10 MARINE MAMMALS

10.1. Introduction

The Bailiwick of Guernsey has a rich marine environment in terms of its biodiversity.

The Bailiwick has the second highest tidal range in the world at over 10 metres or 33 feet on spring tides, the highest tidal range being in the Bay of Fundy in Atlantic Canada. The ebb and flow of the tide therefore means that strong currents increase the flow of nutrients around its waters, causing marine life and key prey species to flourish (e.g. mackerel and sea bass). This in turn attracts animals higher up the food-chain, including cetaceans (dolphins and whales) and pinnipeds (seals).

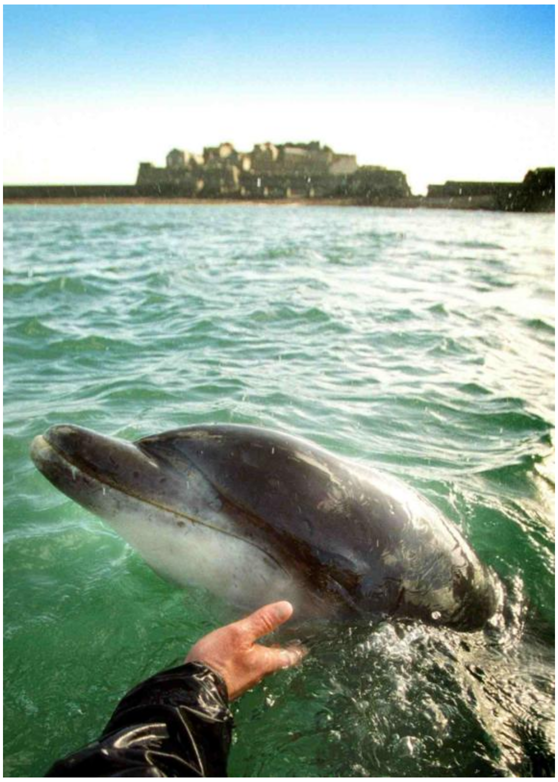

Figure 10.1.1 Bottlenose Dolphin (Chris George)

The islands are also located close to the south western approaches and the Bay of Biscay, which are classed as the fourth most important area for cetaceans in the world.

The following Chapter draws heavily from the Scottish Marine SEA, as this has been found to be the best source of information in this respect, and adapted to reflect data collated about marine mammals in the Bailiwick of Guernsey bio geographic region.

10.2. Baseline Environment

10.2.1 *Seals*

10.2.1.1 <u>Overview of Seal Ecology</u>

Grey Seals (*Halichoerus grypus*) are on the southernmost limit of their natural range in the Bailiwick of Guernsey, with a small colony found on the Humps north of Herm. Numbers recorded around Grand Amfroque typically range between 3 and 8 individuals. The seals are resident and are known to breed in the area.

Occasional sightings of Common Seals also known as Harbour Seals (*Phoca vitulina*) have been recorded, but as these are more of an estuarine species, sightings are rare, and are usually visiting the Bailiwick.

Grey seals occur all year round, and return to shore to haul out on rocks or beaches between foraging trips at sea that can last up to two to three weeks. Seals also come ashore during the breeding season to give birth, and at other times to moult their fur. The distribution of seals around the coast and the timing of lifecycle (pupping and moulting) will be potentially important considerations for the timing of marine renewable energy device deployment.

