

Appendix 13.1 Marine Ecology Effects Review and Screening Evaluation

As set out within **Chapter 13: Marine Ecology**, it was necessary to undertake a comprehensive review of effects and those that are considered to be significant (especially in light of the comments received to date from NRW) and therefore requiring assessment within **Chapter 13: Marine Ecology**.

This appendix (**Appendix 13.1**) has been prepared on the above basis.

The Marine Ecology Study Area, as defined in **Chapter 13: Marine Ecology**, has been characterised using the best available data at the time of writing, including information collected during the bespoke Marine Ecology Benthic Survey and reported in the P&C Project Dragon – Marine Ecology Benthic Survey Report (ABPmer, December 2022)^a, and information gathered during a review of primary and grey literature outlined in this section. The full list of references used to inform this evaluation are presented as endnotes.

Background Studies to Establishing the Baseline

Table 1.1 summarises all surveys and reviews undertaken to inform the review and evaluation process.

Table 1.1: Background surveys and literature

Survey / Study	Overview	Date of Completion
P&C Project Dragon - Marine Ecology Benthic Survey Report (APBmer, 2022)	This survey consists of drop-down video (DDV) data, collected at 11 sampling stations, located along the dock wall within the EIA Study Area.	December, 2022
Desk-based review	A desk-based review has been conducted to identify the potential species present within the Marine Ecology Study Area, to supplement the findings of the Proposed Scheme's Marine Ecology Benthic Survey.	October, 2023

It is noted that the Marine Ecology Survey (ABPmer, 2022) sampling station are located along the perimeter of Crown Wharf and Pheonix Wharf and, as a consequence, do not characterise the entire Marine Ecology Study Area (as defined in **Chapter 13: Marine Ecology**). Therefore, the baseline Coastal Processes, Sediment and Water Quality, Benthic Ecology, Fish Ecology, and Marine Mammal characterisations have been supplemented by desk-based reviews in the following subsections.

Following feedback during Pre-Application Consultation (PAC) the Applicant has committed to undertaking further sediment quality and contaminant sampling survey work within the Marine Ecology Study Area. The results of these surveys are not available at the time of submission, but the results of the survey will be submitted for consideration. Where the result of the survey works

^a This report was provided as part of the EIA Scoping Report (**Volume 2, Appendix 2.1**)

identified a change to any of the conclusions reached within this appendix or **Chapter 13: Marine Ecology**, the respective documents will be updated and re-submitted as part of the Application.

Physical Processes

This subsection provides a baseline characterisation of the physical processes within the Marine Ecology Study Area. This topic was originally scoped out within the EIA Scoping Report (**Appendix 2.1**), but further information on this topic has been requested by NRW. The following section presents the baseline characterisation, followed by a conclusion for further assessment within **Chapter 13: Marine Ecology**.

Bathymetry

Detailed bathymetry data for Port Talbot Docks are not available, however the dock was dredged in 1996 to accommodate larger vessels, and the current reported depth of the dock is 7.7 m (4C Offshore, 2023¹).

Hydrodynamics – Tides

While the wider Swansea Bay area is hyper-tidal (i.e. tidal range >6 m), with a mean spring tidal range of 8.60 m at Port Talbot, and a mean neap range of approximately 4 m (Mackie *et al.*, 2006²; ABPmer *et al.*, 2023³); Port Talbot Docks are isolated from the wider marine environment via a pair of lock gates.

The lock gates are dual steel gates, that are only opened to allow passage of vessels at high tides and are never opened simultaneously.

Some water may be lost from the dock through operation of locks, or during prolonged periods of dry weather, however this water is replaced by feeder channels from the river Afan and from the river Ffrwdwyllt, and not through flooding the dock with marine waters at high tides. The water level within the dock is maintained, and no significant inward tidal flow occurs.

Given the limited water loss from the dock, the volume of inflowing water from the feeder channels will be small when compared with the overall volume of water in the dock and will have a negligible effect on water movement within the dock basin.

Enclosed or semi-enclosed bodies of water do experience the same gravitational forces which cause tidal movements, however even in large, enclosed, water bodies, such water level changes are negligible (<1 mm) and, therefore, no tidal currents capable of resuspending or significantly advecting sediments are initiated (Pugh *et al.*, 2011⁴).

Tidal currents within the confines of Port Talbot Docks are, therefore, negligible.

Given the negligible baseline tidal currents present within the Port Talbot Dock, there is no pathway for effects associated with the new jetty to affect tidal currents.

Hydrodynamics – Waves

The wave climate in the wider Swansea Bay area is controlled by the long fetch distances possible in the Bristol Channel, combined with the prevailing westerly winds (Mackie *et al.*, 2006; ABPmer *et al.*, 2023). The marine wave environment is, therefore, the product of locally generated wind waves, coupled with longer-period Atlantic swells.

The EIA for Tidal Lagoon Swansea Bay (TLSB, 2014⁵), confirms that the strongest winds and predominant wave direction offshore, are from the west and southwest. Offshore waves at Port Talbot and Aberavon beach are typically between 0.7-1.7 m in height (TLSB, 2014).

However, as Port Talbot Docks is isolated from the offshore environment via the lock gates, there is no effect of the longer-period Atlantic swells. The fetch within the dock basin will be limited, with maximum possible fetch distances from the west-southwest of only approximately 500 m.

The location of the proposed development (on the south side of the dock basin) is sheltered from the longest, within-dock, west-southwesterly fetch.

While no direct wave data from within the dock are available, it is reasonable to assume that due to the extremely limited fetch, waves within the dock will be significantly smaller than offshore waves, with short wavelengths (Lamont-Smith and Waseda, 2007⁶). Data from basins with such a short fetch as Port Talbot Docks are lacking in the literature; although waves in lakes with significantly larger fetch (19 km, compared with 500 m fetch in Port Talbot Dock) are reported to have average amplitudes in the region of 27 cm, and wavelengths of 8.5 m (Earle, 2019⁷). It would be reasonable to assume, therefore, that due to the much shorter fetch, the amplitudes and wavelengths of wind generated waves in the dock would be smaller than these parameters.

Given the water depth within the dock (7.7 m), only waves with a wavelength in excess of 15 m would interact with the seabed within the dock; therefore, wave driven resuspension of sediment is unlikely to be significant, except during severe weather conditions. In addition, should resuspension occur, there is no mechanism by which such resuspended sediment could interact with marine or riverine waters outside the dock basin.

The presence of structures in the water column has the potential to interfere with wave propagation, with the change most likely to appear as a wake in the lee of the obstacle, where the baseline or ambient conditions may be modified. Due to the short fetch and relatively sheltered position of the development within the dock, changes are likely to be of limited scale and extent.

Changes to waves as a result of structures are limited to an area downwind of the structure, and typically recover to ambient conditions quickly. In any case, as waves within the dock are not large enough to cause significant sediment transport, any changes to waves as a result of the built structure will also be unlikely to have a consequential effect on sediment transport.

