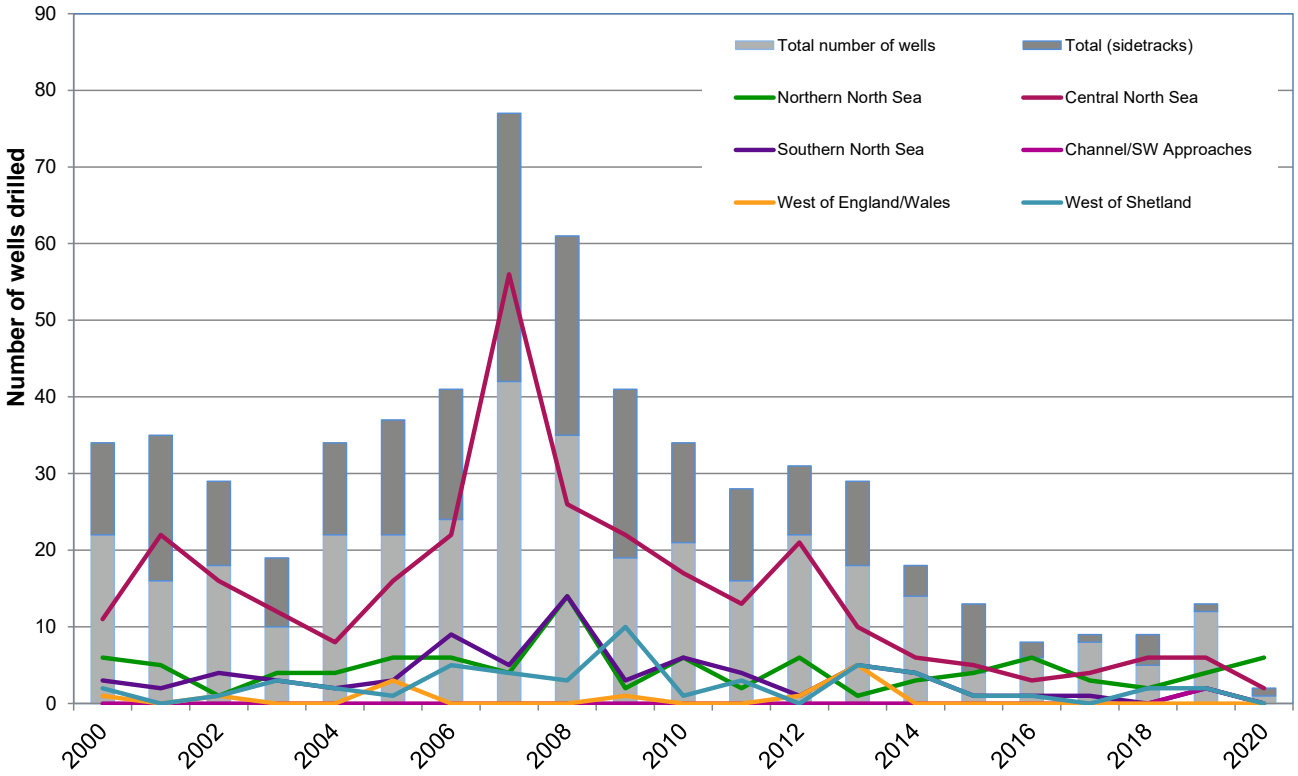
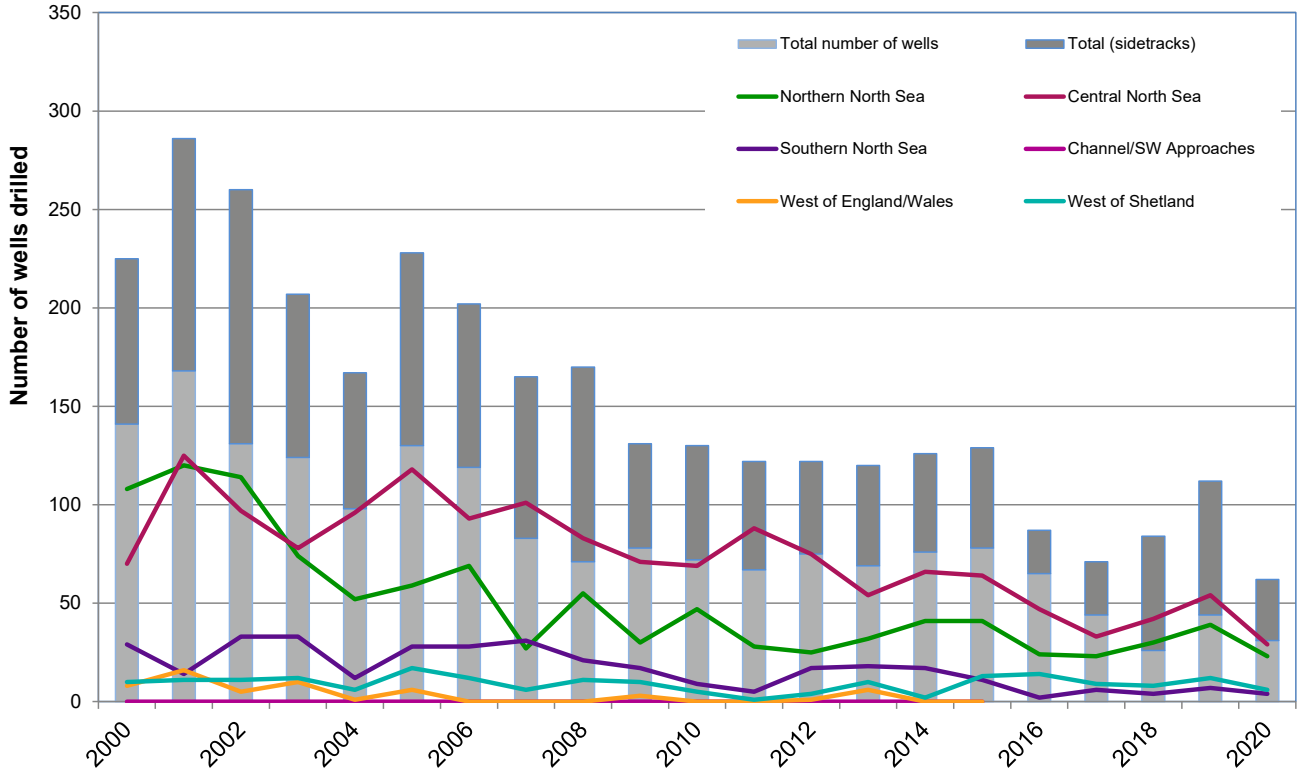


Figure A1h.14: Development drilling on the UKCS, 2000-2020

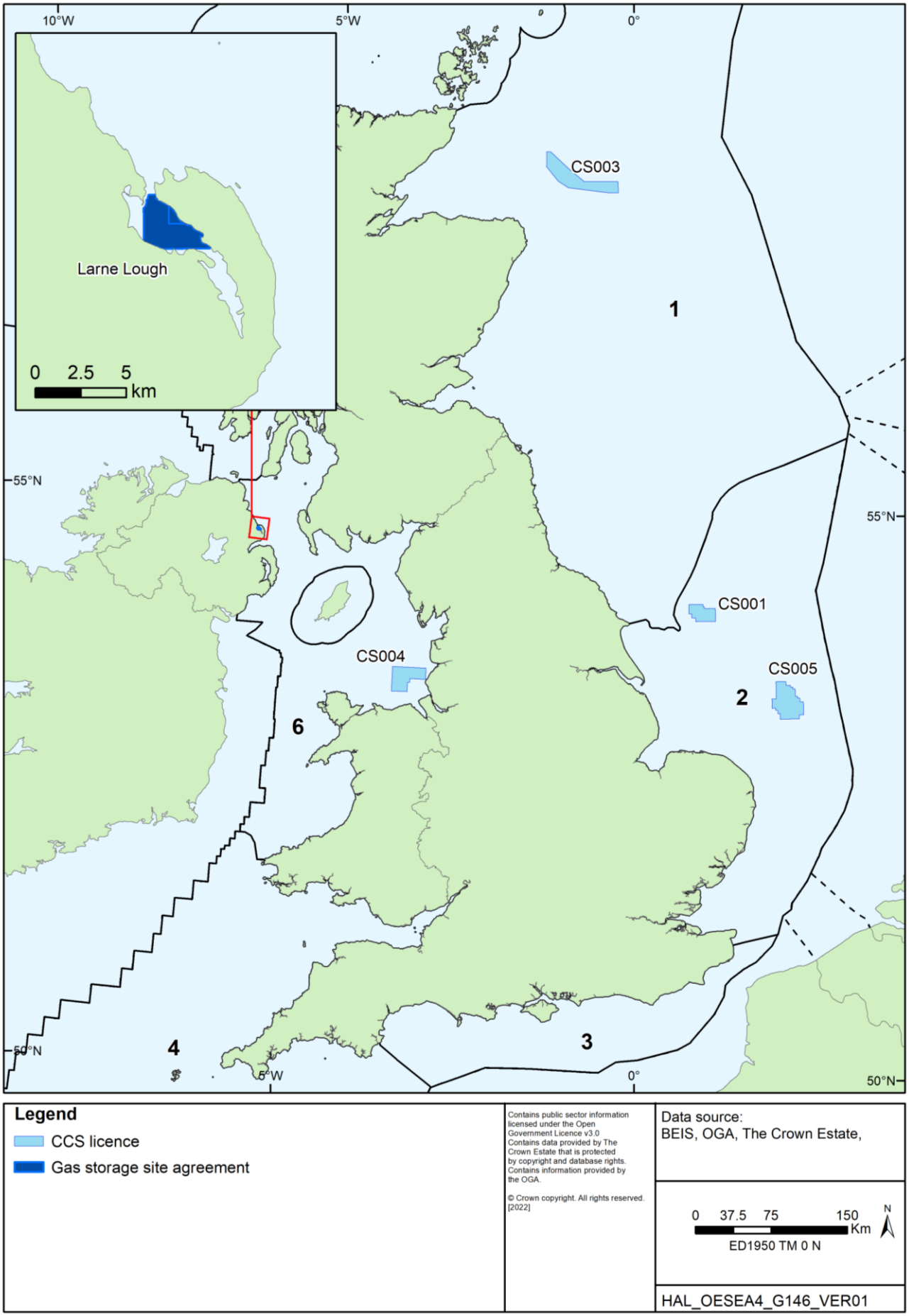


A1h.7 Gas storage, including carbon dioxide

The use of geological formations (depleted hydrocarbon reservoirs, saline aquifers and halite deposits) for the storage of carbon dioxide produced from power generation and industrial processes is currently at an early stage of development, and no storage sites are yet operational. A number of licence/lease applications have been made in recent years (Figure A1h.15) initially covering an appraisal term to assess the viability of formations for geological storage in advance of submitting a storage permit application and related assessments (e.g. EIA). To date, projects have been proposed for storage in depleted hydrocarbon reservoirs (e.g. the Acorn CCS project, and ENI's licence covering the Hamilton, Hamilton North and Lennox fields in the east Irish Sea) and a saline aquifers (e.g. the former Yorkshire and Humber CCS Transportation and Storage Project, and now those projects associated with the Northern Endurance Partnership).

There are presently no offshore natural gas storage facilities in the UK following the closure of Rough in 2017. There have been a number of proposals for new gas storage facilities in the last decade (e.g. Gateway Storage in the Irish Sea, and the Baird and Deborah storage projects in the North Sea), however, none of these projects has been taken forward, and there are presently no leases for gas storage on the UKCS.

Figure A1h.15: Carbon dioxide and gas storage lease/licence areas



A1h.8 Offshore renewable energy activity

A1h.8.1 Wind

Table A1h.1 and Figure A1h.16 shows the status of the offshore wind developments in UK waters. To date, offshore wind development has followed a series of leasing rounds by The Crown Estate for areas of the seabed for commercial development. The responsibility for offshore wind leasing rounds in Scottish waters was transferred to Crown Estate Scotland in 2017, with the most recent round ScotWind, related to the Scottish Government's sectoral wind plan. The cumulative installed offshore wind capacity located on the UKCS is shown in Figure A1h.17 against which the major leasing rounds are noted. A brief history of UK offshore wind leasing is provided below:

- Round 1 was launched in 2001 and is now complete. It involved 18 sites in England and Wales, and added a capacity of ~1.7GW.
- In 2003, the Round 2 was launched with areas located further offshore and in deeper waters. It was formed of the three strategic areas; Greater Wash, Greater Thames and Irish Sea. Developments associated with the round are all but complete (Triton Knoll is presently under construction), and have added another 6.2GW of capacity.
- In 2010 The Crown Estate announced the award of development rights to four Round 1 and Round 2 sites to extend their geographical areas.
- Round 3 commenced in 2010 and featured nine zones across the UKCS. Projects relating to this round are substantially larger than those in Round 1 or 2. The first completed projects to arise from the round were Rampion and Hornsea One. The majority of the remaining projects associated with the Round have been consented or are awaiting consent decisions.
- In addition to Rounds 1, 2 and 3, there was a development programme in Scottish Territorial Waters overseen by the Scottish government. Consented projects under the Round have a collective capacity of 1.8GW.
- In 2013, The Crown Estate announced a leasing round for testing and demonstration of emerging offshore wind technologies.
- In 2017 The Crown Estate launched an opportunity for existing wind farms to apply for project extensions. Seven projects in English and Welsh waters were selected with a potential additional capacity of 2.85GW.
- Round 4 offshore wind leasing was launched in 2020, with six potential projects selected which could result in just under 8GW of capacity.
- ScotWind leasing commenced in 2021 and covers new offshore wind in Scottish territorial and offshore waters. Initially up to 10GW of installed capacity was anticipated, however, initial option agreements cover nearly 25GW.
- The Crown Estate announced a leasing process for commercial scale (~300MW) floating turbine projects in the Celtic Sea in 2021.
- An Innovation and Targeted Oil and Gas (INTOG) leasing round is anticipated to be launched by Crown Estate Scotland to enable developers to apply for tights to build

offshore wind farms specifically to assist in decarbonising upstream offshore oil and gas activities.

Table A1h.1: Current status of UK offshore wind developments (January 2022)

Wind farm	Location	Round	Capacity (MW)	Number of turbines	Status
Regional Sea 1					
Beatrice Demonstrator	Outer Moray Firth	Pilot	10	2	In operation
Beatrice		STW	588	84	In operation
Moray East		3	950	100	In operation
Moray West		3	860	85	Consented
Hywind Scotland	North East Scotland	Demonstration	30	5	In operation
Aberdeen Offshore Wind Farm		Demonstration	93.2	11	In operation
Kincardine		Demonstration	50	8	In operation
Seagreen Phase 1	Outer Firth of Forth	3	1,140	114	Under construction
Seagreen Phase 1a		3	360	36	Consented
Berwick Bank		3	2,300	242	Pre-planning
Marr Bank		3	1,850	-	Pre-planning
Inch Cape		STW	784	72	Consented
Neart na Gaoithe		STW	448	54	Under construction
Methil (Samsung) Demo	Firth of Forth	Demonstration	7	1	In operation
Methil Demonstration Project - 2B Energy		Demonstration	14	1	Pre-planning
Blyth	North East England	1	4	2	Decommissioned
Blyth Demo Phase 1		Demonstration	99	15	In operation
Blyth Demo Phases 2 & 3		Demonstration	-	-	Consented
Teesside		1	62	27	In operation
Regional Sea 2					
Dogger Bank A	Dogger Bank	3	1,200	-	Under Construction
Dogger Bank B		3	1,200	-	Under Construction
Dogger Bank C		3	1,200	-	Consented

Wind farm	Location	Round	Capacity (MW)	Number of turbines	Status
Sofia		3	1,400	-	Consented
Preferred Project 1		4	1,500	-	-
Preferred Project 2		4	1,500	-	-
Hornsea One	Yorkshire and Humber	3	1,218	174	In operation
Hornsea Two		3	1,320	165	Under Construction
Hornsea Three		3	2,400	-	Consented
Hornsea Four		3	1,200	-	In planning
Westermost Rough	Humber (Greater Wash)	2	210	35	In operation
Humber Gateway		2	219	73	In operation
Triton Knoll	Greater Wash	2	857	90	Under construction
Lynn		1	97	27	In operation
Inner Dowsing		1	97	27	In operation
Lincs		2	270	75	In operation
Race Bank		2	573	91	In operation
Dudgeon		2	402	67	In operation
Dudgeon extension		Extension	402	-	Pre-planning
Sheringham Shoal		2	317	88	In operation
Sheringham Shoal extension		Extension	317	-	Pre-planning
Preferred Project 3		4	1,500	-	-
Scroby Sands	East Anglia	1	60	30	In operation
East Anglia One		3	714	102	In operation
East Anglia Three		3	1,400	121	Consented
East Anglia One North		3	800	67	In planning
East Anglia Two		3	900	75	In planning
Norfolk Vanguard		3	1,800	-	Consented
Norfolk Boreas		3	1,800	-	Consented
Galloper	Thames	Extension	353	56	In operation
Five Estuaries		Extension	353	-	Pre-planning
Greater Gabbard		2	504	140	In operation
North Falls		Extension	504	-	Pre-planning

Wind farm	Location	Round	Capacity (MW)	Number of turbines	Status
Gunfleet Sands I		1	108	30	In operation
Gunfleet Sands II		2	65	18	In operation
Gunfleet Sands Demonstration		Demonstration	12	2	In operation
London Array		2	630	175	In operation
Kentish Flats		1	90	30	In operation
Kentish Flats extension		Extension	49.5	15	In operation
Thanet		2	300	100	In operation
Thanet extension		Extension	340	34	Consent refused
Regional Sea 3					
Rampion	English Channel	3	400	116	In operation
Rampion extension		Extension	400	-	Pre-planning
Navitus Bay		3	630	121	Consent refused
Regional Sea 4					
WaveHub	North Cornwall	Demonstration	40	4	In planning
Erebus	Bristol Channel	Demonstration	96	-	In planning
Whitecross		Demonstration	100	-	Pre-planning
Llŷr 1 & 2		Demonstration	200	-	Pre-planning
Regional Sea 6					
Rhyl Flats	Eastern Irish Sea	1	90	25	In operation
Gwynt y Mor		2	576	160	In operation
Awel y Môr		Extension	576	-	Pre-planning
North Hoyle		1	60	30	In operation
Burbo Bank		1	90	25	In operation
Burbo Bank Extension		Extension	258	32	In operation
West of Duddon Sands		2	389	108	In operation
Barrow		1	90	30	In operation
Ormonde		1	150	30	In operation
Walney 1		2	184	51	In operation
Walney 2		2	184	51	In operation
Walney Extension		Extension	660	90	Consented
Preferred Project 4		4	480	-	-

Wind farm	Location	Round	Capacity (MW)	Number of turbines	Status
Preferred Project 5		4	1,500	-	-
Preferred Project 6		4	1,500	-	-
Robin Rigg East	Eastern Irish Sea - Solway Firth	1	90	30	In operation
Robin Rigg West		1	90	30	In operation
Regional Sea 8					
Pentland Floating Offshore Wind	North Scotland	Demonstration	12	2	Consented

Source: The Crown Estate data December 2021, updated using the Planning Inspectorate website, and the BEIS renewable energy database.

Electricity generated by offshore wind increased from 32.15TWh in 2019 to 40.66TWh in 2020, an increase of ~17%, which was the result of a combination of higher wind speed and added capacity. Estimated electricity production by UK offshore wind is provided hourly by The Crown Estate offshore wind electricity map[13]. Cumulative installed capacity increased from ~5GW in 2015 to ~10.5GW in 2020 (see Figure A1h.17).

[13] https://www.thecrownestate.co.uk/en-gb/our-places/asset-map/#tab-2

Figure A1h.16: Wind energy activity and leasing areas

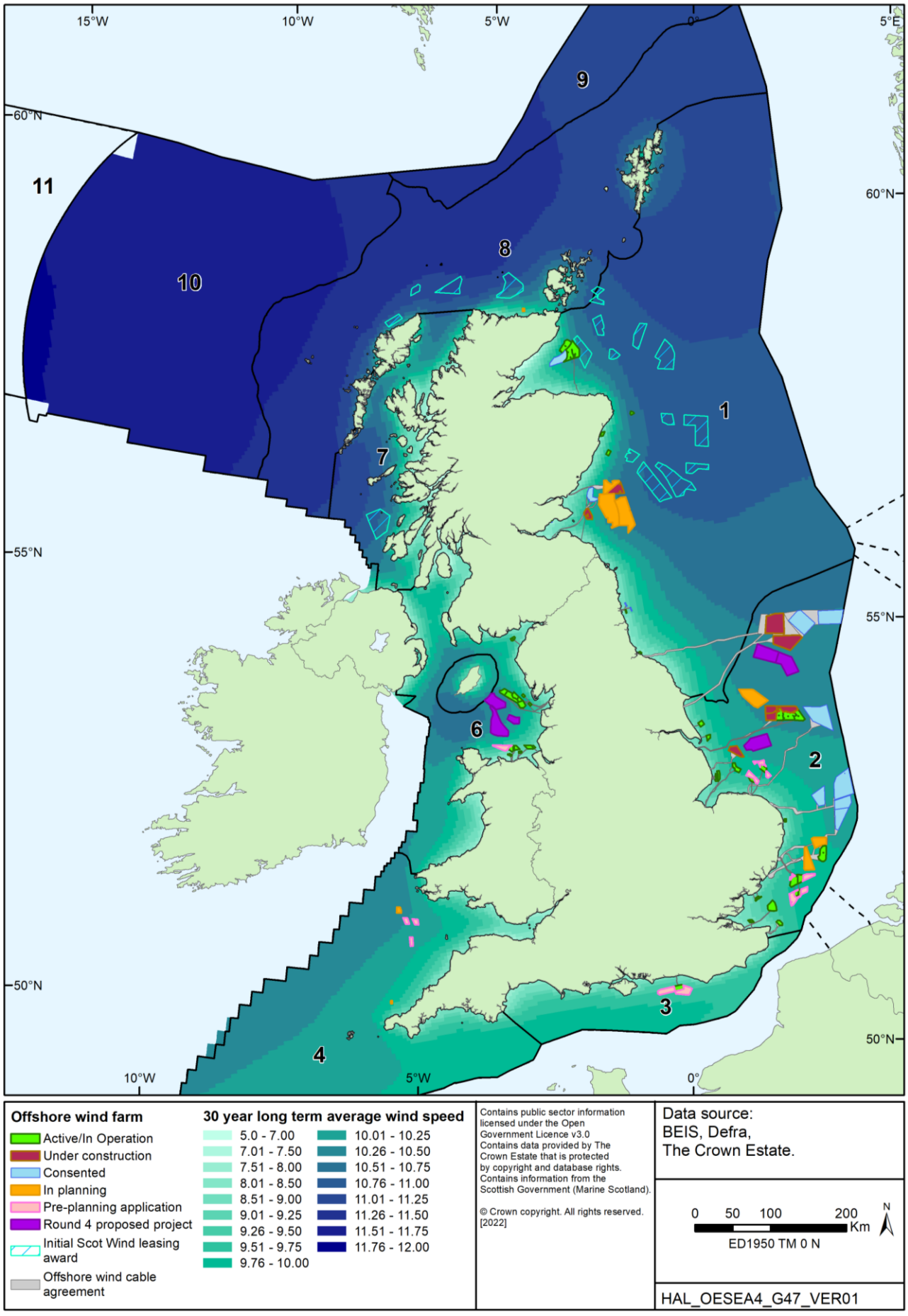
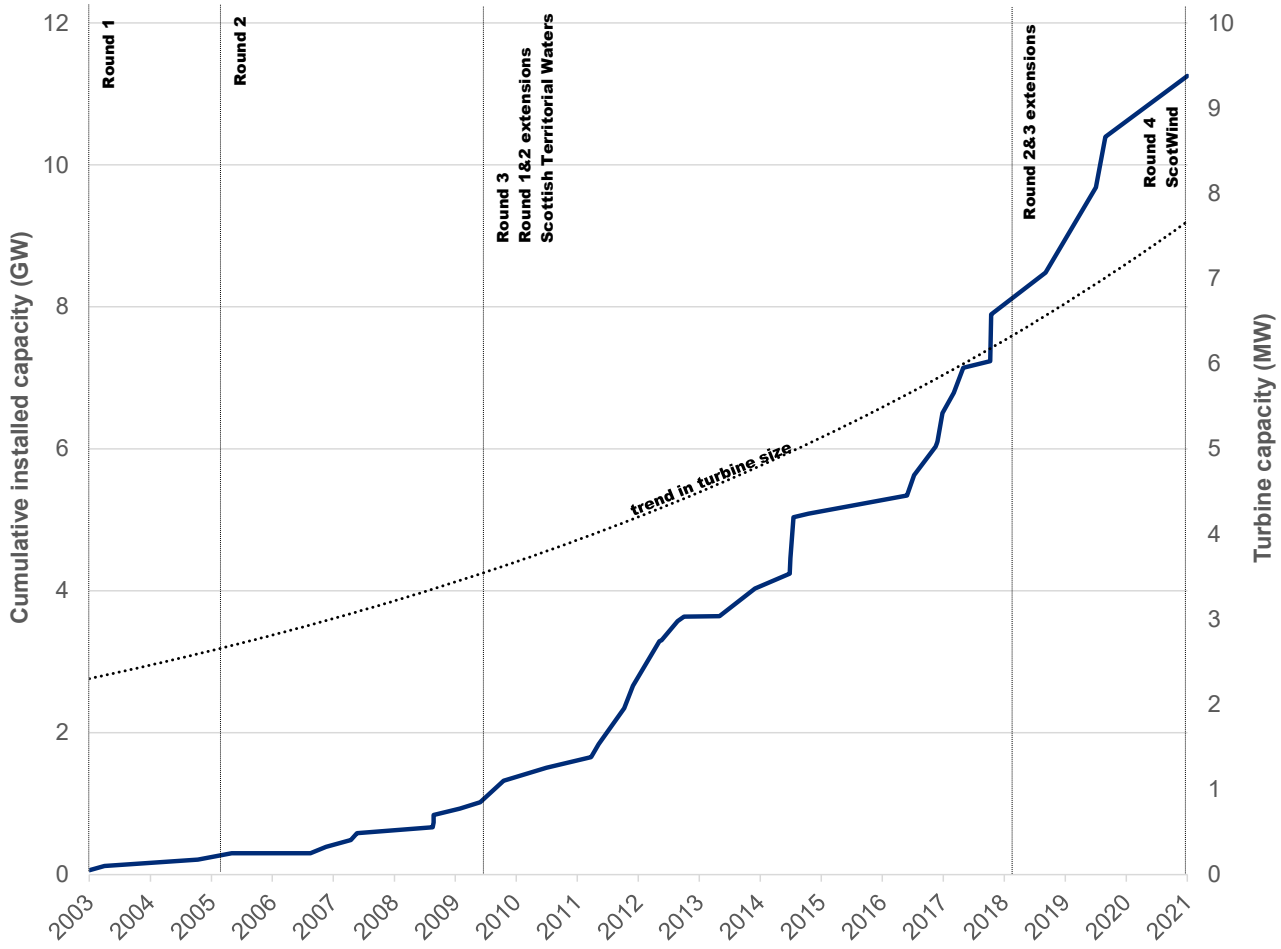


Figure A1h.17: Trend in cumulative operational UK offshore wind installed capacity, 2003-2020



Source: BEIS renewable energy planning database. Note: data correct at December 2021. Excludes Blyth which was decommissioned in 2019.

A1h.8.2 Other marine renewables

Wave and tidal stream development has followed a series of leasing rounds by The Crown Estate for areas of the seabed for test and demonstration projects as well as for commercial development:

- In 2010, the first commercial wave and tidal stream leasing round for ten sites in Scotland's Pentland Firth and Orkney waters was undertaken. 1.2 GW of installed capacity was proposed by the wave and tidal energy developers for 2020, 600MW each from wave and tidal energy.
- Further wave and tidal stream leasing was undertaken in 2013 focussing on test and demonstration projects. Third party organisations were invited to manage them and sublet areas within the zones for test and demonstration activities.
- In September 2015, The Crown Estate announced a new leasing for small-scale wave and tidal stream sites focussed on areas where the existing test and demonstration sites or zones are not fulfilling specific site conditions of a particular technology type or where there is a local development opportunity at a small scale.

Tidal Stream and Wave Energy Projects

Table A1h.2 and Figure A1h.18 provide summary details of current tidal stream and wave projects within UK waters and their status.

Table A1h.2: Status of UK tidal stream projects

Project	Type of project	Capacity (MW)	Status
Tidal Stream: Regional Sea 3			
Perpetuus Tidal Energy Centre (PTEC)	Managed test facility	30	Consented
Tidal Stream: Regional Sea 4			
North Devon Demonstration Zone	Demonstration zone	-	In planning
Ramsey Sound	Engineering demonstration	1.2	Pre-construction
St David's Head	Commercial demonstration	10	In development
Tidal Stream: Regional Sea 6			
Fair Head	Demonstration/commercial	10, further phases up to 100	Pre-planning
Torr Head	Commercial	100	In planning
Holyhead Deep	Demonstration/commercial	0.5, further phases up to 80	Consented/in planning
West Anglesey	Demonstration/commercial	Up to 240	In planning
Bardsey Sound	Demonstration	0.5, further phases up to 2	Consented
Ramsey Sound	Demonstration	1	Consented
Strangford Lough	Demonstration	1.2	Decommissioned
Tidal Stream: Regional Sea 7			
Mull of Kintyre	Demonstration	3	Consented
Isle of Islay (West Islay)	Commercial	30	Consented
Sound of Islay	Demonstration	10	Consented
Connel	Demonstration	0.25	Consented
Tidal Stream: Regional Sea 8			
Inner Sound	Commercial	6, further phases uo to 252 (grid capacity). Consent for up to 398	Under construction
Shapinsay Sound	Managed test facility	-	Operational
Fall of Warness	Managed test facility	-	Operational
Lashy Sound	Commercial	30	In development
Bluemull Sound	Demonstration	0.5	Operational

Project	Type of project	Capacity (MW)	Status
Bluemull Sound (extension)	Demonstration	1.4	Consented
Wave: Regional Sea 4			
FabTest, Falmouth Bay	Managed test facility	-	Operational
Wave Hub	Managed test facility	-	Operational
South Pembrokeshire Demonstration Zone	Demonstration zone	-	In development
Wave: Regional Sea 8			
Scapa Flow	Managed test facility	-	Operational
Billa Croo	Managed test facility	-	Operational

Source: The Crown Estate and Crown Estate Scotland, BEIS renewable energy planning database, individual developer websites

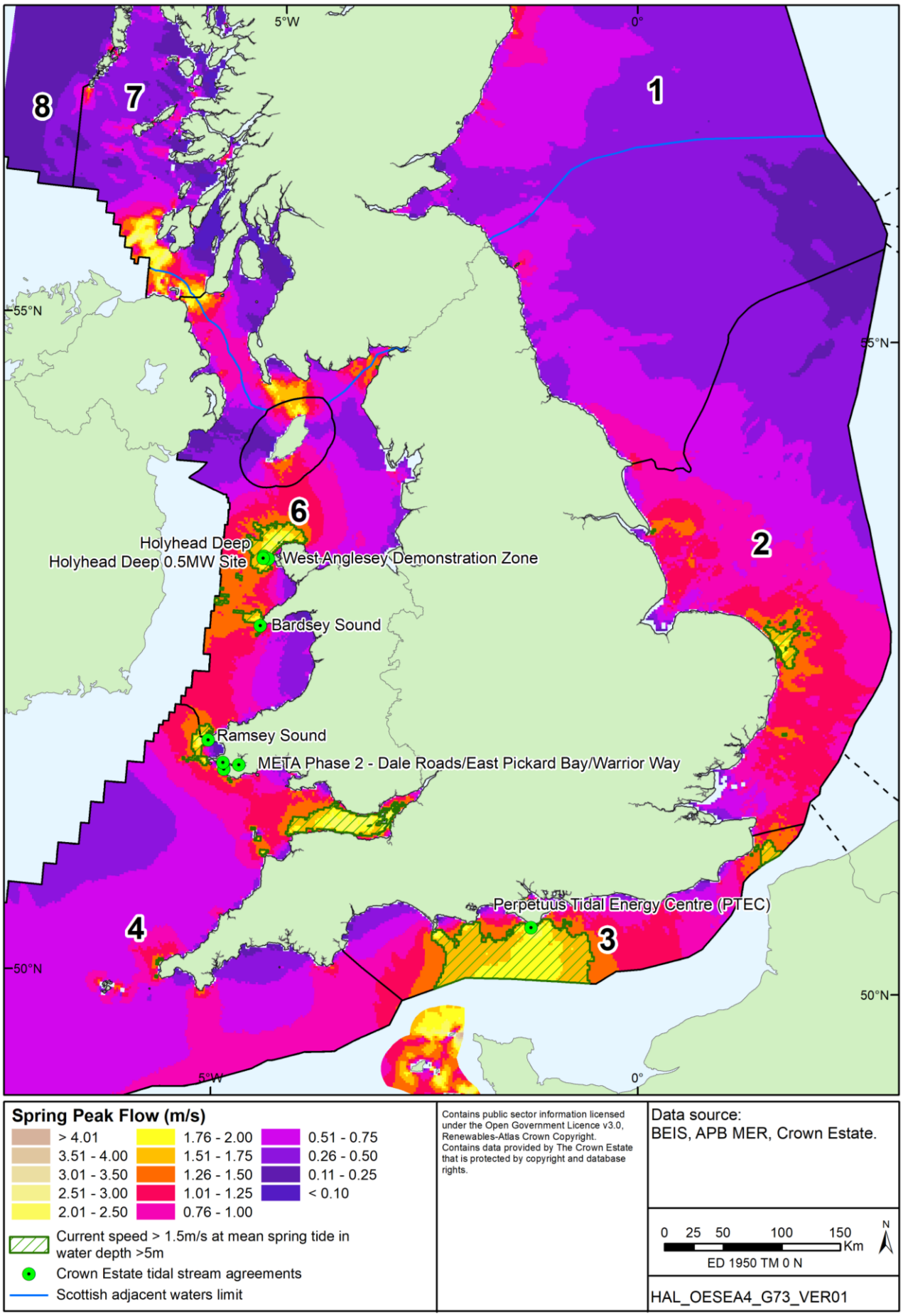
A1h.8.3 Tidal range projects

A pre-application scoping report seeking an opinion for a proposed tidal lagoon in Cardiff Bay was submitted to the Planning Inspectorate in March 2015. The proposed lagoon consisted of a *ca*. 25km long breakwater extending 8km offshore with approximately 60-90 turbines with an expected generating capacity of 1,800 to 2,800MW, though no additional planning activity has taken place since the scoping opinion was issued in January 2016. Two additional lagoon projects (Newport and West Somerset) notified the Planning Inspectorate of their intent to submit a DCO application, however to date no timetable has been set with the Inspectorate. The Tidal Lagoon Swansea Bay project was granted a development consent order in June 2015, however this expired in June 2020[14] and any further consent for the project would need to be sought from Welsh Ministers, as the proposed project has a capacity of less than 350MW.

The DECC Severn Tidal Power Feasibility Study (STPFS), concluded in 2010[15], included a cost-benefit analysis of five short-listed tidal power schemes for the Severn Estuary, examining a variety of tidal technologies including barrages, lagoons and fences. Of these schemes, the Cardiff-Weston tidal barrage was identified as offering best value for money, although it was also found to be the most environmentally damaging of the schemes put forward. At the time, the Government did not see a strategic case for public investment in a Severn tidal power scheme, although it did not preclude a privately-financed scheme coming forward. The Energy and Climate Change Committee undertook an inquiry into private sector plans to construct a tidal barrage across the Severn, concentrating on the proposals from the Hafren Power Company for an 18km tidal barrage between Brean in England and Lavernock Point in Wales. The inquiry concluded that the project was still at a relatively early stage of development and would require further work before it could be taken further. The Committee's final report was published in June 2013[16].

[14] https://committees.parliament.uk/publications/1887/documents/18498/default/
[15] https://www.gov.uk/government/collections/severn-tidal-power-feasibility-study-conclusions
[16] http://www.parliament.uk/business/committees/committees-a-z/commons-select/energy-and-climate-change-committee/inquiries/parliament-2010/a-severn-barrage/

Figure A1h.18: Tidal stream activity and leasing areas (SEA relevant waters)



The Hendry Review[17] assessed the strategic case for tidal lagoons and reported in January 2017. The review made over 30 recommendations and concluded that tidal lagoons would help deliver security of supply; assist in delivering decarbonisation commitments, and would bring supply chain opportunities for the UK. The review also indicated that a small pathfinder project (<500MW, e.g. the Swansea Bay tidal lagoon proposal) should be commissioned and be operational for a reasonable period (to allow in-depth monitoring to be carried out and research to be conducted to address issues) before a financial decision is reached on a larger-scale project. While recognising the potential of tidal lagoon technology to deliver low carbon energy, following further economic analysis the Swansea Bay project was not considered to represent value for money when compared with other low carbon sources of energy (e.g. offshore wind), and support for the project by the UK Government (e.g. through a contract-for-difference (CfD)) was not be taken forward[18]. It is uncertain whether this, or the other tidal range projects noted above, will be developed.

A1h.9 Submarine cables

Submarine cables may be used for telecommunications and electricity transmission (see above) offshore, and these are shown in Figure A1h.19. Interconnectors in operation or planned on the UKCS are shown in Table A1h.3.

Table A1h.3: Operational and planned interconnectors

Name	Country	Capacity (MW)	Year delivered/ expected
IFA	France	2,000	1986
Moyle	Ireland	500	2002
BritNed	Netherlands	1,000	2011
EWIC	Ireland	500	2012
Nemo Link	Belgium	1,000	2019
IFA2	France	1,000	2021
NSL	Norway	1,400	2021
ElecLink	France	1,000	2022
Viking Link	Denmark	1,400	2023
Greenlink	Ireland	500	2023
GridLink	France	1,400	2024
NeuConnect	Germany	1,400	2024
NorthConnect	Norway	1,400	2025
FAB Link	France	1,400	2025

Source: https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/interconnectors

[17] https://hendryreview.wordpress.com/
[18] https://www.gov.uk/government/speeches/proposed-swansea-bay-tidal-lagoon

A1h.10 Electricity network

A1h.10.1 Electricity supply

There are three main components to the supply of electricity in the UK, these are:

- Generation, dominated by large power stations
- The transmission network or National Grid which transmits electricity across the UK from power stations via high voltage (400kV and 275kV) overhead lines
- Regional distribution networks of overhead lines and cables delivering lower voltage power (from 132kV to 230kV) from the grid to consumers

Offshore wind farms are linked to the National Grid via export cables and onshore substations allowing the electricity that is generated to be delivered to consumers.