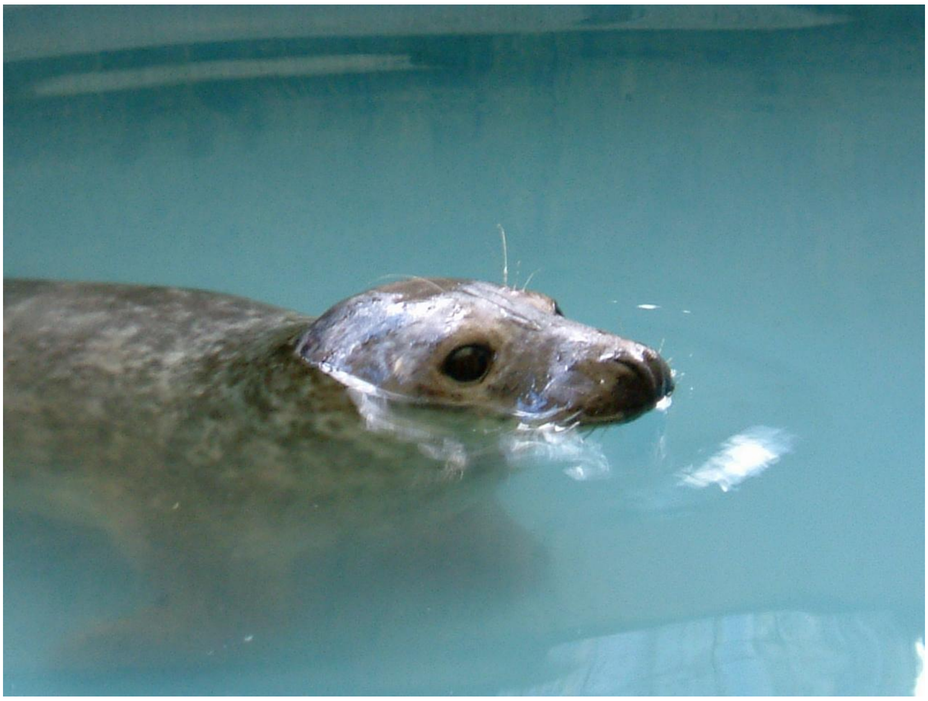

Figure 10.2.1 Atlantic Grey Seal pup (M J Gavet)

Female Grey seals can breed at around 4 years old. The gestation period of the female Grey seal is 11.5 months, including a 3 month delay in the implantation of the fertilised egg. Grey seals give birth to a single pup on beaches or in hidden sea caves from July to November. The pup weighs about 15 kilograms at birth and is born with a silky white coat or lanugo, which is moulted at around 9 - 18 days old. Pups gain about 2 kilograms of weight a day due to the high fat content of their mother's milk (60 per cent fat). After 3 weeks of suckling the pup, the female mates again and then leaves the breeding area (rookery).

Adult seals come ashore to moult their coats in winter-spring (December – March) and at other times to haul out between trips at sea. Fishing trips usually last between one and five days and generally take place within 40-50 km of the haul-out sites. Grey seals are known to travel between Brittany, the Channel Islands and the west coast of Scotland, from research carried out by the Sea Mammal Research Unit (SMRU) using satellite telemetry.

In the wild, grey seal females live up to 40 years, while males live up to 30 years.

Grey and common seals predate on a wide variety of prey, primarily fish, squid and crustaceans. Although the mechanism that seals use to locate prey is poorly understood, it is likely that passive listening, detection of hydrodynamic vibrations, and sight are the principle means of finding and catching prey. Both species can dive to depths of several hundred metres and utilise the full water column around the Bailiwick of Guernsey.

10.2.1.2 Legal Protection

A number of national and international agreements and legislation provide the legal basis for the conservation and protection of seals. Both grey and common seals are listed in Appendix 2 of the Convention of Migratory Species (Bonn Convention) that includes unilateral agreements for the conservation and management of migratory species.

The EU Habitats Directive lists both grey and common seals in Annex 2 and Annex 5, and requires that Special Areas of Conservation (SACs) be established for their protection. There are no SACs in the Bailiwick of Guernsey, due to the fact that the EU Habitats Directive does not apply in the Bailiwick, and the fact that government has not created any SACs within the Bailiwick.

The legislative provisions in the UK for the protection of wild animals are contained primarily in the Wildlife and Countryside Act 1981, sections 9-12. Specific legislation for seals is contained within Schedule 7 of this Act. Other specific legislation includes the Conservation of Seals Act 1970.

There is no such legislation in Guernsey. The northeast Atlantic subpopulation is considered to be endangered by the 2000 IUCN Red List.