Geology

The dock area lies on a geology of marine alluvium, fringed by a storm gravel beach, and lies at a height of between approximately 10-20 m Above Ordnance Datum (AOD) (White Consultants, 2004⁸).

The last, late Devensian glaciation left widespread deposits of boulder clay, which form an extensive and generally featureless cover over the bedrock in valley slopes and floors, underlain by mainly upper Palaeozoic bedrock (Natural Environment Research Council, 1982⁹).

Seabed Sediments

In the offshore area of Swansea Bay, the seabed sediments broadly consist of fine-grained sediments, typically muddy sand and sandy mud (BGS, 1996).

Geophysical and geotechnical survey data, collected in the Port Talbot approach channel (Fugro, 1995; reported in TLSB, 2014), identified the bed sediments as consisting of mud and muddy sand, approximately 0.5-1.5 m thick, underlain by medium sand.

This information has been supplemented by land-based Drop Down Video (DDV) surveys, conducted at 11 stations across the proposed development site and adjacent area (ABPmer, 2023).

These surveys were intended to provide a baseline description of the type of substrate present, and the substrate observed during the survey comprised of fine muddy sediment at 6 of the stations, rocky substrate at 4 stations, and 1 which consisted of mixed substrate with a combination of fine muddy sediment and loose rock (ABPmer, 2023).

The survey stations were situated at the margins of the development area, so it may be inferred that in the previously dredged centre of the basin, that an increased proportion of the medium sand (~0.5 mm), shown above to underlie the muddy sediments, may be present.

Suspended Sediments

No direct Suspended Sediment Concentration (SSC) data are present for within the dock, however SSCs measured in service waters for the neighbouring steel works have been measured at ~12 mg/l, with riverine waters from the river Afan having SSCs ranging from 5-170 mg/l (Suvio, 2011¹⁰).

Similar variability in SSC can be seen in offshore waters, with MODIS satellite data, reported in TLSB (2014) showing typical values of between 8-20 mg/l, but with values in excess of 100s of mg/l reported during storms.

It can be inferred that piling operations associated with construction of the jetty will cause resuspension of the mud to medium sand sized sediments which occur in the vicinity of the construction area.

Any potential effects associated with resuspended sediments are influenced by the distance travelled by the sediments, and the potential thickness of deposition; with both factors controlled by settling velocity and current speed.

Where there is only a relatively low height of initial suspension from the seabed, sediments will deposit within a distance proportional to the grainsize/settling rate. Currents within the dock have been shown to be negligible, as a result of the lack of tidal influence. However, even assuming a current speed of 0.25 m/s, and resuspension of medium sand to the water surface (depth 7.7 m), the maximum extent of dispersion would be in the order of up to approximately 10 m, over a timescale of seconds to minutes.

Finer (silt and mud) sized sediments are likely to persist in suspension for longer, and hence may be transported greater distances within the dock. SSCs plumes may extend 600-700 m metres beyond the site of piling, with distances again limited as a result of the water depth within the dock, and the low current speeds. Fine sediments in suspension would be expected to decrease to background levels within hours of piling ceasing, through settling and dispersion.

As fine sediment would be expected to become more widely dispersed (order of hundreds of metres), they would be less likely to settle with a measurable thickness locally.

In either scenario, the isolation of the site from both the riverine and marine waters, as a consequence of the lock gates and river feeder channels, means that there is no pathway by which

sediments resuspended as a result of construction activities could affect marine or riverine ecological receptors outside the dock basin.

Evaluation Conclusion

Physical Process within the dock are therefore scoped out from further consideration within Chapter 13: Marine Ecology. All potential effect pathways relating to physical processes (e.g. suspended sediment plumes and benthic ecology) outside of the dock will not be considered further within Chapter 13: Marine Ecology as no pathway exists. Pathways relating to physical processes within the dock are considered further in the following sections.

Sediment and Water Quality

This subsection provides a baseline characterisation of the sediment and water quality within the Marine Ecology Study Area. This topic was originally scoped out within the EIA Scoping Report (**Appendix 2.1**), but further information on this topic has been requested by NRW.

A desk-based review of literature and existing data sources was undertaken to support this evaluation. As noted previously, no site-specific data are currently available to inform this evaluation; however, further sediment quality and contaminant sampling survey work within the Marine Ecology Study Area, including the collection of sediment chemistry data and water physico-chemical parameters. As already identified the results of these surveys are not available at the time of submission, but the results of the survey will be submitted for consideration. Where the result of the survey works identified a change to any of the conclusions reached within this appendix or **Chapter 13: Marine Ecology**, they respective documents will be updated and re-submitted as part of the Application.

The baseline section has been sub-divided into sediment quality and water quality.

The Site is set within the industrial town of Port Talbot, known for its significant steelmaking history; the Port Talbot Steelworks is one of the largest in Europe. Driven by the steelworks emissions, a source of particulate matter pollution, the area is affected by poor air quality (Hayes and Chatterton, 2009¹¹). The Port Talbot Docks are separate from the steelworks but are situated in a heavily industrialised area, bounded to the north and east by a private road, a disused railway line to the south, and existing industrial development to the west. Further to the east and south of the proposed development site lies the operational Port Talbot Steelworks, and Hanson Cement Works lies to the north. The development site forms part of the wider dock facilities of Port Talbot, operated by Associated British Ports (ABP).

Sediment Quality

Sediments are a major repository of anthropogenic chemical compounds and pollutants, driven by water column contamination, which can carry and transport their particulate and dissolved forms over long distances, before precipitating or sinking to the bottom. Contaminant concentration in sediments can vary spatially, seasonally and interannually; however, particulate grain size and organic carbon content are critical co-factors, affecting distribution and concentrations. Fine sediments of smaller grain size, with greater amount of organic matter concentration, have been found to trap and retain a greater amount of deposited compounds than coarser substrates (Cefas, 2012¹²).

In situ survey data (imagery data) show a substrate comprising primarily of fine muddy sediment (at 6 stations), rocky substrate (at 4 of the stations), and 1 station consisting of mixed sediment with a combination of fine muddy sediment and loose pebbles and cobbles. Currently, no chemistry data are available for the proposed development area, however, polluted particulate matter from the atmosphere, urban run-off, and historical industrial discharges, prior to strict legislative guidance on pollution, are expected to influence the quality of the sediment. For instance, complex constituents, including phenol, cyanide, ammonia, oil and grease, and suspended solids, are present in the effluents of coke oven from the steelworks (Suvio, 2011), which could have settled into the sediment over the course of many years of unregulated discharge, in the past century.