A1h.10.2 The National Grid

The ownership of the UK's National Electricity Transmission System (NETS) is split up into four areas. The largest in terms of length and share of total transmission covers England and Wales and is owned by National Grid Electricity Transmission. There are two networks in Scotland owned by Scottish Power and Scottish and Southern Energy, and one in Northern Ireland owned by Northern Ireland Electricity. National Grid ESO is the Electricity System Operator (ESO) for Great Britain. The NETS is shown in Figure A1h.20 and is annotated according to a number of needs identified in the recent Energy Ten Year Statement (ETYS) under key message 2 (National Grid ESO 2021), these are, in the next decade the NETS will face growing needs in the following areas:

i. A tripling of wind generation connected across the Scottish networks by 2030 driving higher north to south power transfers.

ii. A doubling at least of transfer requirements from northern Scotland to the Midlands over the next 10 years. New reinforcements will be required to facilitate these power flows through the North of England.

iii. Up to a 12GW increase in transmission connected low carbon and renewable generation in East Anglia from 2020 to 2030 is expected. Future offshore wind connecting along the east coast and new interconnectors in the region are expected to increase the transfer requirements including during low wind periods.

iv. New interconnectors with Europe will place increased requirements on the transmission network, interconnector capacity is anticipated to exceed transmission connected generation in the South of England.

Figure A1h.19: Location of submarine cables

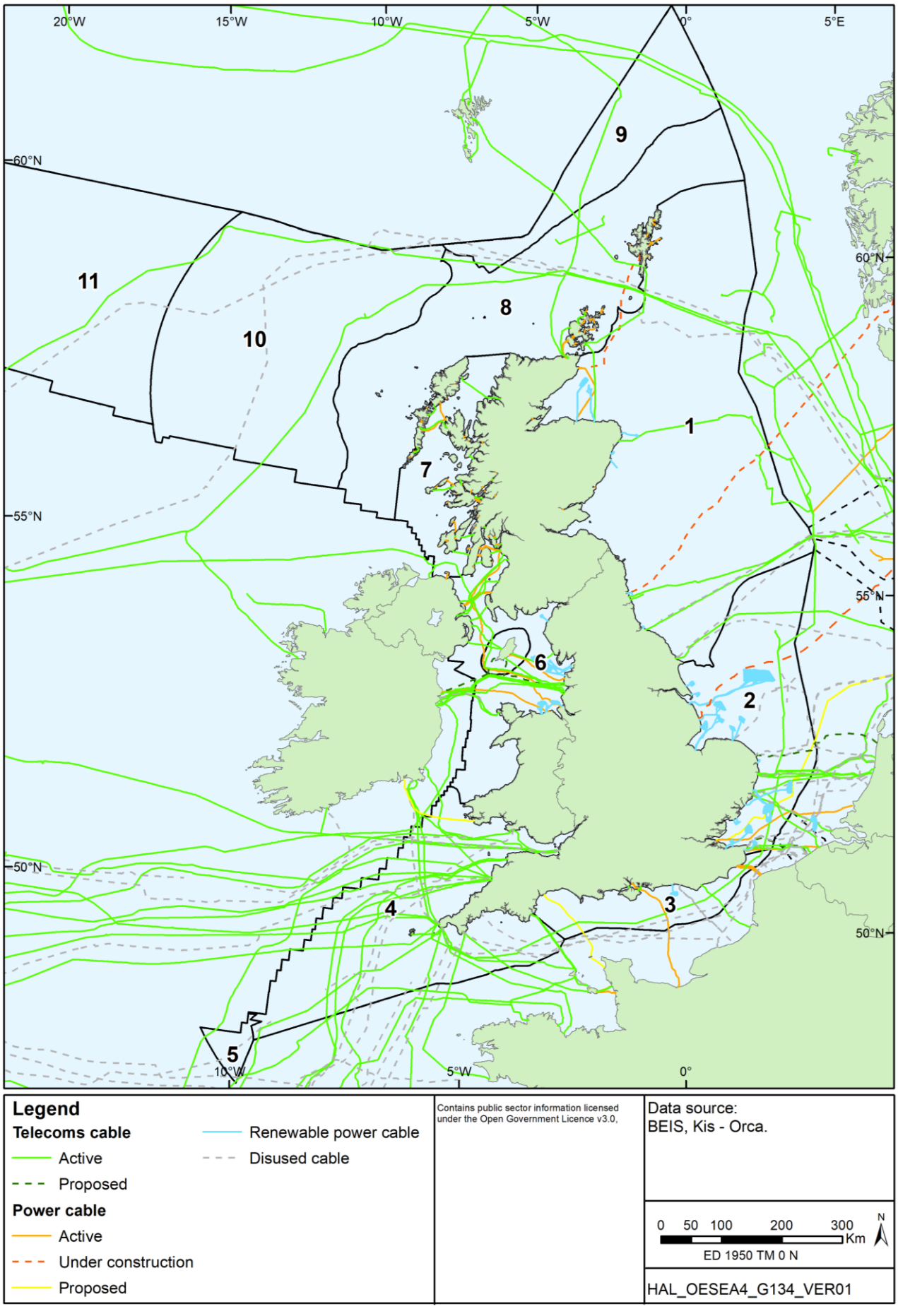
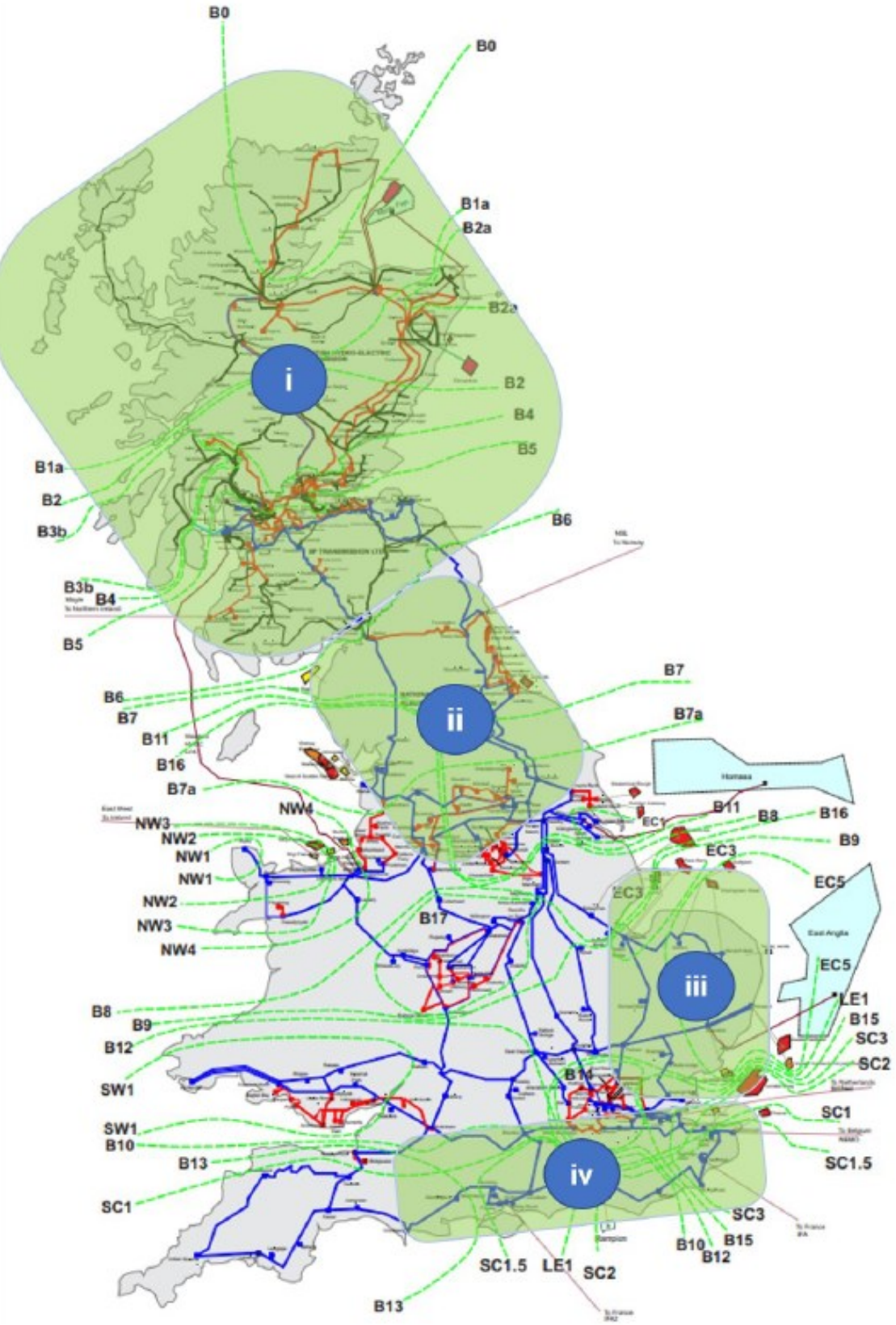


Figure A1h.20: The NETS, ETYS boundaries[19], and broad areas identified in the ETYS as part of key message 2



Source: National Grid ESO (2021)

A1h.10.3 Offshore grid connections and networks

To date, offshore wind grid farms have used radial connections. These are point-to-point connections between an individual wind farm project and its connection with the grid, with no coordination between wind farm operators, for example, to minimise infrastructure and the number of landfalls. While useful during early wind farm development, the scale of current and future deployment related to UK Government targets, makes continuing with radial connections a potential consenting barrier. In order to address this potential barrier, the Offshore Transmission Network Review (OTNR) was launched in 2020 and is led by BEIS with support from a number of other UK Government departments, devolved administrations, The Crown Estate and Crown Estate Scotland, the ESO and Ofgem[20]. The OTNR has two workstreams, one of which is identify and implement changes which can be made in the immediate term focussing on projects due to connect after 2025 (Early Opportunities)[21], and the second is design and implement a new regime that incentivises coordination, including considering the role of multipurpose interconnectors[22] with a focus on projects to be delivered after 2030 (Enduring Regime). The final outputs of the review are expected in 2023.

A "generation map" was produced as part of the OTNR process showing the location of existing and planned offshore wind farms and the expected timing of their connection, the content of which is largely contained in Figure A1h.16, A1h.20 and Figure 2.6 in the main Environmental Report. This is complemented by a separately commissioned East Coast Grid Study (AECOM 2021), which had the objectives of establishing key spatial constraints to future grid connections in the east of England, their related risks, and whether adopting one or more coordinated approaches could mitigate these risks. Conservation sites already subject to multiple cable crossings, the availability of suitable landfalls, and the distance to grid connection points were all highlighted as potential constraints. The study did not discount the potential for future radial connections, but noted that landfalls in particular were a pinch point that made long-term use of this connection method a risk. The study noted that a coordinated approach should result in less infrastructure and less potential for spatial conflict, however, the difference in scale of coordination (e.g. number of cables in a single cable route) were highlighted as something that stakeholders should be made aware of.

A1h.11 Dredging and aggregate extraction

Marine sand and gravel account for 20% of all industrial aggregates in England and Wales used for concrete production for roads and building construction and as a source of material for beach replenishment.

New technologies have allowed the dredging industry to reduce its spatial footprint (both in terms of licensed area and dredged area) and its potential for impact on other users. Aggregate extraction occurs in three main areas in the southern North Sea (Figure A1h.21); off the Humber Estuary, east of Great Yarmouth and Lowestoft and in the Greater Thames Estuary where there are extensive sand and gravel deposits. Extraction in this area accounted

[19] A boundary splits the system into two parts, crossing critical circuit paths that carry power between the areas where power flow limitations may be encountered. When significant transmission system changes occur, new boundaries may be defined and some existing boundaries either removed or amended.
[20] https://www.gov.uk/government/groups/offshore-transmission-network-review
[21] https://www.ofgem.gov.uk/publications/consultation-changes-intended-bring-about-greater-coordination-development-offshore-energy-networks
[22] https://www.gov.uk/government/consultations/offshore-transmission-network-review-proposals-for-an-enduring-regime

for ~60% of the UKs aggregate landings over the period 1998-2017, which totalled 403 million tonnes over the same period (The Crown Estate and the British Marine Aggregate Producers Association 2018). Cumulative footprints for aggregate dredging (where areas are repeatedly dredged over several years) for this period were relatively large for the East Coast (195.7km^2) and Humber region (122.4km^2), and smaller in the Thames (63.2km^2). The other principal dredging areas in UK waters are located in Regional Seas 3, 4 and 6 which make up the remaining ~40% of UK aggregates landings. Aggregate extraction in Regional Sea 3 is centred on the south-east and south-west of the Isle of Wight, in the Owers region and also in the east English Channel (total 135 million tonnes). The principal target for extraction is the Quaternary gravel and sand lag deposit which covers much of the central and eastern English Channel. There are a number of areas in the Severn estuary and in the east Irish Sea (total 39 million tonnes) which are currently licensed for marine aggregate extraction. Detailed dredging records can be used to generate a 'cumulative footprint' map in order to determine what constitutes a 'new' area of dredging and the overall spatial and temporal impact on the marine environment. Figures relating to the cumulative footprint and new areas of seabed dredged for the period 1998-2017 are provided in TCE & BMAPA (2018).

There are currently no licences for marine aggregates extraction in Scotland however the Scottish National Marine Plan recognises the potential for marine aggregates to be extracted in the medium to long term, with former sites in the Clyde and Firths of Forth and Tay having previously been licensed. Similarly, to date extraction in Northern Irish waters has been limited and no areas are presently licensed. Aggregates areas are subject to leasing rounds, the most recent taking place in 2018/19 which resulted in awards of exploration and option agreements for areas in Regional Sea 2, Regional Sea 3 and Regional Sea 6[23]. A further tender round is due to take place in 2021/22.

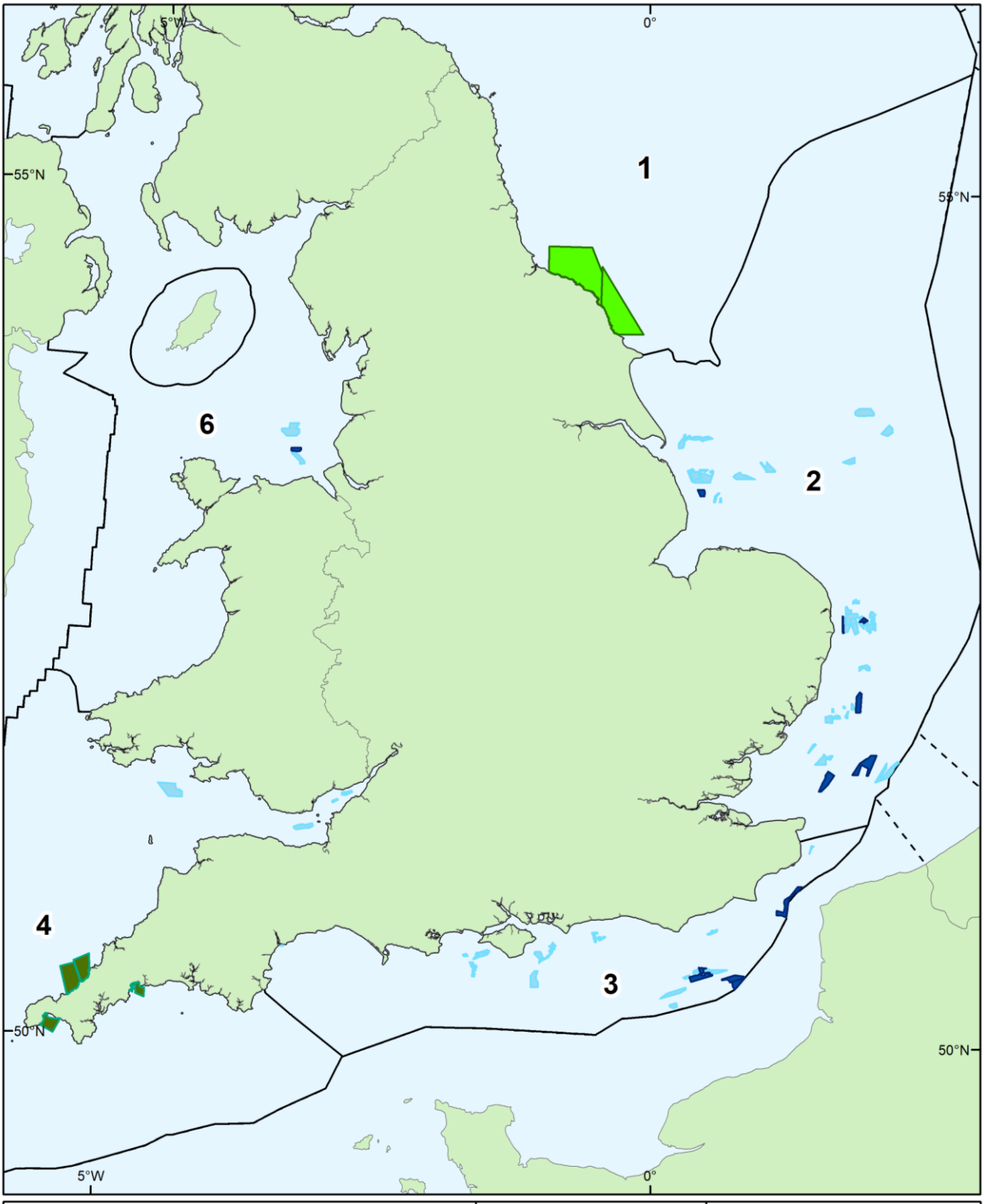
A1h.12 Marine mines

Potash has been commercially extracted from the north Yorkshire coast since 1973 at Boulby potash mine, and more recently an agreement was signed in 2011 between The Crown Estate and then York Potash, for rights to explore for potash off the coast of Hunsdale (Figure A1h.21) for which cores were obtained between 2011 and 2013. It is not clear whether mining of the offshore area will proceed, but the onshore extension of the potash deposit is currently being developed by Anglo American, which acquired Sirius Minerals and its subsidiary York Potash, in 2020.

Cornish Lithium Ltd was granted rights to explore for lithium in areas of the Cornish coast in December 2020. Desk studies will initially take place, with any physical exploration work not anticipated for at least four years from commencement of the lease agreement.

[23] https://www.thecrownestate.co.uk/en-gb/media-and-insights/seabed-and-coastal-notices/archived-notices/

Figure A1h.21: Marine aggregate and mine licences



A1h.13 Marine waste disposal

Since 1994, the dumping at sea of most forms of industrial waste has been prohibited, with the disposal of sewage sludge phased out in 1998. Dredged waste from excavated ports and navigation channels now forms the majority of the remaining material eligible for disposal at sea. Responsibility for licences to carry out disposal in UK waters for England and Wales lies with the Marine Management Organisation. Marine Scotland is the responsible body for Scotland and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland. Licensed waste sites for the disposal of dredged material are generally located in inshore waters and every Regional Sea area that abuts a coastal regional has waste sites located within it. Regional Sea areas 5, 9, 10 and 11 are entirely marine and do not contain any of these sites. The location, type and quantity of dredged material deposited in 2019 around the UK coast are shown in Table A1h.4.

Table A1h.4: Marine disposal around the UK, 2019

Origin	Dredging operation type		Total quantity (tonnes, dry weight)
	Capital	Maintenance	
Regional Sea 1			
Sutors	X		65,709.00
		X	1,487.00
Burghead	X		89.00
		X	1,901.00
Buckie	X		102.00
		X	1,101.00
Aberdeen		X	819,770.00
Montrose		X	275.00
Arbroath		X	2,044.00
Narrow Deep B (Firth of Forth)		X	3,508.00
Oxcars Main (Firth Of Forth)		X	42,281.00
Oxcars Ext A (Firth Of Forth)		X	42,281.00
Oxcars Ext B (Firth Of Forth)		X	121,043.00
Bo'ness		X	409,489.00
Kirkcaldy		X	4,703.00
Granton		X	1,028.00
Eyemouth		X	3,916.00
Blyth A + B		X	128,141.00
North Tyne		X	92,669.00

Origin	Dredging operation type		Total quantity (tonnes, dry weight)
	Capital	Maintenance	
Souter Point (Outer)		X	91,495.00
Sunderland		X	81,206.00
Tees Bay A	X		4,994.00
		X	41,443.00
Whitby		X	20,311.00
Cleveland Potash Outfall		X	13,841.00
Scarborough Rock		X	4,027.00
Regional Sea 2			
Humber 4b/Hook		X	184,506.00
Humber 4b/Hook Extension		X	163,804.00
Humber 4		X	9,517.00
Whitgift Bight (River Ouse)		X	1,593.00
Goole Reach		X	3,186.00
Humber 3a		X	1,191,958.00
Humber 1a		X	367,767.00
Humber 2		X	114,427.00
West Stones		X	17,662.00
Well Beneficial use site 2 (North Norfolk Coast)		X	7,072.00
Wells Outer Harbour B1		X	1,440.00
Boston 7		X	1,853.00
Lowestoft Circular North		X	40,010.00
Harwich Haven		X	1,133,889.00
River Orwell (Abp)		X	18,179.00
Roughs Tower	X		5,590.00
Inner Gabbard East		X	143,875.00
South Falls		X	46,192.00
Whitstable C		X	1,332.00
Pegwell Bay		X	7,611.00
Copperas		X	18,941.00
Erwarton Track		X	9,781.00
Orwell West Track		X	6,521.00

Origin	Dredging operation type		Total quantity (tonnes, dry weight)
	Capital	Maintenance	
Orwell East Track		X	6,521.00
Regional Sea 3			
Dover		X	75,494.00
Eastbourne		X	28,356.00
Sprey Point		X	30,443.00
Newhaven		X	128,481.00
Brighton/ Rottingdean		X	26,059.00
Shoreham		X	60,414.00
Nab Tower	X	X	38,316.00
		X	371,418.00
Ryde Harbour		X	678.00
Hurst Fort	X		1,470.00
		X	56,466.00
Brownsea Experimental		X	7,933.00
Ventnor Harbour (Isle of Wight)	-	-	5,395.00
Regional Sea 4			
Padstow Bay		X	1,580.00
Portishead		X	12,965.00
Avonmouth (Inner)		X	12,848.00
Cardiff Grounds		X	231,581.00
Merkur Buoy		X	22,903.00
Swansea Bay (Outer)		X	966,994.00
Newport		X	112,445.00
Neyland (Off Milford Haven)		X	1,789.00
Plymouth Deep		X	18,263.00
Lantic Bay		Maintenance	2,182.00
Regional Sea 6			
Holyhead North		X	17,717.00
Mostyn Deep (Maintenance)		X	61,793.00
Mersey (Garston Site)		X	27,515.00
Site Z (Liverpool Bay)		X	842,465.00

Origin	Dredging operation type		Total quantity (tonnes, dry weight)
	Capital	Maintenance	
Morecambe Bay: Lune Deep		X	2,925.00
Lune River B		X	195.00
Morecambe Bay B		X	458,853.00
Barrow D		X	1,219,498.00
Workington Anchorage		X	52,460.00
Silloth B		X	16,767.00
Belfast Dredgings C		X	9,172.00
Cloch Point	X		4,543.00
		X	102,200.00
Girvan		X	16,515.00
Carnlough A	X		2,438.00
Warrenpoint B		X	24,581.00
Regional Sea 7			
Stornoway	X		23,650.00
Regional Sea 8			
Foula	X		860.00

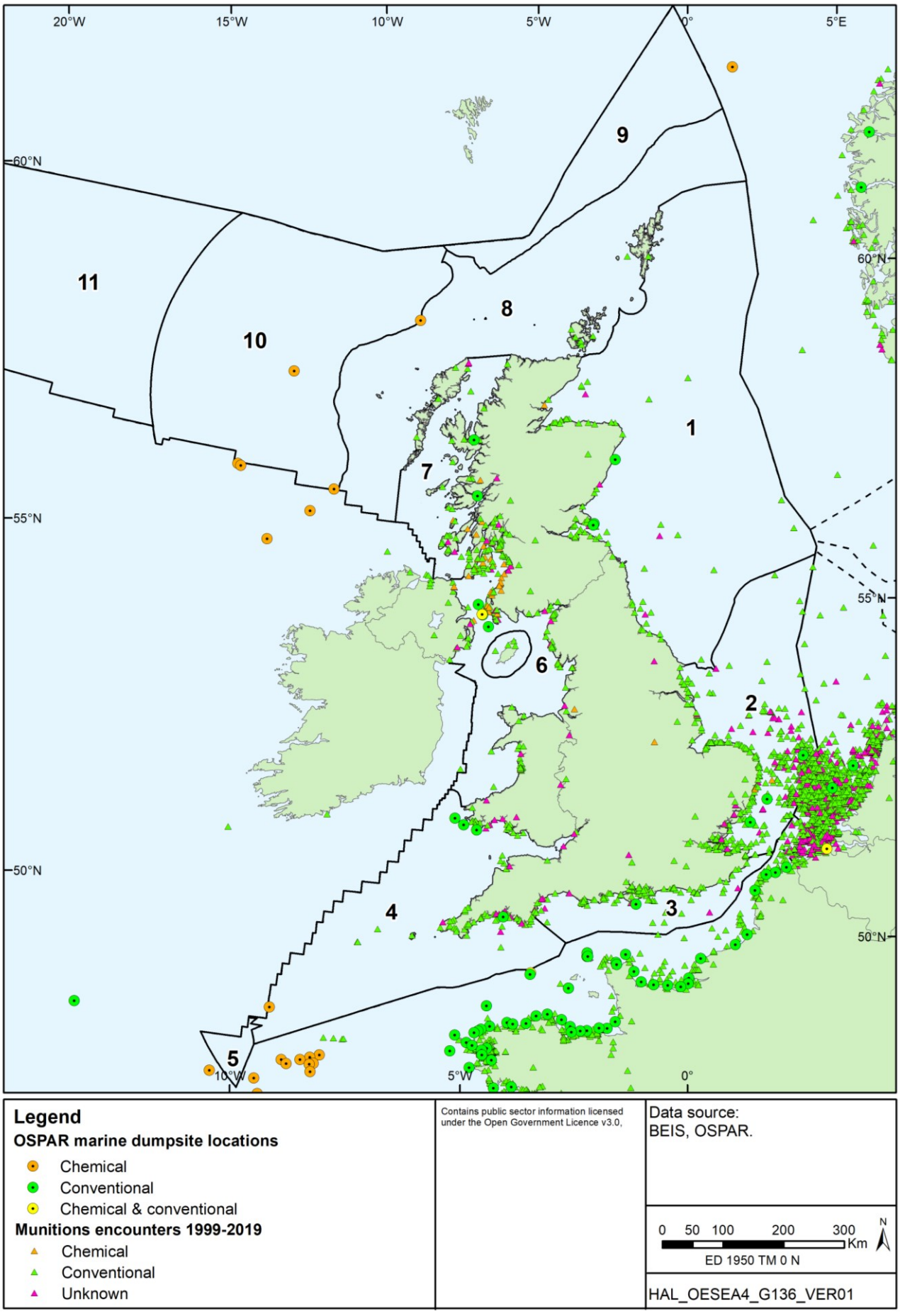
Source: OSPAR (2019), Cefas (2021)

A1h.14 Munitions

Chemical weapons and munitions have been dumped at sea since the end of the First World War. The extent of this dumping is uncertain and remediation technically challenging. OSPAR began a programme of work in 2004 to establish the extent of this dumping and encounters with such material. This has revealed a total of 148 sites, with 1,069 and 8,139 encounters have taken place in the UK and the wider OSPAR area respectively since 1999. The majority of encounters are by fishermen, through dredging and at the coast, and Increasingly through survey activity associated with offshore renewables. Munitions dumping sites and encounters since 1999 are shown in Figure A1h.22. The OSPAR Recommendation 2010/20 requires Contracting Parties to report annually to the OSPAR Commission encounters with conventional and chemical munitions.

The potential hazard posed by dumped munitions varies by type, for instance chemical munitions may have broken open when being dumped or corroded over time leading to the agent to leak out. Some may break down and dissolve (e.g. nerve agents) while others may be insoluble and pose risks on recovery (e.g. mustard gas). Phosphorous devices pose particular risk when disturbed, as they are buoyant and may float to the sea surface posing risks to seafarers or the public should they be washed ashore (OSPAR 2010).

Figure A1h.22: OSPAR munitions dumpsites and encounters, 1999-2019



A1h.15 Tourism and recreation

A1h.15.1 UK context

The tourism industry is socially and economically important to the UK and the coast in particular is a popular destination for British holidaymakers of all age groups. From large traditional seaside resorts to small-scale coastal attractions, this sector makes an important contribution to the local, regional and national character of the coast.

In 2019, the British public made a total of 122.8 million domestic overnight trips (+3.6% on 2018 total), spending £24.7 billion (+2.9% on 2018) (Visit England *et al.* 2020a). Of these, there were 99.1 million domestic overnight tourism trips in England (+1.7% on 2018) with spending of £19.4 billion (+0.5% on 2018); in Scotland, 13.8 million overnight trips were made in 2019 (+17% on 2018), with spend of £3.2 billion (+15.9% on 2018), and in Wales there were 10.7 million overnight trips (+6.8% on 2018) with £2 billion spend (+8.1% on 2018). Of the overnight trips in England, approximately 21% (20.6 million) were to seaside/coastal destinations with a spend of £4.5 billion. Equivalent 2019 figures for Scotland and Wales were 16.7% (2.3 million trips) and 42.8% (4.6 million trips) with a spend of £0.4 billion and £0.9 billion, respectively (Visit England *et al.* 2020a). Since 2011 Northern Ireland data has been collected separately and specific data on trips to the seaside is not provided. However, in 2019 overnight trips by all visitors to Northern Ireland (domestic and external) stood at 5.3 million, up 7% on 2018. Associated expenditure increased by 8% (to £1 billion in 2018) (NISRA 2020a).

There were in excess of 179 million day visits made by the British public to the seaside/coast (11% of all day trips) in 2019, generating a further £5.8 billion spend (9% of total). Of these, 135 million day trips to the seaside/coast were made in England (10% of English total), spending *ca*. £4.4 billion (8% of total); 13 million seaside/coastal day trips were made in Scotland (10% of Scottish total), with spending of £0.5 billion (9% of total); and in Wales, 17 million day trips were made to the seaside/coast (19% of Welsh total), spending £0.7 billion (*ca*. 19% of total) (Visit England *et al.* 2020b).

Overseas residents made 40.9 million visits to the UK in 2019, 1% higher than in 2018 with spending from visits to the UK reaching £28.4 billion (+7% on 2018). Holidays remained the main reason for visits to the UK, accounting for 16.9 million visits (41% of all visits). London attracted 21.7 million overnight visits by overseas residents in 2019 (+3% on 2018), and £15.7 billion (+6% on 2018) was spent on these visits. Overnight visits to the rest of England was 16.9 million (+3.7% on 2018), spending £9 billion (+9.6% on 2018). Visits to Scotland which had increased since 2010, dropped 7.2% to 3.5 million in 2019 although spending increased 6.7% to £2.5 billion. Visits to Wales in 2019 increased by 3.5% to 1 million with spending increasing by 18.9% to £0.5 billion (Office for National Statistics (ONS) 2020). In 2019, the value of exports in the tourism sector – the spending on both goods and services by overseas visitors to the UK – was £28.4 billion, a rise of 7.3% on 2018 (all measured in current prices and not adjusted for inflation) (Department for Digital, Culture, Media & Sport 2020[24])

Tourism Direct Gross Value Added (TDGVA) is a measure of the importance of tourism in the UK economy and is based on how the expenditure of tourists drives the output of the tourism industries and other sectors. In monetary terms, and measured in current prices, TDGVA

[24] https://www.gov.uk/government/publications/dcms-economic-estimates-2019-trade-report/dcms-sectors-economic-estimates-2019-trade

stood at £59.7 billion in 2017 (the most recent year for data). There were approximately 1.6 million tourism direct employment (TDE) jobs and an estimated 1.2 million tourism direct full-time equivalents (TDFTE) employees in the UK[25]. Due to methodology changes, data from 2017 and previous years are not directly comparable (ONS 2019). In their submission to the Department of Culture, Media and Sport Select Committee inquiry into the impact of Covid-19, the National Coastal Tourism Academy (NCTA 2020) indicated that coastal tourism pre-Covid was valued at £13.7bn in England and £17.1bn for Great Britain.

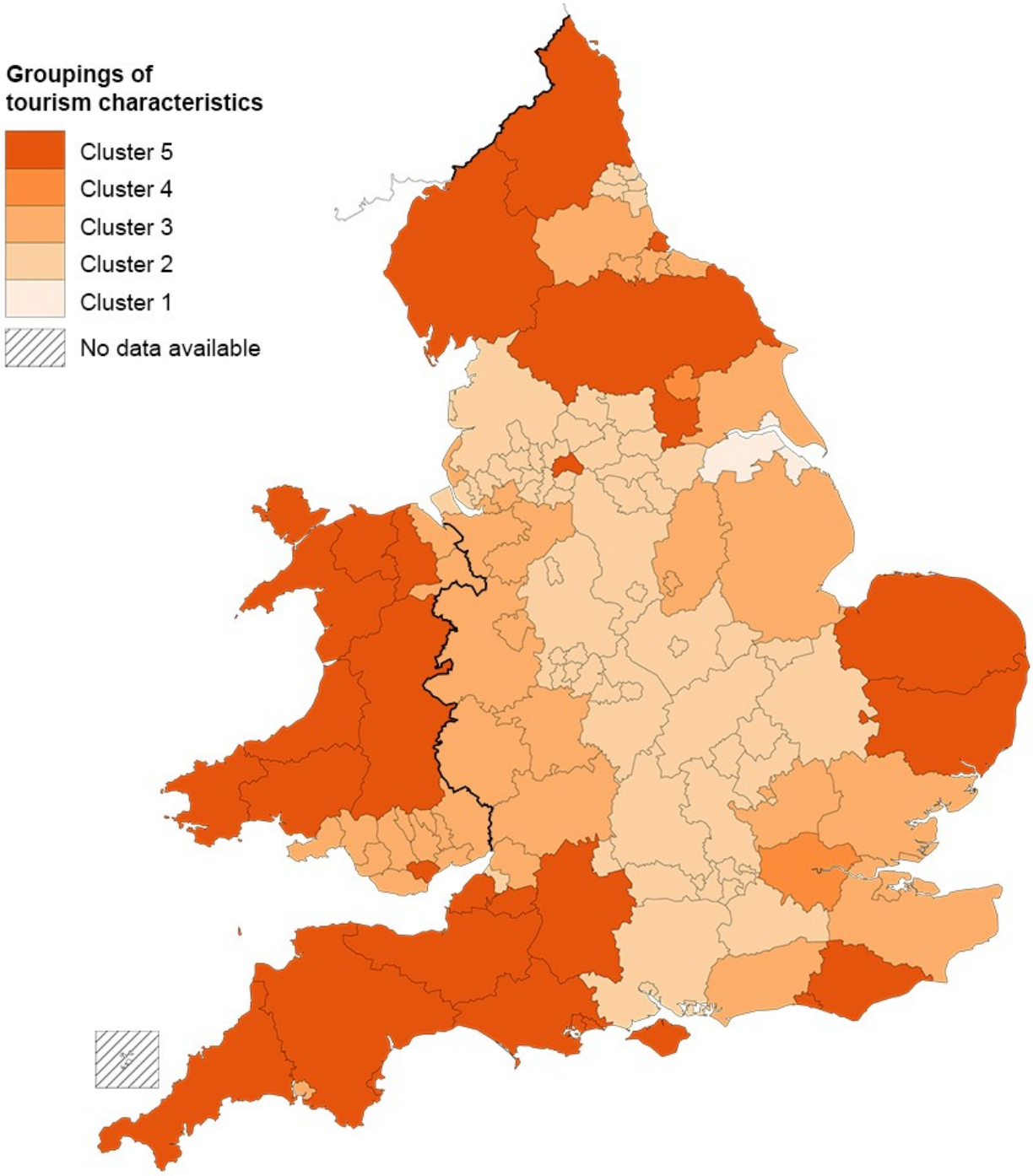
The ONS published a spatial classification of areas in England and Wales to group areas that have similar tourism characteristics (ONS 2015). Using data for 2011-2013 across a number of themes (employment and industry, domestic day visits, domestic overnight tourism and inbound tourism), 5 distinct clusters of counties and unitary authorities were described (Figure A1h.23).

Of most relevance to OESEA4 are those areas grouped within cluster 5 (includes mid, north and west Wales, south-west England, with parts of East Anglia, the north, the Isle of Wight and east Sussex) as many of these are coastal and include the more traditional holiday destinations in England and Wales. Within this cluster there is a higher percentage of nights stayed for holiday and visiting friends and relatives purposes (compared to business, studying or 'other' purposes), which is mostly consistent with inbound visitors. Also, there is a higher than average expenditure per trip, which in rural areas would imply longer stays (on holidays, for example) and a higher percentage of jobs in accommodation for visitors. There are also higher percentages of day visits spent exploring an area or participating in an outdoor leisure activity, also both tourist and holiday activities. Tourism with a holiday purpose is both prevalent and of high importance in these locations, so the areas in cluster 5 are also labelled as 'holiday hotspots'. Figure A1h.24 highlights the percentage of tourism enterprises and the percentage of main jobs in tourism industries (2011-2013 average) for these holiday hotspots. As shown, Gwynedd in north-west Wales had the highest percentage of main jobs in tourism (14.9%) followed by the Isle of Anglesey (14.0%). Torbay in Devon had the highest percentage of tourism enterprises (16.2%) followed by the Isle of Wight (15.5%) with Poole the lowest of these areas (8.0%) (ONS 2015).

The UK Marine Policy Statement (HM Government 2011) indicated that the sea provides a variety of tourism and recreational opportunities which vary from area to area but will include pleasure boating, sailing, recreational diving (including diving on wrecks), sea angling, kayaking and surfing, as well as exploration of underwater and coastal heritage assets. The coast also provides inspiration for a range of artistic and cultural activities and food-based tourism. There is also growing interest in eco-tourism and wildlife experiences. All these activities can generate a considerable amount of income for the economy and can be a mainstay for many coastal towns, supporting their quality of life, and providing health and well-being benefits, with many local businesses relying on the marine environment for their livelihoods.