10.2.1.3 Seal Distribution

Atlantic grey seals are on the southernmost limit of their range, and are therefore confined to a few individuals, mainly found around the Grand Amfroque area, north of Herm Island, where up to 8 individuals have been recorded at any one time. Atlantic grey seals travel extensively around Bailiwick waters foraging, etc., and have been recorded in various bays around Guernsey's coast. In the winter months 2-3 seal pups are found by animal welfare organisations stranded on Guernsey beaches, separated from their mothers, probably due to winter storms.

Seals have been tracked by the Sea Mammal Research Unit in St. Andrew's, Scotland, travelling down from the west coast of Scotland to the Channel Islands a Brittany using satellite telemetry. They are therefore a highly mobile species.

10.2.2. Cetaceans

10.2.2.1 Introduction

The waters around the Bailiwick of Guernsey (the REA study area), are used by a diverse range of cetaceans. The area offers a variety of habitats in close proximity as well as areas of high productivity. Despite the abundance and diversity of cetaceans in local waters our knowledge of the abundance and particularly the population structures and conservation status of these animals remains remarkably basic.

Figure 10.2.2 Long-finned Pilot Whales off Fermain, Guernsey by Tony Rive

10.2.2.2 Cetacean Ecology

Cetaceans (whales, dolphins and porpoises) occupy a wide range of ecological niches. They are all predators, consuming primarily fish, crustaceans and squid but the key factors likely to be important for marine renewables are their modes of foraging, selected habitats, body size and patterns of seasonal occurrence. Cetaceans are classified into two groups by their foraging methods , Odontocetes (toothed whales) and Mysticetes (baleen whales).

Odontocetes

The odontocetes (literally "toothed whales") are raptorial feeders and attack and consume individual prey items. This group includes the sperm whale (*Physeter macrocephalus*), beaked whales (Family *Ziphiidae*) and all dolphins and porpoises including the killer whale (*Orcinus orca*) and bottlenose dolphin (*Tursiops truncates*). With the exception of the Sperm Whale, these animals tend to be smaller than the baleen whales. High frequency sound (several kHz or more) appears to be especially important for these animals as they use it for echolocation to locate their prey, communicate and navigate.

Marine odontocetes are exposed to a diverse array of threats but their comparatively low reproductive rates increase their vulnerability. At the extreme, killer whales do not mature until their teens and females may produce less than 10 offspring in a lifetime. They are exposed to a wide variety of anthropogenic pressures from entanglement in fishing gear to pollution, both chemical and acoustic. Odontocetes are found occasionally in all Bailiwick marine habitats from onshore to offshore. Some species show clear seasonal migrations (for example Long-finned pilot whales moving inshore from pelagic waters in the summer), while other populations such as Short-beaked common dolphins (*Delphis delphinus*), Bottlenose dolphins (*Tursiops truncatus*) , and Harbour Porpoise (*Phocoena phocoena*) are resident all year.

Mysticetes

This group of larger toothless whales consume swarming or schooling prey by engulfing many prey items simultaneously. Baleen plates on the upper and lower jaws act as filters to remove water and trap food inside the mouth. Representatives of this group are known to occasionally frequent Bailiwick waters, mainly offshore in deeper pelagic waters, but occasionally inshore. It is unknown how these animals locate their prey but passive listening is likely. They vocalise, and therefore probably have hearing with peak sensitivities at low frequencies (several kHz or less). Being large, they are especially vulnerable to collisions with moving objects such as ships and potentially the blades of tidal generator devices.

Despite their great size they reproduce comparatively young and often and so have a capacity for population growth. That said, numbers of all species, except minke whales (*Balaenoptera acutorostrata*), in the north Atlantic were massively reduced by whaling and many have yet to recover their former numbers. The total fin whale population in the North Atlantic is estimated at 35,000 to 50,000. Fin whales carry high levels of bio accumulating pollutants such as heavy metals and organochlorine (pesticides) compounds; these have been demonstrated to accumulate with age and to transfer between generations via lactation. The health implications for accumulations of pollutants in all cetaceans are still poorly understood. Fin whales may also be negatively impacted by noise and disturbance from vessels and other underwater noise, which may mask their social sounds.