The existing steelworks in Port Talbot Docks are currently subject to consent limits for discharges to the aqueous environment, which are constantly monitored; therefore, active sources of contaminants are currently limited and infrequent, primarily originating from possible water treatment system malfunctions. Currently, only natural coolant water from the steelworks, which is not affected by industrial processing impurities, is discharged into Port Talbot Docks, limiting its role as a potential source of active pollution. However, air pollution in the form of particulate matter PM₁₀ and polyaromatic hydrocarbons (PAH) is actively found at the steelworks site (Neath Port Talbot County Borough Council, 2020¹³), which is expected to indirectly affect (via sink) the dock water, creating a pathway for reducing sediment quality.

The current absence of *in situ* data leads to a number of uncertainties and, therefore, the worst case scenario has been assumed. Potentially high concentrations of sedimentary organic matter, associated with freshwater and enclosed bodies of water (Stumn *et al.*, 2012¹⁴), are expected within the Marine Ecology Study Area, composed primarily of deposited material and detritus originated from decaying biological activity. This is because, in the absence of active sediment transport driven by tidal dynamics (flushing action), organic matter sinks directly through the water column and accumulates passively on the bottom of the dock, decaying and remineralising over time, and releasing dissolved inorganic nutrients. The accumulation of organic material and finer sediments (e.g. from dust) therefore promotes the accumulation of other potentially polluting substance. Precautionarily, and in the worst case scenario, metal contaminants at Cefas Action Level (AL) 2 concentrations and CSQG Probable Effects Levels (PELs) of hydrocarbons, such as Polycyclic Aromatic Hydrocarbons (PAHs) and Total Hydrocarbons (THCs) could, potentially, be present within the Marine Ecology Study Area.

Water quality

Port Talbot Docks are classified as a heavily modified transitional water body under the Water Framework Directive (WFD) (Afan Estuary Incl. Docks ID GB541005800600), with an overall status of Moderate ecological potential (Water Watch Wales, 2021¹⁵). The transitional water body has an overall Chemical Status of Good potential, indicating High status of EQS Dangerous Substances concentrations (priority hazardous substances have not been assessed in 2021) and highlighting unpolluted levels of inorganic macronutrient at the stations sampled, scoring Good for Dissolved Inorganic Nitrogen concentration and High for Dissolved Oxygen concentration.

The water within Port Talbot Docks is abstracted by Port Talbot steelworks to be used as a coolant. At peak production levels in 2007, the limit of abstraction volume was 206,343,000 m³/yr (Suvio 2011). Process water is treated, impurities are removed, and the water is released back into Port Talbot Docks. The water, when recycled back into the dock, is typically at least 3°C warmer than neighbouring bodies of water (Holmes and Callaway, 2021¹⁶).

The water within Port Talbot Docks is classified as freshwater, influenced by saline water which is introduced through the opening of the dock gates. On average eight vessels per month transit through the seaward lock gates (Holmes and Callaway, 2021) which leads to brackish conditions, exacerbated by seasonal variations driven by increased temperatures, solar radiation, decreased freshwater input (from the Afan River through a weir) and evaporation in the summer months. Typical analysis of Dock water is (Suvio, 2011):

- pH 7.6;
- Chloride ranging from 110 ppm to 1,060 ppm (seasonal variation); and
- Conductivity ranging from 486 $\mu\text{S}/\text{cm}$ to 2,840 $\mu\text{S}/\text{cm}$.

Brackish water is defined as having a chloride content more than 400 ppm or an electrical conductivity greater than 1,500 $\mu\text{S}/\text{cm}$ (Shevah, 2014¹⁷).

SSC for the Steelworks service water (collected from different locations within and outside the Docks), has been measured at ~12 mg/l. Background SSC within the river Afan ranges from 5 mg/l to 170 mg/l (Suvio, 2011), indicating elevated background turbidity in the area generally associated with freshwater and muddy sediments. This correlates with the poor water clarity identified within the benthic survey (ABPmer, 2022), and suggests that the background SSC within the Marine Ecology Study Area falls within the normal range of the surrounding waterbodies.

Evaluation Conclusion

The baseline characterisation, informed by the desktop review, concludes that contaminated sediments may be present in Port Talbot Docks, which may indirectly impact other marine ecology receptors, such as benthic ecology and fish ecology. In the absence of site-specific survey data to inform this assessment and **applying a precautionary approach sediment and water quality is scoped-in for further assessment within Chapter 13: Marine Ecology.**

Benthic Ecology

This subsection provides a baseline characterisation of the benthic species and habitats present within the Marine Ecology Study Area. This topic was originally scoped out within the EIA Scoping Report (**Appendix 2.1**), but further information on this topic has been requested following consultation with NRW.

Due to significant previous infrastructure works, such as the 1996 dredging campaign within Port Talbot Docks to increase depths by 2 m (Swansea Docks, 2023¹⁸), the habitats within the Marine Ecology Study Area are not considered well established. Furthermore, Port Talbot Docks is primarily a freshwater environment, fed via a channel from the Green Park Weir on the river Afan, with an ingress of salt/brackish water once the lock gates are open at high tide to facilitate vessel movement.

A baseline benthic survey was conducted to identify the benthic species and habitats present within the EIA Study Area (APBmer, 2022). This survey consists of DDV data, collected at 11 sampling stations, located along the dock wall within the EIA Study Area. The benthic survey confirmed the EIA Study Area as a freshwater/brackish environment, with benthic flora and fauna predominantly

consisting of biofilm (ABPmer, 2022). As such, the EIA Study Area is not considered a marine environment with respect to benthic species and/or habitats.

Invasive non-native species (INNS), including the dark false mussel *Mytilopsis leucophaeata* and the hydroid *Cordylophora caspia*, were not identified by the DDV survey, however their presence within the wider Port Talbot Docks (and therefore, by implication, the Marine Ecology Study Area) was noted within the Benthic Survey Report (ABPmer, 2022; Oliver, 2015¹⁹; Holmes and Calloway, 2021). These species are both tolerant of brackish waters, and are, therefore, likely to be present closer to the lock gates of Port Talbot Docks, where saltwater ingress is greater, than at the EIA Study Area.

No other marine or freshwater benthic species were recorded within the Benthic Survey Report (ABPmer, 2022), however it is likely that infauna are present within sediments, and that small crustaceans are present feeding on/sheltering within biofilm on submerged structures (ABPmer, 2022). No benthic species or habitats of conservation interest were identified within the Benthic Survey Report, which included a review of evidence to supplement the DDV survey (ABPmer, 2022).

To supplement the determinations of the Benthic Survey Report (ABPmer, 2022), a database search using the National Biodiversity Network (NBN) data portal has been conducted (NBN Trust, 2023²⁰). This is a common approach conducted for the purposes of EIA when evidence gaps exist. The NBN Atlas search was restricted to a 0.5 km radius around the centre of the Port Talbot Dock, which includes the full extent of the Marine Ecology Study Area. The search identified the presence of a number of common infaunal species, including the amphipod *Gammarus tigrinus*, the Asian clam *Corbicula fluminea*, Oligochaete and Nereid annelid species, and *Asellus* freshwater isopod species. The search also identified the presence of two plant species: Japanese knotweed *Fallopia japonica* and curly waterweed *Lagarosiphon major*, considered significant pest species within urbanised freshwater environments.