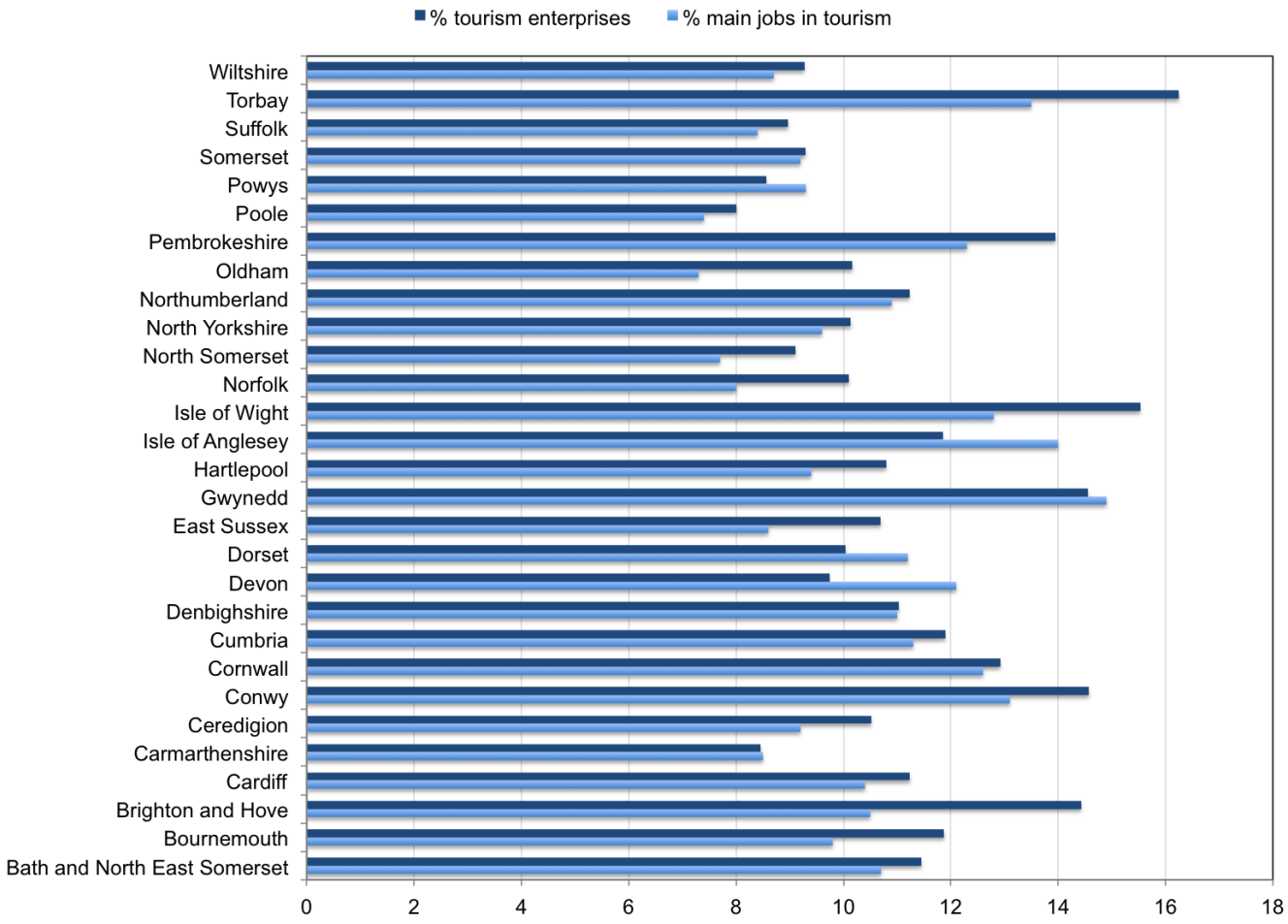
[25] Tourism direct employment (TDE) is a measure of jobs within the UK that are supported directly by demand from tourists. Tourism totals for TDE and tourism direct full-time equivalents (TDFTE) include employment data relating to jobs that support tourism activities in both the tourism industries and other consumption products (non-tourism industries) (ONS 2019).

Figure A1h.23: Cluster analysis showing areas that share similar tourism characteristics by county and unitary authority, 2011 to 2013



Source: ONS (2015)

Figure A1h.24: The percentage of main jobs in the tourism industry and the percentage of tourism enterprises for 'holiday hotspots' in cluster 5



Source: Annual Population Survey (APS), Inter Departmental Business Register (IDBR) - Office for National Statistics

The importance of tourism and recreation is reflected in the marine plans. For example, relevant policies (TR-1) of the most recent English marine plans (e.g. South East, South West, North East, North West) indicate that:

- Proposals that promote or facilitate sustainable tourism and recreation activities, or that create appropriate opportunities to expand or diversify the current use of facilities, should be supported. Proposals that may have a significant adverse impact on tourism and recreation activities they must demonstrate that they will, in order of preference: a) avoid; b) minimise, c) mitigate adverse impacts so they are no longer significant.

Relevant objectives of Scotland's National Marine Plan (Scottish Government 2015) in terms of recreation and tourism include: to position Scotland as a world-class sustainable coastal and marine tourism and recreation destination through the sustainable development of coastal and marine recreation activities and industries in Scotland; protection and enhancement of the unique, natural resources which attract visitors and which are relied upon for recreational activities, and continued and improved access to marine and coastal resources for tourism activities and recreational use.

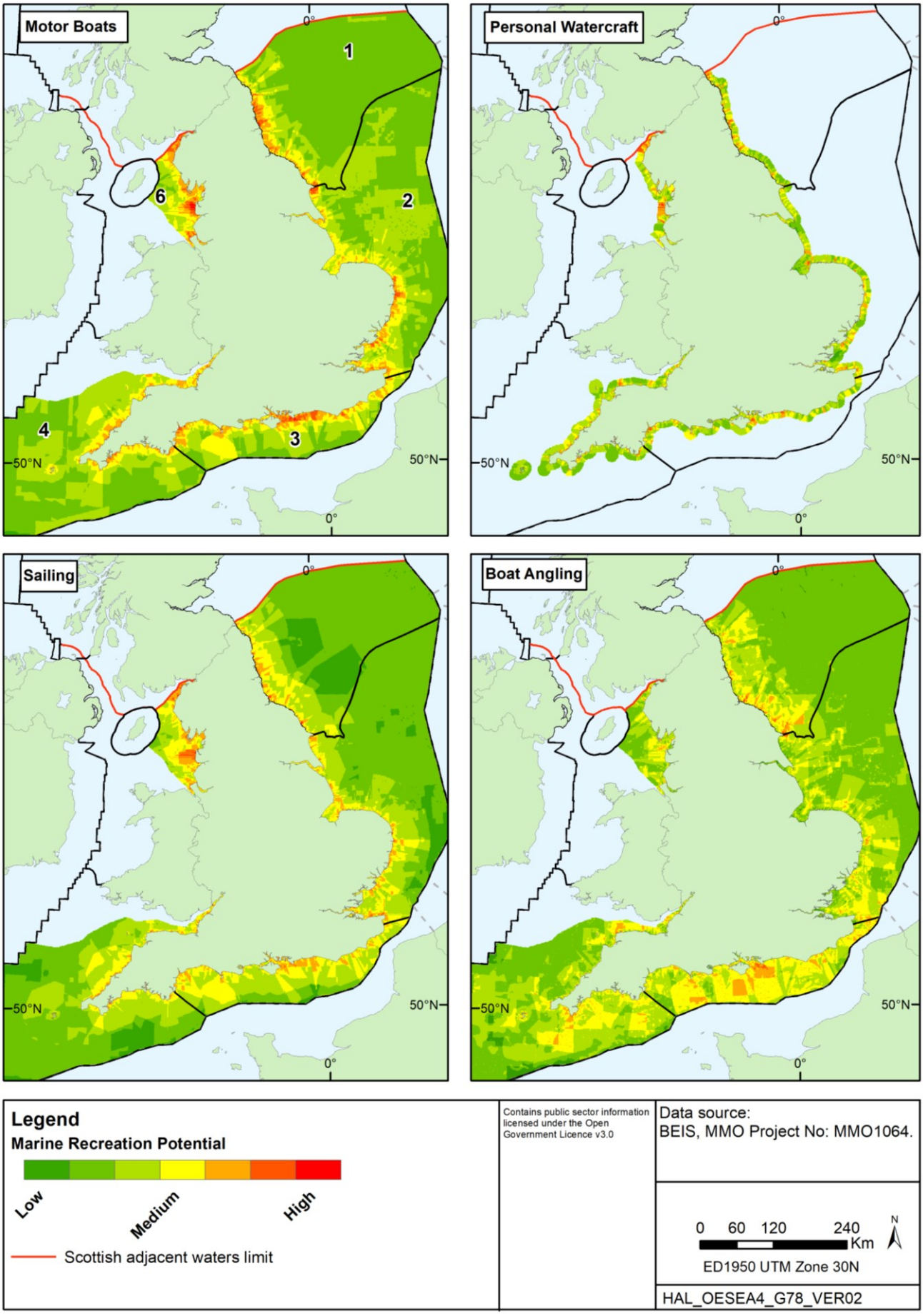
The first strategic framework for Scotland's marine tourism sector *('Awakening the Giant'*, Scottish Tourism Alliance 2014) highlighted the economic importance of the Scottish marine tourism industry, but focussed primarily on developing the growth of sailing tourism in Scotland. By 2016, visitor expenditure on sailing tourism reached £131 million and the overall contribution of the sector was £411 million in 2017/18. A second strategic framework (*'Giant Strides'*, Scottish Tourism Alliance 2020) takes a broader view of marine tourism (including a much wider range of recreational activities), its role within coastal and island communities and the significant benefits marine tourism can deliver for communities, the environment and the economy of Scotland. The strategy aims to grow marine tourism's overall economic contribution to over £500 million by 2025.

The water sports participation survey for 2018 (Arkenford 2018) estimated that *ca*. 32% of the UK population (or 17 million people) participated in water sports. The most popular activities in 2018 were the same as in previous years: spending general leisure time at the beach, coastal walking and outdoor swimming. Summer remains the key season when most of the activity takes place, with over half of people participating between June and August.

A number of relevant GIS-based mapping projects have been undertaken which either predicted (MMO 2014a) or described (Wales Activity Mapping (WAM) project - http://www.walesactivitymapping.org.uk/) marine recreational activities around the English and south west Wales coasts, respectively, which have informed online mapping resources for marine planning[26]. For example, Figure A1h.25 highlights elements of the modelled recreational activity layers on the MMO explore marine plans digital service. The models were developed for 12 recreational activities through a process of stakeholder consultation, spatial analysis and stakeholder validation. Model predictions demonstrated that vessel based activities were broadly successful with key controls governed by access to infrastructure, such as marinas, slipways and moorings. The more near shore, beach focused, activities such as surfing and windsurfing were more sensitive to the input data, with critical dependency on a 'land access' parameter formed in the model which categorised ease of access to roads and footpaths (MMO 2014b). Similarly, both the Marine Scotland National Marine Plan interactive mapping tool[27] and the Northern Ireland Marine Mapviewer[28] support a number of leisure and recreation layers of relevance.

[26] https://explore-marine-plans.marineservices.org.uk/
[27] https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=495
[28] https://appsd.daera-ni.gov.uk/marinemapviewer/

Figure A1h.25: Modelled recreational activity in English waters



A1h.15.2 Bathing waters, Blue Flag beaches and marinas

As described in Section A1g.5.3, bathing waters are quality classified according to two microbiological parameters (*Escherichia coli* and intestinal enterococci) defined by the Bathing Water Directive 76/160/EEC. Since 2016, there have been fairly minor variations in the reported quality of UK bathing waters which tend to be related to weather conditions, as combined sewer overflows operate more frequently during wet weather, diffuse pollution from urban and agricultural sources is increased, and in poor summers there is less sunlight to kill off bacteria in water. In 2019, out of the 628 UK coastal bathing waters reported:

- 415 (66.1%) were classified as excellent;
- 143 (22.8%) as good;
- 51 (8.1%) as sufficient;
- 15 (2.4%) as poor, and
- 4 (0.6%) were not classified

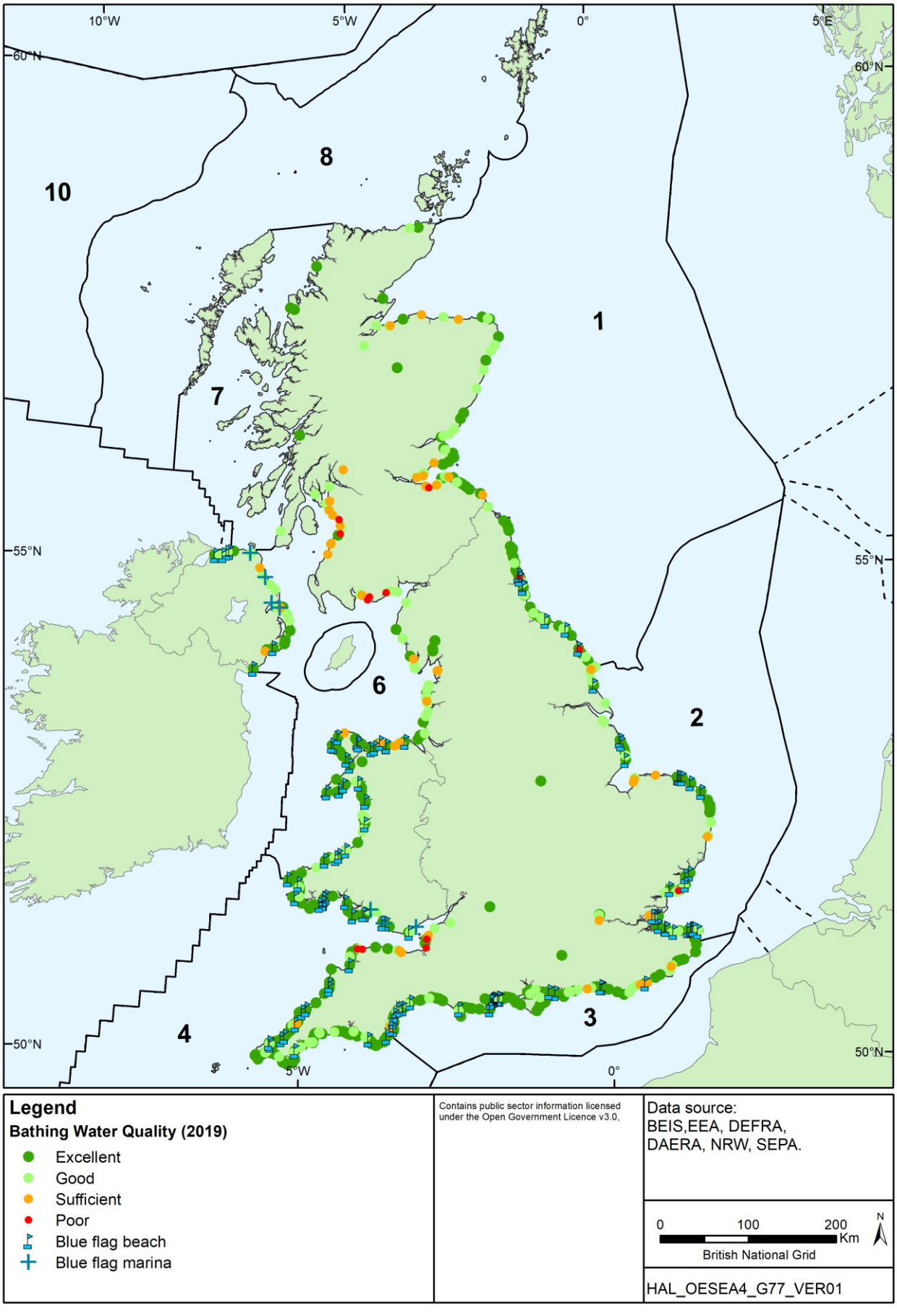
Figure A1h.26 indicates the quality of bathing waters around the UK coast for 2019 in relation to each Regional Sea. Blue Flag beaches and marinas are located along the UK coast (see Figure A1h.26 although Scotland stopped making applications to the scheme in 2016 in favour of Scotland's Beach Awards[29]). Criteria for their successful selection are exhaustive and attention is brought to the Blue Flag website (https://www.blueflag.global/criteria) which provides this information. In brief, beach and marina designations are subject to 33 and 38 criteria respectively covering aspects of:

- Environmental education and information
- Water quality
- Environmental management
- Safety and services

Some of these criteria are imperative while others are provided as guidance, and some are not applicable in all geographic areas. Blue Flags are awarded on a seasonal basis, and may be withdrawn if criteria are not met during the season or the conditions change.

[29] https://www.keepscotlandbeautiful.org/community-and-place/scotlands-beach-awards/

Figure A1h.26: UK bathing waters and Blue Flag sites (2019)



A1h.15.3 National trails, coastal paths and long distance routes

There is a network of National Trails in the UK (Figure A1h.27), many of which traverse areas of distinctive coastline, often coinciding with National Parks or Areas of Outstanding Natural Beauty (AONB). These are major attractions for an increasing number of outdoor enthusiasts intent on walking part or the entirety of a trail, often camping along the way.

Under the *Marine and Coastal Access Act 2009* (as amended), a new continuous National Trail will be completed around the English coastline. The status of sections of the England Coast Path are shown on Figure A1h.27, and Natural England has indicated that the path will be fully walkable by the end of the current Parliament[30]. The 1,400km long Wales Coast Path was completed in 2012. Scotland has 26 Great Trails[31] some of which have coastal stretches. There are also a number of coastal paths proposed as part of the National Walking and Cycling Network). Northern Ireland has a number of long distance walks with the Causeway Coast Way of most relevance (see Figure A1h.27).

A1h.15.4 Notable features by region

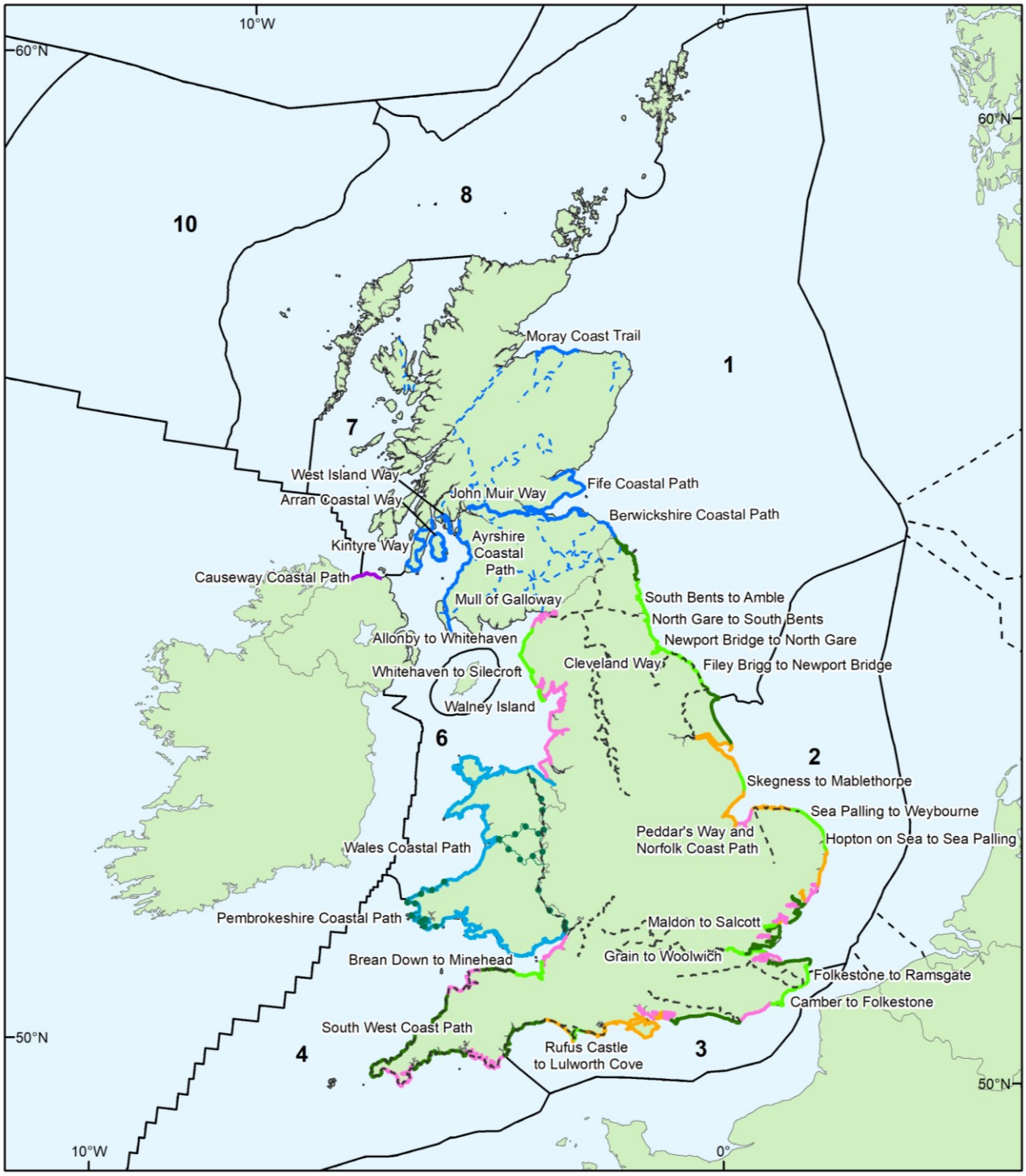
1.15.4.1 Features of Regional Seas 1 & 2

There were almost 8 million (average of 3 years 2017-2019) domestic overnight trips to the Scottish counties which border Regional Sea 1, with associated spending of £1.9 billion (Visit England *et al.* 2020a). 82 million (average 2017-2019) domestic day visits were taken to the Scottish counties within the region, worth £3.3 billion (Visit England *et al.* 2020b). Edinburgh (19.7 million), the Highland (11.6 million) region and Fife (8.6 million) received the most overnight visits. With respect to day visits, 26% of those made to the south of Scotland were to the seaside or coastal destination with lower proportions for the north (18%) and east (11%) of Scotland (Visit England *et al.* 2020b). In 2017, employment in tourism industries was highest in Edinburgh and Highland (both 13% of local authority total employment), with the Shetland Islands at 10%[32].

The Scotland Visitor Survey conducted in May to September of 2015 and 2016 for Visit Scotland indicated that 50% of those surveyed chose Scotland for its scenery/landscape[33]. The coastal zone is an important resource for this key industry. There are numerous coastal nature conservation areas along the coastline of Shetland, Orkney and the mainland. Examples include the Dornoch Firth, Loch of Strathbeg, Sands of Forvie, Fowlsheugh, St. Cyrus, Montrose Basin, Eden Estuary, Aberlady Bay and the Firth of Forth Islands.

[30] https://www.gov.uk/government/collections/england-coast-path-improving-public-access-to-the-coast
[31] https://www.scotlandsgreattrails.com/
[32] https://www.visitscotland.org/binaries/content/assets/dot-org/pdf/research-papers-2/insights-topic-paper---tourism-employment-2018-table-6-updated-jan-2019.pdf
[33] https://www.visitscotland.org/binaries/content/assets/dot-org/pdf/research-papers/motivations-to-visit-2015-16.pdf

Figure A1h.27: National trails, coastal paths and long distance routes



Within Regional Sea 1 particular developments highlight the local importance of wildlife based attractions, for example:

- The Scottish Dolphin Centre at Spey Bay received 92,060 visits in 2018[34].
- The North Berwick Seabird centre received 267,559 visits in 2018[35].
- Direct tourism expenditure reliant solely on the presence of the east of Scotland bottlenose dolphin population was estimated to be at least £4 million in 2010, providing approximately 202 Full Time Equivalent jobs (Davies *et al.* 2010).

Wildlife tourism is important in Scotland although recent economic valuations are not available. However, data for 2015 indicates that 0.4 million domestic visits included visiting a wildlife attraction/nature reserve when in Scotland, with 0.5 million visits including bird or wildlife watching, 25% of which were in the east of Scotland (Visit Scotland 2017). A report for the Scottish Government by the International Centre for Tourism and Hospitality Research, Bournemouth University estimated the net economic impact of wildlife tourism in Scotland as £65 million, with 2,763 FTE jobs in existence because of the activities of wildlife tourism (ICTHR 2010). Net economic impact was highest in the Highlands and Islands region (£32 million and 1,386 FTE jobs). In the same year, an SNH commissioned study (Bryden *et al.* 2010) used a wider definition of the wildlife sector (to also include those who enjoy wildlife as only part of their holiday), to estimate the value to the economy of wildlife tourism as £127 million per year.

The north-eastern coast of Scotland has little formal coastal activity, however, historical and cultural sites such as Dunnottar Castle in Aberdeenshire, Culross in Fife and the Fisheries Museum at Anstruther are to be found along the region's coastline. Dolphin watching occurs at several locations within the Moray Firth, from Cromarty to Nairn and to the east, the Scottish Dolphin Centre at Spey Bay, received over 95,000 visits in 2016[36]. There are many coastal paths in the area, for example around Sandside Bay, John o' Groats and Duncansby Head.

The many coastal golf courses in the area, some of which are recognised internationally e.g. St. Andrews, Carnoustie and Muirfield are of great significance as an attraction for overseas visitors. Golf courses, like historical and archaeological sites, also tend to have a longer 'season', being less dependent on summer weather conditions.

A number of beaches have European Blue Flag status (see Figure A1h.26 above) although Scotland no longer supports the scheme. Many old and relatively underused harbours have developed small-scale marinas and sailing centres e.g. Whitehills near Banff and Peterhead (Aberdeenshire). The coastline and nearshore area of the region provides a variety of opportunities for other water-based sports and recreational activities including sport fishing, wind-surfing, sailing and diving. There is no official coastal footpath around the region but the

[34] https://www.visitscotland.org/binaries/content/assets/dot-org/pdf/research-papers-2/regional-factsheets/grampian-factsheet-2018.pdf

[35] https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwidjbuLub7tAhXkpHEKHSd4CUcQFjADegQIDBAC&url=https%3A%2F%2Fwww.eastlothian.gov.uk%2Fdownload%2Fdownloads%2Fid%2F28174%2Feast_lothian_visitor_survey_2018.pdf&usg=AOvVaw1eDe2v269djQklsf49wWgB

[36] https://www.visitscotland.org/binaries/content/assets/dot-org/pdf/research-papers-2/wildlife-topic-paper-2017.pdf

Fife Coastal Footpath stretches from North Queensferry in the south for 150km to the Tay Bridge in the north and attracts many walkers annually and the Moray Coast Trail stretches for approximately 50 miles between Findhorn and Cullen. The east coast of Scotland also contains several of the UK's prime wildfowling areas – Montrose Basin, the Tay and Eden Estuaries and several sections of the Firth of Forth.

Across the border into England, tourism is not a major land use or coastal activity in the northern section, where the largest centres are Berwick and Holy Island. The north-east represented the lowest proportion of all English regions for domestic trips in 2019, 4% of overnight trips (4.3 million) and spend (£0.8 billion) (Visit England *et al.* 2020a), and 4% of volume (72 million trips) and 5% of spending (£3.3 billion) for day visits. Of the day trips, 26% were to a seaside/coast destination compared to the national average of 12% (Visit England *et al.* 2020b).

The wild and unspoilt natural scenery of much of the north-east attracts many tourists in pursuit of open-air leisure activities including walking, bird watching, wildfowling and golf. The region also supports a relatively large surfing community (estimated at 32,695 surfers or 6.54% of the UK total, Surfers Against Sewage 2013). Fortresses line much of the coastline such as Tynemouth, Dunstanburgh and Bamburgh Castles. The Christian seat of learning once found at Lindisfarne and the seal colony on the Farne Islands also attract further tourists to the area. Birdwatching is popular in the Lindisfarne National Nature Reserve and Budle Bay. A 55km stretch of the England Coast Path from North Gare to South Bents was opened to the public in 2014 (see Figure A1h.27 above). Further south, the 110km long Cleveland Way National Trail includes the Heritage Coast between Saltburn and Filey[37].

In contrast, the central heavily developed area of the coast has only one major tourism centre, at Whitley Bay, which is close to the major conurbations of Tyne & Wear and an important traditional seaside resort. Tourism is a crucial source of income and employment on the stretch of coastline between Staithes and Flamborough Head, which includes the traditional coastal resorts of Whitby, Scarborough and Filey. Scarborough for example was second on the list of the most visited English cities and towns after London for holiday trips by GB residents (1.1 million trips, average 2017-2019)[38]. One in ten overnight trips and day visits in England in 2019 were to the Yorkshire and the Humber region (9.6 million overnight trips and 141 million day trips worth £1.7 billion and £6.4 billion respectively) (Visit England *et al.* 2020a). Of the day trips, 11% were to a seaside destination compared to the national average of 10% (Visit England *et al.* 2020b).

Many of the area's coastal towns have had a long association with the tourism industry, most notably Mablethorpe, Skegness in Lincolnshire and Great Yarmouth in Norfolk. An average of 2.3 million and 3 million overnight domestic trips per annum were made to Lincolnshire and Norfolk between 2017 and 2019, with total spend of £0.3 and £0.7 billion, respectively (Visit England *et al.* 2020a). The 150km Peddars Way and Norfolk Coast Path National Trail takes in the coast between Hunstanton and Cromer and a 41km stretch of the England Coast Path from Sea Palling to Weybourne opened in 2014 (see Figure A1h.27 above). These, in addition to many other coastal footpaths and the region's rich wildlife (popular for birdwatching and wildfowling alike) attract further visitors. The north Norfolk coast is also a popular destination for dinghy sailors and windsurfers. The East marine plan evidence and issues report indicated that leisure boating was the most popular and economically valuable part of the marine water

[37] https://www.nationaltrail.co.uk/en_GB/trails/cleveland-way/
[38] https://www.visitbritain.org/sites/default/files/vb-corporate/a_listing_of_the_most_visited_towns_2017-19.xls

sports industry, with 101 Royal Yachting Association (RYA) training areas, 33 RYA marinas, 37 recreational craft marinas and 6 RYA racing areas in the area (MMO 12).

Coastal areas of Essex and Kent are major areas for tourism with a number of highly developed traditional seaside resorts, particularly Southend-on-Sea, Clacton-on-Sea, Margate and Ramsgate. An average of 1.8 million and 2.7 million overnight domestic trips per annum were made to Essex and Kent between 2017 and 2019, with total spend of £0.2 and £0.4 billion, respectively (Visit England *et al.* 2020a). In the wider east and south east of England regions, trips to the seaside represented 13% of day trips taken (Visit England *et al.* 2020b). The east of England region has one of the highest participation rates (36.2%) for any water sports activities in the UK as well as any boating activity (11.9%) (Arkenford 2015). Based on the number and distribution of wildfowling clubs from which a wildfowling permit can be obtained[39], the east and south-east region of England is one of the most important areas in Britain for wildfowling, with shooting taking place on many of the major estuaries including the Humber and Wash.

There are several well used coastal paths in the area that attract many walkers and sightseers; the Suffolk Coastal Path runs for 80km from Lowestoft to Felixstowe, around the Kent coast the Saxon Shore Way runs 262km from Gravesend to Hastings, the North Downs Way (a National Trail) follows the cliff top between Dover and Folkestone and there are many other areas of open public access along sections of the coast.

1.15.4.2 Features of Regional Sea 3

The following description comes primarily from the South Plans analytical report (MMO 2014b) as Regional Sea 3 coincides with the inshore and offshore plan areas. The region's coast is a popular tourist destination with a large number of seaside towns and attractions. The eastern half of the coastline is highly accessible to London and the south-east. This is reflected in the domestic overnight trips and associated spend to the region (e.g. Hampshire (3.2 million trips, £0.5 billion (average 2017-2019), East Sussex (2.4 million trips, £0.4 billion), West Sussex (1.6 million trips, £0.3 billion), Brighton and Hove (1.1 million trips, £0.2 billion) and Isle of Wight (0.8 million trips, £0.2 billion). The south-east received 218 million domestic day visits (13% of which were to the seaside/coast), spending £8 billion in 2019. The western part of Regional Sea 3 sits within the south-west region which has the largest share of the English domestic tourism market. For example, Dorset and Devon had an average (2017-2019) of 3 million and 5 million overnight domestic trips respectively, with total spend of £0.6 billion and £1.2 billion, respectively (Visit England *et al.* 2020a). Of the 148 million domestic day trips to the south-west region, 21% were trips to the seaside (Visit England *et al.* 2020b).

Wildlife and natural landscapes attract many visitors to the plan areas. Popular destinations include the New Forest National Park (which stretches for 42km from Hurst Spit to Calshot), the South Downs National Park (which stretches for 140km from Winchester to Eastbourne) and the South Devon, East Devon, Dorset, High Weald, Isle of Wight and Kent Downs AONBs. Other designations include sites of special scientific interest and national nature reserves. Many of these marine environments are protected as special areas of conservation (SACs) and special protection areas (SPAs).

The Jurassic Coast, England's only natural World Heritage site (located along the Dorset and East Devon coast), receives over 5 million visitors each year. Other natural heritage attractions include the South West Coast Path (from Minehead in Somerset to Poole Harbour

[39] https://basc.org.uk/wildfowling/club-advice-and-information/wildfowling-clubs-links/

in Dorset with the latter section from Dartmouth to Poole Harbour in Regional Sea 3), the Solent Way (stretching for 97km from Milford on Sea to Emsworth in Hampshire), Berry Head (Devon), Lulworth Cove and Durdle Door (Dorset), The Needles (Isle of Wight), Seven Sisters, Beachy Head (Sussex) and Dungeness (Kent). The first stretch of the England Coast Path, from Rufus Castle on Portland to Lulworth Cove (Weymouth Bay), part of the SW Coast Path opened to the public in June 2012[40].

The south coast is host to a variety of wildlife watching activities with tourists hoping to see (among other species): whales, dolphins, basking sharks, seals and waterbirds. Most of the boat-based wildlife watching is focused between the coastline of the River Dart and Berry Head, Devon. Wildlife watching is also popular along the Jurassic Coast, Portland Bill and the Isle of Purbeck as well as within natural harbours such as Poole.

Other notable activities related to tourism in the plan areas include the cruise industry, conference trade, heritage tourism (land based and underwater sites), diving and sea angling.

The region has a high recreational value and is very popular for activities including pleasure boating, sailing, diving (including diving on wrecks), sea angling, kayaking, surfing, windsurfing and exploration of underwater and coastal heritage assets (Arkenford 2015). There are also many blue flag beaches (see Figure A1h.26 above) and popular rural beaches such as Studland beach in Dorset which receives one million visitors each year (Fisher Associates 2011).

The marine recreation sector is inherently linked with tourism; many people visit the area to try a new recreational activity or to simply walk on the beach and enjoy the surrounding views. Furthermore, there are many marine and coastal designations (including national parks, areas of outstanding natural beauty and the Jurassic Coast World Heritage Site) which attract visitors to the area. In 2012 the number of people employed by coastal tourism on the south coast was estimated to be over 47,000 people, significantly more than any other marine sector (the next highest being ports and shipping at just below 7,000), indicating the importance of coastal tourism to employment (MMO 2014b).

Leisure boating is the most popular and economically valuable part of the marine water sports industry. The greatest density of Royal Yachting Association clubs and privately owned marinas in the UK lie on the region's coast with the Solent, Isle of Wight, River Dart and Brighton some of the most popular recreational boating areas in the UK. Sailing also takes place at Shoreham and Poole Harbour, the development of the Weymouth and Portland National Sailing Academy (an Olympics 2012 legacy) increasing sailing activity in the area. The presence of recreational boating activities are also common to people on or visiting the south coast, thus adding to the sense of place and character of the area.

The south coast has the greatest number of marinas and berths in the UK, indicating the interest in sailing activities and demand for associated facilities. Coastal marinas in the south-east and south-west contribute an estimated £36 million each year to the economy. Furthermore, many craft moor within estuaries without having a recognised marina, such as the Teign estuary, where there are around 10 free to use, publicly accessible slipways.

There are many international sailing and boating events in the region such as Cowes week, Round the Island race and Southampton Boat Show. These generate revenue for the local

[40] https://www.gov.uk/government/collections/england-coast-path-portland-to-lulworth

economy and attract tourists to the area, approximately £6.4million income is generated for local businesses through tourism expenditure during Cowes week.

Weymouth and Portland are also popular diving sites due to the large number of wrecks and reefs, along with Torbay, Selsey and the Isle of Purbeck.

The region has some of the most popular stretches of coastline for wind and kite surfing despite the optimum conditions being infrequent compared to other areas. Popular sites include Poole Bay, Brighton, Bournemouth, Camber, Eastbourne, Hayling Island, Langstone Harbour, Shoreham and Lancing.

Surfing is popular on the south coast, with hotspots around Hastings, Birling Gap and West Wittering. The Dorset coastline is also popular with surfers due to its sheltered nature. Dorset is also home to Europe's first artificial surf reef at Boscombe. The importance of the region for surfing is highlighted by recent analysis of the economic contribution of domestic surfing to the UK which estimated that south coast surfers spent over £400 million annually or 39% of the UK surfer total (Surfers Against Sewage 2013). Paddle sports (canoeing, sea kayaking, stand-up paddle boarding) occur predominantly inshore at locations such as Poole Harbour, Studland Bay, the Dart Estuary, Hamble and Itchen Estuaries, Torbay and the Isle of Purbeck.

The Solent Way, South Downs Way and South West Coast Path are popular with walkers enjoying the views of the coastline and out to sea.

1.15.4.3 Features of Regional Seas 4 & 5

Overnight domestic trips to the south-west region represented 19% of the total trips to England, and 21% of spend in 2019 – 18.9 million trips and £4.1 billion in spend. Of these, an average (2017-2019) of over 9.3 million overnight trips were made to the English local authorities bordering Regional Sea 4, with a spend of £2.2 billion (Visit England *et al.* 2020a). There were also 148 million day trips to the south west region (11% of all day trips in England), with £5 billion in spending (Visit England *et al.* 2020b). Cornwall and the Isles of Scilly had an average of 4.3 million domestic overnight trips (2017-2019), with total spend of £1.2 billion. There were 2.7 million (average 2017-2019) domestic overnight trips to the Welsh counties which border Regional Sea 4, with associated spending of £0.5 billion (Visit England *et al.* 2020a). There were also 38.5 and 23.6 million domestic day trips to these regions with spending of £1.6 billion and £0.8 billion. Cardiff (15.2 million), Swansea (9.3 million), Carmarthenshire (6.3 million) and Pembrokeshire (6 million) received the most visits. At a national level, 19% of domestic day trips to Wales included a seaside/coastal location with the figure for south west Wales slightly above the average (22%) and south east Wales (14%), slightly below (Visit England *et al.* 2020b).