The breeding biology of most baleen whales in the north-east Atlantic is little known. Common minke whales (*B. acutorostrata*) for example, are summer visitors and migrate to the tropics to breed in winter. Whaling records suggest that other species, such as fin whales (*Balaenoptera physalus*), do likewise but the recent recordings of their calls in northern seas in winter suggests more complex seasonal movements.

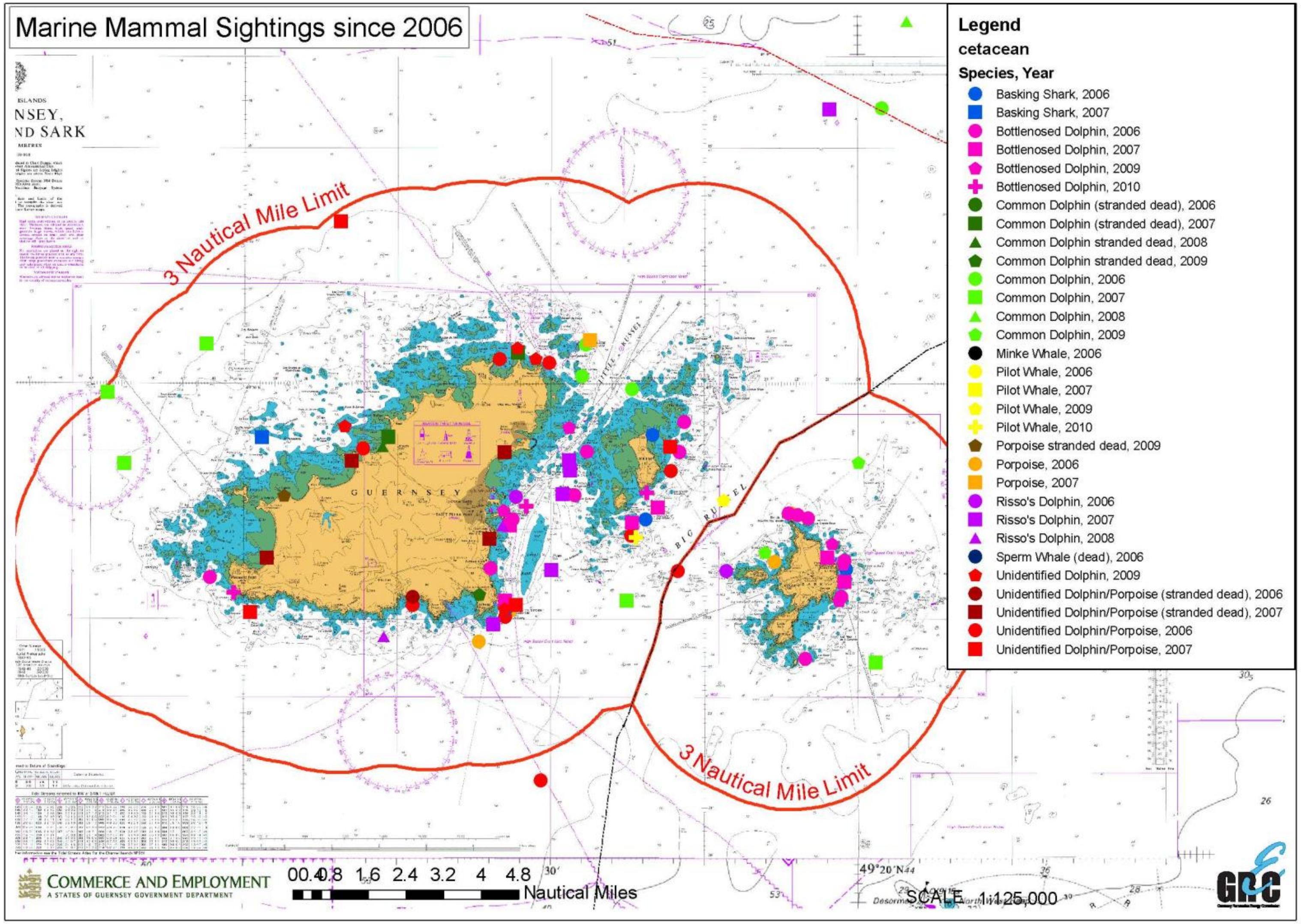

Figure 10.2.3 Marine Mammal Distribution from Guernsey Biological Record Centre Recordings 2006-2010

Table 10.2.1 Key cetacean species in the Study Area

Species	Species Group	Feeding Strategy
Bottlenose Dolphin	Odontocete	Raptorial Feeder
Harbour Porpoise	Odontocete	Raptorial Feeder
Long-finned Pilot Whale	Odontocete	Raptorial Feeder
Sperm Whale	Odontocete	Raptorial Feeder
Risso’s Dolphin	Odontocete	Raptorial Feeder
Common Dolphin	Odontocete	Raptorial Feeder
Killer Whale	Odontocete	Raptorial Feeder
Fin Whale	Mysticete	Bulk/Filter Feeder
Common Minke Whale	Mysticete	Bulk/Filter Feeder

Sensory Capabilities in Cetaceans and Seals

Vision

Seals primarily use vision to navigate in the marine environment, avoid obstacles and forage for food. Their large eyes face forward giving them binocular vision. Colour vision in cetaceans and seals is limited and skewed to the blue-green region of the spectrum. The underwater colour of marine renewable devices may therefore appear different (more or less obvious) to these species than humans.

Cetacean eyes are placed on both sides of the head and so give a more panoramic view. The visual fields do overlap, but binocular vision has yet to be demonstrated.

Figure 10.2.4 Common Dolphin by Mike Cave

Sound

Marine mammals have acute active and passive hearing capabilities. Passive hearing refers to sounds already in the marine environment, and active means producing sound and interpreting the returning echoes.