In the absence of additional evidence to identify the Marine Ecology Study Area as containing key benthic species and habitats, and in addition to the Marine Ecology Study Area's isolation from the Afan river and the wider marine environment, it is concluded that the Marine Ecology Study Area is impoverished in terms of benthic ecology and is unlikely to provide substantial ecosystem services within the region.

Evaluation Conclusion

For the reasons outlined above, **effect pathways relating to physical processes and benthic ecology will be scoped-out from further consideration within Chapter 13: Marine Ecology. However, pathways relating to sediment and water quality and benthic ecology will be scoped-in for assessment.**

Fish Ecology

This subsection provides a baseline characterisation of the fish species present within the Marine Ecology Study Area.

The fish species identified within the Marine Ecology Study Area include freshwater game species, hardy marine species, and diadromous species (Angling Trust, 2023²¹). As a result, the Marine Ecology Study Area is a popular haunt for recreational fishermen. However, no commercial fishing occurs within Port Talbot Docks and, therefore, the fish resident within the Marine Ecology Study Area are not considered of commercial importance. Species of fish that are considered potentially

present within Port Talbot Docks, based on the desk-based review and online data, are presented in **Table 1.2**.

The freshwater species present within the Marine Ecology Study Area, such as roach *Rutilus rutilus*, rudd *Scardinius erythrophthalmus*, perch *Perca fluviatilis*, and pike *Esox lucius*, are characteristic of larger freshwater ponds, lakes, and reservoirs in Wales (ABPmer, 2022; Wildlife Trust Wales, 2023; Fishing in Wales, 2023²²), and are, therefore, expected to be resident within Port Talbot Docks. These species are native to freshwater environments in the UK, and Port Talbot Docks are not thought to be artificially stocked with additional, non-native, coarse (game) fish stocks. Tench *Tinca tinca* are less common in Welsh waterways than in the remainder of the UK, however this species is likely to prefer silt sediments within the Marine Ecology Study Area (Wildlife Trust Wales, 2023²³).

The marine species present within the Marine Ecology Study Area are limited, due to the predominantly freshwater environment within Port Talbot Docks, with periodic increases in salinity bringing salt/brackish water into Port Talbot Docks. Whilst unidentified, there is potential for marine species to enter the Marine Ecology Study Area when lock gates are open, however this is unlikely unless species are well adapted to the brackish environment outside the lock gates.

Bass *Dicentrarchus labrax* is the only marine species (that is not diadromous) identified as present within the Marine Ecology Study Area (APBmer, 2022; Angling Trust, 2023). This species is naturally found within marine and estuarine environments and is, therefore, considered highly adaptable to both (brackish) freshwater and saltwater environments. It is expected that this species will be present in the southwest corner of the Marine Ecology Study Area, around the lock gates, where salinity is likely to be greatest.

Diadromous species that may be present within the Marine Ecology Study Area are likely to be in transit to and from freshwater spawning grounds (anadromous species) or marine spawning grounds (catadromous species). The river Afan itself provides a migratory pathway for diadromous fish, which are able to navigate up-and down-river, through the inclusion of a fish pass at the newly refurbished Green Park Weir (Afan Valley Angling, 2023²⁴); which feeds water from the river Afan into Port Talbot Docks via a feeder channel. The Green Park Weir also includes a smolt screen, which is intended to prevent Atlantic salmon *Salmo salar* smolts from entering Port Talbot Docks via the feeder channel and, therefore, from being caught in a 'migratory trap' and unable to complete their respective spawning cycles (Hawkins *et al.*, 2020²⁵).

Additional species, such as Allis shad *Alosa alosa*, twaite shad *Alosa fallax*, river lamprey *Lampetra fluviatilis*, and sea lamprey *Petromyzon marinus* are present within the wider Swansea Bay area (Tidal Lagoon (Swansea Bay) PLC, 2017²⁶; Lowe *et al.*, 2022²⁷; Countryside Council for Wales, 2009²⁸). However, based on the documents reviewed (as outlined in the reference list), there are no records of these species within the Marine Ecology Study Area, or the river Afan. In addition, the Marine Ecology Study Area and the river Afan are not considered important as facilitators for the spawning migrations of these species, and therefore these species are not considered present within the Marine Ecology Study Area.

Most diadromous fish species identified as potentially present within the Marine Ecology Study Area are of high conservation value and afforded protection within UK and EU legislation. **Table 1.3** summarises the legislation afforded to each diadromous fish species identified within the Marine Ecology Study Area. There are no designated Special Areas of Conservation (SAC) or Natura2000 sites that afford protection to diadromous fish species identified in **Table 1.3**. The closest SAC with designated fish populations is the Carmarthen Bay and Estuaries/Bae Caerfyrddin ac Aberoedd SAC

designated for diadromous fish species that, due to distance from the Marine Ecology Study Area are not considered present within the Marine Ecology Study Area.

Evaluation Conclusion

Fish Ecology will be scoped-in for further assessment within **Chapter 13: Marine Ecology**. Therefore, all information provided within this Appendix will be incorporated into the baseline section of **Chapter 13: Marine Ecology**.

Table 1.2: Fish species identified within the Marine Ecology Study Area

Species	Receptor group	Description	Reference
Bass <i>Dicentrarchus labrax</i>	Fish with swim bladders not involved in hearing.	A marine fish. A common predatory species around southern UK coastlines, forming schools of young fish before becoming more independent when mature. Prefers shallow marine environments, but is known to reside in brackish estuarine environments, particularly in summer months.	Angling Trust, 2023; APBmer, 2022; Wierniki <i>et al.</i> , 2020 ²⁹ ; Kastelein <i>et al.</i> , 2017 ³⁰ ; Popper <i>et al.</i> , 2014; Reeve, 2007 ³¹ .
Mullet spp. <i>Chelon</i> spp.	Fish with swim bladders not involved in hearing.	A diadromous fish. Grey thick-lipped mullet (<i>Chelon labrosus</i>) is common within southern UK estuarine environments, but also present in Scottish waters, and is the most likely species present within the Marine Ecology Study Area. Thin-lipped mullet (<i>C. ramada</i>) is potentially present within the Marine Ecology Study Area during warmer months. Both species feed on algae and vegetation.	Angling Trust, 2023; APBmer, 2022; Wierniki <i>et al.</i> , 2020; Barnes, 2008 ³² ; Thompson, 1990 ³³ .
Brown/sea trout <i>Salmo trutta</i>	Fish with swim bladders not involved in hearing.	A diadromous fish. Specifically, an anadromous species and therefore present within the coastal marine environment after maturing. Returns to freshwater to spawn as is characteristic of salmonids. A predatory species of small fish and invertebrates.	Angling Trust, 2023; APBmer, 2022; Harding <i>et al.</i> , 2016 ³⁴ ; Nash, 2021 ³⁵ .
Atlantic salmon <i>Salmo salar</i>	Fish with swim bladders not involved in hearing.	A diadromous fish. Specifically, an anadromous species and, therefore, present within the coastal marine environment after maturing. Returns to freshwater to spawn as is characteristic of salmonids. This species has been included as a precaution due to the presence of Atlantic salmon on the river Afan, and the consequent, but very limited, potential for the species to enter the Marine Ecology Study Area via the lock gates. There is also very	APBmer, 2022; Cefas, 2022 ³⁶ ; Harding <i>et al.</i> , 2016; Jensen <i>et al.</i> , 2012 ³⁷ ; Mawle <i>et al.</i> , 2003 ³⁸ .