Major land- and water-based leisure facilities are concentrated in traditional coastal holiday areas, most of which are in Devon; including Seaton, Sidmouth and Budleigh Salterton, Exmouth and Dawlish on the Exe Estuary, Teignmouth, the Tor Bay area and Salcombe. Beaches are important recreational sites and those with excellent water quality in the region include Blackpool Sands, Slapton Sands, Mill Bay, Salcombe, Thurlestone North and South, Bigbury-on-Sea North and South, and Challaborough[41]. On the south Wales coast bathing waters with excellent water quality include Langland Bay, Caswell Bay, Tenby North and

[41] https://www.gov.uk/government/publications/bathing-waters-in-england-compliance-reports/bathing-water-classifications-2019

South, Freshwater West and Marloes Sands to list a few[42]. There are several important coastal nature reserves in the region, popular locations for bird watchers and naturalists. Slapton Ley National Nature Reserve field studies centre and the visitor centre at Dawlish Warren Local Nature Reserve both provide programmes of guided walks and activities. Sites on the Exe Estuary and the inner Salcombe-Kingsbridge Estuary are also popular with bird watchers. In south Wales, a wide variety of coastal habitats support important sites for wildfowl and waders including the Severn Estuary, Burry Inlet, Carmarthen Bay and for seabirds, islands such as Skomer, Skokholm and Grassholm.

Several important coastal rock climbing locations exist in the region, for example at Berry Head, and the region hosts the South West Coast Path (see Figure A1h.27 above). The path runs from Minehead in Somerset to Poole Harbour in Dorset (over 1,000km) and attracted almost 9 million users in 2012 (The South West Research Company 2014). Relevant stretches of the Wales Coast Path covers the following different regions: South Wales Coast & Severn Estuary (characterised by city life, industrial heritage, wildlife watching opportunities); Gower & Swansea Bay (busy city of Swansea to the Gower Peninsula); Carmarthenshire (estuaries of Tywi, Taf and Gwendraeth), and Pembrokeshire (rugged cliffs, beaches and coves)[43]. The Pembrokeshire part of the Wales Coast Path follows the route of the 300km long Pembrokeshire Coast Path National Trail[44].

There are approximately 20 marinas listed for the south-west region according to the UK sailing, sail cruising and yachting guide[45] with a further 6 listed in south Wales, primarily in and around Milford Haven[46]. The south-west region of the Royal Yachting Association (includes Gloucestershire, Wiltshire, Bristol and Avon, Somerset, West Dorset, Devon and Cornwall) has over 15,000 members, representing almost 17% of the English membership[47].

The south-west of England (35.6%) and Wales (30.8%) were among those regions with the highest rates of participation in water sports activities in 2014 (Arkenford 2015). Water-based activities of note in the region include:

- Water skiing, in the Exe and Teign Estuaries, Salcombe, Thurlestone, Jennycliff Bay and Cawsand Bay
- Windsurfing at Exmouth, Dawlish, Teignmouth, Compass Cove, Blackpool Sands, Slapton Sands, Salcombe, Bigbury Bay, Wembury Bay and Plymouth Sound
- Coastal rowing in sheltered estuaries including Exeter, Dartmouth and Torquay
- Sea canoeing at Axmouth, Exeter, Exmouth, Paignton and Plymouth
- Scuba diving at Fort Bovisand, is one of the country's leading diver training schools

[42] https://naturalresources.wales/evidence-and-data/research-and-reports/water-reports/2019-wales-bathing-water-quality-report/?lang=en
[43] https://www.walescoastpath.gov.uk/places-to-go/south-wales-coast-and-severn-estuary/?lang=en
[44] http://nt.pcnpa.org.uk/website/sitefiles/nt_page.asp?PageID=2
[45] http://www.bluemoment.com/marinassw2.html
[46] http://www.bluemoment.com/marinaswales.html
[47] https://www.rya.org.uk/SiteCollectionDocuments/Club_Membership_Census/Insights/2020/South_West_Insights_2020.pdf

The south-west is an important area for surfing with Cornwall and Devon supporting a large number of surfing spots[48] and surfers (estimated at over 110,000 by Surfers Against Sewage (2013). SAS (2013) estimated that these surfers were responsible for spend of over £620 million, representing over 60% of the UK total. Pembrokeshire and the Gower Peninsula are the main areas for surfing on the south Wales coast with Cardiff and Swansea supporting relatively large numbers of surfers (over 39,000 and 12,000 respectively).

Wildfowling takes place on a number of the area's estuaries including the Taw and Torridge, Camel, Exe and Teign[49].

1.15.4.4 Features of Regional Sea 6

In 2019, there were 7.9 million domestic overnight trips to the English local authorities bordering Regional Sea 6, with associated spending of £1.7 billion (Visit England *et al.* 2020a). 174 million tourism day visits were taken each year to the region, worth £5.4 billion, equating to 12.5% of England's day visit market. Only 9% of day trips to the region were to the seaside, similar to the English average of 10%. The most popular places in the north-west were Blackpool (1.1 million domestic overnight trips, £0.3 billion spend, average 2017-2019) Liverpool (1.7 million domestic overnight trips, £0.4 billion spend) and Cumbria (3.6 million trips, £0.8 billion spend) (Visit England *et al.* 2020a). The north Wales region received a total of 4.2 million domestic overnight trips with total spend of £0.8 billion and 24.4 million domestic day trips (£0.7 billion spend). Conwy (6.5 million), Gwynedd (5.4 million) and Denbighshire (4 million) received the most day visits. At a national level, 19% of domestic day trips to Wales included a seaside/coastal location with the figure for north Wales region being 25% of day trips (the highest for the Welsh regions). There were approximately 2.1 million domestic overnight visits to the Scottish counties adjacent to Regional Sea 6 (average 2017-2019), spending £0.4 billion, with Argyll and Bute (0.8 million) and Dumfries and Galloway (0.7 million) receiving the most overnight trips (Visit England *et al.* 2020a). There were also 25.1 million day trips to these counties with spend of £0.9 billion with South Ayrshire in addition to Dumfries and Galloway and Argyll and Bute, the most popular for domestic day trips. Only 4% of day trips to the west of Scotland had a seaside or coastal destination although the same figure for the south of Scotland was 26%, compared to a Scottish average of 10% (Visit England *et al.* 2020b). In 2019 there were approximately 4.2 million overnight trips to the Northern Ireland counties adjacent to Regional Sea 6 with spend of almost £0.8 billion. Belfast (1.9 million), the Causeway Coast and Glens (1.1 million) and Newry, Mourne and Down (0.5 million) received the most visits (NISRA 2020b).

The north Wales and Lancashire coasts are dominated by traditional seaside resorts, while Cumbria and Dumfries and Galloway are important for more active leisure pursuits. Tourism provides significant income for the region and is a major employer. For example, in many of the relevant Welsh counties, tourism industries were responsible for a large proportion of total employment in 2012: Conwy (19.7%), Pembrokeshire (19%), Anglesey (18%), Gwynedd (17.3%) and Ceredigion (14.4%)[50]. Similarly, in other parts of the region the tourism industry is a significant employer: South Lakeland (24.6%), Blackpool (19.6%), Allerdale (16.8%) and South Ayrshire (14.9%). NISRA (2020b) indicated that in 2019 around one in ten of all employee jobs were in tourism related industries with Belfast accounting for 31% of all tourism

[48] http://magicseaweed.com/UK-Ireland-Surf-Forecast/1/
[49] https://basc.org.uk/wildfowling/club-advice-and-information/wildfowling-clubs-links/
[50] https://www.visitengland.com/sites/default/files/ons_employment_worksheet_for_website.xlsx

related jobs. Ards and North Down and Causeway Coast and Glens local government districts both have over 13% of local employment in the tourism industry.

Much of the west Wales coast of Dyfed and Gwynedd is rugged and undeveloped, but there are significant tourist areas. These include: Aberporth, New Quay, Aberaeron, Aberystwyth, Borth, Tywyn, Barmouth, Harlech, Porthmadog, Criccieth, Pwllheli and Abersoch. The beaches of Caernarfon Bay and Anglesey have all attracted leisure developments. A major and regionally important tourist area is located at Llandudno on Conwy Bay. This resort, along with Colwyn Bay to the east serves many visitors from the industrial towns of north-west England, and is a significant traditional seaside recreational area. Great Orme is a popular Country Park and attracts many visitors, particularly for walking.

As indicated in the summary for Regional Seas 4 and 5 above, participation in water sports activities in 2014 was relatively high in Wales (30.8%) with the north-west of England amongst the lowest (18.4%). By contrast, participation rates in Northern Ireland were the highest in the UK (63.3%). Spending general leisure time at the beach and coastal walking represented the most popular activities, particularly in Northern Ireland with participation in these activities much lower in the north-west (Arkenford 2015). An RYA mapping tool indicates that there are approximately 30 RYA clubs on the coast of Northern Ireland[51].

There are a number of surf spots primarily on the north and west coast of Wales and SAS (2013) estimated that there were approximately 13,000 surfers in the region.

According to the distribution of wildfowling clubs from which a wildfowling permit can be obtained[52], there are a number of areas which support wildfowling clubs including the southern Solway, the River Kent estuary, the Mersey, Ribble, Wyre and Lune estuaries.

1.15.4.5 Features of Regional Seas 7 & 8

There were *ca*. 3.1 million (average 2017-2019) domestic overnight trips to the Scottish regions adjacent to Regional Seas 7 and 8, with associated spending of £0.8 billion. The Highland region (2 million trips) was the most popular with Argyll and Bute and Eilean Siar (the Western Isles) receiving 0.8 million and 0.2 million overnight trips respectively (Visit England *et al.* 2020a). 20 million tourism day visits were taken each year (average 2017-2019) to the relevant Scottish regions (11.6 million of which were to the Highland region), worth £0.9 billion. In the north of Scotland 18% of day trips were to the seaside/coast (Visit England *et al.* 2020b). As described for Regional Sea 6, the Causeway Coast and Glens region of Northern Ireland received 1.1 million overnight visitors with £0.2 billion spend.

The unspoilt coastal environment of Regional Seas 7 and 8 and the wild natural scenery attract tourists in pursuit of a wide range of activities and interests including walking, bird and cetacean watching, wildfowling, sailing, fishing, diving and the maritime history of the region. Visitor surveys for the relevant coastal regions of Scotland highlight the importance of the scenery and landscape in attracting tourists to the region[53].

Foremost attractions in Shetland include the Fair Isle bird observatory, the National Nature Reserve on the Isle of Noss, Fetlar Nature Reserve and Sumburgh Head RSPB Nature

[51] http://www.rya.org.uk/wheresmynearest/Pages/directory.aspx#map/t-1
[52] https://basc.org.uk/wildfowling/club-advice-and-information/wildfowling-clubs-links/
[53] https://www.visitscotland.org/binaries/content/assets/dot-org/pdf/research-papers/motivations-to-visit-2015-16.pdf

Reserve. Wildlife interests are also important in Orkney and include a popular bird observatory at North Ronaldsay and several popular RSPB and Scottish Wildlife Trust reserves. Scapa Flow is a focus for waterskiing, windsurfing, motorised water sports and wreck diving, while there are a number of coastal paths on the north coast of Scotland, including those at Duncansby Head, John O'Groats and Sandside Bay.

The relative remoteness of the Northern Highlands and Western Isles means that they receive fewer tourists than south-west Scotland and the coast of Northern Ireland. Most of the region's tourism and leisure infrastructure is concentrated to the south and east of the Firth of Clyde, one of the most intensively-used areas for coastal recreation in Scotland. Yachting takes place in most areas throughout the isles, but most activity is concentrated in the south. The RYA mapping function[54] indicates that there are no RYA clubs on Shetland and 4 on Orkney with approximately 30 sailing clubs along the west coast of mainland Scotland, mostly in the south.

The north coast of Northern Ireland has a developed tourist infrastructure and a number of coastal attractions. The Causeway Coast Way, for example, takes in attractions like the Giant's Causeway, Dunluce Castle ruins, and the Carrick-a-rede Rope Bridge. The Giant's Causeway World Heritage Site was Northern Ireland's top visitor destination in 2019 with 1 million visitors[55]. Beaches are used in the summer months, most of which are rural in nature and a number held Blue Flag awards in 2020 including Magillan, Benone Strand, Portstewart Strand, Portrush West Strand and Whiterocks Beach[56]. Other popular coastal recreational activities include golf, sea angling, swimming, surfing, canoeing, windsurfing and scuba diving.

A1h.15.5 Evolution of the baseline

At the start of 2020, the British tourism sector was estimated to be worth £127 billion to the economy annually, supported around 3 million jobs and accounted for 200,000 SMEs. Off the back of a strong 2019, VisitBritain had been forecasting inbound tourism to grow by 2.9% to 39.7 million visits and for spending to grow by 6.6% to £26.6 billion[57].

However, COVID-19 has had a huge impact on both inbound and domestic tourism in the UK. VisitBritain's latest central scenario forecast[58] for inbound tourism to the UK in 2020, is for a decline of 76% in visits to 9.7 million and a decline of 80% in spending to £5.7 billion. This would represent a loss vs the pre-COVID forecast of 32.3 million visits and £24.7 billion spending. The forecast for inbound tourism in 2021 is for 16.9 million visits, up 73% on 2020 but only 41% of the 2019 level; and £9.0 billion to be spent by inbound tourists, up 59% on 2020 but only 32% of the 2019 level.

Visit Britain have also forecast £28.5 billion in domestic tourism spending in 2020, down 63% compared to 2019. This comprises £7.8bn from overnight tourism, down from £19.5bn in 2019, and £20.7bn from day trips, down from £56.5bn in 2019. The 2020 forecast is for a decline of 60% for overnights and 63% for leisure day trips. A recovery to £51.6 billion in domestic tourism spending in 2021 is forecast; up 82% compared to 2020 but still only 68% of the level of spending seen in 2019.

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[54] http://www.rya.org.uk/wheresmynearest/Pages/directory.aspx#map/t-1
[55] https://www.nisra.gov.uk/sites/nisra.gov.uk/files/publications/Tourism-statistics-publication-Local-Government-District-Publication-2019.pdf
[56] https://www.blueflag.global/all-bf-sites
[57] https://www.visitbritain.org/sites/default/files/vb-corporate/Documents-Library/documents/helping_the_tourism_industry_recover_from_covid_4_may_2.pdf
[58] https://www.visitbritain.org/2021-tourism-forecast

It should be noted that Visit Britain emphasised the difficulties of forecasting given the fast-moving COVID-19 situation. The central scenario forecasts reflect a snapshot in time based on current understanding and a set of assumptions. Subsequent developments could change the outlook.

In the longer term, recovery of the tourism sector may be supported by the Tourism Sector Deal (HM Government 2019) although this may have to be updated in light of the impact of COVID-19 on the sector.

A1h.15.6 Environmental issues

A marine strategic scoping exercise (Welsh Government 2015) to inform the development of the Welsh National Marine Plan identified a number of relevant environmental issues with respect to tourism and recreation which are likely to apply to all coastal areas of the UK.

Increased levels of recreational activities have the potential to increase the risk of negative effects on the marine environment; however, the scale and the impact of recreational activities vary considerably, change rapidly and the impacts are, therefore, hard to define and challenging to manage. For example, experience in Pembrokeshire suggests that marine and coastal recreational activity is increasingly being provided through small individual, mobile enterprises that make extensive use of social media for promotion purposes (as opposed to the larger outdoor and often residential recreation centres and businesses of the past), which can create significant challenges in terms of managing frequency, levels and impacts (social and environmental) of recreational use along the coast. As with tourism, recreational activities rely on the benefits of healthy marine environments, coasts and landscapes. A balance is, therefore, needed to retain both the level of recreational activities to support socio-economic benefits to the area and promoting good environmental status.

It is inevitable that recreational activities (hotspots) overlap with sites of designated and significant landscapes, historic heritage, nature conservation and other key interests along the coastline (Welsh Government 2015).

The East marine plan (HM Government 2014) highlighted that it was important to recognise that, apart from recreational sailing, the majority of tourism and recreation activities occur on the coastline and in the inshore area e.g. surfing. Therefore, this sector is spatially constrained. Tourism and recreation rely on the preservation of the historic environment and heritage assets, a healthy marine environment including good water quality, clean beaches, abundant wildlife and a healthy ecosystem to attract people. Issues identified through the development of the East marine plans include the potential for displacement of tourism and recreation due to increases in new activities and the cumulative effect of other activities.

A1h.16 Recreational sea angling

A1h.16.1 UK context

Sea angling is a popular leisure activity in the UK, with social and economic benefits including being an important contributor to coastal tourism. Estimates of the number of active participants in the UK vary from year-to-year and between different surveys, but are in the region of one million people (e.g. British Marine *et al.* 2009, Arkenford 2018; Armstrong *et al*. 2013, AFBI 2014, Hyder *et al*. 2018). The ‘Sea Angling 2012’ survey (Armstrong *et al*. 2013) provided a benchmark of information on sea angling activity, with a focus on England, based on household surveys, face-to-face interviews, catch diaries and online surveys with a total of

over 11,000 people. Subsequently, a revised monitoring programme was undertaken from 2015-2017 to estimate participation, effort, catch, and economic impact of sea anglers resident in the UK; results are reported in Hyder *et al*. (2020a).

Participation levels presented in Hyder *et al*. (2020a) were based on the results of the 2015-2017 Watersports Participation Surveys, which comprise an annual omnibus face-to-face survey of *ca*. 12,000 households across the UK, designed to ensure a representative sample (e.g. Arkenford 2018). The surveys estimated that, on average, 823,000 people aged 16+ years old in the UK went sea angling annually over the period 2015-2017, representing a participation rate of 1.6%. In total, it was estimated that they fished on an average of 7 million days per year, equating to 8.5 days per angler per year. Shore-based angling accounted for the majority of activities (average 5.1 million days per year), followed by angling from a private vessel (1.3 million days), then kayak or charter vessel (0.3 million days each). These statistics and those which follow relate to fishing with rod and line, or handline; while some recreational fishing occurs with other techniques (e.g. spearfishing, nets, pots, hand gathering), participation rates were low, resulting in an uncertain average estimate of 0.5 million days per year.

Numbers and participation rates varied between different countries and regions of the UK (Table A1h.5); while England had, by far, the highest number of sea anglers and days fished, participation rates were highest in Wales and Northern Ireland. However, it was noted that estimates for Scotland, Northern Ireland and, to a lesser extent, Wales, were likely unreliable due to the low numbers of anglers interviewed. Within England, participation rates were highest in the south-west. Earlier country-specific surveys have estimated *ca*. 125,000 sea anglers (18+ years old) in Scotland (Radford *et al.* 2009) and *ca*. 65,000 sea anglers (18+ years old) in Northern Ireland (McMinn 2013).

Table A1h.5: Estimated average participation in sea angling in the UK from 2015-2017

Region	Number of sea anglers	% Participation	Total days fished (million)
England	607,000	1.4	4.6
Wales	72,000	2.8	0.8
Scotland	81,000	1.8	0.7
Northern Ireland	67,000	4.4	0.9
UK	**823,000**	**1.6**	**7.0**

Note: Values for Wales, Scotland and Northern Ireland were uncertain due to small numbers of sea anglers interviewed in these regions. Source: Hyder et al. (2020a).

Hyder *et al*. (2020a) also gathered data through a nationwide panel of sea anglers who kept a diary of recreational sea angling activities, catches and spend: 292 and 639 anglers provided the minimum of six months of data in 2016 and 2017, respectively. Results from the face-to-face survey and diary data were combined to estimate total UK catches; corrections were made for age, differences in frequency of fishing ('avidity'), and type of fishing (shore, boat), between the diary sample and the UK WPS sample. Nonetheless, some bias in catches and expenditure may remain if there is a trend of anglers completing a diary being more experienced or skilled than the general angling population.

Diary data indicated a total of 100 different species caught during the study. Sufficient data were available to provide raised estimates of total UK numbers caught for 68 individual species and tonnage for 32 species. Across the 68 species the total number of fish caught in 2017 was estimated as 54.5 million, of which *ca*. 80% were released. Whiting and mackerel were the most frequently caught species, followed by lesser-spotted dogfish; combined, these three species accounted for approximately half of the total fish caught in 2017. Bass, bib, pollack, cod and dab were the next most frequently caught, together accounting for approximately one quarter of the total fish caught. The remaining catch (*ca*. one quarter) was made up of a variety of species, the most commonly caught being black sea bream, flounder, ballan wrasse, saithe, plaice, thornback ray and conger eel. The species composition was very similar in 2016 and 2017.

Data from Sea Angling 2012 indicated that anglers fishing from boats were more successful than their shore-based counterparts, catching an average of five fish per day, compared to two fish per day from the shore. Therefore, despite the dominance of shore-based fishing in terms of participation and effort, this activity was estimated to account for only 43% of fish caught (Armstrong *et al*. 2013).

Of the 32 species for which tonnage was estimated (the most frequently caught species), an estimated 6,784 tonnes were retained in 2017 (Hyder *et al*. 2020a). Of EU Data Collection Framework species (bass, cod, European eel, pollack, salmon, sea trout, elasmobranchs and highly migratory ICCAT species), cod, pollack and bass dominated the retained catches by number and weight. Catches of sea bass are mainly in the south-west, but fish are caught in the southern north sea, English Channel and Celtic Sea. Catches of cod are more evenly distributed around the UK, with the largest catch in the central North Sea.

These anglers make a significant contribution to the economy. Diary data from 2017 indicated an average trip expenditure of £86, and £841 spent on capital items; this was scaled up to an estimated direct impact of £847 million expenditure, including £388 million Gross Value Added and 8,900 jobs. Taking indirect effects into account, the total estimated economic impact of sea angling in the UK in 2017 was estimated to be £1.94 billion and supporting *ca*. 16,300 jobs (Hyder *et al*. 2020a). For example, bait is often collected locally and may be an important secondary industry in an angling region, with estimates of the value ranging from £25-90 million annually (Defra 2010).

A1h.16.2 Spatial distribution of recreational sea angling

In addition to data gathered on activity levels, catches and economic impact at regional levels, as described above, there is a need for information on the spatial distribution of recreational sea angling at a sufficiently high resolution to support marine spatial planning.

This was first addressed in Wales (Monkman *et al*. 2015, 2018), which is highly regarded as a venue for sea angling, in particular for its bass and other specialist experiences including blue shark, tope, and smooth hound sport angling. A variety of data sources (such as interviews, online survey, port census and online records of fishers' knowledge) were drawn together to generate activity layers indicating the key areas for shore- and vessel-based angling. While these layers will be subject to unquantifiable bias and may fail to identify areas highly valued by fishers, they do provide qualitative predictions of where recreational fishers fish, identifying high and low activity areas (vs intermediate areas) (Monkman *et al*. 2018). Shore-based angling activity was widely distributed around the coast of Wales, although greater along the north and south coasts compared to mid/west Wales. The density of activity was estimated to be particularly high around Anglesey, Pembrokeshire and The Gower Peninsula. In the

summer months, activity notably in areas such as Anglesey, the Llŷn Peninsula, Ceredigion and Pembrokeshire (Monkman *et al.* 2015). Charter boat activity was greatest off the north coast, the northern half of Cardigan Bay, and the south coast between the Gower Peninsula and Cardiff (Richardson 2006, Monkman *et al*. 2015). Private boat activity was widely distributed around the coast, with activity generally greatest close to population centres with vessel storage and launch facilities; particular aggregations of activity included inshore waters around Conwy, the south coast of the Llŷn Peninsula, Milford Haven, Tenby to Saundersfoot, Llanelli, Swansea and Cardiff (Monkman *et al*. 2015).

An MMO-commissioned study sought to model recreational use of the English coast and marine environment, including shore- and boat-based angling, based on the scoring of a series of parameters for each activity modelled (MMO 2014b). Parameters determined to strongly influence angling included those associated with access and facilities (e.g. marinas, slipways, land access), as well as water depth, wind and wave magnitude, and presence of wrecks (boat angling). Output layers provide a predicted activity level at a 1km^2 grid cell resolution. For selected areas, model outputs were validated with existing data of activity levels and additional stakeholder consultations; validation revealed models to be broadly accurate for water-based activities which relied on access infrastructure such as slipways. Areas of high angling activity included the south coast, particularly off parts of the Hampshire and Dorset coasts, south-west Cornwall and the Bristol Channel coast; waters off the mouth of Morecambe Bay; the Kent coast; and, much of the east coast from Flamborough Head north.

More recently, another MMO-commissioned project aimed to provide spatio-temporal data specifically on sea angling activity in England using similar methods as Monkman *et al.* (2015, 2018), to assist in marine spatial planning (MMO 2020b). Public online user generated content, angling literature, available datasets and other sources were identified. Online data was extracted using data mining methods and used to identify sites for recreational sea angling and spatiotemporal trends in the distribution of activity and catches across England were estimated. Spatial layers were generated that showed the distribution of recreational sea angling from the shore around the coast of England; validation exercises showed outputs accorded well with expert stakeholder knowledge. Analysis of the predicted value rankings indicated that the south coast (Regional Sea 3) had the greatest proportion of coast (37%) predicted to be of high value to shore angling, with Regional Sea 6, the least (21%). The top three ranked species across all marine plan areas combined were cod, whiting and sea bass. Rays, flatfish species and whiting also had high values for most marine plan areas. A general pattern across all marine plan areas was a shift from sea bass toward the gadoids with the onset of winter.

Key regions for angling include south west England, Northumberland, Pembrokeshire, the Firth of Clyde, Argyll and the Western Isles, the Solway Firth and the East Grampian coast (British Marine Federation *et al*. 2009; Land Use Consultants 2007, CCW 2009).

The Sea Angling 2012 survey identified 399 charter boats in England, of which 210 were based at ports along the south coast, 144 at North Sea ports and the remaining 45 at Bristol Channel and Irish Sea ports. This compares closely to the 364 charter vessels identified as operating from 91 ports and launch facilities across England by MMO (2020b). As of April 2021, the Charter Boats UK website[59] lists 157 charter boats based in England, 33 in Wales, 10 in Scotland and 3 in Northern Ireland (although this is not likely to be a full complement). Boat anglers typically returned approximately 50% of fish they caught. Elasmobranch species

[59] https://www.charterboats-uk.co.uk/boats/

were nearly always released, although there were no catches of large pelagic sharks (mako, porbeagle or blue) reported possibly due to specialist shark angling boats either being missed by, or declining to participate in, the survey (Armstrong *et al*. 2013). The recreational blue shark fishery is conducted between June and September off the Cornish coast. Here, six charter vessels catch and release between 200-600 blue sharks annually (Mitchell *et al*. 2014).

A1h.16.3 Evolution of the baseline

While there have been multiple surveys by different groups to estimate the number of people actively participating in recreational sea angling over time, all are subject to error and are limited in their ability to detect any trends. The Watersports Participation Survey provides an annual survey of over 12,000 adults to generate estimates of the number of people actively participating in different water sports in the UK (Table A1h.6). Identification of inter-annual differences in participation is complicated by the use of different categories for sea angling between surveys, and a lack of definitions provided for those categories. Nonetheless, there is some evidence that the numbers participating in sea angling has declined. A marine and recreation land use audit (CCW 2009) reported that angling had declined due to reductions in fish stocks.

Table A1h.6: Participation in recreational sea angling, 2015-2018

	2015	2017	2018
Survey respondents	12,739	12,730	12,790
Sea angling From boat/kayak From rocks or shore	1.4% (694,000) 0.7% (364,00) 1.2% (588,000)	1.7% (902,000)	1.4% (758,000)
Recreational sea fishing	0.2% (104,000)	0.5% (242,000)	0.3% (172,000)

Source: Watersports participation surveys 2015, 2018 (Arkenford 2015, 2018)

A1h.16.4 Environmental issues

MRF can have substantial impacts on fish stocks (e.g. Hyder *et al*. 2018; Radford *et al*. 2018). This can occur via a number of different mechanisms including: high stock exploitation, selective harvesting causing demographic effects by shifting population structure and ecological effects by altering community structure, habitat destruction, unwanted catch and release mortality/disease, introduction of non-native species, and incidental catches of vulnerable species (Hyder *et al*. 2020b). In particular, there is growing evidence of the importance of MRF in biomass removal with recreational removals (harvest plus fish that die after release) for some species estimated at between 2-43% of the total catch (Hyder *et al*. 2018, Radford *et al*. 2018). In their ecosystem overview of the Greater North Sea, ICES (2019) indicate that the proportional impact of recreational fishing on fish stocks is increasing as commercial operations are restrained.

A1h.17 Fisheries

A1h.17.1 UK context

The UK fishing industry operates throughout UK waters, from the shoreline to the national boundaries. The livelihoods of fishermen depend on their ability to make optimum use of prime fishing grounds and to adapt to changing circumstances to maximise profit. Consequently they are vulnerable to being displaced by other users. This section provides an overview of the UK

fishing industry, followed by a more detailed look at specific fishing activity within each Regional Sea. The data used in this report were obtained largely from the Marine Management Organisation (MMO) and the Scottish Government, who collect Vessel Monitoring System (VMS) data and landings and logbook data. This information is used to generate maps describing the distribution of fishing effort and landings around the UK, allowing examination of fishing activity within each Regional Sea. Recently available data has been presented, in most cases from 2018 or 2019 and some data are presented as averages covering several years.

The UK fishing industry maintains an important position in the UK economy, particularly in remote coastal regions such as parts of Scotland, where the industry can support up to a quarter of all jobs (PMSU 2004). In 2019, there were 12,043 working fishermen in the UK (of which *ca*. 80% were full time), operating 5,911 vessels (MMO 2020). These vessels, while fishing in UK and non-UK waters, landed 621,900 tonnes of sea fish and shellfish in 2019 (391,200 tonnes into UK ports), with a total value of £987 million (£762 million into UK ports) (MMO 2020a). Additionally, foreign vessels landed 50,896 tonnes of sea fish and shellfish (key species: mackerel, hake, saithe) into UK ports in 2019, with a total value of £73 million.

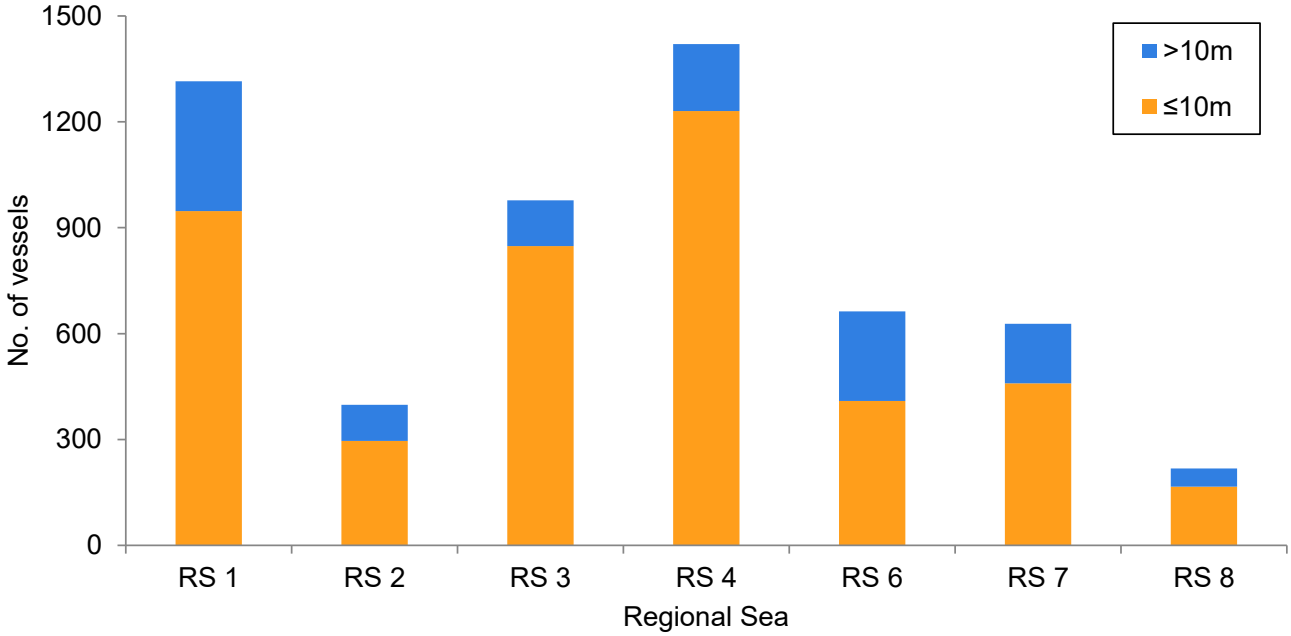
An analysis of wider data indicated that a total of almost 2 million tonnes of fish and shellfish was landed from the UK EEZ by UK and non-UK vessels in 2018, with a value of *ca*. £1.7 billion (Napier 2020). Of this total, non-UK vessels accounted for 71% of the landings (52% by value), with vessels from Norway, Denmark, the Netherlands, France, Ireland and Germany accounting for the majority of landings (Napier 2020).

Fish processing supported over 19,000 jobs in the UK in 2018, 17,000 of which were in majority sea fish processing sites, the reminder being in salmon and trout-only sites (Seafish 2019). The UK is a net importer of seafood: imports in 2019 totalled 687,000 tonnes with a value of £3.3 billion, compared to exports of 452,000 tonnes worth £2 billion (Seafish 2020).

A1h.17.2 Fishing ports and vessels

There are over 350 ports around the UK coast supporting active fishing vessels. Vessels range in size from small day boats of just a few metres in length, to large pelagic and demersal trawlers, able to fish for weeks at a time and store large quantities of catch. Smaller vessels make up an inshore fleet that is both active and also very important to the economy of many coastal areas. For this baseline, vessels have been split into two groups: ≤10m and >10m, as is regularly done when reporting fisheries statistics. The ≤10m fleet comprises almost 80% of the total UK fleet by numbers. Vessels operating in the inshore fishery are considered to be day boats, typically completing and returning from a fishing port within a day. Most inshore fisheries take place within 25nm of shore. Inshore fisheries may be particularly vulnerable to spatial exclusion as these smaller vessels are unable to travel further afield to fish new grounds. Smaller vessels are distributed relatively evenly around the coast, with particularly large concentrations along the south and northeast coasts of England and the west of Scotland, where inshore fisheries are particularly important (Figure A1h.28). Larger vessels are more abundant in ports on the northeast coast of Scotland, the Devon/Cornwall peninsula and Northern Ireland. A breakdown of fleet size by Regional Sea is provided in Figures A1h.28 and A1h.29.

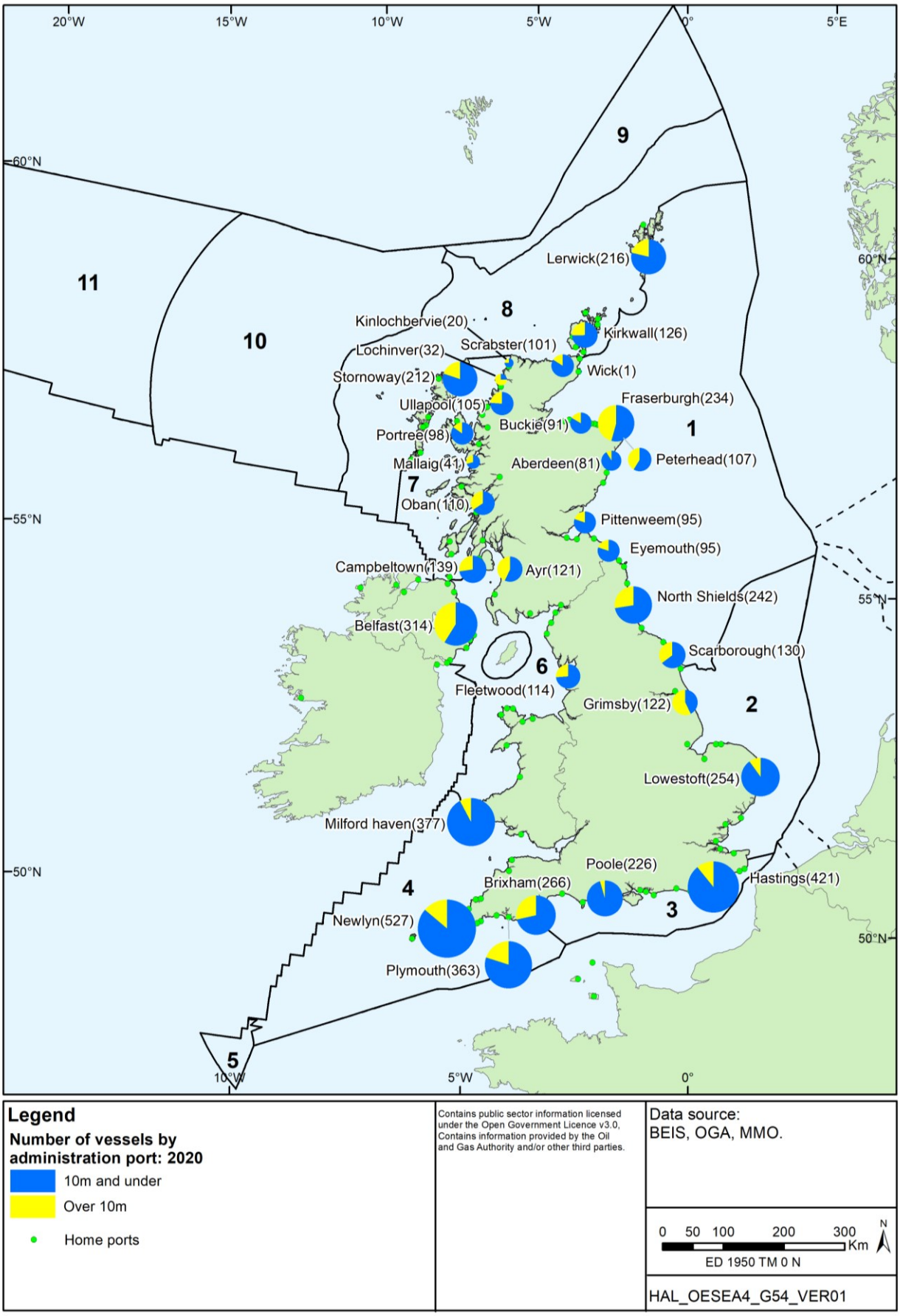
Figure A1h.28: The number of fishing vessels based in each coastal Regional Sea in 2020



Notes: Based on administrative port. Regional Sea 4 values include 168 vessels operating from a home port in the Channel Islands. Data valid as of 01 August 2020. Source: MMO vessel statistics[60]

[60] https://www.gov.uk/government/collections/uk-vessel-lists

Figure A1h.29: The distribution of UK vessels by administrative ports in 2020



Note: Vessel numbers include those operating from the labelled administrative port (as a home port) in addition to vessels operating from other home ports (mapped as green dots) associated with that administrative port. A total of 168 vessels assigned to the administrative port of Plymouth operate from a home port in the Channel Islands.