Toothed dolphins and whales (Odontocetes) are known to use passive and active listening when navigating and foraging. The peak energy in echolocation signals are typically at high frequencies giving these animals good fine scale discrimination abilities. However, unlike vision, the information derived from echolocation is limited by the update frequency of the sound pulses and hence their perception of objects has a stroboscopic nature. It is unknown therefore how echo locating animals will therefore perceive rotating objects such as marine turbines. In addition, update rates are limited by the travel time of sound. Detection of distant objects requires use of a longer inter-pulse interval than close objects and small odontocetes are known to attempt to minimise their inter-pulse intervals when foraging. A consequence of this is that their active echolocation is continuously turned to the distance of interest but with the sacrifice of not being able to detect more distant objects. Thus while these animals may be capable of detecting distant objects they may be effectively blind to them when foraging on nearby prey.

The hearing sensitivities of seals and mysticetes (baleen whales) differ significantly to odontocetes. It seems that their use of sound to locate objects in the water column is primarily passive. Whereas odontocetes are primarily high frequency specialists, mysticetes are low-frequency specialists, and seals hear a wide range of frequencies between.

Mechano-reception

Seals use their whiskers to sense small-scale hydrodynamic vibrations and vortices in the water column. The organ(s) used to receive these signals need not be large or at any obvious location in the body, so searches for such organs have not been successful. Seals are thought to use this sense to detect the wake of prey species.

Electro-reception

Electricity cables produce small electric and magnetic fields, which have the potential to affect migration and prey detection in seals and cetaceans. Little is known about the abilities of marine mammals to use an electromagnetic sense. As in mechano-reception searches for the organs controlling this sense have so-far proven unsuccessful.