Species	Receptor group	Description	Reference
		limited potential for smolts to be present within the Marine Ecology Study Area due to the smolt screen present on the Green Park Weir. Despite this, it cannot be determined that Atlantic salmon will not be present within the Marine Ecology Study Area, particularly as brown/sea trout are identified as present, despite being known to have larger smolt sizes than Atlantic salmon. A predatory species of small fish and invertebrates.	
Bream <i>Abramis brama</i>	Fish with a swim bladder not involved in hearing.	A freshwater fish. A potamodromous species which is mostly present in rivers, lakes and backwaters. However, this species can also be found in brackish waters. Adults are usually found in shoals in these habitats, whereas larvae and juveniles are present in still water bodies. Adults feed on insects, small crustaceans, molluscs, and plants.	Angling Trust, 2023; APBmer, 2022; Kirin and Chunchukova, 2017 ³⁹ .
Pike <i>Esox lucius</i>	Fish with a swim bladder not involved in hearing.	A freshwater fish. A species which can be found in eutrophic and oligotrophic lakes, rivers and brackish waters. This species is predatory towards other fish species and is a keystone freshwater species.	Angling Trust, 2023; APBmer, 2022; Wierniki <i>et al.</i> , 2020; Forsman <i>et al.</i> , 2015 ⁴⁰ ; Mann <i>et al.</i> , 2007 ⁴¹ .
Perch <i>Perca fluviatilis</i>	Fish with a swim bladder not involved in hearing.	A freshwater fish. This species is common throughout the UK's rivers, ponds, and lakes. Perch is predatory and feeds on other fish and invertebrates.	Angling Trust, 2023; Wildlife Trust Wales, 2023 APBmer, 2022; Wierniki <i>et al.</i> , 2020; Amoser <i>et al.</i> , 2004 ⁴² .
Roach <i>Rutilus rutilus</i> .	Fish with a swim bladder-inner ear connection used in hearing.	A freshwater fish. This freshwater species commonly found in ponds, lakes, and rivers in shoals. This species is omnivorous and will feed on invertebrates, fish eggs, plants, and seeds.	Angling Trust, 2023; Wildlife Trusts, 2023 ⁴³ ; APBmer, 2022;

Species	Receptor group	Description	Reference
		This species is noted for having developed ossicles connecting the swim bladder to the inner ear, and thus expresses a swim bladder-inner ear connection used in hearing.	Wierniki <i>et al.</i> , 2020; Amoser <i>et al.</i> , 2004; Laming and Morrow, 1981.
Rudd <i>Scardinius erythrophthalmus</i>	Fish with a swim bladder not involved in hearing.	A freshwater fish. This species is usually found in stagnant lakes, dams, reservoirs, or slowly flowing streams. Rudd prefer areas rich in plants as they spawn on the vegetation. Juveniles consume unicellular algae and phytoplankton, with their diet shifting towards soft macrophytes. Their diet can also be seasonal, as they will prefer to consume zooplankton and small invertebrates in the spring and autumn, and macrophytes and algae in the summer.	Angling Trust, 2023; APBmer, 2022; Zapletal <i>et al.</i> , 2019 ⁴⁴ ; Wolnicki <i>et al.</i> , 2009 ⁴⁵ .
Tench <i>Tinca tinca</i>	Fish with a swim bladder not involved in hearing.	A freshwater fish. This species is present in lowland lakes and slow-flowing rivers throughout the UK which have lots of plant life. This species tends to conceal itself within vegetation. Tench consumes invertebrates such as pond snails and will spawn in the summer months.	Angling Trust, 2023; Wildlife Trust Wales, 2023; APBmer, 2022.
European eel <i>Anguilla anguilla</i>	Fish with a swim bladder not involved in hearing.	A diadromous fish. Specifically, a catadromous species and therefore present within freshwater environments for the majority of the lifecycle. The species exclusively returns to the Sargasso Sea to spawn. European eel is well known to occupy riverine environments along the south coast of Wales and has been identified as present within the Marine Ecology Study Area.	Angling Trust, 2023; APBmer, 2022; Piper <i>et al.</i> , 2019 ⁴⁶ ; Pelster, 2017 ⁴⁷ .

Table 1.3: Conservation status and protection measures afforded to diadromous fish species within the Marine Ecology Study Area

Species	Conservation Status (Europe)	UK/EU Protection
Mullet spp. <i>Chelon</i> spp.	Listed as Least Concern on the IUCN Red List of Threatened Species (Freyhof, 2010 ⁴⁸).	None
Brown/sea trout <i>S. trutta</i>	Listed as Least Concern on the IUCN Red List of Threatened Species (Freyhof, 2011 ⁴⁹).	A UK Biodiversity Framework (2010) Priority Fish Species (superseding the UK Biodiversity Action Plan (2007)). Listed as a Schedule 7 Priority Species under the environmental (Wales) Act, 2016.
Atlantic salmon <i>S. salar</i>	Listed as Vulnerable on the IUCN Red List of Threatened Species (Freyhof, 2014 ⁵⁰). Assessed as having Poor Status (assessed in 2022) on the OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR, 2022b ⁵¹).	A UK Biodiversity Framework (2010) Priority Fish Species (superseding the UK Biodiversity Action Plan (2007)). Listed as an Annex II and Annex V Protected Species (EU Habitats Directive). Note this listing only applies in freshwater. Listed as a Schedule 7 Priority Species under the environmental (Wales) Act, 2016. Listed within the OSPAR List of Threatened and/or Declining Species and Habitats
European eel <i>A. anguilla</i>	Listed as Critically Endangered on the IUCN Red List of Threatened Species (Freyhof and Kottelat, 2010 ⁵²). Assessed as having Poor Status (assessed in 2022) on the OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR, 2022a ⁵³).	A UK Biodiversity Framework (2010) Priority Fish Species (superseding the UK Biodiversity Action Plan (2007)). Listed as a Schedule 7 Priority Species under the environmental (Wales) Act, 2016. Protected under the England and Wales Eel Management Plan.