A1h.17.3 Fisheries management

The UK has now left the EU Common Fisheries Policy and the agreement reached on fisheries as part of the Trade and Cooperation Agreement[61] sets out new quota sharing arrangements for shared fish stocks. This will be phased in over five years, with the majority of this value (15%) being transferred in the first year (2021). The agreement provides for a five and half year adjustment period during which there will be stable and reciprocal access to each other's waters, including access to a limited part of the UK's territorial waters for EU vessels which regularly fished in these areas between 2012 and 2016. The agreement creates a framework for annual negotiations on fishing opportunities and access to waters and establishes a Specialised Committee on Fisheries to facilitate cooperation on fisheries management[62]. The first of these annual negotiations between the UK and EU concluded (2 June 2021) on an agreement in principle setting out catch limits for 75 shared fish stocks for 2021, as well as for some deep-sea stocks for 2021 and 2022[63].

In the UK, the *Fisheries Act 2020* establishes a domestic system of fisheries management between the Secretary of State for Environment, Food and Rural Affairs and the Devolved Administrations, known collectively as the Fisheries Administrations. Within two years of enactment, the Fisheries Administrations are required to publish a joint fisheries statement (JFS) setting out the policies to achieve the high level fisheries objectives set out in the Act. The JFS will encompass several aspects of policy, including:

- Distribution of allocated quota to fishing vessels and Producer Organisations.
- Fisheries management plans, broken down by stock, type of fishing and geographical area.
- Actions to maintain or restore stocks to a level capable of producing maximum sustainable yield (MSY) within the fisheries management plans.

Alongside the JFS will be a Secretary of State Fisheries Statement (SSFS), which fulfils a similar purpose to the JFS but concerns only reserved functions not otherwise covered in the JFS. The SSFS will set overall UK catch and effort quotas, and their distribution between the four administrations[64]. Until the publication of the JFS, the fisheries authorities are able to (independently or jointly) publish fisheries management plans for particular fish stocks, fishing types and areas of sea.

The Act specifies that any fishing by a British vessel requires a licence, apart from in very specific circumstances (e.g. salmon and trout fishing, small boats without an engine, purely recreational fishing or within the waters of the Crown Dependencies). Licences are granted by the relevant fisheries authority, and are specific to fishing area, time period, quantity and description of fish, and fishing method. Foreign fishing vessels can only enter UK waters if they are fishing with a relevant sea fishing licence, or for a purpose recognised in an international agreement between the UK and other nations. Licenses can be granted by any of

61 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/982648/TS_8.2021_UK_EU_EAEC_Trade_and_Cooperation_Agreement.pdf

62 https://www.gov.uk/government/publications/ukeu-and-eaec-trade-and-cooperation-agreement-ts-no82021/summary-the-uks-new-relationship-with-the-eu#fisheries

63 https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_21_2828

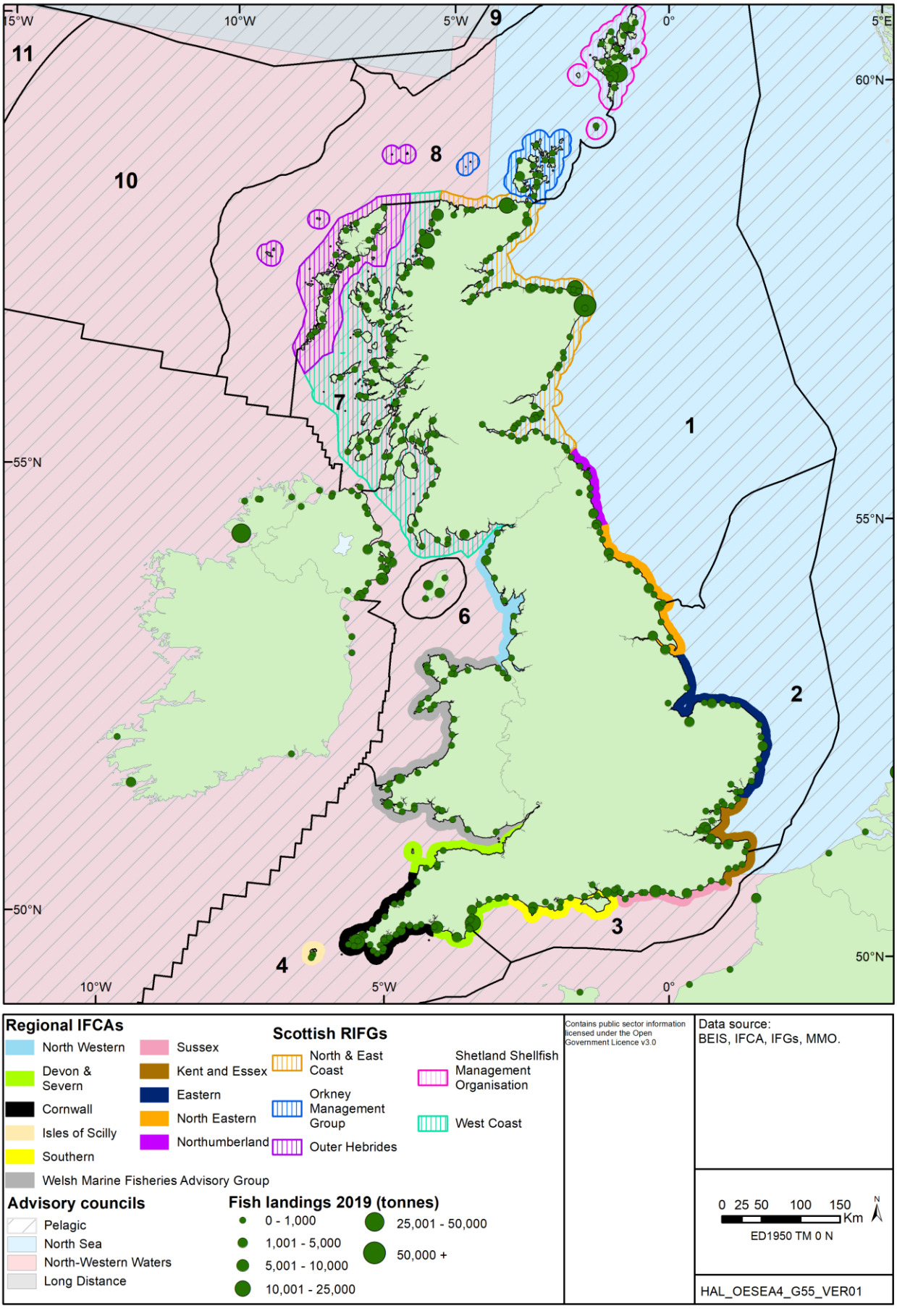
64 https://www.fisheriesappg.org/blog/2020/12/16/the-fisheries-act-2020-what-you-need-to-know

the four fisheries authorities via the newly created Single Issuing Authority, but only for the waters they represent (e.g. Scottish Ministers can only grant licenses for Scottish waters).

Advice from scientific bodies such as ICES (International Council for the Exploration of the Sea) will be considered in the management process. It also appears likely that the three Regional Advisory Councils (RACs) which covered UK waters (Figure A1h.31) – the North Sea RAC, the North Western Waters RAC and the South Western Waters RAC – will continue to produce advice and recommendations on fisheries management with respect to UK waters[65]. The inshore waters (within 6 nautical miles of the high mean water mark) of England are under the jurisdiction of ten Inshore Fisheries and Conservation Authorities (IFCAs), which were established in 2011 to replace Sea Fisheries Committees (SFCs). The Welsh Government has full responsibility for the management and enforcement of sea fisheries in Wales, advised by three Inshore Fisheries Groups representing north, mid and south Wales. In Scotland, fisheries management is controlled by Marine Scotland, who work in conjunction with five Regional Inshore Fisheries Groups (RIFGs) (Figure A1h.31). These non-statutory bodies are able to impose closed areas and technical measures in their local region. Salmon and sea trout are managed by the Environment Agency which also exercises the powers of an IFCA in many of the estuaries of England and Wales.

[65] https://www.pelagic-ac.org/media/pdf/2021ref18%20Response%20COM%20on%20clarification%20Annex%20III%20CFP%20Brexit.pdf

Figure A1h.31: UK fisheries management and ports by landings in 2019



A1h.17.4 Distribution of fishing effort

1.17.4.1 VMS and logbook data

Total fishing effort is not evenly distributed around the UK coast, although it plays an important role in all coastal communities. VMS is a satellite based method of monitoring the position and movements of vessels in UK waters. Figure A1h.32 shows the average annual density of UK vessels in 2019, split by gear type in Figures A1h.33. This data shows shelf areas to the north and west of Scotland, along with the western English Channel and the Irish Sea waters around the Isle of Man to be amongst the most heavily fished in the UK. The collection of VMS data however, is only mandatory for vessels over 12m in length (implementation of VMS on vessels under 12m in England is not expected until late 2022[66]) and therefore activity of smaller vessels operating inshore is likely to be under-represented.

In order to gain a better understanding of the fishing activities of small inshore vessels, landings data from 2019 as reported by MMO were used to derive maps of fishing activity (Figure A1h.34 and 35), which were split by species group (Figure A1h.36). It is clear that most fishing activity takes place in coastal waters, for both static (such as pots, traps and gillnets) and mobile gears (such as trawls and dredges). Total fishing effort is generally greater among vessels using mobile gears. There is little seasonal variation in fishing effort, although many fisheries are seasonal, because many fishermen will target different species throughout the year. It should be noted that skippers of vessels <10m are not obliged to complete logbooks, although many now do.

[66] https://www.gov.uk/guidance/inshore-vessel-monitoring-i-vms-for-under-12m-fishing-vessels-registered-in-england

Figure A1h.32: Total fishing effort of UK vessels >15m length in 2019

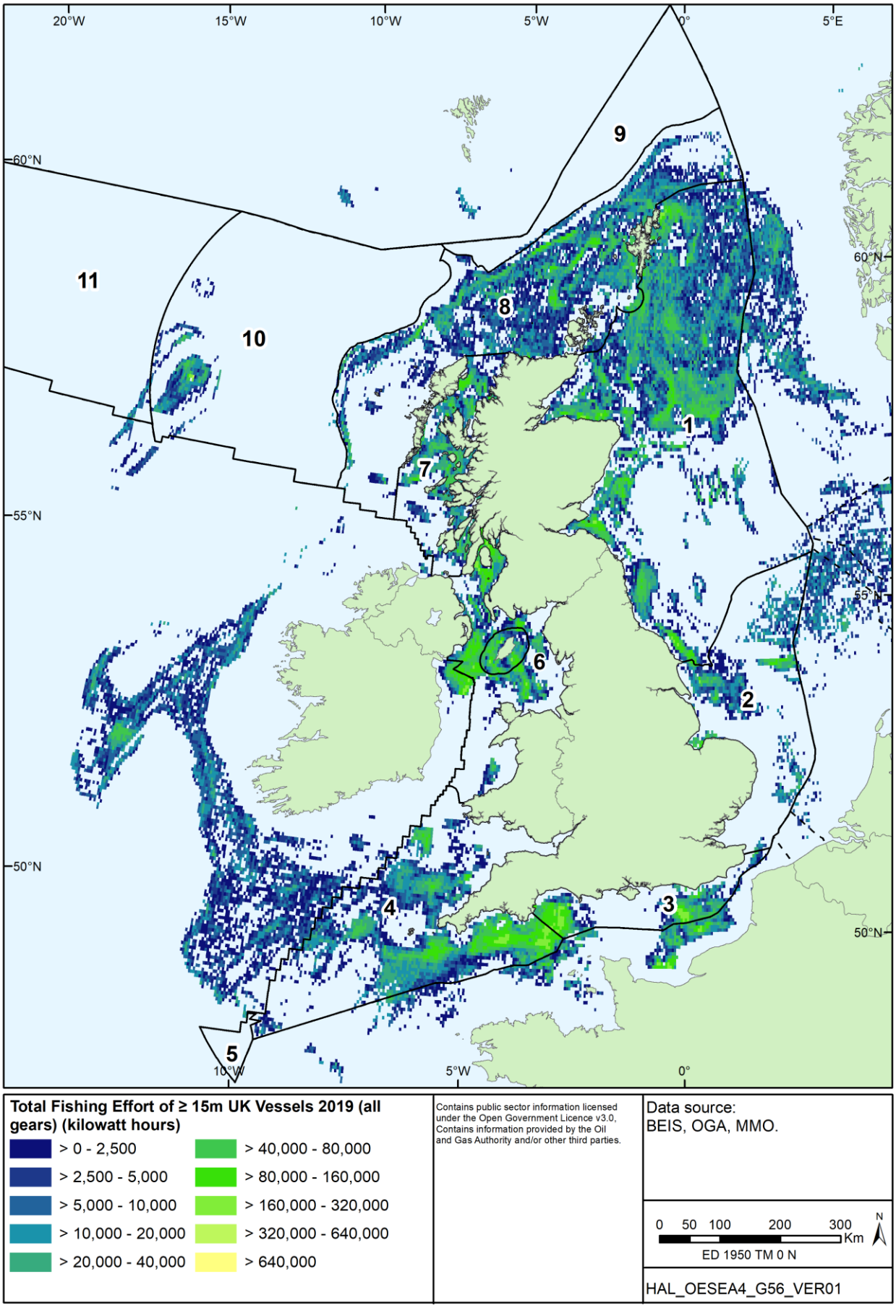


Figure A1h.33: Fishing effort of UK vessels >15m length in 2019, by gear type

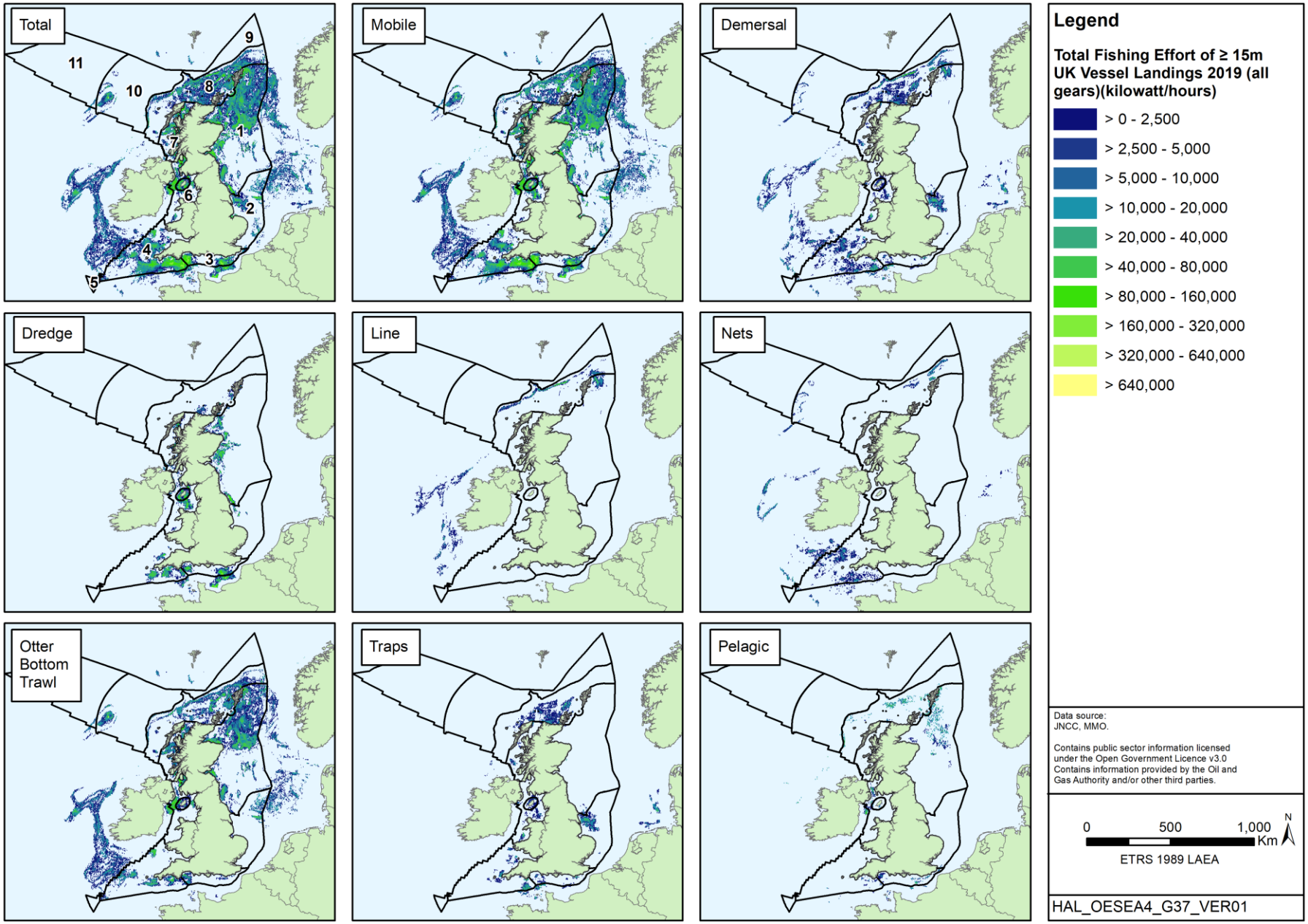


Figure A1h.34: Landings (live weight) by UK vessels per ICES rectangle in 2019

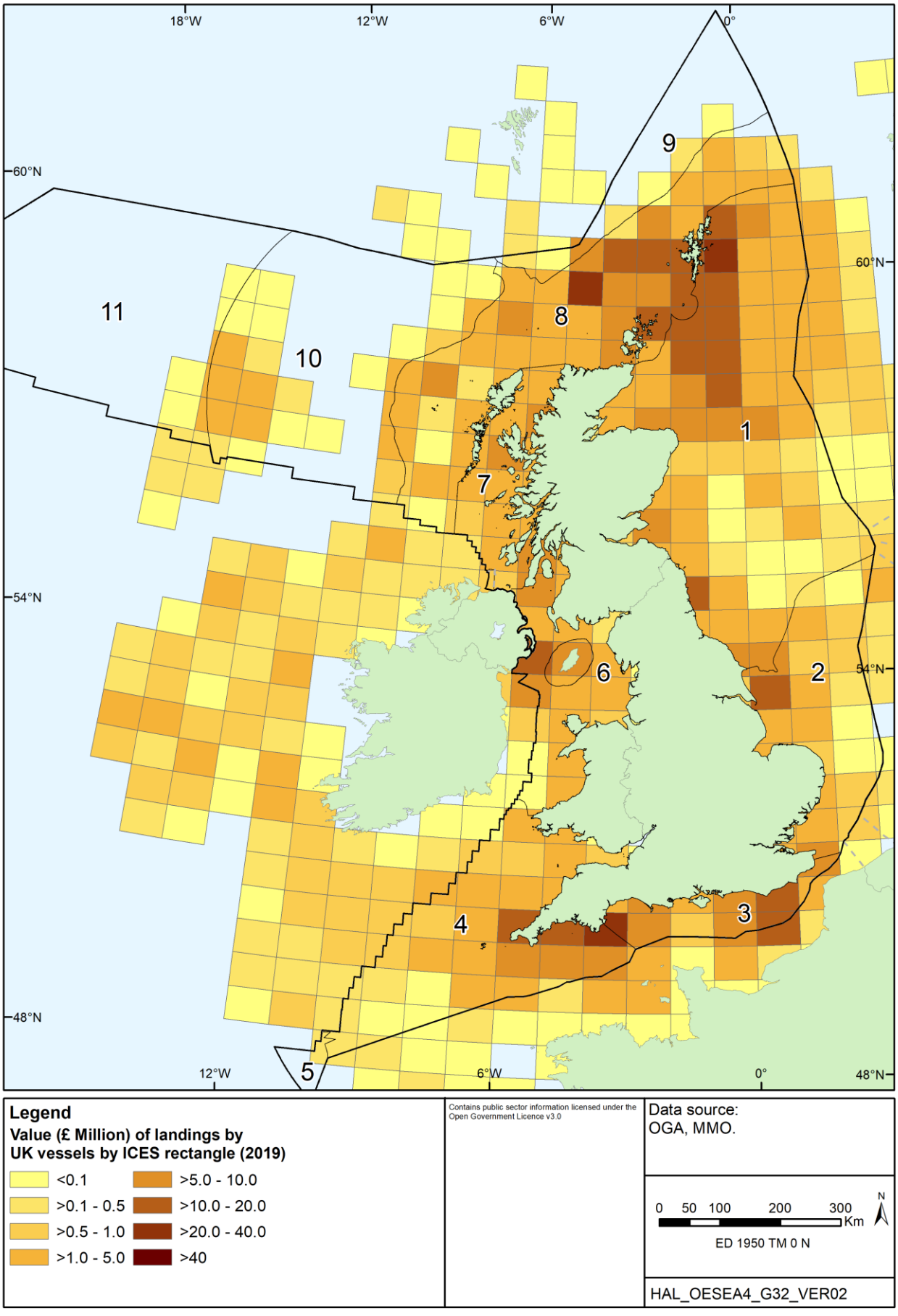


Figure A1h.35: Landings (value) by UK vessels per ICES rectangle in 2019

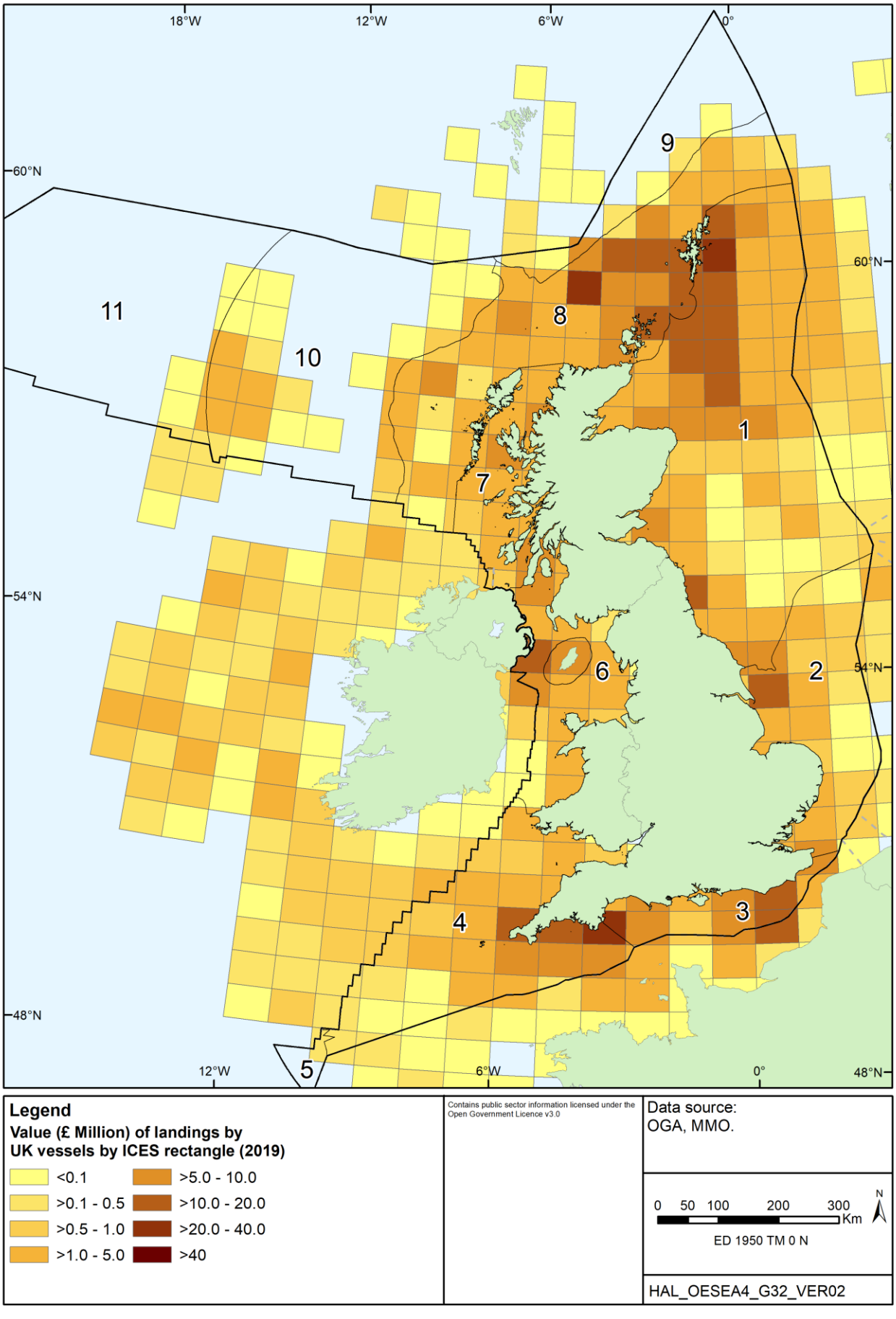
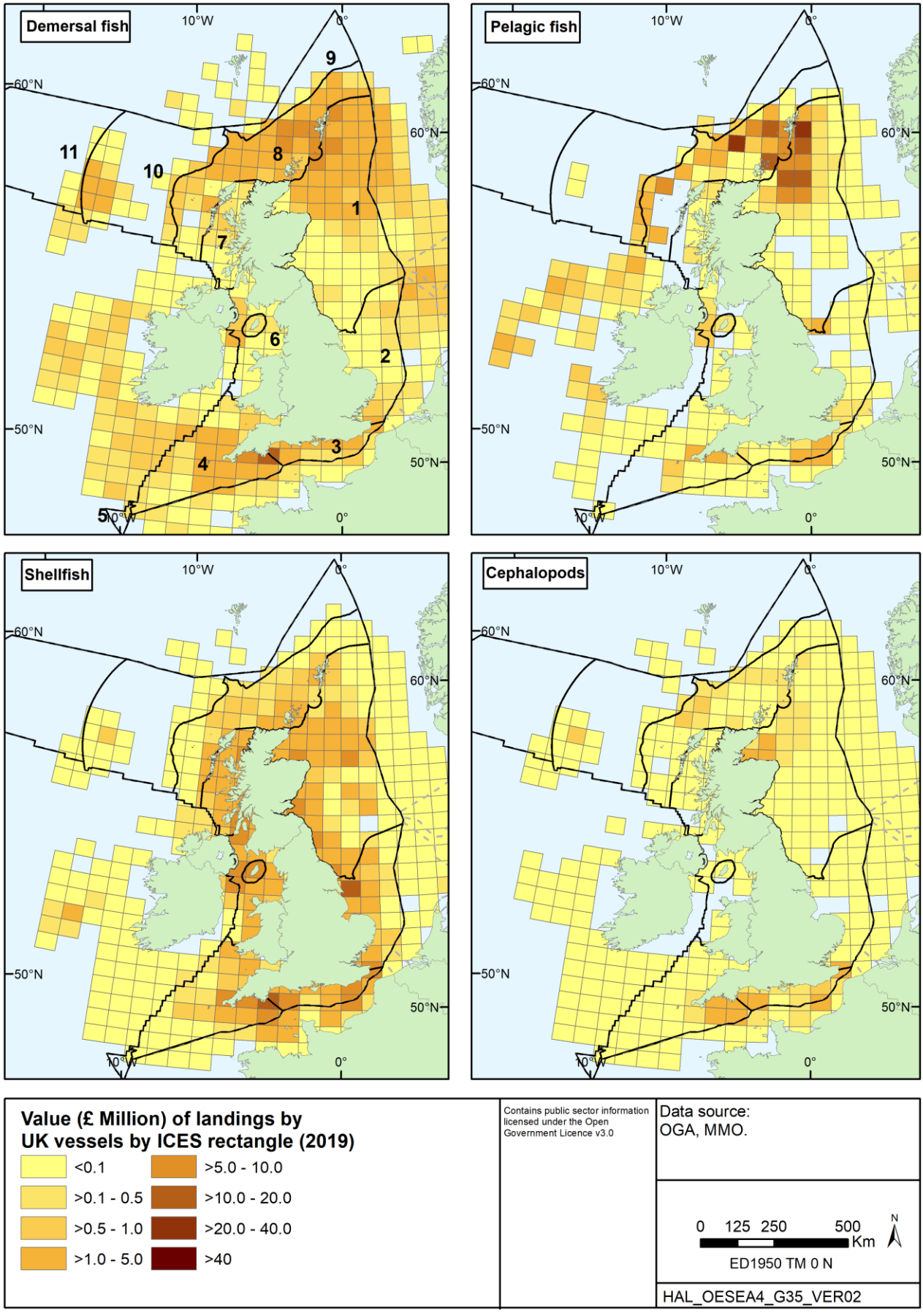


Figure A1h.36: Density of UK landings (value) by species group, 2019



Note: Shellfish category includes cephalopods

A1h.17.5 Gears and landings

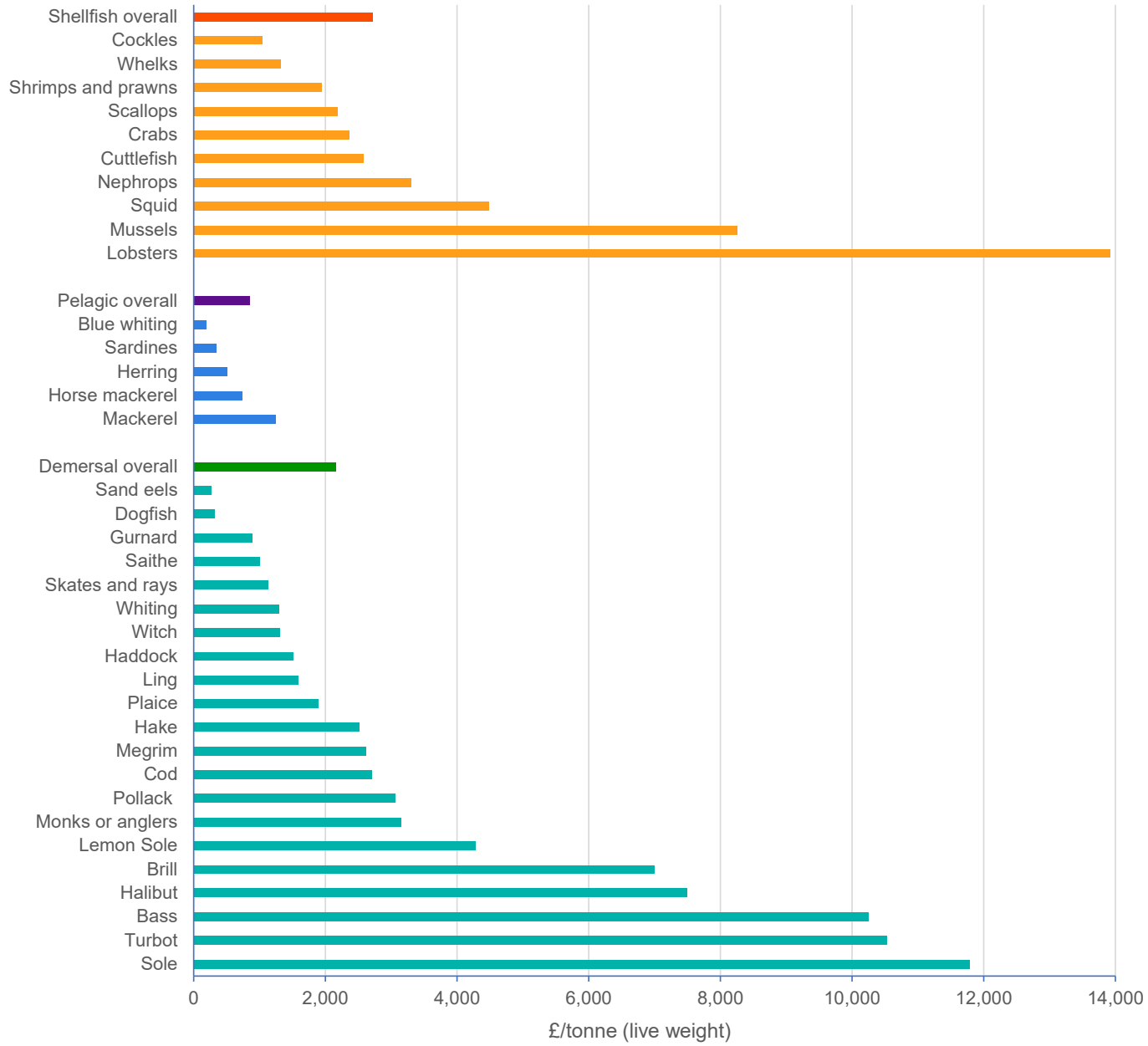
Fisheries may be broken down simply into the following sectors: demersal, pelagic and shellfish. The shellfish sector is typically the most valuable in the UK, with lobsters, squid, cuttlefish and *Nephrops* all particularly high value catch (Figure A1h.37). Pelagic fish are usually caught in large numbers but at low values; in 2019, mackerel fetched the highest price (£1,244/tonne). While intermediate to pelagic (£854/tonne) and shellfish (£2,714/tonne) overall, the demersal sector (£2,166/tonne overall) contains several of the highest value individual species, with sole, turbot, bass, halibut and brill all valued at >£7,000/tonne. The main fishing gear used by each sector is summarised in Table A1h.7.

Table A1h.7: Summary of the main fishing gear used around the UK

Category	Sub-category	Examples of species	Fishing gear
Demersal	Roundfish	Cod, whiting, haddock, saithe, pollack, dogfish.	Demersal otter trawl, pair trawl, seine net, gill net, trammel net, longline, handline.
	Flatfish	Sole, plaice, flounder, turbot, monkfish, rays.	Beam trawl, demersal otter trawl, seine net, tangle net, trammel net, longline.
Pelagic	Small pelagic	Mackerel, herring, sprat.	Gillnet, pelagic trawl, handline.
	Large pelagic	Bass, mullet.	Gillnet, pelagic trawl, demersal trawl, beach seine, handlines.
	Diadromous	Salmon, sea trout, eel.	Gillnet, beach seine (salmonids), trap, hand-held nets, fyke nets (eels).
Shellfish	Crustaceans	Lobsters, crabs, crawfish, *Nephrops*, shrimp.	Pot, tangle nets, beam trawl (shrimp), demersal otter trawl (*Nephrops*)
	Molluscs	Cockles, mussels, scallops, oysters, clams, whelks, periwinkles, cuttlefish, squid.	Dredges (bivalves), trawls (cephalopods and queen scallops), pots (whelks) hand-gathering (bivalves and gastropods), traps (cuttlefish), jigging (cephalopods).

Source: Adapted from Walmsley & Pawson (2008)

Figure A1h.37: Average value per tonne of the main species landed into the UK in 2019



Source: Table 2.17 - Average price of fish landed by UK vessels into the UK: 1938 to 2019, MMO (2020a)

1.17.5.1 Demersal fisheries

Demersal fish are those species living on or close to the seabed, such as gadoids and flatfish. They are usually caught with demersal trawls, most commonly otter trawls or beam trawls, although other methods such as gill netting or long-lining may be used. These are static methods of fishing in which a net or hooked line is laid, left and recovered following a set period of fishing. In terms of the weight and value of landings, the UK demersal sector is dominated by vessels >18m in length, with these accounting for approximately 80% of landings by weight and 70% by value in 2019.

Demersal fisheries are generally mixed, with catch compositions varying considerably from haul to haul. Consequently, demersal stocks are difficult to manage as the target species may only make up a small percentage of total catch. The largest component of the UK demersal

catch is haddock (approximately one quarter by weight), with cod, monkfish, saithe, whiting and hake also important, each making up >7% of the total UK landings by weight (Table A1h.8). Haddock, cod and monkfish comprise approximately half the total landed weight and value, although the most valuable species per tonne are sole, turbot and bass. Note, the figures in Table A1h.8 are only UK landings by UK boats; over the same period, foreign vessels landed an average of 32,000 tonnes, worth an average of £54 million, into the UK annually, with hake and saithe accounting for almost half of those landings by weight.

Table A1h.8: Average annual demersal landings into the UK by UK vessels, 2015-2019

Species	Quantity ('000 tonnes)	Value (£ million)
Bass	0.5	4.6
Brill	0.3	2.0
Cod	20.9	47.0
Dogfish	1.8	0.5
Gurnard	1.8	1.3
Haddock	33.5	48.0
Hake	10.8	25.2
Halibut	0.2	1.2
Lemon sole	1.7	7.3
Ling	5.1	7.7
Megrim	3.2	8.7
Monkfish	15.3	43.7
Plaice	4.4	6.3
Pollack	1.6	3.9
Saithe	11.2	10.5
Sandeel	0.3	0.1
Skates and rays	2.7	3.2
Sole	1.5	14.5
Turbot	0.5	4.9
Whiting	11.0	12.9
Witch	0.9	1.1
Other demersal	3.6	8.4
Total	**132.7**	**263.2**

Source: Table 2.2 - Landings into the UK by UK vessels: 2015 to 2019 (MMO 2020a)

1.17.5.2 Pelagic fisheries

Pelagic fish such as herring and mackerel typically form large shoals in open water which can be targeted relatively easily by pelagic trawlers. Consequently, pelagic hauls are usually fairly "clean" with little bycatch. Pelagic fisheries may also include industrial fisheries which target low value, small pelagic species such as blue whiting and sprat for use in products such as fishmeal and fish oil. The UK pelagic sector is dominated by larger vessels, with those >24m in length accounting for *ca*. 96% of landings by weight and value in 2019 (MMO 2020a). More mackerel is landed in the UK than any other species, and it comprises over half of all pelagic landings (Table A1h.9). It is also by far the most valuable pelagic stock, typically comprising almost 80% of the total pelagic value. Herring is also an important component. The smaller pelagic species are very low value and these are primarily targeted by industrial trawlers. The figures presented in Table A1h.9 underestimate the importance of pelagic fisheries to the UK fleet, as almost 50% of pelagic species caught in the UK EEZ by UK vessels are landed elsewhere in Europe, primarily Denmark, Ireland, the Netherlands and Norway (MMO 2020a). Foreign vessels landed an average (2015-2019) of 17,500 tonnes of pelagic species, worth an average of £13 million, into the UK annually, with mackerel accounting for 65% of those landings by weight.