Chemo reception

The olfactory sense (sense of smell) in marine mammals is severely restricted in comparison to other species groups such as fish. In seals it is used to detect predators in the air at haul out sites. However, when underwater seals close their nostrils to prevent water from entering the pharynx, and do not use this sense underwater. There is no firm evidence to suggest that cetaceans use this sense to navigate or orientate underwater.

10.2.2.3 Distribution

Inshore waterways

Several cetacean species are regularly reported in these habitats off the Bailiwick. Of these, the most frequent are Harbour porpoises (*P. phocoena*) and Bottlenose dolphins (*T. truncates*). Within the inshore section of the study area, cetacean manoeuvrability may be limited by shallows, shorelines or strong currents.

Coastal waters

Coastal waters are defined as waters inshore of the continental shelf break and therefore compromise the majority of the study area. As described above, there are currently no synoptic population estimates for cetaceans in Bailiwick waters but the most abundant species in coastal waters are likely to be Harbour porpoises (*P. phocoena*), Minke whales (*B. acutorostrata*), Risso's dolphins (*Grampus griseus*) and Common dolphins (*Delphinus delphis*), Long-finned Pilot whales (*Globicephala melas*) and Bottlenose dolphins (*T. truncates*).

Offshore waters

Offshore waters are considered areas associated with the shelf break (approximately located at the 200m contour and beyond). Species inhabiting offshore waters are therefore outside the REA study area.

10.3. Potential Effects

Table 10.3.1: Potential Effects

Activity	Positive Effect	Negative Effect
Installation		
Survey work (sonar)		Effects on cetacean ability to communicate effectively in pods, and use echolocation. Low Frequency Active Sonar – is thought to be responsible for hearing damage and haemorrhaging in marine mammals leading to mass strandings and death.
Turbine noise		Studies have shown that turbine noise from offshore wind turbines effects cetaceans and pinnipeds. See Koschinski, S., B.M. Culik, O.D. Henriksen, N. Tregenza, G. Ellis, C. Jansen, and G. Kathe (2003).
Traffic		Boat traffic is widely believed to cause disturbance and physical injury to cetaceans and is frequently cited as an important threat to their welfare and conservation. As a result, numerous codes of practice have been proposed which restrict the movement of boats in the vicinity of cetaceans. There are, however, relatively few quantitative studies on the behaviour of cetaceans in the presence of boats. Goodwin, L. and P.A. Cotton (2004).

Activity	Positive Effect	Negative Effect
Explosion and piling operations		Use of explosives on bedrock, and piling operations can have a detrimental impact on cetaceans, not only if in close proximity and the corresponding threat of physical trauma from explosions, but also in terms of injury and distress incurred as a result of the noise associated with such operations.
Pollution		Threat to cetaceans from bio-accumulating sub lethal and lethal compounds/chemicals used in the installation of devices, including anti-foulants. These toxins can be absorbed by mammals in their fat tissue and passed down to future generations through weaning.
Physical disturbance		Disturbance to breeding and haul out sites (seals) can cause mothers to abandon their young. The main geographical area for concern in this regard is Grand Amfroque (the Humps, north of Herm).

Activity	Positive Effect	Negative Effect
Reduced visibility		Reduced visibility can occur as a result of seabed installation and the disturbance of sediment through an increase in turbidity. This can have effects on foraging for prey and social interactions. Given that tidal turbines are likely to be installed in high energy environments, as small amount of sediment is likely to be disturbed. This will have to be assessed on a case-by-case basis.
Disturbance of contaminated sediments		Possible during cable and device installation. May have potential detrimental impacts on species that are sensitive to contamination.
Operation and maintenance		
Turbine Noise		Studies have shown that turbine noise from offshore wind turbines effects cetaceans and pinnipeds. See Koschinski, S., B.M. Culik, O.D. Henriksen, N. Tregenza, G. Ellis, C. Jansen, and G. Kathe (2003).