Marine Mammals

This section outlines the existing environment in respect of marine mammals. This topic was originally scoped out within the EIA Scoping Report (**Appendix 2.1**), but further information on this topic was requested by NRW (July 2023), although subsequently NRW agreed that marine mammals could be scoped out (September 2023). However the following section presents the baseline characterisation for background, followed by a evaluation conclusion.

In this chapter marine mammals include cetaceans (whales, dolphins and porpoise) and pinnipeds (seals). A desk-based review of literature and existing data sources was undertaken to support this Report, with data sources listed and summarised below:

- Baines and Evans (2012) - The Atlas of the Marine Mammals of Wales describes the temporal and spatial distribution and relative abundance of all marine mammal species sighted, detected or stranded in Welsh waters, concentrating on species regularly sighted;
- Evans and Waggitt (2023) - An update of the Atlas of the Marine Mammals of Wales above, using a finer scale analysis; and
- Special Committee on Seals (SCOS) (2021) - Scientific advice on matters related to the management of seal populations, including foraging ranges for grey and harbour seal.

There are no publicly available records or sightings of any marine mammal species within Port Talbot Docks or the Marine Ecology Study Area. Cetacean species recorded outside Port Talbot Docks and beyond the Marine Ecology Study Area include harbour porpoise, common dolphin, common bottlenose dolphin, Risso's dolphin and minke whale. According to Evans and Waggitt (2023), harbour porpoise are the most common species of cetacean found in Welsh waters, followed by common bottlenose dolphin.

Species recorded occasionally in Welsh waters include fin whale *Balaenoptera physalus*, killer whale *Orcinus orca*, long-finned pilot whale *Globicephala melas*, white-beaked dolphin *Lagenorhynchus albirostris*, and Atlantic white-sided dolphin *Lagenorhynchus acutus*. Recorded as casual visitors to the region are humpback whale *Megaptera novaeangliae*, sei whale *Balaenoptera borealis*, bowhead whale *Balaena mysticetus*, sperm whale *Physeter macrocephalus*, pygmy sperm whale *Kogia breviceps*, northern bottlenose whale *Hyperoodon ampullatus*, Cuvier's *Ziphius cavirostris*, Sowerby's *Mesoplodon bidens* and Blainville's beaked whale *Mesoplodon densirostris*, and striped dolphin *Stenella coeruleoalba* (Baines and Evans, 2012; Evans and Waggitt, 2023).

Table 1.4 summarises the most commonly recorded marine mammal species present in Welsh waters beyond the Marine Ecology Study Area. None of the species listed has been recorded or sighted in the Marine Ecology Study Area.

Table 1.4: Common marine mammal species identified beyond the Marine Ecology Study Area

Species	IUCN Status (Europe)	Biology and geographical distribution
Grey seal <i>Halichoerus grypus</i>	Least Concern	Food: Their feeding behaviour can be demersal or benthic. Sandeels, cod and saithe all account for a typical grey seal diet, which varies depending on availability. Habitat: Present in the North Atlantic continental shelf, in cold temperate waters. Population size is estimated at 315,000 adults.
Harbour porpoise <i>Phocoena phocoena</i>	Vulnerable	The species is listed in Appendix II of CITES. Food: Wide variety of fish and cephalopods. Habitat: Typically found in continental shelf waters in cold temperate to sub-polar waters of the Northern Hemisphere. They frequently visit shallow waters of estuaries, tidal channels and shallow bays.
Common dolphin <i>Delphinus delphis</i>	Data Deficient	Food: Range of prey including small fish, shellfish and cephalopods. Habitat: Distributed throughout temperate and tropical waters of the Pacific and North Atlantic Oceans and adjacent seas, most commonly found in offshore waters.
Common bottlenose dolphin <i>Tursiops truncatus</i>	Data Deficient	Food: Range of prey, including benthic and pelagic fish. Habitat: Distributed globally in temperate and tropical zones, and occurs in regional populations and in both inshore and offshore habitats.
Risso's dolphin <i>Grampus griseus</i>	Data Deficient	Food: Mainly cephalopods, but also small fish. Habitat: Distributed globally in tropical and temperate waters in both hemispheres, suggested to be a continental shelf species in northwest Europe.
Minke whale <i>Balaenoptera acutorostrata</i>	Least Concern	Food: Filter feeders, mainly feeding on teleost fish, plankton and pelagic crustaceans. Habitat: Distributed in northern hemisphere tropical, temperate and polar seas, most often seen in coastal and inshore areas but also occasionally in inlets, bays and estuaries.

Source: Prepared by ERM with data extracted from IUCN (2023^{liv}), Reid *et al.* (2003^{lv}), and Evans and Waggitt (2023).

In 2015, the Inter-Agency Marine Mammal Working Group (IAMMWG) defined Management Units (MUs) for the seven most common cetacean species found in UK waters. Those recorded in Welsh waters, but beyond the Marine Ecology Study Area, include harbour porpoise, common dolphin, common bottlenose dolphin, Risso's dolphin, and minke whale (IAMMWG 2015^{lvi}) and are defined as follows:

- Harbour porpoise: Celtic and Irish Sea MU (CIS MU);

- Common dolphin: Celtic and Greater North Sea MU (CGNS MU);
- Common bottlenose dolphin: Offshore Channel and South West England (OCSW MU);
- Risso's dolphin: CGNS MU; and
- Minke whale: CGNS MU.

Grey seal are commonly recorded beyond the Marine Ecology Study Area and is a feature of the Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC (boundary is 32 km from the Marine Ecology Study Area).

The baseline has been assessed to identify the potential for marine mammal presence within the Marine Ecology Study Area. The marine waters surrounding Port Talbot and the wider Swansea Bay are known to be frequented by harbour porpoise *Phocoena phocoena* and grey seal *Halichoerus grypus* (Evans and Waggitt, 2023). However, there are no publicly available records of either species, or any additional marine mammal species, within the Marine Ecology Study Area.

No marine mammal species have been recorded in the Marine Ecology Study Area. Furthermore, the assumptions of the underwater noise model for fish, applying the worst-case scenario for effects associated with piling activities of the Proposed Scheme, result in a distance to Temporary Threshold Shift (TTS) of 153 m. While these results are not directly applicable to marine mammals, it further suggests that only a very small and enclosed area will be affected. The effects will not be felt beyond the outer lock gate of Port Talbot Docks, and as marine mammals are not present within the Marine Ecology Study Area there is no potential impact pathway as a result of underwater noise.

Furthermore, due to the current level of vessel traffic associated with the Port Talbot Dock, marine mammals will not be exposed to a significant elevation above current background levels of vessel traffic, or potential indirect effects associated with shipping movements arising from the operation of the Proposed Scheme, therefore no significant effects are considered likely.