Table A1h.9: Average annual pelagic landings into the UK by UK vessels, 2015-2019

Species	Quantity ('000 tonnes)	Value (£ million)
Blue whiting	13.3	2.3
Herring	41.5	18.4
Horse mackerel	1.5	0.9
Mackerel	87.3	79.4
Sardines	6.9	2.4
Other pelagic	3.8	1.0
Total	**154.3**	**104.4**

Source: Table 2.2 - Landings into the UK by UK vessels: 2015 to 2019 (MMO 2020a)

1.17.5.3 Shellfish fisheries

Shellfish fisheries target a number of molluscs (bivalves and gastropods) and crustaceans (such as crabs or *Nephrops*). Shellfish are caught using a variety of methods including dredges, trawls, static gears and by hand picking – see Table A1h.7 above. In terms of vessel sizes, the shellfish sector has the most balanced representation, with vessels under 10m length representing an important component (23% landings by weight and 27% by value in 2019). In contrast to the pelagic and demersal sectors, larger vessels of >18m only account for approximately one third of landings by weight and value.

The shellfish sector is the most valuable in the UK, with total landings by UK vessels in 2019 worth £367 million. *Nephrops*, crabs, scallops and whelks comprised the greatest proportion of the UK landed shellfish catch in 2019, with the most valuable being *Nephrops*, crabs and scallops (Table A1h.10). Lobsters, squid, cuttlefish are also very valuable per tonne (Figure A1h.37), but do not represent a large proportion of the shellfish catch. Foreign vessels landed an average (2015-2019) of 1,500 tonnes of shellfish species, worth an average of £3.4 million, into the UK annually, with scallops accounting for 60% of those landings by weight.

Table A1h.10: Average annual shellfish landings into the UK by UK vessels, 2015-2019

Species	Quantity ('000 tonnes)	Value (£ million)
Cockles	8.0	5.9
Crabs	30.4	56.3
Cuttlefish	5.4	15.5
Lobsters	3.3	41.5
Mussels	0.5	0.6
Nephrops	29.1	96.1
Scallops	33.7	69.1
Shrimps and prawns	0.6	1.9
Squid	2.7	11.2
Whelks	20.9	23.0
Other shellfish	1.4	6.8
Total	**136.1**	**327.9**

Source: Table 2.2 - Landings into the UK by UK vessels: 2015 to 2019 (MMO 2020a)

A1h.17.6 Regional distribution of fisheries

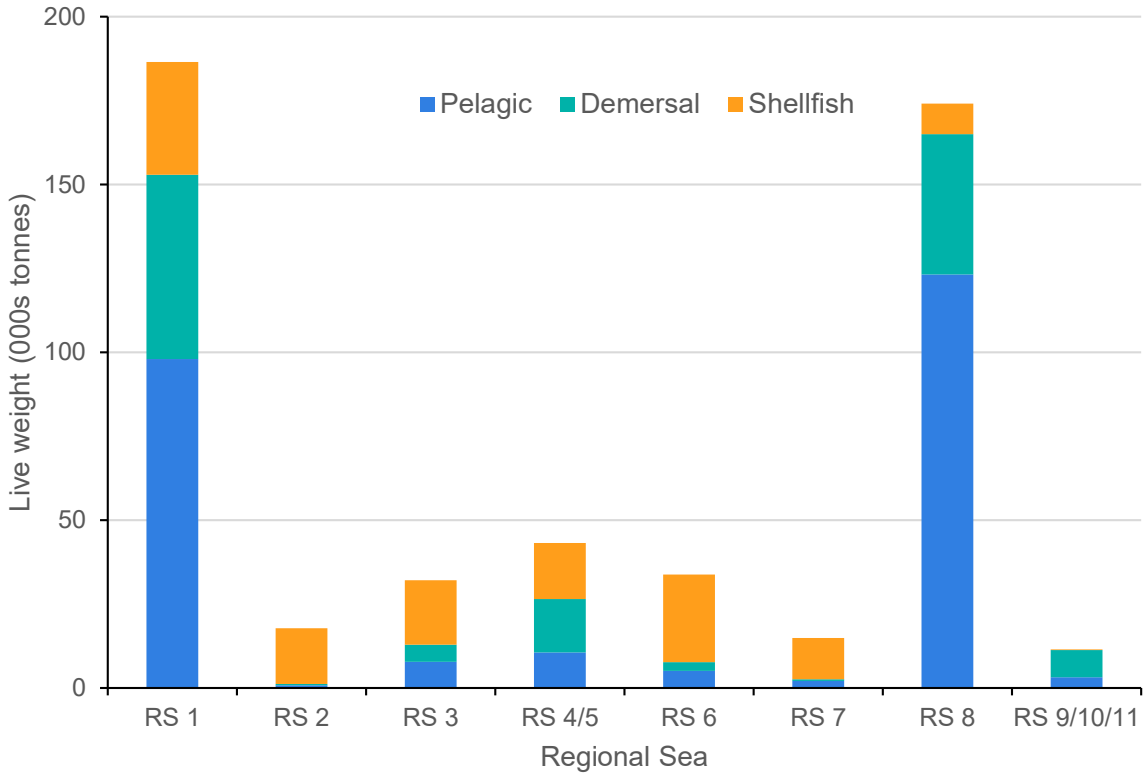
Data in Table A1h.11 and Figure A1h.36 show the landings from ICES areas relevant to each Regional Sea. This offers an indication of the main patterns in the breakdown of fisheries by species group. Landings are greater from Regional Seas with large offshore fisheries around the north of the UK (RS 1 and 8), with pelagic species important in these regions. In areas where fishing activity is generally coastal, such as Regional Seas 2, 3 and 6, landings are lower and shellfish dominate. These figures are further discussed in later sections. It is important to note that these figures are estimates based on areas roughly corresponding with Regional Sea areas, and only include information on UK vessels.

Table A1h.11: Annual landings in 2019 by UK vessels from ICES statistical rectangles overlapping with Regional Seas

RS	Area[1]	Total		Demersal		Pelagic		Shellfish	
		Weight[2]	Value[3]	Weight	Value	Weight	Value	Weight	Value
1	236,756	186.5	310.3	54.9	95.3	98	102.7	33.6	112.3
2	107,559	17.7	28.7	<1	1.5	<1	0.5	16.5	26.7
3	43,303	32.1	61.8	5.1	14.2	7.8	5.6	19.3	42
4/5	179,653	43.1	103.9	15.9	51.9	10.6	5.1	16.6	46.9
6	98,539	33.7	61.4	2.6	3.8	5.1	2.2	26.1	55.4
7	51,223	14.8	52.3	<1	2.8	2.1	0.7	12.3	48.9
8	139,229	174.1	237.1	41.9	93.1	123.2	114.1	9	29.9
9/10/11	376,509	11.5	16.7	8.1	14.8	3.2	0.9	<1	1
Total	**1,299,697**	**513.6**	**872.3**	**129.4**	**277.4**	**250.6**	**231.8**	**133.6**	**363.1**

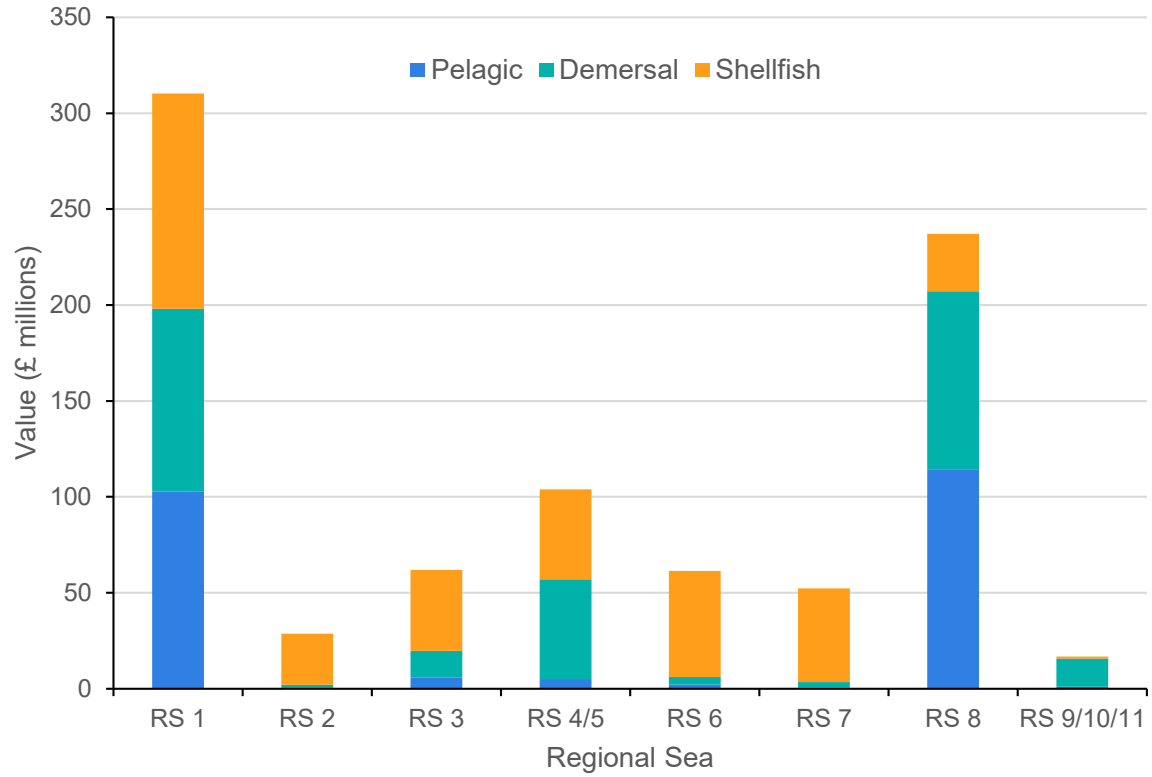
Notes: [1] km^2 covered by ICES statistical rectangles which overlap with Regional Seas, including the entire area of each rectangle (i.e. not trimmed to Regional Sea boundaries); [2] live weight in '000 tonnes; [3] value in millions GBP.
Source: MMO (2020a)

Figure A1h.38: Annual landings (live weight) in 2019 by UK vessels, by species group and Regional Sea



Source: MMO (2020a)

Figure A1h.39: Annual landings (value) in 2019 by UK vessels, by species group and Regional Sea



Source: MMO (2020a)

Figure A1h.34 shows the distribution and scale of landings from waters around the UK by ICES rectangle. Landings are generally highest around the coast in southern regions, while to the north, they are greater further offshore, on the productive continental shelf. A similar pattern may be observed in the distribution of landings by value (Figure A1h.35). When the landings are divided by species group (Figure A1h.36), it can be seen that demersal landings follow the overall pattern, with particularly high values around Cornwall and Shetland, while the greatest value of pelagic fishing takes place to the north of Scotland, where herring and mackerel are typically found migrating between spawning and feeding grounds. Shellfish fisheries have a strong coastal distribution, with particularly important areas including the west of Scotland, the Firth of Forth, north of the Humber Estuary and along the south of England, while the seasonal fisheries for cuttlefish (south Devon and Cornwall) and squid (Moray Firth) are clearly identified.

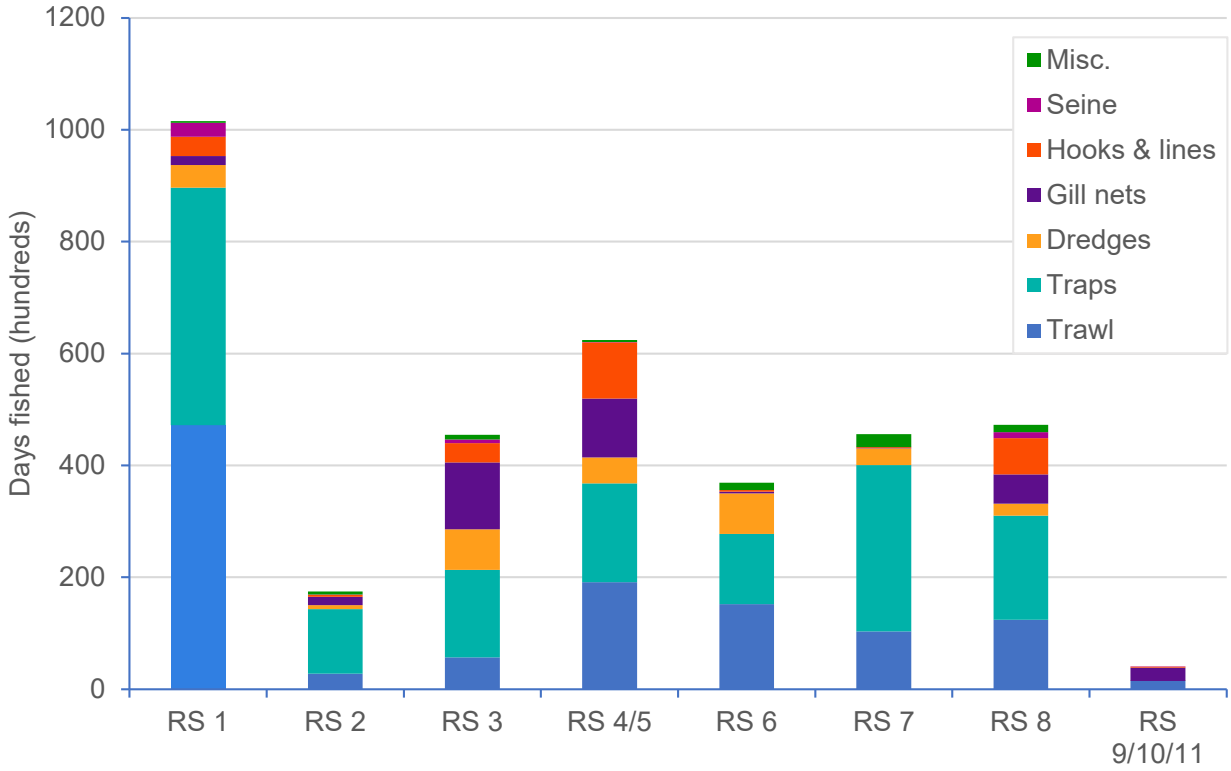
The dominance of bottom trawls in UK fisheries can be seen in Table A1h.12 and Figure A1h.40, with traps and dredges (predominantly for shellfish) also important. These figures are examined in greater detail in individual Regional Sea sections. It is important to note that these figures are estimates, based on areas roughly corresponding with Regional Sea areas and only include information on UK vessels.

Table A1h.12: Days fished in 2019 from ICES statistical rectangles overlapping with Regional Seas, by gear type

RS	Area[1]	Days fished (hundreds) by gear category[2]							
		All	Trawl[3]	Traps	Dredges[4]	Gill nets[5]	Hooks & lines	Seine	Misc.
1	236,756	1,015.91	472.1	424.55	30.3	15.82	34.59	24.99	3.36
2	107,559	175.4	28.1	115.02	7.18	14.66	4.05	0.41	5.03
3	43,303	454.5	56.8	156.42	72.79	119.58	34.08	6.77	8.04
4/5	179,653	628.86	191.63	176.1	46.46	105.67	100.3	0.39	3.59
6	98,539	369.27	152.09	125.35	72.65	2.83	3.24	0	12.95
7	51,223	457.32	103.4	297.16	29.97	0.22	1.97	0.17	23.04
8	139,229	472.48	124.13	186.27	21.56	52.24	64.6	10.94	12.73
9/10/11	376,509	40.6	14.87	0.06	0.01	23.73	1.85	0.08	0
UK	1,299,697	3,614.34	1,143.12	1,480.93	290.92	334.75	244.68	43.75	68.74

Notes: RS = Regional Sea; [1] km^2 covered by ICES statistical rectangles which overlap with Regional Seas, including the entire area of each rectangle (i.e. not trimmed to Regional Sea boundaries); [2] hundreds days; [3] all specified bottom trawls, Nephrops trawls, unspecified trawls; [4] boat & mechanised dredges, pumps; [5] gill and entangle nets (fixed and drift). Source: Days fished by ICES rectangle in 2019 by UK vessel, MMO (pers. com.)

Figure A1h.40: Mean annual days fished in 2019 by UK vessels by gear type



Source: Days fished by ICES rectangle in 2019 by UK vessel, MMO (pers. com.)

A1h.17.7 Features of Regional Sea 1

1.17.7.1 Summary of fisheries

Fishing effort in the central and northern North Sea is dominated by demersal trawling for gadoids, plaice and monkfish, as well as *Nephrops*. Thirty percent of fishermen in Scotland (and 13% of UK fishermen) are based in Aberdeenshire, highlighting the importance of the industry to the region (MMO 2020a). The mixed demersal fishery targets cod, haddock, whiting, saithe and monkfish, while a shelf-edge fishery for saithe carried out by Norwegian, French and German vessels is also important. The Fladen Ground in the north of the region and the Farne Deeps, a deep-water trench 10-20 miles off the northeast coast of England, are particularly productive regions for demersal trawling (Walmsley & Pawson 2008, Northumberland IFCA website[67]). Inshore, gillnets and trammel nets are used to trap cod in winter and plaice (in the summer) and lemon sole are valuable catches. Licensed fisheries for salmon and sea trout exist in the region and drift nets may be used to capture these species (North-eastern IFCA website[68]). A fishery for the veined squid, *Loligo forbesii*, has developed in the Moray Firth over the last 20 years, with fishermen taking advantage of the lack of quota restrictions on this species. The region supports important industrial fisheries for sandeels (central North Sea) and Norway pout (northern North Sea) carried out by Danish, Norwegian and UK vessels (ICES website[69]). The pelagic fleet targets herring at spawning grounds off Shetland in autumn and off the Farne Isles, using purse seiners and pelagic trawls. Extensive

[67] http://www.nifca.gov.uk/
[68] http://www.ne-ifca.gov.uk/
[69] http://ices.dk/Pages/default.aspx

and directed mackerel fisheries operate in the north of the region as migrating mackerel return to feeding grounds.

The Fladen Ground is exploited for shellfish as it supports large and valuable populations of both pink shrimp and *Nephrops*. Demersal trawlers also catch *Nephrops* within the Moray Firth, Firth of Forth and the Farne Deeps. In coastal regions, baited creels are set for lobsters, brown crabs, velvet crabs and green crabs (Scottish IFGs website[70]). Scallops are exploited in the Moray Firth and to the east of Scotland, while queen scallops, mussels and cockles are also harvested in the region. The main wild mussel fishery is in the Dornoch Firth (Scottish IFGs website[12]). Cockles are predominantly taken from Shetland and Orkney. Whelks and periwinkles are lower value species that are also taken from coasts around the region.

Table A1h.13: Live weight and value by species in 2019 by UK vessels from ICES statistical rectangles overlapping with Regional Sea 1, showing main species

Sector	Species	Live weight (tonnes)	Value (£)
Demersal	Cod	7,485	20,678,866
	Haddock	16,660	22,915,010
	Hake	3,055	7,080,190
	Ling	1,530	2,462,802
	Megrim	424	1,477,520
	Monkfish	3,618	11,285,620
	Plaice	1,556	2,514,897
	Saithe	7,548	7,813,037
	Sandeel	660	170,900
	Whiting	9,289	11,791,908
	Witch	751	1,041,621
Pelagic	Herring	23,726	11,614,026
	Mackerel	74,250	91,101,244
Shellfish	Crabs	6,820	16,346,126
	Lobsters	1,374	19,516,558
	Nephrops	18,388	56,718,621
	Scallops	4,193	9,310,502
	Squid	2,092	8,567,752
	Whelks	553	668,024
	Other shellfish [1]	184	1,205,234

[70] http://ifgs.org.uk/

Notes: Species shown include those contributing ≥1% of the total live weight and/or value for that sector for the relevant Regional Sea in 2019; [1] 'Other shellfish' dominated (by weight and value) by razor clams. Source: 2019 UK fleet landings by ICES rectangle (MMO 2020a).

1.17.7.2 Ports and vessels

The northern North Sea supports the largest proportion of vessels >10m (31%) of any UK region, suggesting that offshore fishing grounds are particularly important in the region. Larger vessels tend to be based along the Aberdeenshire coast while vessels <10m are more abundant in the northeast of England. This region contains 10 of the top 50 UK fishing ports (by landed weight), including the biggest three, Peterhead, Lerwick and Fraserburgh). Landings at these ports are dominated by pelagic and demersal catch, reflecting the large vessels that operate from these fisheries (Table A1h.14). Shellfish landings increase in importance in smaller ports, where a greater proportion of smaller boats, working in inshore fisheries, are found.

Table A1h.14: Annual landings into key ports in Regional Sea 1: 5-year mean (2015-2019)

	No. of vessels[1]		Demersal		Pelagic		Shellfish	
Port	≤10m	>10m	Quantity	Value	Quantity	Value	Quantity	Value
Peterhead	42	32	48.1	81.1	89.8	62.9	3.9	12.2
Lerwick	73	17	10.7	20.3	31.7	22.7	0.54	1.2
Fraserburgh	68	57	7.8	12.2	9.5	7.6	5.8	18.9
North Shields	32	25	0.6	0.7	<0.1	<0.1	1.6	5.1
Hartlepool	25	3	0.2	0.3	<0.1	<0.1	1.2	3.2
Scarborough	26	10	0.2	0.3	<0.1	<0.1	2.1	6.0
Pittenweem	36	6	<0.1	<0.1	<0.1	<0.1	1.4	4.4
Blyth			0.3	0.3	<0.1	<0.1	0.7	2.5
Eyemouth	43	7	<0.1	0.1	<0.1	<0.1	1.2	3.7
Buckie	37	16	0.2	0.3	<0.1	<0.1	1.0	3.4

Notes: Quantity in '000 tonnes; value in million GBP. [1]From UK fishing vessel list (excluding islands) as at 1st April 2021. Source: Table 2.14 - Landings into UK ports by UK vessels: 2015 to 2019 (MMO 2020a), https://www.gov.uk/government/collections/uk-vessel-lists

1.17.7.3 Distribution of fishing effort

VMS data shows that the majority of fishing effort carried out by larger vessels in the region takes place in offshore areas to the north, particularly around the Fladen Ground (Figure A1h.32). In inshore areas, the Firth of Forth, the Moray Firth and the Farne Deeps off the northeast coast of England are sites of high densities of fishing effort, particularly of mobile gears (Figure A1h.33), while static gear fisheries operate along the coastline of the region, particularly in the Firth of Forth. Inshore fisheries in the region show slight seasonal variation, with greater fishing effort in the summer and autumn, particularly in the Moray Firth and off the northeast of England. Similar distributions are shown by landings data which also particularly highlight the disparity in fishing effort between the north of the region and the south. Landings

data shows the waters to the south and east of Shetland produce the most landings and the greatest total landed value (Figures A1h.34 and A1h.35).

1.17.7.4 Gears and landings

Shellfish, pelagic and demersal species are all caught in large numbers from the northern North Sea, making the region one of the most productive in UK waters. Catch from the region is dominated by high value whitefish, including cod, haddock, monkfish and whiting, as well as *Nephrops*. There are significant landings of pelagic species in the region, reflecting the important herring and mackerel stocks that are exploited in the area. In 2019 pelagic species made up 53% of the live weight, but only 33% of the value. The remaining landed value was split between shellfish (36%) and demersal (31%) species (Table A1h.11). The fishing effort by days fished is dominated by demersal trawls (46%) and traps (42%), reflecting the importance of demersal and shellfish stocks (Table A1h.12). The region was heavily fished by foreign vessels which are not included in these figures.

A1h.17.8 Features of Regional Sea 2

1.17.8.1 Summary of fisheries

Fish communities within the southern North Sea are dominated by small benthic groups such as flatfish. Comparisons of catch rates have shown that in general the catchability of these smaller demersal species is greater using beam trawls than otter trawls. Consequently, beam trawling effort is greatest in the southern North Sea, while otter trawling is less frequent in the region. Beam trawl activity is concentrated in the Southern Bight and the fleet mainly targets plaice and sole, with other species such as dab and grey gurnard forming a valuable bycatch. Over 70% of all beam trawling effort in the North Sea was carried out by Dutch vessels operating largely in the southern North Sea, including in UK waters (Piet *et al*. 2007). In recent years, the Dutch fleet has adopted new gear types, such as the pulse trawl, in which the traditional, dragged tickler chain is replaced by electrical stimulation (van Marlen *et al*. 2014). Nevertheless, fleets exploiting North Sea flatfish have decreased in size in recent years (Poos & Verkempynck 2015). Cod catches are typically highest in the southern North Sea in the 1st and 2nd quarters of the year. Haddock is only rarely caught in the southern North Sea, during years of very strong recruitment. There are also significant seine and gillnet fisheries for plaice towards the north of the region. Industrial fisheries target the sandeel populations of the southern and central North Sea, with Danish and Norwegian fleets particularly important exploiters of this resource. The fishery is focused on the Dogger Bank and takes place mainly during the summer months (Rogers & Stocks 2001). Skates and rays are an important local fishery in the outer Thames estuary, and bass landings have increased in recent years (Eastern IFCA website[71]). The proximity of the region to the continental coastline means that it was fished by an international fleet, with France and Belgium exercising some historical fishing rights between 6-12 nautical miles (Jones *et al*. 2004).

Pelagic fisheries in the southern North Sea mainly target herring, sprat and horse mackerel. Purse seiners and pelagic trawls are usually used in the herring fishery, with the greatest landings in the 3rd quarter. In spring, landings of herring are concentrated off the Lincolnshire and East Anglia coastline[72] and important feeding grounds for herring are found off Flamborough Head and in the Humber Estuary (Jones *et al*. 2004). Sprat and horse mackerel are also fished along the English coast. Targeted mackerel fishing is prohibited in the southern

[71] http://www.eastern-ifca.gov.uk/
[72] https://www.ices.dk/about-ICES/projects/EU-RFP/EU%20Repository/ICES%20FIshMap/ICES%20FishMap%20species%20factsheet-herring.pdf

North Sea throughout the year[73]. Licenses to catch salmon and sea trout may be obtained for the River Humber and around the coast of East Anglia. There is no licensed fishery for these species in the Thames Estuary. Fyke nets, eel criggs and pots are used to catch eels from spring to autumn in the Rivers Humber and Thames and in many of the smaller estuaries of East Anglia and Essex (Walmsley & Pawson 2008).

Shellfish fisheries are important in the region, particularly in inshore waters where a number of species are harvested from estuaries and bays. In addition to these fisheries, *Nephrops* may be landed from the Dogger Bank, particularly during autumn and winter. Edible crabs and lobsters are also valuable species, typically caught with static gear such as pots or creels, while fisheries for pink and brown shrimps are also prosecuted (Eastern IFCA website[58]). The Humber Estuary is an important site for shrimp trawling and crab and lobster potting, while the Wash is a prime habitat for mussels, cockles and brown shrimp (Eastern IFCA website[58]). An important cockle fishery in the Thames supports both local and visiting vessels. There are also wild and cultivated oyster fisheries along the Essex and north Kent coast (Kent & Essex IFCA website[74]). The whelk fishery has grown in recent years to such an extent that an emergency byelaw was put in place in April 2015 that requires a person to hold a valid permit in order to harvest the stock. In 2016, this was replaced by whelk permit byelaw which introduced a commercial and recreational pot limitation (Eastern IFCA website[58]).

Table A1h.15: Live weight and value of landings in 2019 by UK vessels from ICES statistical rectangles overlapping with Regional Sea 2, showing main species

Sector	Species	Live weight (tonnes)	Value (£)
Demersal	Bass	27	263.545
	Brill	6	23,382
	Cod	8	17,742
	Dogfish	5	1,733
	Gurnard	9	11,855
	Plaice	35	50,851
	Skates and rays	141	166,491
	Sole	120	
	Turbot	5	27,454
	Whiting	14	11,790
	Other demersal	61	68,925
Pelagic	Herring	232	106,382
	Horse mackerel	341	324,111
	Mackerel	39	12,770

[73] https://www.ices.dk/about-ICES/projects/EU-RFP/EU%20Repository/ICES%20FIshMap/ICES%20FishMap%20species%20factsheet-mackerel.pdf
[74] http://www.kentandessex-ifca.gov.uk/

Sector	Species	Live weight (tonnes)	Value (£)
	Sprats	170	43,520
Shellfish	Cockles	7,596	6,667,369
	Crabs	3,641	7,396,887
	Lobsters	452	6,200,204
	Shrimps and prawns	339	627,486
	Whelks	4,338	5,419,450

Notes: Species shown include those contributing ≥1% of the total live weight and/or value for that sector for the relevant Regional Sea in 2019. Source: 2019 UK fleet landings by ICES rectangle (MMO 2020a).

1.17.8.2 Ports and vessels

Seventy four percent of vessels based at ports in the region were <10m, with ports in the region among the smallest, reflecting the importance of inshore fisheries to the region. Ports in the region are concentrated along the Suffolk and Essex coasts, with few ports to the north of the Wash along the Lincolnshire coast. The region contained 8 of the top fifty UK ports by landed weight in 2019, although none of these were in the top 10. With the exception of Grimsby, at which a significant catch of demersal fish is landed, landings at the other ports are almost exclusively of shellfish (Table A1h.16).

Table A1h.16: Annual landings into key ports in Regional Sea 2: 5-year mean (2015-2019)

	No. of vessels[1]		Demersal		Pelagic		Shellfish	
Port	≤10m	>10m	Quantity	Value	Quantity	Value	Quantity	Value
Leigh-on-Sea	10	13	<0.1	0.1	0.1	<0.1	4.3	2.6
Grimsby	10	12	1.0	1.6	<0.1	<0.1	3.3	6.3
Hull	0	11	1.7	3.3	<0.1	<0.1	<0.1	0.1
Bridlington	19	22	<0.1	<0.1	<0.1	<0.1	3.4	9.2
Whitstable	14	5	<0.1	<0.1	<0.1	<0.1	1.6	2.1
Wells	11	3	<0.1	<0.1	<0.1	<0.1	1.1	1.5
Queenborough	4	4	<0.1	<0.1	<0.1	<0.1	0.7	0.9
Lowestoft	22	4	0.1	0.2	<0.1	<0.1	0.9	0.9

Notes: Quantity in '000 tonnes; value in million GBP. [1]From UK fishing vessel list (excluding islands) as at 1st April 2021. Source: Table 2.14 - Landings into UK ports by UK vessels: 2015 to 2019 (MMO 2020a), https://www.gov.uk/government/collections/uk-vessel-lists

1.17.8.3 Distribution of fishing effort

There is relatively little fishing effort recorded by boats supplying VMS data, with the majority of effort concentrated in the north of the region on the Dogger Bank, within the Wash and to the north and east of the Humber Estuary. Fishing effort is considerably lower in the region than in the northern North Sea and effort is predominantly coastal, both for mobile and static gears.

1.17.8.4 Gears and landings

UK vessels report a relatively low level of landings, both in terms of weight and value from this Regional Sea (Table A1h.16). Shellfish dominate landings by weight and value contributing approximately 93% of both (Table A1h.11). This is reflected in the largely coastal distribution of landings density in the region. High values of landings observed in the Thames estuary and

to a lesser extent the Wash may be explained by the high amount of high value shellfish caught in these areas. The most common gear types observed in the region were traps (66% of total days fished) and trawls (16%) (Table A1h.12). The region was heavily fished by foreign vessels which are not included in these figures.

A1h.17.9 Features of Regional Sea 3

1.17.9.1 Summary of fisheries

The eastern English Channel represents the smallest of the Regional Seas and its coastal nature means that inshore fisheries are particularly important. Much fishing activity is undertaken by beach boats that set nets out to 6 miles offshore, with most vessels being day boats, particularly to the west of the region where waters are less sheltered (Walmsley & Pawson 2008).

The main demersal fisheries in the region use trammel and gill nets to catch plaice and sole (mainly a spring fishery) and rays, cod and bass (in cooler months) (Sussex IFCA website[75]). The valuable sole fishery was subject to considerable international competition, particularly as Belgium and France had historical fishing rights around the southeast of England. Other demersal species that are targeted in this way include the valuable turbot and brill, which are relatively abundant in the summer (Sussex IFCA website[17], Southern IFCA website[76]). Otter and beam trawls are also used in the region, primarily to target flatfish, although trawlers also take advantage of high species diversity in the region to land cuttlefish, squid, black bream or red mullet, species which are not subject to quota restrictions and may still attract a high price (Walmsley & Pawson 2008). The cuttlefish fishery is highly seasonal, with cuttlefish moving close to the shore in the summer months (Sussex IFCA website[17]).

The pelagic sector is small in the region. Herring, mackerel and sprat are all caught in small quantities, while a number of bays and estuaries act as nursery grounds for sandeel and bass, supporting small scale industrial and recreational fisheries (Sussex IFCA website[60]). The Beaulieu River, Christchurch Harbour and Poole Harbour all support licensed salmon and sea trout seine net fisheries. Licensed fisheries for eels operate in the region, with fyke nets used to capture yellow eels in summer and silver eels in autumn (Walmsley & Pawson 2008).

The inshore fleet operating in this region is highly adaptable, and many trawlers that have targeted whitefish in the summer months will switch to scallop dredging in the winter. Scallop dredging is a highly opportunistic fishery as the scallop beds in the region are transient, but scallops fetch a high price. Clams, cockles and mussels, which may be harvested by dredging or hand-picking, are landed in the region, while the whelk fishery has increased in importance in recent years (Sussex IFCA website[17]). Crabs and lobsters are important in the region, with lobsters typically found on rocky grounds inshore and brown crabs taken further offshore. Some fleets around the Isle of Wight depend on the lobster fishery, particularly in summer. The region is notable for its oyster fisheries. The Solent provides an example of one of the few healthy and self-regenerating native oyster fisheries, which may be harvested in beam trawls and scallop dredges. A small population of Manila clams in Poole Harbour supports a small fleet (Walmsley & Pawson 2008).

[75] http://www.sussex-ifca.gov.uk/
[76] http://www.southern-ifca.gov.uk/

Table A1h.17: Live weight and value of landings by species in 2019 by UK vessels from ICES statistical rectangles overlapping with Regional Sea 3, showing main species

Sector	Species	Live weight (tonnes)	Value (£)
Demersal	Bass	208	2,105,738
	Brill	60	409,687
	Dogfish	321	88,661
	Gurnard	600	732,002
	Lemon sole	67	259,775
	Monkfish	158	455,095
	Plaice	837	1,468,803
	Skates and rays	677	816,986
	Sole	441	4,816,977
	Turbot	85	875,570
	Whiting	395	272,267
	Other demersal[1]	1,189	1,741,411
Pelagic	Herring	4,013	2,345,176
	Horse mackerel	3,237	2,919,030
	Mackerel	124	163,411
	Sardines	124	711,536
	Sprats	177	43,952
	Other pelagic	73	60,993
Shellfish	Cockles	1,953	3,256,384
	Crabs	1,248	3,261,051
	Cuttlefish	1,214	3,057,174
	Lobsters	143	2,014,873
	Mussels	70	833,700
	Scallops	7,102	14,926,576
	Squid	698	3,979,588
	Whelks	6,495	9,387,007
	Other shellfish	325	1,263,384

Notes: Species shown include those contributing ≥1% of the total live weight and/or value for that sector for the relevant Regional Sea in 2019; [1] 'Other demersal' dominated (by weight) by pouting, red mullet, smoothhound and sea breams; [2] ''Other pelagic dominated (by weight) by anchovy; [3] Other shellfish' dominated (by weight) by clams. Source: 2019 UK fleet landings by ICES rectangle (MMO 2020a).

1.17.9.2 Ports and vessels

There is a very high density of small boats at ports along the coast of the region. Over 75% of fishing vessels registered at ports in the eastern Channel in 2019 were <10m. This reflects the inshore nature of many of the fisheries in the region. The region contains 6 of the top 50 UK ports by landed weight with landings at these ports mainly of shellfish species, apart from at Brixham where significant demersal landings are reported (Table A1h.18).

Table A1h.18: Annual landings into key ports in Regional Sea 3: 5-year mean (2015-2019)

	No. of vessels[1]		Demersal		Pelagic		Shellfish	
Port	≤10m	>10m	Quantity	Value	Quantity	Value	Quantity	Value
Brixham	77	57	4.8	15.6	1.5	0.4	6.8	17.5
Shoreham	39	8	0.5	1.2	<0.1	<0.1	5.4	10.8
Weymouth	29	3	0.1	0.7	<0.1	<0.1	1.6	3.4
Eastbourne	39	5	0.2	0.8	<0.1	<0.1	1.3	2.1
Portsmouth	38	0	0.1	0.4	<0.1	<0.1	1.5	2.6
Teignmouth	15	2	<0.1	0.1	1.2	0.3	0.2	0.5

Notes: Quantity in '000 tonnes; value in million GBP. [1]From UK fishing vessel list (excluding islands) as at 1st April 2021. Source: Table 2.14 - Landings into UK ports by UK vessels: 2015 to 2019 (MMO 2020a), https://www.gov.uk/government/collections/uk-vessel-lists

1.17.9.3 Distribution of fishing effort

VMS data show the greatest fishing effort to be in the east of this region, with the greatest density of effort along the Sussex coast (Figure A1h.32). Information extracted from logbooks and landings data indicates significant effort occurs in the west of the region, reflecting the number of smaller vessels operating in these waters that would not contribute to VMS data. The use of static gears concentrated inshore, while mobile gears are in use throughout the region. As in Regional Sea 2, a large number of foreign vessels operated in the region.

1.17.9.4 Gears and landings

The largest sector within the region, when measured by landed weight, is shellfish (61%) which accounts for 68% of the total landed value, although there is also a valuable demersal sector which contributes approximately 23% of the total landed value in the region (Table A1h.11). There is a notable cephalopod sector operating in the region which mainly targets cuttlefish (Figure A1h.36). Static gears are particularly important in the region, with traps accounting for 34% of total days fished. Gill nets (26%), dredges (16%) and trawls (12%) are also well used in the region (Table A1h.12). The use of static gears in the region may account for the high value of demersal catch in the region, as these fishing methods tend to cause less damage to caught fish than trawling. The region was heavily fished by foreign vessels which are not included in these figures.