Activity	Positive Effect	Negative Effect
Traffic		Boat traffic is widely believed to cause disturbance and physical injury to cetaceans and is frequently cited as an important threat to their welfare and conservation. As a result, numerous codes of practice have been proposed which restrict the movement of boats in the vicinity of cetaceans. There are, however, relatively few quantitative studies on the behaviour of cetaceans in the presence of boats. Goodwin, L. and P.A. Cotton (2004).
Pollution		Threat to cetaceans from bio-accumulating sub lethal and lethal compounds/chemicals used in the installation of devices, including anti-foulants. These toxins can be absorbed by mammals in their fat tissue and passed down to future generations through weaning of calves and pups.

Activity	Positive Effect	Negative Effect
Electromagnetic radiation		Threat to cetaceans from electromagnetic fields used in undersea export cables, etc. This may disrupt feeding patterns, breeding sites, etc., although this area is yet to be researched thoroughly. Some theories have implicated exposure to EMF as the cause of a number of adverse health effects in humans. These include, but are not limited to, childhood leukemia; adult leukemia; and neurodegenerative diseases. The impact on cetaceans in this respect has not been studied. The best understood biological effect of electromagnetic fields is to cause dielectric heating. For example, touching or standing around an antenna while a high-power transmitter is in operation can cause severe burns.
Non-ionising radiation		Non-ionising radiation (e.g. arc welding and cutting equipment, lasers, crack detection equipment) – the use of non-ionising radiation may present a risk to cetaceans in close proximity to work being undertaken which involves the use of such radiation (e.g. visual problems).

Activity	Positive Effect	Negative Effect
Ionising Radiation		Ionising radiation – Alpha, Beta and Gamma Radiation, used in site radiography for checking structural integrity of welds, metals, etc. may be a risk to cetaceans in close proximity to the work.
Detection failure		Certain factors (dark conditions, background noise, turbidity), etc., may inhibit species ability to detect tidal generation devices and increase the risk of collision.
Diving constraints		Marine mammals are accomplished divers and typically dive close to aerobic dive limitations. This means that animals do not have unlimited time and manoeuvrability underwater and may have few options other than upwards at the end of a dive.
Group effects		Groups of marine mammals may be at greater risk than solitary animals.
Attraction		Marine devices may actually attract species to the area. A recent example of this was a solitary dolphin which visited Channel Island waters which displayed an attraction to underwater propellers, and was injured as a result.

Activity	Positive Effect	Negative Effect
Confusion and Distraction		It is possible that marine mammals may become distracted or confused by the presence of marine renewable devices and this could lead to potentially serious consequences in terms of harm to the animal.
Disease and life stage		It is likely that less agile or vulnerable animals (e.g. juveniles, elderly and the diseased) will be at more risk due to reduced sensory ability and perception.
Position		The position of tidal devices in narrow channels could seriously impair key migration routes/foraging areas for marine mammals, and this therefore needs to be taken carefully into account during the marine spatial planning and consent stage.
Temporal		Collision risk will vary with seasonal changes. Some species increase in numbers off the Bailiwick's shores in the summer and autumn. For example long-finned pilot whales are known to come inshore from off the continental shelf during the summer after cephalopods (prey species). Whilst present all year round common dolphin will also aggregate in large groups after mackerel and sea bass, etc.

Activity	Positive Effect	Negative Effect
Prohibition of Fisheries in renewable generation site	Increased marine life from No Take Zone - If fisheries are prohibited in the area of the tidal generator array, then this will have an impact in terms of increased biodiversity, which should be beneficial to cetaceans and pinnipeds in terms of increased food resources. Reduction in traffic - Restrictions on vessel movements within tidal array areas would result in a reduction in the risk of collision between marine mammals and vessels. Reduction in amount of Greenhouse Gas released into the atmosphere, including carbon dioxide from tidal generation will ultimately benefit cetacean populations in terms of counteracting the effects of global warming and acidification of our oceans.	