Evaluation Conclusion

On the basis of the above, and NRW's updated comments in the PAC response which agree that no significant effects are considered likely, **marine mammals are scooped-out from further consideration within Chapter 13: Marine Ecology.**

References

-
- ¹ 4C Offshore. 2023. *Port Talbot - Quays and Terminals*. Available at: <https://www.4coffshore.com/ports/port-infrastructure-port-talbot-united-kingdom-pid18.html> [Accessed: October 2023].
- ² Mackie, A.S.Y., James, J.W.C., Rees, E.I.S., Darbyshire, T., Philpott, S.L., Mortimer, K., Jenkins, G.O. and Morando, A. 2006. *The Outer Bristol Channel Marine Habitat Study. Studies in Marine Biodiversity and Systematics from the National Museum of Wales*, BIOMOR Reports 4: 228 pp.
- ³ ABPmer, 2023. *Atlas of UK Marine Renewables Resources*. Available online at: <https://www.abpmer.co.uk/experience/atlas-of-uk-marine-renewable-energy-resources/> [Accessed: October 2023].
- ⁴ Pugh, D.T., Woodworth, P.L., and Bos, M.S. 2011, Lunar tides in Loch Ness, Scotland. *Journal of Geophysical Research*, 116: C11040.
- ⁵ Tidal Lagoon Swansea Bay, 2014. *Tidal Lagoon Swansea Bay – Environmental Statement: Coastal Processes, Sediment Transport and Contamination*. 106pp
- ⁶ Lamont-Smith T, and Waseda T, 2007. Wind Wave Growth at Short Fetch. *Journal of Physical Oceanography*, 38: pp. 1597-1606.
- ⁷ Earle S, 2019. *Physical Geology*. 2nd Edition. Bccampus, Victoria.
- ⁸ White Consultants, 2004. *Neath Port Talbot Landmap Landscape Assessment*. 165pp.
- ⁹ Natural Environment Research Council, 1982. *British Regional Geology*. Third Edition. 152pp.
- ¹⁰ Suvio, P. 2011. *From Threat to an Asset: Water in Steelworks How modern steelworks can improve water related performance via benchmarking and development of High Density Sludge (HDS) Process*. Thesis submitted to the Cardiff University for a degree of Engineering Doctorate. School of Engineering. Cardiff University
- ¹¹ Hayes, E. and Chatterton, T. 2009. *An independent review of monitoring measures undertaken in Neath Port Talbot in respect of particulate matter (PM₁₀)*. Report prepared for the Welsh Assembly Government by the University of the West of England, Bristol, October 2009.
- ¹² Cefas. 2012. *Monitoring of the quality of the marine environment, 2008–2010*. Sci. Ser. Aquat. Environ. Monit. Rep., CEFAS Lowestoft, 63: 111pp.
- ¹³ Neath Port Talbot County Borough Council, 2020. *2020 Air quality progress report*. 105 pp.
- ¹⁴ Stumm, W., Morgan, J.J. 2012. *Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters*. John Wiley & Sons: Hoboken, NJ, USA, 2012; Volume 126.
- ¹⁵ Water Watch Wales (2021). *Water Framework Directive data*. Available at: <https://waterwatchwales.naturalresourceswales.gov.uk/en/> [Accessed September 2023].
- ¹⁶ Holmes, S. and Callaway, R. 2021. Fouling communities and non-native species within five ports along the Bristol Channel, South Wales, UK. *Estuarine, Coastal and Shelf Science*, 252: 107295. Available from: <https://www.sciencedirect.com/science/article/pii/S0272771421001487> [Accessed October 2023].
- ¹⁷ Shevah, Y. 2014. *Chapter 1.4 Adaptation to Water Scarcity and Regional Cooperation in the Middle East*. Editor(s): Satinder Ahuja, *Comprehensive Water Quality and Purification*, Elsevier, 2014, pp 40-70.
- ¹⁸ Swansea Docks, 2023. *Port Talbot Docks and Tidal Harbour*. Available at: <http://www.swanseadocks.co.uk/docksnewsite/pthistory.html> [Accessed: July 2023].
- ¹⁹ Oliver, P.G., 2015. Old shell collection casts new light on an alien species. The dark false mussel (*Mytilopsis leucophaeata*) may have been in Britain as early as 1800. *Journal of Conchology*, 42(1): pp. 63-66.
- ²⁰ National Biodiversity Network (NBN) Trust, 2023. *The National Biodiversity Network (NBN) Atlas*. Available at: <https://records.nbnatlas.org/explore/your-area> [Accessed September 2023].

-
- ²¹ Angling Trust, 2023. *Port Talbot Docks*. Available at: <https://fishingwales.net/fishing-locations/port-talbot-docks> [Accessed: June 2023].
- ²² Fishing in Wales, 2023. *Silver fish – Roach, Rudd and Dace*. Available at: <https://fishingwales.net/species/silver-fish-roach-rudd-and-dace/> [Accessed: June 2023].
- ²³ Wildlife Trust Wales, 2023. Freshwater fish. Available at: <https://www.wtwales.org/wildlife-explorer/freshwater-fish> [Accessed: June 2023].
- ²⁴ Afan Valley Angling, 2023. *Rivers and fisheries*. Available at: <https://afanvalleyangling.org/fishing/> [Accessed: July, 2023].
- ²⁵ Hawkins, S.J., O'shaughnessy, K.A., Adams, L.A., Langston, W.J., Bray, S., Allen, J.R., Wilkinson, S., Bohn, K., Mieszkowska, N., and Firth, L.B. 2020. Recovery of an urbanised estuary: clean-up, de-industrialisation and restoration of redundant dock-basins in the Mersey. *Marine Pollution Bulletin*, 156, p. 111150.
- ²⁶ Tidal Lagoon (Swansea Bay) PLC, 2017. Report to Inform Habitats Regulations Assessment for Determination of Marine Licence. Available at: [http://www.pasas.org.uk/4.%20TL%20Report%20to%20Inform%20Habitats%20Regulations%20Assessment%20\(HRA\)%20for%20Determination%20of%20Marine%20Licence%20070717.pdf](http://www.pasas.org.uk/4.%20TL%20Report%20to%20Inform%20Habitats%20Regulations%20Assessment%20(HRA)%20for%20Determination%20of%20Marine%20Licence%20070717.pdf) [Accessed: June 2023].
- ²⁷ Lowe, C.D., Tregenza, N.J., Allen, C.J., Blow, G.E., Nuuttila, H., Bertelli, C.M., Mendzil, A.F., Stamp, T., Sheehan, E.V., Davies, P., and Gordon, J.C., 2022. A novel method for identifying coded tags recorded on aquatic acoustic monitoring systems. *Environmental Monitoring and Assessment*, 194(806): p. 806.
- ²⁸ Countryside Council for Wales, 2009. *Carmarthen Bay and Estuaries/Bae Caerfyrddin ac Aberoedd European Marine Site*. 74 pp.
- ²⁹ Wiernicki, C.J., Liang, D., Bailey, H., and Secor, D.H., 2020. The effect of swim bladder presence and morphology on sound frequency detection for fishes. *Reviews in Fisheries Science & Aquaculture*, 28(4): pp. 459-477.
- ³⁰ Kastelein, R.A., Jennings, N., Kommeren, A., Helder-Hoek, L., and Schop, J., 2017. Acoustic dose-behavioral response relationship in sea bass (*Dicentrarchus labrax*) exposed to playbacks of pile driving sounds. *Marine Environmental Research*, 130: pp. 315-324.
- ³¹ Reeve, A., 2007. *Dicentrarchus labrax* Bass. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available at: <https://www.marlin.ac.uk/species/detail/2127> [Accessed: June 2023].
- ³² Barnes, M.K.S., 2008. *Chelon labrosus* Grey thick-lipped mullet. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: <https://www.marlin.ac.uk/species/detail/155> [Accessed: June 2023].
- ³³ Thompson, J.M., 1990. *Mugilidae*. In J.C. Quero, J.C. Hureau, C. Karrer, A. Post and L. Saldanha (eds.), *Check-list of the fishes of the eastern tropical Atlantic (CLOFETA)*. JNICT, Lisbon; SEI, Paris; and UNESCO, Paris. Vol. 2. (Ref. 7399), pp. 855-859.
- ³⁴ Harding, H., Bruintjes, R., Radford, A.N., and Simpson, S.D., 2016. *Measurement of hearing in the Atlantic salmon (Salmo salar) using auditory evoked potentials, and effects of pile driving playback on salmon behaviour and physiology*. A report for Marine Scotland Science.
- ³⁵ Nash, R.A., 2021. *Salmo trutta* Brown trout. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available at: <https://www.marlin.ac.uk/species/detail/2332> [Accessed: June 2023].
- ³⁶ Cefas, 2022. *Salmon stocks and fisheries in England and Wales, 2021*. A report prepared for ICES.
- ³⁷ Jensen, A.J., Finstad, B., Fiske, P., Hvidsten, N.A., Rikardsen, A.H., and Saksgård, L., 2012. Timing of smolt migration in sympatric populations of Atlantic salmon (*Salmo salar*), brown trout (*Salmo*