A1h.17.10 Regional Seas 4 & 5

1.17.10.1 Summary of fisheries

The southwest of England is one of the main fishing regions in the UK with Plymouth and Newlyn accounting for 30% of the fishermen in England (MMO 2020a). Landings are predominantly of shellfish and demersal species, although there is a high value demersal sector, operating particularly out of Plymouth and Newlyn. The pelagic fishery in the region is smaller, but with important seasonal stocks of mackerel (Cornwall IFCA website[77]). Fishing effort and landings density are highest off the southwest peninsula. There is considerable flexibility displayed by the industry in this region. It is common for beam trawlers to switch between targeting whitefish and scallops, depending on demand, restrictions and season, while otter trawlers will switch between demersal and pelagic fishing to take advantage of

[77] http://www.cornwall-ifca.gov.uk/

migrating mackerel and herring (Walmsley & Pawson 2008). In the eastern waters of the region, otter and beam trawlers target sole, plaice, rays, turbot and monkfish in the winter months, while cuttlefish provide an important, non-quota restricted catch. Gill and tangle nets are set around the region to catch a variety of gadoids and flatfish. In Cornish waters, beam trawling for monkfish, megrim, lemon sole and sole represents an important sector and one which has been increasing since the 1980s (Walmsley & Pawson 2008). Otter trawls exploit seasonal fisheries, while gill nets are often set out around the reefs and wrecks of the region. Larger vessels may go out to deeper waters up to 70 miles offshore, to the southwest of Ireland to catch hake, an otherwise infrequent target in UK waters. There is a considerable amount of trawler activity in the Bristol Channel, with substantial international competition for the sole stock. Belgium and France exercised historical fishing rights in the waters of this region (Coates 2005).

Mackerel is an important stock in the region but, due to over-fishing, an extensive protected area around the coast of Cornwall, known as the "Mackerel Box" was set up in which trawling and seining for the species is prohibited (MMO website[78]). As a result, a traditional handline fishery flourishes on both coasts of the region and was one of the first seven UK fisheries to have earned Marine Stewardship Council certification as a sustainable fishery (MSC website[79]). The fishery is most active between autumn and spring along the south coast of the region, and over summer off the north coast. Drift nets may be deployed to capture herring and sprat, while sardines (or pilchard) and horse mackerel are targeted by industrial trawlers from as far afield as Scotland and Denmark. Bass is regularly caught in drift nets and gill nets in inshore waters, particularly in nursery areas off the Burry Inlet and Three Rivers off South Wales (Walmsley & Pawson 2008, Devon & Severn IFCA website[80]). Sardines are the target of a specialized Cornish fleet employing purpose built ring nets, typically operating at night.

Potting for lobster and crabs is important in the region. As well as brown crabs, new fisheries for velvet crabs, green crabs and spider crabs are developing in the region (Walmsley & Pawson 2008). Scallops are dredged off the coasts of Cornwall and Devon, but dredging is restricted around the south coast of Wales, by local byelaws. The Burry Inlet and Three Rivers area is the site of an important licensed hand-gathered cockle fishery, while whelk fishing has been growing in importance in Carmarthen Bay since the mid-1990s (Walmsley & Pawson 2008). The development of hydraulic dredging has led to a growing fishery for clams such as razorshells. Cuttlefish and squid are also frequently caught in the region, using pots and jigs in the spring and summer months.

Licensed salmon fisheries operate in the Rivers Exe, Teign, Dart, Taw, Torridge, Fowey, Camel, Tywi, Wye, Taf and Cleddau. Fyke nets are set in most of the large rivers in the region, and dip nets for elvers are used in winter and spring in some rivers on the north coast of Devon (Walmsley & Pawson 2008).

The Isles of Scilly (Regional Sea 5) supports 22 licensed and active fishing vessels, 21 of which use static gear, and the other a small otter trawler. Vessels longer than 11m and weighing more than 10 tonnes are prohibited from fishing within the 6 mile nautical boundary around the islands. Local vessels mainly pot for crustaceans (3,500-5,000 pots are estimated

[78] https://www.gov.uk/government/organisations/marine-management-organisation
[79] https://www.msc.org/
[80] http://www.devonandsevernifca.gov.uk/

to be in use during the season), or catch mackerel and pollack with nets and hand-lines (Isles of Scilly IFCA website[81]).

Table A1h.19: Live weight and value of landings by species in 2019 by UK vessels from ICES statistical rectangles overlapping with Regional Seas 4 and 5, showing main species

Sector	Species	Live weight (tonnes)	Value (£)
Demersal	Bass	170	1,766,644
	Brill	229	1,719,880
	Dogfish	1,066	386,422
	Gurnard	745	859,150
	Haddock	482	1,050,708
	Hake	1,766	5,406,664
	Lemon sole	709	3,246,726
	Megrim	1,225	2,738,939
	Monkfish	2,695	8,014,835
	Plaice	1,208	2,945,553
	Pollack	845	2,042,897
	Skates and rays	1,453	1,800,910
	Sole	1,031	13,100,759
	Turbot	304	3,442,939
	Whiting	441	593,662
	Other demersal[1]	1,212	2,210,669
Pelagic	Horse mackerel	1,337	11,126,193
	Mackerel	668	988,629
	Sardines	6,914	2,351,052
	Sprats	1,367	341,290
	Other pelagic[2]	289	247,064
Shellfish	Crabs	5,645	15,307,392
	Cuttlefish	3,692	9,585,476
	Lobsters	484	6,517,886
	Nephrops	473	1,674,658
	Scallops	3,831	9,113,528
	Squid	154	1,065,627
	Whelks	1,993	2,555,676
	Other shellfish[3]	339	1,082,343

Notes: Species shown include those contributing ≥1% of the total live weight and/or value for that sector for the relevant Regional Sea in 2019; [1] 'Other demersal' dominated (by weight) by pouting, smoothhound and John Dory; [2] 'Other pelagic' dominated (by weight) by anchovy; [3] 'Other shellfish' dominated (by weight) by octopus.
Source: 2019 UK fleet landings by ICES rectangle (MMO 2020a).

1.17.10.2 Ports and vessels

There are more vessels based in this region than in any other, and the area also has a high average number of vessels per port. Vessels <10m make up over 70% of the fleet, reflecting the importance of inshore fisheries in the region, although offshore fishing grounds to the

[81] http://www.scillyifca.gov.uk/

southwest of England and the south of Ireland mean that there is a higher proportion of larger vessels based in the west of the region than the east. There are few large ports on the north Devon and south Wales coasts along the Bristol Channel. The easy access to offshore fishing grounds also means a substantial number of large vessels are based in the region. The region contains 5 of the top 50 UK ports (Table A1h.20).

Table A1h.20: Annual landings into key ports in Regional Sea 4: 5-year mean (2015-2019)

	No. of vessels[1]		Demersal		Pelagic		Shellfish	
Port	≤10m	>10m	Quantity	Value	Quantity	Value	Quantity	Value
Newlyn	144	49	6.5	19	4.2	1.7	2.7	7.7
Plymouth	90	30	1.4	4.6	5.7	2.9	2.9	6.6
Mevagissey	52	4	0.6	1.7	0.6	0.4	0.1	0.2
Milford Haven	42	14	0.7	1.8	<0.1	<0.1	0.8	1.9
Falmouth	0	0	0.1	0.3	0.9	0.3	0.6	1.2

Notes: Quantity in '000 tonnes; value in million GBP. [1]From UK fishing vessel list (excluding islands) as at 1st April 2021. Source: Table 2.14 - Landings into UK ports by UK vessels: 2015 to 2019 (MMO 2020a), https://www.gov.uk/government/collections/uk-vessel-lists

1.17.10.3 Distribution of fishing effort

VMS records indicate a high density of vessels operating particularly around the south of Devon and Cornwall, as well as in offshore waters to the southwest (Figure A1h.32). Inshore, effort is greatest along the south coast of the region, between the major ports of Exmouth, Plymouth and Falmouth, with this pattern maintained when mobile gears are considered separately. There is also substantial fishing effort using mobile gears in the mouth of the Bristol Channel. Fishing effort using static gears is most abundant in western areas of the peninsula. There is also a high density of fishing effort in deeper waters to the southwest of Wales, particularly of vessels using mobile gears, while static gears are concentrated around the coast. Foreign vessels are widespread beyond territorial waters throughout the region.

1.17.10.4 Gears and landings

Landings from these Regional Seas are dominated by demersal fish and shellfish (with a combined contribution to landings of 74% by weight and 95% by value) (Table A1h.11). There is also a substantial cephalopod fishery (largely for cuttlefish) making up nearly 20% of the total value. Valuable shellfish landings in Carmarthen Bay are evident. A variety of gear types are used in the region, with significant fishing effort with respect to trawls (30%), traps (28%), gill nets (17%), hooks and lines (16%) and dredges (7%) (Table A1h.12). The demersal catch in the region is of very high value, possible due to the high level of use of selective fishing methods such as line fishing and gillnetting in the region. The region was heavily fished by foreign vessels which are not included in these figures.

A1h.17.11 Features of Regional Sea 6

1.17.11.1 Summary of fisheries

Fishing in the Irish Sea is dominated by otter trawlers, beam trawlers, scallop dredgers and potters. Otter trawlers target cod, whiting, plaice and *Nephrops* at grounds to the east and west of the Isle of Man, southwest Wales, the Firth of Clyde and Liverpool Bay. There is a significant summer *Nephrops* fishery off the coast of Whitehaven and a rather larger one in the deeper water between the Isle of Man and Ireland. Beam trawlers in the region were predominantly Belgian, along with UK and French vessels. The fishery is mainly based southwest of the Isle of Man, in Liverpool Bay and Cardigan Bay. Static gears are also used to

catch demersal species, and an increasing number of trawlers have switched to using gill, tangle and trammel nets (Walmsley & Pawson 2008). Static netting is mainly used to catch sole, plaice, flounder, rays, turbot and brill (Walmsley & Pawson 2008). There are licensed fisheries for salmon and sea trout in the region, with a key area for the fishery being the Solway Firth (North-west IFCA website[82]). Pelagic fisheries in the region are limited. Bass is caught with gill nets and handlines from spring to autumn, while some drift netting and pair trawling for herring takes place over autumn and winter, particularly at spawning grounds around the Isle of Man. A limited amount of netting for herring and mackerel takes place and there is an important charter fishery for mackerel.

Scallop dredging and potting, predominantly carried out by UK vessels, are key fisheries in the Irish Sea. Dredging for scallops takes place around Anglesey and the Isle of Man and to a lesser extent, within the Firth of Clyde and Cardigan Bay. Scallop fisheries are closed in coastal areas of the Irish Sea between June and October or November although fishing for queen scallops may be carried out year round. Potting is a particular feature of Cardigan Bay, where lobsters, crabs and prawns are all important fisheries. The lobster fishery operates in the bay, as well as around the Lleyn Peninsula from April to November. Brown crabs are also caught in pots around the Lleyn Peninsula, while spider crabs and crawfish are developing fisheries in the south of Cardigan Bay (Walmsley & Pawson 2008). Morecambe Bay, the Solway Firth, and the Dee, Ribble and Duddon estuaries are sites of shrimp fishing, while potting for shrimps has increased in Cardigan Bay in recent years, particularly during winter, when it is a substitute for the summer peaking lobster fishery. Shoreline cultivation of mussels, Manila clams and oysters takes place in the region and Morecambe Bay and the Solway Firth support important hand-raked and mechanically dredged cockle fisheries (Mills & Eastwood 2005).

Table A1h.21: Live weight and value of landings by species in 2019 by UK vessels from ICES statistical rectangles overlapping with Regional Sea 6, showing main species

Sector	Species	Live weight (tonnes)	Value (£)
Demersal	Bass	7	66,726
	Brill	28	117,103
	Cod	196	558,742
	Dogfish	449	108,205
	Haddock	1,201	1,746,676
	Hake	130	310,780
	Monkfish	157	347,029
	Plaice	57	43,508
	Pollack	38	103,247
	Skates and rays	161	128,468
	Sole	15	94,271
	Turbot	9	59,407
	Whiting	63	58,400
	Witch	31	15,347
	Other demersal[1]	37	28,827
Pelagic	Herring	5,061	2,189,161

[82] http://www.nw-ifca.gov.uk/

Sector	Species	Live weight (tonnes)	Value (£)
Shellfish	Crabs	2,552	4,930,574
	Lobsters	335	4,347,262
	Nephrops	9,218	22,442,078
	Scallops	7,514	12,353,483
	Whelks	5,904	6,916,690
	Other shellfish[2]	493	4,332,021

Notes: Species shown include those contributing ≥1% of the total live weight and/or value for that sector for the relevant Regional Sea in 2019; [1] 'Other demersal' dominated (by weight) by conger eel; [2] 'Other shellfish' dominated (by weight) by razor clam. Source: 2019 UK fleet landings by ICES rectangle (MMO 2020a).

1.17.11.2 Ports and vessels

The coastline around Regional Sea 6 has more ports than any other Regional Sea area, even excluding Manx and Irish ports, although the average number of registered fishing vessels per port is low. Most of the vessels in these ports (62%) are of boats below 10m, although Northern Irish ports tend to have a greater number of larger vessels – Kilkeel has one of the largest >10m fleet in the UK. Eleven of the top 50 UK and Manx (Douglas and Peel) ports by landings are based in Regional Sea 6, with landings at these ports, in common with the rest of the region, dominated by shellfish (Table A1h.22).

Table A1h.22: Annual landings into key ports in Regional Sea 6: 5-year mean (2015-2019)

	No. of vessels[1]		Demersal		Pelagic		Shellfish	
Port	≤10m	>10m	Quantity	Value	Quantity	Value	Quantity	Value
Kilkeel	35	51	1.4	2.0	<0.1	<0.1	3.5	7.4
Belfast	0	2	<0.1	<0.1	5.1	3.1	<0.1	<0.1
Ardglass	20	17	0.3	0.2	0.4	0.1	2.3	5.0
Portavogie	29	20	0.4	0.4	<0.1	<0.1	2.6	5.8
Douglas	-[2]	-[2]	<0.1	<0.1	<0.1	<0.1	2.8	3.2
Kirkcudbright	2	8	<0.1	<0.1	<0.1	<0.1	2.6	3.5
Fishguard	10	0	<0.1	<0.1	<0.1	<0.1	1.6	2.0
Troon and Saltcoats	0	5	<0.1	<0.1	<0.1	<0.1	0.8	1.9
Campbeltown	42	21	<0.1	<0.1	<0.1	<0.1	1.4	3.5
Whitehaven	13	8	0.1	0.1	<0.1	<0.1	1.5	2.1
Peel	-[2]	-[2]	<0.1	<0.1	<0.1	<0.1	1.9	3.5

Notes: Quantity in '000 tonnes; value in million GBP. [1]From UK fishing vessel list (excluding islands) as at 1st April 2021, does not include vessels registered in Isle of Man[2]. Source: Table 2.14 - Landings into UK ports by UK vessels: 2015 to 2019 (MMO 2020a), https://www.gov.uk/government/collections/uk-vessel-lists.

1.17.11.3 Distribution of fishing effort

The distribution of fishing effort in the Irish Sea, as depicted by VMS data, is particularly great in the north of the region (Figure A1h.32), with hotspots of fishing activity to the west of the Isle of Man and off the Cumbrian coast at Whitehaven. Significant activity can also be seen in Cardigan Bay and the Solway Firth. This pattern of distribution is mirrored by logbook data, both for all gears and mobile gears. Use of static gear is most frequent in waters around the northwest of Wales.

1.17.11.4 Gears and landings

Shellfish dominate landings in the region making up 77% of landings by weight and 90% by value (Table A1h.11). The most valuable landings are obtained from waters to the west of the Isle of Man, where important *Nephrops* and gadoid stocks are fished. With the exception of the northern North Sea (Regional Sea 1), more shellfish is landed from the Irish Sea than any other Regional Sea. The dominant method fishing method in the Irish Sea is the bottom trawl (41% days fished), with traps (34%) and dredges (20%) also common (Table A1h.12).

A1h.17.12 Features of Regional Sea 7

1.17.12.1 Summary of fisheries

The sheltered, inshore waters of the Minch and adjacent sea lochs make Regional Sea 7 ideal for small day boats. Most of the vessels operating here are small, local boats, although there is a significant amount of Northern Irish activity in these inshore waters (Scottish IFGs website[83]). Most fishing in the region is for shellfish, with crabs (edible and velvet), lobsters and whelk caught alongside major fisheries for scallop and *Nephrops*. *Nephrops*, caught by trawls and creels, is the most valuable fisheries in the area, followed by scallop, caught by dredging and, at lesser amounts, by hand. Razorshell is a growing fishery (Scottish IFGs website[25]). There is a significant high value trap fishery for wrasse species which are used for lice control in salmon farms[84]. There is also a sizeable industrial fishery targeting sandeel, alongside small scale pelagic fisheries for herring and mackerel and demersal fisheries for small flatfish and gadoids, such as cod, haddock and saithe, which use the region as a nursery ground. Salmon and sea trout are also abundant in the rivers and lochs of the west of Scotland and licensed fisheries for these species exist.

Table A1h.23: Live weight and value of landings by species in 2019 by UK vessels from ICES statistical rectangles overlapping with Regional Sea 7, showing main species

Sector	Species	Live weight (tonnes)	Value (£)
Demersal	Cod	6	13,519
	Dogfish	11	10,209
	Haddock	236	264,770
	Hake	6	7,062
	Lemon sole	5	13,186
	Megrim	13	23,898
	Monkfish	73	196,940
	Plaice	7	9,086
	Skates and rays	55	49,595
	Whiting	9	6,158
	Witch	13	10,132
	Other demersal[1]	43	2,127,360
Pelagic	Herring	491	195,526
	Horse mackerel	255	110,253
	Mackerel	34	37,375
	Sprats	1,298	345,856

[83] https://rifg.scot/
[84] https://www.gov.scot/publications/wild-wrasse-harvesting-consultation-proposed-new-mandatory-fishing-measures/

Sector	Species	Live weight (tonnes)	Value (£)
Shellfish	Crabs	4,268	10,057,766
	Lobsters	253	3,535,632
	Nephrops	4,968	27,386,189
	Scallops	2,330	5,813,750
	Whelks	187	208,388
	Other shellfish[2]	249	1,832,385

Notes: Species shown include those contributing ≥1% of the total live weight and/or value for that sector for the relevant Regional Sea in 2019; [1] 'Other demersal' dominated (by weight) by wrasses; [2] 'Other shellfish' dominated (by weight) by razor clam. Source: 2019 UK fleet landings by ICES rectangle (MMO 2020a)

1.17.12.2 Ports and vessels

The western coast supports numerous small ports and harbours, the largest of which are Ullapool, Kinlochbervie, Oban and Mallaig[85]. The proximity to the region of the shelf edge and offshore fishing grounds still supports many larger vessels. Five of the top fifty UK ports by landing weight are found within the region with landings into these ports dominated by demersal species (Table A1h.24).

Table A1h.24: Annual landings into key ports in Regional Sea 7: 5-year mean (2015-2019)

	No. of vessels[1]		Demersal		Pelagic		Shellfish	
Port	≤10m	>10m	Quantity	Value	Quantity	Value	Quantity	Value
Ullapool	51	20	6.6	12.7	<0.1	<0.1	1.4	4.3
Kinlochbervie	8	5	7.5	13.8	<0.1	<0.1	0.4	1.4
Mallaig	14	6	0.7	1.2	0.3	0.3	1.9	6.4
Lochinver	9	14	1.3	3.2	<0.1	<0.1	0.3	1.2
Oban	33	26	<0.1	<0.1	<0.1	<0.1	1.2	3.7

Notes: Quantity in '000 tonnes; value in million GBP. [1]From UK fishing vessel list (excluding islands) as at 1st April 2021. Source: Table 2.14 - Landings into UK ports by UK vessels: 2015 to 2019 (MMO 2020a), https://www.gov.uk/government/collections/uk-vessel-lists.

1.17.12.3 Distribution of fishing effort

The region is widely fished, with the greatest densities in The Minch. This distribution may be seen both using data derived from VMS (Figure A1h.32) and logbooks. Static gears are mainly set in sheltered bays and lochs. Very few foreign vessels operate in the region, as much of it is within UK territorial waters. Fishing in this region is slightly seasonal, with the greatest effort recorded in spring.

1.17.12.4 Gears and landings

Landings in the region are dominated by shellfish, which contribute 83% of the weight and 93% of the value of landings (Table A1h.11). Shellfish landings are predominantly of high value *Nephrops,* crabs, scallop and lobsters. Important scallop grounds are found along the east coast of the Isle of Lewis, to the west of the Isle of Skye and along the coast to the south of the region (Mason 1983). The most frequently used gear types are bottom trawls and traps (for

[85] https://www.gov.scot/publications/scotlands-marine-atlas-information-national-marine-plan/pages/44/

Nephrops, crabs, lobsters and sandeels), which comprise almost 88% of days fished by UK vessels between them, while dredges (7%) are used to harvest scallop (Table A1h.12).

A1h.17.13 Regional Sea 8

1.17.13.1 Summary of fisheries

The seas of the Scottish continental shelf region are heavily fished by both the UK fleet and foreign vessels. There are four main demersal fleets in operation in the region (Gordon 2006):

- Mixed roundfish otter trawl – UK, Irish, French and German vessels target haddock, cod and other gadoids both on the shelf and along the shelf edge.
- *Nephrops* otter trawl – Irish and British vessels use fine mesh nets to target *Nephrops* in offshore areas, usually with a significant bycatch.
- Monkfish, megrim and hake otter trawl – these species are targeted on and around the shelf edge, mainly by UK and French trawlers.
- Saithe otter trawl – predominantly French vessels operating in shelf edge waters to the north of Scotland.

Large and important pelagic fisheries operate in this Regional Sea as both herring and mackerel migrate over the Scottish shelf between spawning and feeding grounds. The west of Scotland herring stock has been targeted by UK, Dutch and German vessels, while higher value mackerel was the target of a substantial Irish fleet in the area. Norway pout has been targeted by industrial fleets, primarily from Danish vessels (Gordon 2006).

Inshore fisheries in the region are dominated by shellfish harvesting around the coastlines of Lewis, Harris, Orkney and Shetland.

Table A1h.25: Live weight and value of landings by species in 2019 by UK vessels from ICES statistical rectangles overlapping with Regional Sea 8, showing main species

Sector	Species	Live weight (tonnes)	Value (£)
Demersal	Cod	8,491	23,971,684
	Gurnard	459	186,468
	Haddock	6,075	10,077,120
	Hake	4,297	10,435,847
	Lemon sole	424	1,825,071
	Ling	3,633	5,725,326
	Megrim	1,697	4,993,314
	Monkfish	6,046	19,674,980
	Plaice	701	1,199,744
	Saithe	5,990	5,607,237
	Skates and rays	518	440,958
	Whiting	2,209	2,978,530
	Other demersal[1]	950	4,737,127
Pelagic	Blue whiting	7,649	3,071,509
	Herring	40,069	22,560,786
	Horse mackerel	2,081	1,144,479

Sector	Species	Live weight (tonnes)	Value (£)
	Mackerel	73,940	87,339,471
Shellfish	Crabs	4,900	11,852,660
	Lobsters	274	3,932,380
	Nephrops	801	3,715,267
	Scallops	1,664	5,167,247
	Squid	936	4,444,763
	Whelks	425	490,948

Notes: Species shown include those contributing ≥1% of the total live weight and/or value for that sector for the relevant Regional Sea in 2019; [1] 'Other demersal' dominated (by value) by wrasses and blue ling. Source: 2019 UK fleet landings by ICES rectangle (MMO 2020a)

1.17.13.2 Ports and vessels

The region does not have an extensive coastline, comprising mainly just the western fringes of the Hebrides, Orkney and Shetland and north of Scotland. Consequently there are relatively few ports and vessels based in the region. Much of the fishing effort in the region is carried out from boats based elsewhere in the UK and abroad. Of the top 50 UK fishing ports, four are based in this region, at Scalloway and Cullivoe in Shetland, Stromness in Orkney and Scrabster. Landings at these ports comprise mainly demersal fish with very few pelagic landings (Table A1h.26).

Table A1h.26: Annual landings into key ports in Regional Sea 8: 5-year mean (2015-2019)

	No. of vessels[1]		Demersal		Pelagic		Shellfish	
Port	≤10m	>10m	Quantity	Value	Quantity	Value	Quantity	Value
Scrabster	63	15	13.3	26.6	<0.1	<0.1	2.4	5.4
Scalloway And Isles	14	3	6.5	13.0	0.1	0.1	0.4	0.7
Cullivoe	0	0	2.5	4.9	<0.1	<0.1	0.2	0.4
Stromness	0	3	<0.1	<0.1	<0.1	<0.1	1.6	2.9

Notes: Quantity in '000 tonnes; value in million GBP. [1]From UK fishing vessel list (excluding islands) as at 1st April 2021. Source: Table 2.14 - Landings into UK ports by UK vessels: 2015 to 2019 (MMO 2020a), https://www.gov.uk/government/collections/uk-vessel-lists.

1.17.13.3 Distribution of fishing effort

The VMS data indicates a high level of fishing effort throughout this region (Figure A1h.32). Logbook-derived data suggests a more uniform distribution across the shelf. Densities of vessels are highest along the shelf edge, with hotspots of activity to the north of the Hebrides and around Orkney and Shetland islands. Most of these vessels were using mobile gears, although a significant amount of static gear usage can be identified around the shelf edge (Figure A1h.33).

1.17.13.4 Gears and landings

This and Regional Sea 1 are the most productive of the Regional Seas, with landings largely comprising pelagic fish (much of which is caught by industrial freeze trawlers) comprising over 70% of the landed weight, and 48% of the value (Table A1h.11). The importance of pelagic fisheries in this region, particularly off the north of Scotland, is clear in Figure A1h.33. The high efficiency of pelagic fishing means that these landings are achieved despite relatively little fishing effort (in terms of total days at sea) when compared to other Regional Seas, in

particular, 1, 4/5, 6 and 7 (Table A1h.12). Traps (39% days fished) and bottom trawls (26% days fished) are the dominant gear types used in the region, reflected in the high quantities of demersal and shellfish species caught around the shelf. The region was heavily fished by foreign vessels which are not included in these figures.

A1h.17.14 Regional Seas 9, 10 & 11

1.17.14.1 Summary of fisheries

These regions are entirely non-coastal and too far from shore for small day boats. The fisheries in the region are predominantly demersal, with the Rockall Bank, Hatton Bank and areas around the numerous sea mounts and ridges particularly suitable for large gadoids, monkfish and flatfish. Areas like the Rockall Trough and Faroe Shetland Channel support significant deep sea fisheries. The Rockall Bank is the site of a major targeted demersal trawl fishery for haddock, primarily pursued by Russian vessels operating outside of the European Exclusive Economic Zone (beyond 200 nautical miles from shore) (Gordon 2006). Vessels target deep water species such as blue ling, roundnose grenadier and black scabbardfish around the margins of the Rockall Trough, while French vessels operate a small fishery for deep water sharks (Gordon 2006). Over the Hatton Bank, roundnose grenadier and Baird's slickhead are fished, with many Spanish vessels working in the area. There are also mixed demersal trawls catching monkfish, saithe, cod and haddock within the region. A feature of the demersal fisheries of the region is the use of static methods such as longlines (used by Norwegian vessels targeting ling and tusk) and gill nets (a popular method among Spanish vessels targeting hake). There is concern about the sustainability of deep sea stocks, due to the low fecundity and long life cycles of many of these species. Consequently, numerous closed areas have been set up (Ásmundsson 2015). Trawling is banned in certain areas around the Rockall and Hatton Banks and at the Darwin Mounds (in part because of the presence of fragile coral habitats), directed fishing for orange roughy is not permitted along much of the shelf edge, while a "Haddock Box" where only longlining is permitted, exists near Rockall. A number of fish species including orange roughy, blue ling, leafscale gulper shark, Portugese dogfish and roundnose grenadier are protected features of the recently designated West of Scotland MPA, covering a large deep water area within the Rockall Trough.

Pelagic fisheries in the region target herring and mackerel, but the most important pelagic fisheries in these waters are industrial fisheries for small, "low value" pelagics, particularly blue whiting (Gordon 2006). Shellfish fisheries in the region are limited.

Table A1h.27: Live weight and value of landings by species in 2019 by UK vessels from ICES statistical rectangles overlapping with Regional Seas 9, 10 and 11, showing main species

Sector	Species	Live weight (tonnes)	Value (£)
Demersal	Cod	79	239,848
	Haddock	5,241	8,519,129
	Hake	113	305,039
	Ling	422	631,797
	Megrim	239	365,756
	Monkfish	1,357	4,031,657
	Saithe	217	193,806
	Other demersal[1]	277	320,804
Pelagic	Blue whiting	2,651	572,649
	Horse mackerel	153	87,216

Sector	Species	Live weight (tonnes)	Value (£)
	Mackerel	382	272,275
Shellfish	Squid	223	983,274

Notes: Species shown include those contributing ≥1% of the total live weight and/or value for that sector for the relevant Regional Sea in 2019; [1] 'Other demersal' dominated (by value) by blue ling, Greenland halibut, black scabbard fish and torsk (tusk). Source: 2019 UK fleet landings by ICES rectangle (MMO 2020a)

1.17.14.2 Distribution of fishing effort

Fishing effort is sporadic in these Regional Seas, and is mainly concentrated around the Rockall Bank, Rosemary Bank, Wyville Thomson Ridge and shelf edges, the outlines of which can be clearly made out by the distribution of VMS data (Figures A1h.32 and 33). A large number of foreign (non-EU) vessels work in the region.

1.17.14.3 Gears and landings

There is relatively little fishing effort in the region (*ca*. 1% of UK total days at sea, Table A1h.12) and landings into UK ports from these Regional Seas are much lower than from other areas (representing *ca*. 2% of UK landings by weight and value, Table A1h.11). Most of the landings (by weight) are of demersal species (66% by weight, 89% by value). The main gear types used are gill nets (58% of days fished) and demersal trawls (37%). The regions are heavily fished by foreign vessels which will not be included in these figures.

A1h.17.15 Evolution of the baseline

The fishing industry is dynamic with frequent and sometimes unpredictable changes in fish abundance and distribution, climatic conditions, management regulations and fuel costs all affecting activity. Consequently the baseline is rapidly evolving.

1.17.15.1 Trends in the fishing industry

The size and capacity of the UK fishing fleet has declined over the past decade, with 566 fewer vessels (9% reduction) and 4.5% lower gross tonnage[86] in 2019 than 2010 (Figure A1h.41). Compared to 2018, the number of UK vessels has fallen by 125, a decrease of 2% and similar to the change between 2017 and 2018. Three-quarters of these were vessels under 10m in length (MMO 2020a). Almost 80% of the UK fleet is made up of vessels 10 metres and under in length and these vessels account for 9% of the fleet's tonnage and 35% of the fleet's power. Vessels over 24 metres in length account for just 4% of the total number but 63% of the fleet's capacity and 35% of the fleet's power (MMO 2020a).

The decrease in tonnage in the UK fleet is largely accounted for by a significant decline in the number of vessels employing demersal trawls or seines, which will typically target commercially valuable quota species. As well as the implementation of tighter quotas in many stocks over recent years, the shrinkage in the UK fleet may be due to rising fuel costs, which are limiting profit margins and making the continued running of many boats - particularly older, less efficient models – less viable, and government led decommissioning schemes (MMO 2020a). The increase in capacity since 2016 suggests the addition of a small number of larger vessels given that vessel numbers have decreased over the same period.

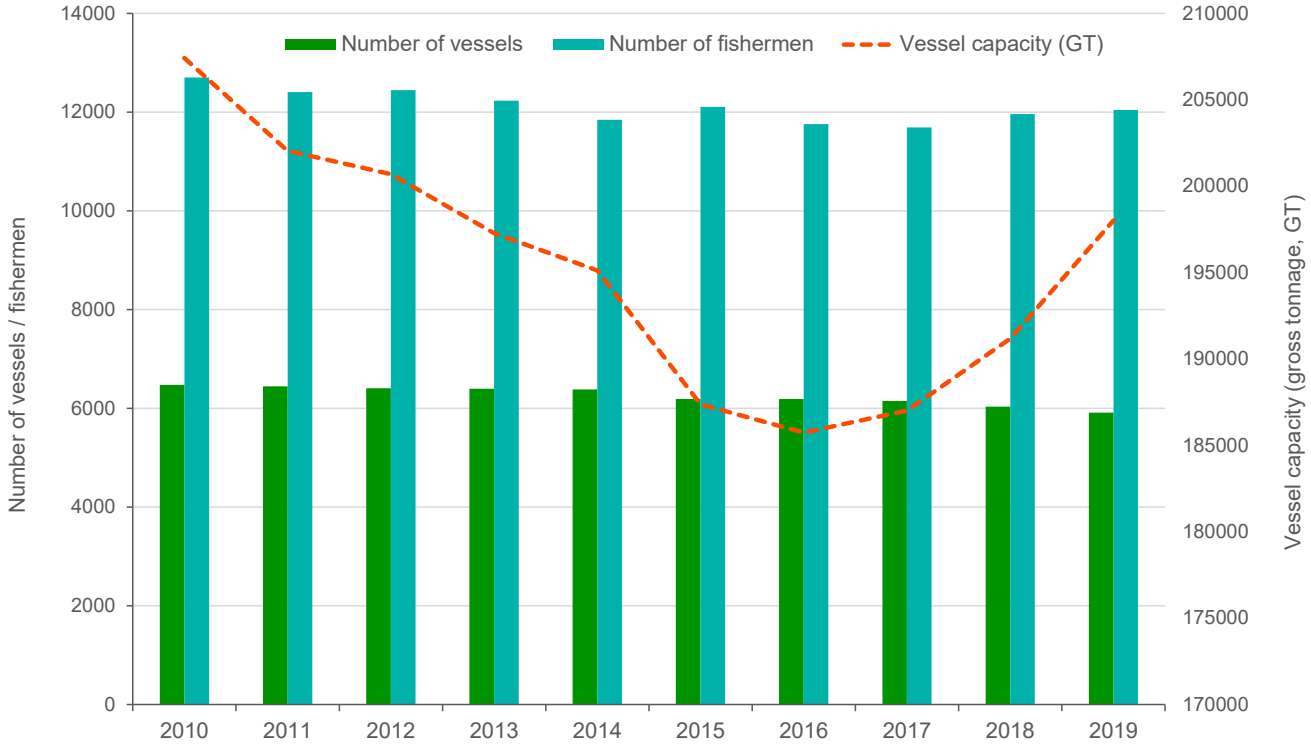
[86] Fishing capacity is the physical dimension of fishing vessels, measured in gross tonnage (GT), or – in engine power terms – kilowatts (kW). GT days is a measure of effort, representing the sum of the products of fishing capacity and time at sea for each vessel.

The number of working fishermen has fluctuated slightly over the past 10 years, from a high of 12,703 in 2010 to a low of 11,692 in 2017. Overall, the number of working fishermen in 2019 was 5% lower than in 2010 (Figure A1h.41), representing less of a reduction than that experienced in the preceding decade.

Effort by the demersal trawl and seine segment of the fleet fell by 36 per cent between 2004 and 2019, to 35 million kW days at sea. The beam trawl segment, which has relatively lower levels of effort (7 million kW days at sea in 2019) fell by 60 per cent over the same period.

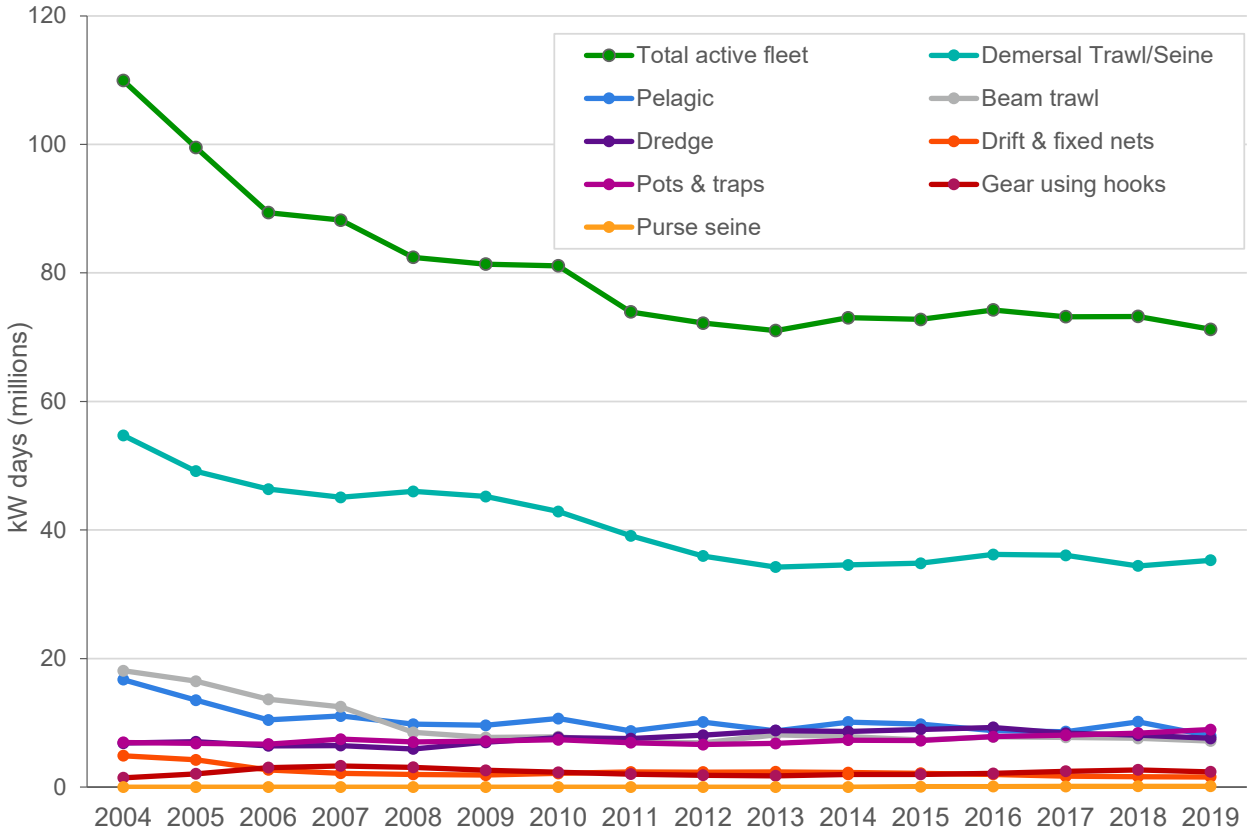
The reduction in effort in the demersal trawl and seine segment was largely due to decommissioning exercises carried out by UK fisheries administrations between 2001-2002 and 2003. The latter focussed on removing fleet capacity targeting cod in the Cod Recovery Zone (a combination of North Sea, West of Scotland and Irish Sea fishing areas) and was particularly focussed on vessels that used demersal trawls for whitefish. A further exercise was carried out to remove excess beam trawl fishing capacity in the Western Channel fishing area as part of the recovery regime for sole (MMO 2020a).

Figure A1h.41: UK fleet size, capacity and number of working fishermen, 2010-2019



Source: Section 1 – Fleet, UK sea fisheries statistics 2019 (MMO 2020a)

Figure A1h.42: UK fishing fleet effort (kW days), for vessels > 10m length, 2004 to 2019



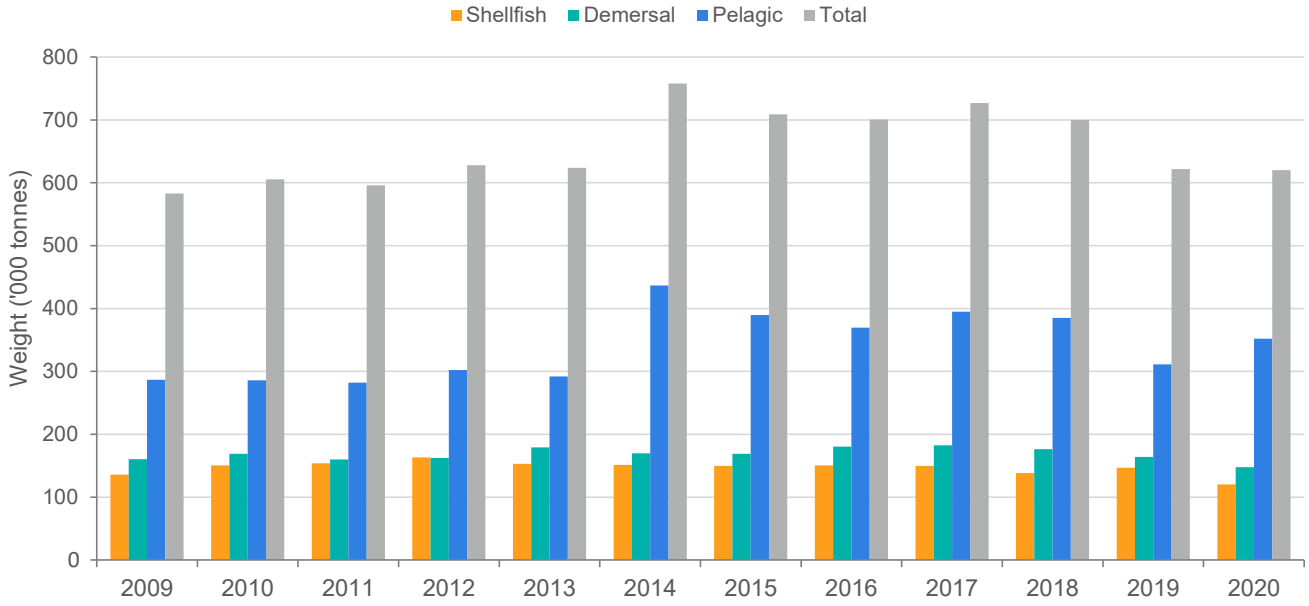
Source: Table 3.4 - Fishing effort - kW days (millions) for the over 10m UK fishing fleet: 2004 to 2019 (MMO 2020a)

The total weight of landings in 2020 (provisional data) was 6% higher than that in 2009 (Figure A1h.43). Total landings were fairly stable at around 600,000 tonnes from 2009-2013, then experienced a step increase from 2014 and remained around 700,000 until decreasing in 2019 and 2020 (most probably due to COVID restrictions, with the most severe impact (measured by value of fish landed) in April 2020[87]). Pelagic fish accounted for the majority of the increase in landings, followed by demersal fish. The sharp increase in pelagic landings (up by 49% from 2013 to 2014) is most likely due to a large increase in the mackerel quota, which resulted in landings of this species rising from 164,000 tonnes in 2013 to 288,000 tonnes in 2014. Shellfish landings by weight have remained fairly stable since 2009. In terms of the total value of landings, despite some year-to-year decreases, there is an overall trend of a steady increase with the total value in 2019 being 62%% higher than in 2009 (Figure A1h.44).

Over the last 10-15 years, a number of new fisheries have developed for less traditional food species, particularly for shellfish (whelks and razorshells in the Irish Sea) and cephalopods (squid in the Moray Firth), but also for finfish. This is particularly the case in the southern regions, where species diversity is higher and the abundances of many warm water species are increasing.

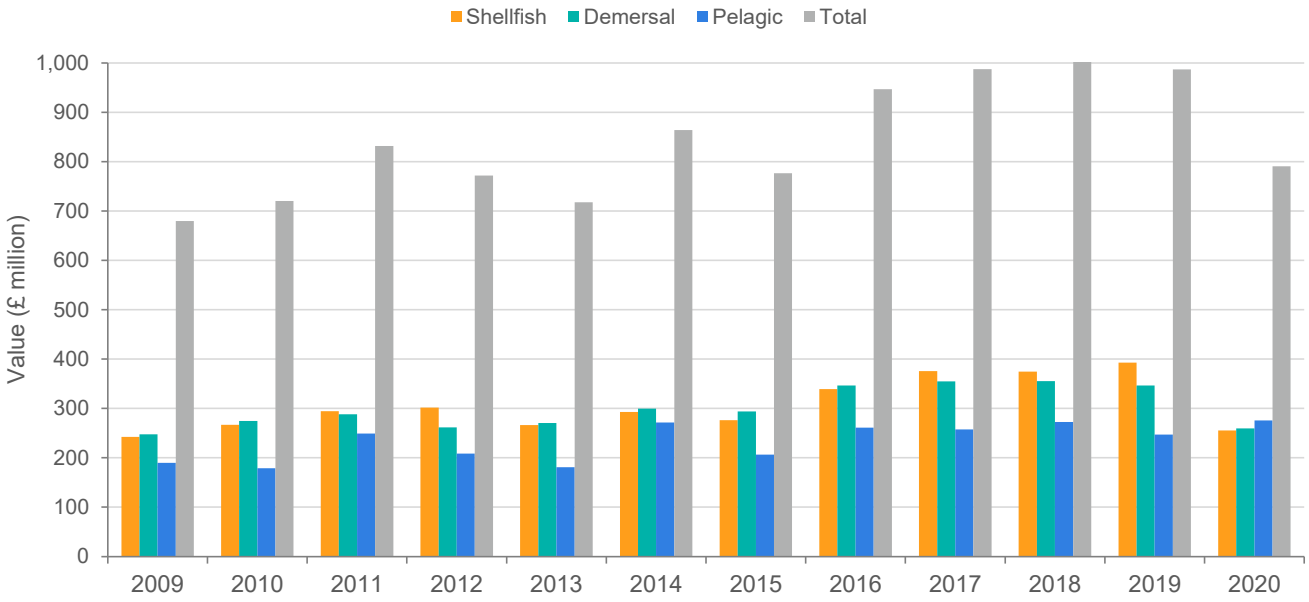
87 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/965022/Monthly_UK_Sea_Fisheries_Statistics_-_December_2020__1_.pdf

Figure A1h.43: Landings into the UK and abroad by UK vessels, 2009-2020



Source: Section 2 – Landings, UK sea fisheries statistics 2019 (MMO 2020a), monthly UK sea fisheries statistics – reported landings: December 2020 (MMO & National Statistics 2021)
https://www.gov.uk/government/statistics/monthly-sea-fisheries-statistics-december-2020

Figure A1h.44: Value of landings into the UK and abroad by UK vessels, 2009-2020



Source: Section 2 – Landings, UK sea fisheries statistics 2019 (MMO 2020a), monthly UK sea fisheries statistics – reported landings: December 2020 (MMO & National Statistics 2021)
https://www.gov.uk/government/statistics/monthly-sea-fisheries-statistics-december-2020

1.17.15.2 Developments in fisheries management

UK fisheries are likely to be subject to substantial changes in coming years as a result of technical developments, economics and changes in management strategy as well as changes in target species abundance, composition and distribution. Over the course of the past

century, fishing efficiency has increased with technological advances, increasing the pressure on marine ecosystems as a wider range of environments and species become exploitable. There are two ways of managing fisheries: managing catch or managing effort. Currently, management is focused on catch and is based largely on TACs and national fleet quotas. However, the demersal trawls dominating UK fisheries are characterised by yielding a very mixed catch, so single species quotas do not reflect the true impact of fishing. In response, ICES has developed mixed-fisheries considerations as part of their advice, where various trade-offs associated with moving from single-stock management to mixed-fisheries management are explored through various scenarios. Methods of protecting the whole ecosystem in management (the Ecosystem Approach) are increasingly being developed with ICES now considering ecosystem-based management as the primary way of managing human activities affecting marine ecosystems[88]. The 25 Year Environment Plan[89] notes that an ecosystem approach to fisheries management will account for, and seek to minimise, impacts on non-commercial species and the marine environment generally, including through technical conservation measures. An ecosystem-based approach is also fundamental to Scotland's Fisheries Management Strategy 2020 -2030[90]. Conflict with other users, such as the wind and renewables industry is resolved, where possible, through negotiation, and compromise, with Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) an important driver of this communication in the UK.

Under the *Marine and Coastal Access Act 2009,* the MMO can introduce byelaws to manage fishing for the conservation of marine flora, fauna or habitats. There are currently six MMO byelaws in force which protect specified areas of the designated feature(s) of that MPA from the impacts of bottom towed fishing gear, covering: Margate and Long Sands European Marine Site; West of Walney Marine Conservation Zone; Inner Dowsing, Race Bank and North Ridge European Marine Site; Haisborough, Hammond and Winterton European Marine Site; Start Point to Plymouth Sound and Eddystone European Marine Site, and Land's End and Cape Bank European Marine Site[91]. Draft bylaws propose to prohibit all bottom towed fishing, including demersal and semi-pelagic trawls, demersal seines and dredges throughout the Dogger Bank SAC, South Dorset MCZ and in specified areas of The Canyons MCZ, including small buffer areas around the sites[92]. Of note is the recent closure of the Dogger Bank area to scallop fishing following a rapid increase in scallop dredging activity in the area. Scallop fishing in UK waters around Dogger Bank resumed from 5 April except in the SAC where a closure will remain in place until the outcome of the MMO consultation on a proposed byelaw is decided[93].

Measures such as establishing closed areas, days at sea limits, reducing vessel power and limiting capacity through occasional decommissioning schemes have become increasingly popular. In addition, there have been a number of technical developments in recent years to decrease levels of bycatch by allowing the escape of non-target, under-sized or juvenile fish and to prevent the entanglement of cetaceans, seals and turtles in gear. These developments include separator panels, escape panels and square meshed panels in trawl nets to allow non-

[88] https://issuu.com/icesdk/docs/ices_annual_report_2020_uk
[89] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf
[90] https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2020/12/scotlands-future-fisheries-management-strategy-2020-2030/documents/scotlands-fisheries-management-strategy-2020-2030/scotlands-fisheries-management-strategy-2020-2030/govscot%3Adocument/scotlands-fisheries-management-strategy-2020-2030.pdf
[91] https://www.gov.uk/guidance/marine-conservation-byelaws
[92] https://consult.defra.gov.uk/mmo/formal-consultation-mmo-mpa-assessments/
[93] https://www.gov.uk/government/news/dogger-bank-scallops

target and under-sized fish to escape, and acoustic “pingers” to deter predatory marine mammals. A decrease in bycatch will increase the efficiency of fishing, resulting in fewer discards and allowing a reduction in fishing effort. This in turn, is likely to lead to more generous quotas being awarded.

Pressure may also be put on the fishing industry by non-governmental organisations such as the Marine Stewardship Council (MSC) who assess fisheries and certify those that are sustainable and with low environmental impact. There are currently 14 MSC certified fisheries in UK waters, covering a broad range of species, fishing method and geographical range[94].

Encouraging these sustainable fisheries in this way, as well as encouraging the public to embrace less traditional food species, will also ease the pressure on key species. The principle of “Balanced Harvest” of fish stocks, aiming to spread catch over the widest possible range of species, stocks and sizes, in proportion to their natural productivity (Garcia *et al*. 2015, Zhou *et al*. 2019) would be supported by such a move.

A1h.17.16 Environmental issues

Fishing has a number of direct effects on the marine environment. The most obvious of these is the problem of over-exploiting a fish stock, leading to declines in abundance to the level at which the population becomes unsustainable. Overfishing can lead to problems other than a simple decline in abundance. The act of selectively removing large, predatory species from the community, as commercial fisheries tend to, can lead to marine ecosystems becoming dominated by short-lived organisms from lower trophic levels such as small, planktivorous fish and invertebrates. This phenomenon is known as fishing down the food web (Pauly *et al*. 1998). Data indicate that the biomass of fish from high trophic levels declined by two thirds in the North Atlantic in the second half of the Twentieth Century (Christensen *et al*. 2003). Thurstan *et al*. (2010) showed that over 118 years from 1889-2007, the landings per unit of fishing power in the bottom trawl sector fell by 94%, a demonstration of the scale of the decline in demersal fish stocks since the advent of industrial fishing. Anderson *et al*. (2008) and Perry *et al*. (2010) argue that the de-stabilisation of fish stocks caused by heavy fishing leads to increased fluctuations in abundance and therefore increased vulnerability to natural events. This was also illustrated by Lindegren *et al*. (2010) who demonstrate the increased resilience to environmental change of the Atlantic cod in the Sound separating the North and Baltic Seas, where a trawling ban has been in place since 1932, compared to the neighbouring waters.

The latest (2018) status assessments (‘Good Environmental Status’, GES) under the Marine Strategy (Defra 2019) indicate that approximately half of UK fish (quota) stocks are fished above maximum sustainable yield (MSY). However, the proportion of stocks fished within MSY has increased from 12% in 1990 to 53% in 2015. Fishing mortality estimates have declined significantly in recent years in 67% of assessed stocks in UK waters[95], and recent ICES advice suggests a greater degree of optimism about the future of these stocks than has been present for a number of years. For example, the majority of North Sea fish stocks are now fished at rates at or below MSY. Overall fishing mortality for shellfish, demersal, and pelagic fish stocks has reduced since the late 1990s. Relative spawning-stock biomass has also increased since 2000 and is now above or close to the biomass reference points used in stock assessments of most stocks in the North Sea. A number of stocks still have a relatively high fishing pressure, namely cod stocks, sole stocks, saithe and blue whiting (ICES 2021).

[94] https://www.msc.org/uk/what-we-are-doing/uk-irish-fisheries
[95] https://moat.cefas.co.uk/pressures-from-human-activities/commercial-fish-and-shellfish/

OSPAR is developing a number of relevant indicators[96] including: the proportion of large fish (Large Fish Index); size composition in fish communities, and recovery in the population abundance of sensitive fish species, all of which appear to be showing positive signs of recovery (albeit often limited by lack of data).

The mixed nature of the demersal trawl fisheries also leads to high numbers of unwanted, low-value or immature fish being caught. These fish would once have been discarded – it has been estimated that for every kilogram of sole caught by beam trawls in the North Sea, up to 14kg of other animals will also be killed (Covey & Laffoley 2002, cited in RCEP 2004). In the North Sea between 2010 and 2012, 40% of all catch was discarded, including 78% of plaice and dabs (IMARES 2014). This represents both a biological and an economic loss. However, a ban on discarding, which came into force in pelagic and industrial fisheries in January 2015, and in demersal fisheries in January 2016, aims to limit this loss. The landing obligation or discard ban was applied in a transitional period up to 2019 with full implementation from January 2019[97]. For some mixed fisheries, the difficulty of avoiding all unwanted catches and the potential for choke species[98], has led to the adoption of delegated acts by the Commission which provide some flexibility as regards the landing obligation. The landing obligation has been retained, with some minor amendment, into UK legislation and will continue to apply in UK territorial waters[99]. Bycatch may also include larger animals; trawl nets catch and drown cetaceans and seals which are attracted by the shoaling fish, and baited long-lines are known to catch and drown diving seabirds (Løkkeborg 1998). Lost fishing gear can continue to act as a source of animal mortality for many years, a process known as “ghost fishing”.

Fishing can also cause considerable damage to the wider marine environment. Bottom trawling is a destructive method, destroying fragile habitats and organisms and crushing benthic invertebrates such as crustaceans, molluscs and echinoderms. ICES, using VMS data to map surface abrasion pressure caused by trawls (ICES Advice[100]), estimated that for the Greater North Sea, 90% of the fishing effort with bottom-contacting gears occurred in about a third to half of the area, representing ‘core fishing grounds’. These core fishing grounds contributed most of the landings of fish and shellfish by weight and value with almost 80% of the fishing effort and landings, and about 70% of the value, occurring in only 20% of the surface area of the Greater North Sea ecoregion. Beam trawling is particularly destructive, using tickler chains that penetrate up to 8cm into the sediment (RCEP 2004). Rumohr & Kujawski (2000) found a significant change in epifaunal community between 1912 and 1986 that they linked to trawling activity. They found that between these dates, bivalve abundance had declined, while more motile scavengers, such as crustaceans and gastropods, had increased in abundance, possibly in response to high levels of discards and injured invertebrates. Trawling not only modifies the diversity and structure of benthic communities, but is also likely to affect the productivity of the ecosystem by re-suspending nutrients into the water column in a pulse, which may increase pelagic productivity (RCEP 2004). Scallop dredges are similarly damaging, being of a heavy metal construction, and usually with large teeth or a cutting bar designed to dig scallops out from the sediment, and have been linked to

[96] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/fish-and-food-webs/
[97] https://www.gov.uk/government/publications/technical-conservation-and-landing-obligation-rules-and-regulations-2020/landing-obligation-general-requirements-2020
[98] A species for which the available quota is exhausted before the quotas of (some of) the other species that are caught together in a (mixed) fishery are exhausted. Source: https://ec.europa.eu/oceans-and-fisheries/fisheries/rules/discarding-fisheries_en
[99] https://www.daera-ni.gov.uk/articles/fish-landing-obligation
[100] https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/Special_requests/eu.2017.13.pdf

a number of detrimental effects including long term changes in seabed community structure (Bradshaw *et al*. 2002). New technologies and fishing methods such as pulse trawling (where an electric pulse replaces the dragged tickler chain (van Marlen *et al*. 2014) or the hydraulic jet elevator, which uses a system of water jets to dislodge shellfish from the seabed, in place of dredges, will reduce the damage caused by these fisheries as they become more widespread.

Shifts in the benthic community of the North Sea were described by Robinson & Frid (2008), as well as the losses of entire taxa, apparently through damage from trawling over several decades. Atkinson *et al*. (2010) reported that shellfisheries (predominantly cockle and mussel) conflict with waterbirds in the Norfolk Wash region, by removing prey. In conjunction with nutrient inputs in the area, this has resulted in a decline in species of waterbird, including the knot, shelduck and oystercatcher and a change in the assemblage towards one dominated by species which rely more on less heavily exploited prey items, such as worms.

Based on bottom trawling intensity, the impact of bottom trawling on benthic habitats was assessed for the first time as part of the OSPAR's 2017 Intermediate Assessment. The extent of physical damage to predominant and special habitats indicator[101] highlighted that 86% of the assessed areas in the Greater North Sea and the Celtic Seas had physical disturbance, of which 58% showed higher disturbance. 74% of all assessed areas experienced consistent pressure year on year, which is very likely to affect the ability of habitats to recover[102]. It is estimated that some areas of the North Sea may take up to 15 years to recover from one pass of a beam trawl, with those areas experiencing low levels of natural disturbance the most sensitive (Hiddink *et al*. 2006). As found by Stelzenmüller *et al*. (2008), fishing pressure is often higher in areas with the least tide stress.

The fishing industry is potentially affected by a number of environmental issues, such as contamination of fish through riverine discharges, algal blooms, pollution originating from shipping or hydrocarbon production, underwater noise disturbance, EMF effects and the effects of climate change on fish distributions (see Appendix A1a.5).

A1h.18 Mariculture

A1h.18.1 UK context

Mariculture is the cultivation of marine shellfish, finfish and seaweed within coastal waters. In 2018 (the latest year that UK figures available), total UK aquaculture production (including from freshwater) was 189,921 tonnes (valued at £0.96 billion), of which mariculture represented approximately 95% (180,415 tonnes, £0.93 billion) (Cefas, *pers. com*.). UK mariculture is dominated by Scottish salmon production which accounted for 86% (156,025 tonnes, £0.88 billion) of all mariculture production in 2018 (Munro 2020a, Cefas, *pers. com*.).

Marine shellfish and finfish cultivation principally takes place along the west coast of Scotland, the Inner and Outer Hebrides and the Northern Isles where it can play an important role in the economy of rural communities (e.g. Biggar Economics 2020). Mariculture in England, Wales and Northern Ireland is on a smaller scale and primarily of shellfish (mussels and oysters).

[101] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/extent-physical-damage-predominant-and-special-habitats/
[102] https://www.ospar.org/work-areas/eiha/fishing-mariculture

1.18.1.1 Scotland

Finfish

Scotland, the third biggest producer of farmed Atlantic salmon in the world, and the largest in the EU[103], produced 203,881 tonnes of salmon in 2019 (estimated value of almost £1.1 billion), an increase of over 30% on the 2018 total and the highest ever level of production recorded in Scotland. Production for 2020 is projected to be 207,630 tonnes (Munro 2020a). The principal finfish species cultivated are salmon and rainbow trout (seawater production of 4,083 tonnes in 2019), with smaller numbers of other species such as brown/sea trout (24 tonnes), halibut (production total commercially sensitive), lumpsucker (21 tonnes) and wrasse (10 tonnes) also farmed. The production of lumpsucker and wrasse are targeted at the salmon industry where they are used as a biological control for parasites (Munro 2020a).

Salmon production sites are principally located around the west and northern coasts, in Regional Seas 7, 8, and in the northern sections of Regional Seas 1 and 6 (Figure A1h.45, Table A1h.28). There were 226 active sites in 2019 although only 146 of these produced fish for harvest (Munro 2020a). Of the 2019 total (203,881 tonnes), 70,860 tonnes was mature salmon, with the rest being made up of 0-year fish (fish harvested in year of input - 931 tonnes), grilse (fish harvested in January to August of first year – 72,423 tonnes) and pre-salmon (fish harvested in September to December of first year - 59,847 tonnes) (Table A1h.28). The majority of fish were produced in seawater cages with 28 tonnes of production from seawater tank sites in 2019 (Munro 2020a).

[103] https://digitalpublications.parliament.scot/ResearchBriefings/Report/2018/2/13/Salmon-Farming-in-Scotland

Figure A1h.45: Location of mariculture sites around the UK

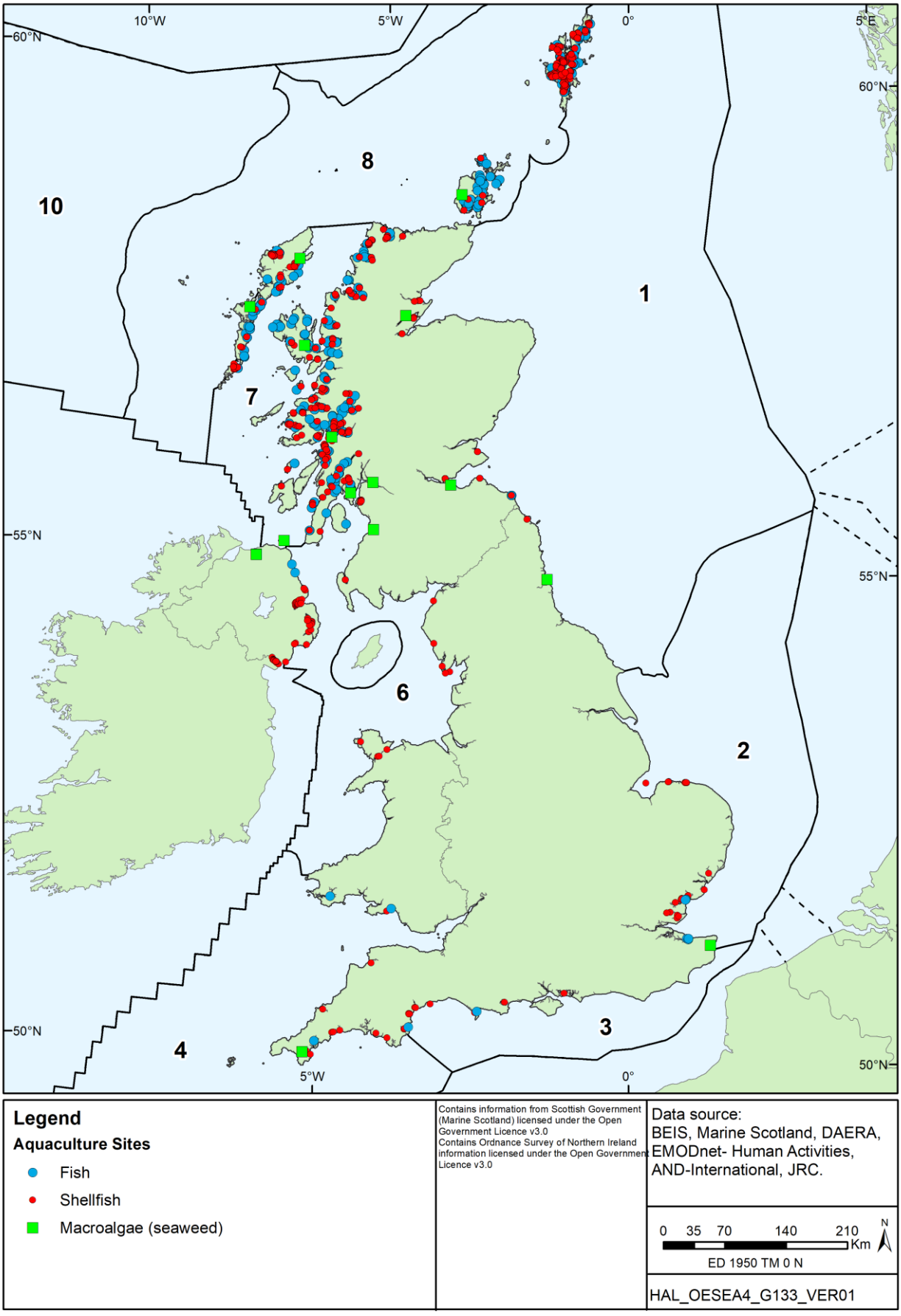


Table A1h.28: Salmon production in Scotland by region, 2019

Region	Staff employed F/TF/T	P/T	Annual production (tonnes)	Year of input (tonnes)	Grilse (tonnes)	Pre-salmon (tonnes)	Year 2 Salmon (tonnes)
North west	662	32	66,633	472	35,020	21,873	9,268
Orkney	110	1	17,758	0	6,393	5,952	5,413
Shetland	227	6	36,141	459	11,478	12,451	11,753
South west	338	7	44,881	0	8,071	13,846	22,964
Western Isles	254	14	38,468	0	11,281	5,725	21,462
All Scotland	1,591	60	203,881	931	72,243	59,847	70,860

Source: Munro (2020a)

Shellfish

The Food Standards Agency has classified shellfish production areas in the UK with the latest areas designated for Scotland summarised in Table A1h.29. Regional Sea 7 and Shetland (straddling Regional Seas 1 and 8) have the greatest number of production areas and sites in Scotland. The west coast also cultivates a diverse range of species.

Table A1h.29: Summary of shellfish farming by production area (April 2020 – March 2021)

Local Authority Area	Number of production areas	Number of sites	Species cultivated[#]
Regional Sea 1			
East Lothian	2	2	Razors
Fife Council	4	6	Razors, surf clams
Ross & Cromarty	3	4	Mussel, Pacific oyster,
Shetland Islands Council	51	99	Mussel
Regional Sea 6			
Dumfries & Galloway	4	5	Native oyster, razors
North Ayrshire Council	2	2	Razors, Pacific oyster
South Ayrshire Council	5	5	Razors
Regional Sea 7			
Argyll & Bute	43	52	Mussel, Pacific oyster, razors, common cockles, carpet clams
Lewis & Harris	18	28	Mussel, common cockles, Pacific oyster, razors

Local Authority Area	Number of production areas	Number of sites	Species cultivated#
Uist & Barra	6	6	Common cockles, Pacific oyster
Highland Council – Lochaber	11	13	Mussel, Pacific oyster, native oyster
Skye & Lochalsh	4	4	Mussel, Pacific oyster, common cockles, razors
Sutherland	5	13	Mussel, Pacific oyster

Notes: # species cultivated at majority of the beds listed first. Source: Food Standards Scotland website[104]

In 2019, shellfish production in Scotland was dominated by the common mussel and Pacific oyster, with smaller quantities of king scallop, queen scallop and native oyster (Munro 2020b). Mussel production, for the table, decreased by 3% in 2019 to 6,699 tonnes with production from Shetland accounting for the greatest contribution (79%). Pacific oyster production increased by 14% from 2018 to 4,610,000 individuals with the Strathclyde region producing 53% of Scotland's total. The production of farmed scallops decreased by 16% to 26,000 individuals, all from the Highland region. Production of native oysters decreased by 27% from 2018 to 103,000 individuals. Historical data for all shellfish species show that production levels vary year on year. This can be due to a number of different factors such as poor spat fall, algal toxins, poor growth, adverse weather and fluctuations in market prices (Munro 2020b).

The total value for all shellfish species cultivated in Scotland in 2019 was estimated to be approximately £7.9 million, a decrease of 17% from the £9.5 million estimated in 2018. In 2019, there were 129 active shellfish farming businesses in operation, operating 326 active and 165 producing farms. The industry employed 136 full-time and 141 part-time and casual workers during 2019 (Munro 2020b).

Small scale seaweed harvesting is found around Scotland, and there are currently (as of April 2021) seventeen marine licence applications (six of which have been granted, two pre-application) for macroalgal farms with the Licensing Operations Team of Marine Scotland[105]. These applications cover sites on the west coast near Oban, Isle of Skye, Lewis, Orkney and in the east, the Moray Firth.

1.18.1.2 England and Wales

The latest mariculture production figures for England and Wales are for 2018 with the collection of 2019 data delayed by COVID (Cefas, *pers. com.*). There was no finfish production from coastal and marine waters. Shellfish production in England was of mussels (1,793 tonnes, £2.1 million) and Pacific oyster (964 tonnes, £2.4 million), with native oysters (8 tonnes, £0.03 million) also produced. Welsh production was dominated by mussels (3,520 tonnes, £4.2 million) with Pacific oysters (25 tonnes, £0.06 million) also produced.

Shellfish production areas (September 2020 – August 2021) are scattered throughout Regional Seas 1, 2, 3, 4 and 6 (Food Standards Agency website[106]). Only one production area, at Holy

[104] https://www.foodstandards.gov.scot/downloads/Final_Annual_Classification_2020-2021_-_All_Sites.pdf
[105] https://marine.gov.scot/marine-licence-applications
[106] https://www.food.gov.uk/sites/default/files/media/document/shellfish-classification-list-england-and-wales-2020-2021.pdf

Island, is present in Regional Sea 1, cultivating Pacific oyster. Twenty four production areas are located in Regional Seas 2 and 3, supporting 77 and 32 classification zones respectively, making them regionally very important. Species cultivated include common cockles, native and Pacific oysters, mussels and razors. The Wash, Thames Estuary and the North Kent Coast are among the most important areas within Regional Sea 2, and Poole Harbour is important within Regional Sea 3.

Regional Sea 4 supports 19 production areas, with 57 classification zones. The production areas at the Fal and Taw estuaries are important in the region. Principal species cultivated within Regional Sea 4 include mussel and Pacific oyster, with smaller numbers of native oyster and cockles (Burry Inlet) also grown. Some 11 production areas with over 34 classification zones are found in Regional Sea 6, with mussel being the most common species cultivated. Morecambe Bay, Menai Straits and Dee are the among the most important production areas in the region.

There are also classification zones for the cultivation of other species including Manila clam (*Tapes philippinarum*) (Colne, North Kent Coast, Southampton Water, Poole Harbour), hard clam (*Mercenaria mercenaria*) (Colne, Blackwater, Crouch, Roach, Langstone Harbour, Portsmouth Harbour, Southampton Water and Solent) and surf clam (*Spisula solida*) (Exe, Start Bay).

1.18.1.3 Northern Ireland

The mariculture sector in Northern Ireland is predominately based on shellfish: at present there are 78 licensed farms (covering 88 sites), 45 of which are licensed for shellfish cultivation (44 marine and 1 land based site) and 33 for the cultivation of finfish (31 inland and 2 marine) (DAERA website[107]). Shellfish production in 2018 was of mussels (2,060 tonnes, £1.8 million) and Pacific oysters (909 tonnes, £3 million) (Cefas, *pers. com.).* There was no finfish production exclusively from marine waters.

Shellfish harvesting areas are located at Belfast Lough (14 beds for mussels), Carlingford Lough (7, mussels and oysters), Dundrum Bay (2, mussels and oysters), Killough (1, oysters), Larne Lough (1, oysters), Lough Foyle (4, mussels and oysters) and Strangford Lough (3, oysters and mussels)[108].

A1h.18.2 Evolution of the baseline

Salmon production in Scotland has increased steadily from 154,164 tonnes in 2010 to an estimated 207,630 in 2020, although a number of years (2016 and 2018) saw considerable production declines compared to the previous years (Munro 2020a). Scottish mussel production, for the table, decreased by 3% in 2019 to 6,699 tonnes, while Pacific oyster production increased by 14% from 2018. Similar fluctuations in shellfish production have been experienced in England, Wales and Northern Ireland (Cefas, *pers. com*). Production levels vary year on year due to a number of different factors such as poor spat fall, algal toxins, poor growth, adverse weather and fluctuations in market prices (Munro 2020b). Strategic plans for the growth of aquaculture in the UK have been produced, e.g. for Scotland to 2030 (Scotland Food and Drink 2017) and England to 2040 (Huntington & Cappell 2020), which indicate

[107] https://www.daera-ni.gov.uk/articles/introduction-aquaculture
[108] https://www.food.gov.uk/sites/default/files/media/document/ni-2021-shellfish-classification-list_v14.pdf

significant growth potential although not without associated environmental concerns (see below).

Climate change may have effects on mariculture in years to come. The potential effects are described by Gubbins *et al*. (2013) and Collins *et al*. (2020) and include thermal stress for cold-water species, increased incidence of disease, increased storminess increasing damage to farms and fish escapes, and ocean acidification potentially having a detrimental effect on mollusc larvae development. With respect to finfish mariculture, increased problems associated with some diseases and parasites, notably sea lice and gill disease (which has emerged as a serious problem), are likely to increase in the short term and to get worse in the longer term. Harmful Algal Blooms (HABs) and jellyfish swarms/invasions may also get worse, however complex ecosystem interactions make responses uncertain (Collins *et al*. 2020). The situation for shellfish is similar to finfish, although they are additionally at risk of accumulation of toxins from HABs, and recruitment failure, and, in the longer term, to sea-level rise and ocean acidification (Collins *et al*. 2020). Present inshore aquaculture sites will remain important in the medium-term future, and there are continuous developments that may also help mitigate against climate change impacts on growth, disease, pollution and physical damage (Collins *et al*. 2020). However, suitable space for aquaculture expansion in inshore waters is limited. Therefore, offshore production is being developed for bivalves in Lyme Bay and the Irish Sea, and is projected for finfish by 2030 (Defra 2015, Black & Hughes 2017, Collins *et al.* 2020). Whilst evidence of climate change impacts on mariculture has increased since the last MCCIP report (Gubbins *et al*. 2013), there remains a lot of uncertainty and contradictory impacts and the association with climate change cannot be confirmed (Colins *et al*. 2020).

A1h.18.3 Environmental issues

Key environmental issues associated with mariculture include the introduction of nutrients or chemicals into the local environment. Accumulations of faecal matter or uneaten feed may de-oxygenate the local seabed and alter the benthic community as well as increasing phytoplankton levels, potentially causing eutrophication and harmful algal blooms (Defra 2010). Disinfectants and antibiotics may have toxic or other harmful effects on benthic fauna and consequently in the UK their use is regulated (Defra 2010). High concentrations of animals at farms may also lead to outbreaks of disease which may be spread to the wild population. For example, increased densities of larval sea lice are associated with salmonid farming, leading to increased incidence of infection among wild fish (Defra 2010, see also SAMS (2018) review of environmental impacts of salmon farming in Scotland). In an attempt to counter parasites without using chemical solutions, a number of businesses have been breeding various wrasse species and lumpsuckers for use as biological parasite controls. In 2019, 13 tonnes of lumpsucker were produced at 3 sites and 2020 production is estimated at 21 tonnes. Similarly, wrasse production from 3 sites in 2019 was 3 tonnes, estimated to rise to 10 tonnes in 2020 (Munro 2020a). Disease, such as enteric redmouth disease (ERM) can affect fish kept at high densities. In 2019, a total of 52.4 million fish were vaccinated across 46 sites with the majority of fish vaccinated against furunculosis, vibriosis and IPN, with smaller numbers of fish being vaccinated against ERM and SAV (Munro 2020a).

Mariculture has been implicated in the introduction of non-native species into the UK. It is believed that up to half of all non-native marine algal species have been introduced through mariculture, for example the brown seaweed *Sargassum muticum* originally from Japan. Collins et al. (2020) indicates that populations of feral Pacific oyster, *Crassostrea gigas* have recently been observed as far north as Shetland (Shelmerdine *et al.* 2017). The spread of *C. gigas* out with aquaculture sites can have consequences for local biodiversity (Nehls & Buttge 2007), although these may be positive (e.g. Christianen *et al*. 2018). Feral oysters can also act

as disease reservoirs (for example, the ostreid herpesvirus 1 (OsHV-1) has been found in feral oysters in a disease management buffer zone in the Thames estuary). Increased water temperatures may have contributed to the establishment of feral populations of Manilla clams (*Ruditapes philippinarum*) following introduction for cultivation (Humphreys *et al*. 2015).

The escape of farmed fish and consequent interbreeding with wild stocks may lead to a loss of genetic diversity and potentially naturally selected adaptations (for example, the ability of salmon to find a "home river" for spawning), potentially resulting in reduced population fitness (Defra 2010, SAMS 2018). In 2020, there were three incidents resulting in the loss of 136,470 fish from salmon seawater sites, there were 15 additional incidents reported where the companies confirmed there was no loss (14 reports) or an unknown (1 report) loss of fish (Scotland's Aquaculture website[109]).

Previously, a significant proportion of wild caught fish was used as fishmeal for the aquaculture industry. However, modern salmon feeds in Scotland are currently based on a blend of high levels of terrestrial plant meals and vegetable oils with only low levels of marine ingredients, essentially fishmeal and fish oil, although krill products are also used in small amounts in some feeds. Although accurate data are not yet available for Scotland, replacement of marine ingredients has increased in the last three years and, in 2017, it is likely that feed formulations in Norway contained up to 80% plant-derived ingredients and only around 20% FM and FO, with similar declines likely in Scottish salmon feeds (see SAMS 2018).

[109] http://aquaculture.scotland.gov.uk/data/fish_escapes.aspx

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