trutta), and Arctic char (*Salvelinus alpinus*). *Canadian Journal of Fisheries and Aquatic Sciences*, 69(4): pp. 711-723.

³⁸ Mawle, G.W., and Milner, N.J., 2003. *The Return of salmon to cleaner rivers-England and Wales*. Salmon at the Edge, pp. 186-199.

³⁹ Kirin, D., and Chunchukova, M., 2017. Ecological studies on the circulation of nickel in *Abramis brama* and *Pomphorhynchus tereticollis* from the freshwater ecosystem of the Danube River, Bulgaria. *Agricultural Sciences*, 9(21): pp. 77-81.

⁴⁰ Forsman, A., Tibblin, P., Berggren, H., Nordahl, O., Koch-Schmidt, P., and Larsson, P., 2015. Pike *Esox lucius* as an emerging model organism for studies in ecology and evolutionary biology: A review. *Journal of Fish Biology*, 87(2): pp. 472-479.

⁴¹ Mann, D.A., Cott, P.A., Hanna, B.W., and Popper, A.N., 2007. Hearing in eight species of northern Canadian freshwater fishes. *Journal of Fish Biology*, 70(1): pp. 109-120.

⁴² Amoser, S., Wysocki, L.E., and Ladich, F., 2004. Noise emission during the first powerboat race in an alpine lake and potential impact on fish communities. *Journal of the Acoustical Society of America*, 116(6): pp. 3789-3797.

⁴³ Wildlife Trusts, 2023. Roach. Available at: <https://www.wildlifetrusts.org/wildlife-explorer/freshwater-fish/roach> [Accessed: July 2023].

⁴⁴ Zapletal, T., Andreas, M., Adámek, Z., Špaček, J., Mikl, L., and Mareš, J., 2019. Endangered aquatic macrophytes in the diet of rudd (*Scardinius erythrophthalmus*). *Folia Zoologica*, 68(1): pp. 1-8.

⁴⁵ Wolnicki, J., Sikorska, J. and Kamiński, R., 2009. Response of larval and juvenile rudd *Scardinius erythrophthalmus* (L.) to different diets under controlled conditions. *Czech Journal of Animal Science*, 54(7): pp. 331-337.

⁴⁶ Piper, A.T., White, P.R., Wright, R.M., Leighton, T.G., and Kemp, P.S., 2019. Response of seaward-migrating European eel (*Anguilla anguilla*) to an infrasound deterrent. *Ecological Engineering*, 127: pp. 480-486.

⁴⁷ Pelster, B., 2017. Swimbladder function and the spawning migration of the European eel *Anguilla anguilla*. *Physiological Adaptations to Swimming in Fish*, p. 79.

⁴⁸ Freyhof, J., 2010. *Chelon labrosus* (Europe assessment). The IUCN Red List of Threatened Species 2010. Available at: <https://www.iucnredlist.org/species/135689/4181617> [Accessed: June 2023].

⁴⁹ Freyhof, J., 2011. *Salmo trutta*. The IUCN Red List of Threatened Species 2011. Available at: <https://www.iucnredlist.org/species/19861/9050312> [Accessed: June 2023].

⁵⁰ Freyhof, J., 2014. *Salmo salar* (Europe assessment). The IUCN Red List of Threatened Species 2014. Available at: <https://www.iucnredlist.org/species/19855/2532398> [Accessed: June 2023].

⁵¹ OSPAR, 2022b. *Status Assessment 2022 – Atlantic salmon*. OSPAR reference BDC2022/Atlantic salmon. Available at: <https://oap.ospar.org/en/ospar-assessments/committee-assessments/biodiversity-committee/status-assessments/atlantic-salmon/> [Accessed: June 2023].

⁵² Freyhof, J., and Kottelat, M., 2010. *Anguilla anguilla* (Europe assessment). The IUCN Red List of Threatened Species 2010. Available at: <https://www.iucnredlist.org/species/60344/12353683> [Accessed: June 2023].

⁵³ OSPAR, 2022a. *Status Assessment 2022 – European Eel*. OSPAR reference BDC2022/European eel. Available at: <https://oap.ospar.org/en/ospar-assessments/committee-assessments/biodiversity-committee/status-assessments/european-eel/#method-used> [Accessed: June 2023].

^{liv} IUCN, 2023. *RedList*. Available at: <https://www.iucnredlist.org/> [Accessed September 2023].

^{lv} Reid JB, Evans PGH, and Northridge SP, 2003. *Atlas of Cetacean distribution in north-west European waters*. JNCC, Peterborough, UK.

^{lvi} IAMMWG (Inter-Agency Marine Mammal Working Group), 2015. The use of harbour porpoise sightings data to inform the development of Special Areas of Conservation in UK waters. JNCC Report No. 565, JNCC Peterborough.