Activity	Positive Effect	Negative Effect
Decommissioning		Noise pollution - associated with decommissioning would need to be carefully assessed and mitigation measures introduced where appropriate and reasonably practicable to reduce the impact on cetacean and pinniped populations. Chemical pollution – release of chemicals in the marine environment would need to be carefully assessed as part of an Environmental Impact Assessment prior to the decommissioning of devices. This would need to be done under the UK Food and Environmental Protection Act.
	Artificial reefs - Decommissioning of devices could involve the majority of the structure being left on the sea-bed, provided that it was compliant with the requirements of the UK Food and Environmental Protection Act, and licences sourced. The structures could form artificial reefs, increasing the biodiversity of the area, and as a result benefiting marine mammals in terms of increased prey resources.	

10.4 Sensitivity of receptors

Table 10.4.1: Sensitivity of Marine Mammals to Impacts from Wave and Tidal Arrays

Species Group	Physical Disturbance	Marine Noise	Habitat Exclusion	Reduced Visibility	Flow Disruption	Contamination	EMF	Haul-out (risk of injury to seals hauling out on devices)	Foraging (increase in foraging opportunities)
Seals	High (near breeding sites)	H	M	H	L M* locally	L M* near breeding sites	Not known	H	Not known
Baleen/ Sperm Whales	Not known	M	M/H	M	L	L	Not known	N/A	Not known
Dolphins	Not known	H	M/H	M	L	L	Not known	N/A	Not known
Harbour Porpoise	Not known	H	H	M	L	L	Not known	N/A	Not known

H = High M =Medium L = Low

Table 10.4.2: Estimated Sensitivity to Collision Risk

Species Group	Low Tidal Flow		High Tidal Flow	
	Exposed moving parts	Static parts	Exposed moving parts	Static parts
Seals	L/M	L	H	M
Baleen/Sperm Whales	L/M	L/M*†	H	M/H
Dolphins	L/M	L	H	M
Harbour Porpoise	L/M	L	H	M

* UK stranding schemes recurrently recover cetacean carcasses that have been involved in traumatic conflict with sharp or massive objects. A proportion of these injuries is known to have contributed to the cause of death and is unlikely to be related to fisheries. The exact circumstances of these interactions are rarely known but indicate that these species are vulnerable to collision with objects on the sea floor, water column or surface.

† Entanglement in static mooring lines is a widely documented cause of death in large whales.

The sensitivity to collision risk has been estimated based on what is known about these animals and how they use the marine environment, these estimates are not based on any empirical data. Further research needs to be developed as the industry develops to further understand these sensitivities and therefore the potential effects.

Whilst sensitivity to static parts has been identified as low-medium, a distinction needs to be drawn between larger, more apparent static objects and tethers, chains, umbilicals which may be less easily detected, particularly in poor visibility or by juvenile or elderly/ill individuals. A large number of tethers/umbilicals in an array of devices could give a "maze" effect, which, once they have entered the area, individuals may not be able to negotiate.

Identify the likelihoods of the impact affecting the subject.

- The likelihood of collision with a sub-sea device is more likely with cetaceans, although cetaceans do have good sensory perception through eyesight and echolocation. As far as pinnipeds are concerned, reference should be made to studies carried out in Stangford Lough about the impacts on the local grey seal population from a MCT renewable energy sub-tidal device.
- The likelihood of acoustic disturbance to marine mammals from underwater noise associated with surveying operations, piling and drilling, use of explosives, and the noise generated by the turbine itself is high. It could

mean that populations move to other quieter locations, and care needs to be taken not to establish tidal devices near to key feeding areas (e.g. off St. Martin's Point where large accumulations of prey species such as mackerel occur).

- The possibility of direct and indirect ecological effects on the entire food chain from the placement of tidal devices due to changes in tidal mixing. Depending on the scale of the development, renewable energy devices may affect the abundance of phytoplankton in the area, and therefore species higher up the food chain, including key prey species. The difficulty is that the environmental impacts are not yet understood. For further information see: A Renewable Engineer's Essential Guide to Marine Ecology (Scott, B.E., University of Aberdeen).

- The possibility of chemical pollution from anti-foulants and lubricants and the sub-lethal and lethal effects of persistent bio-accumulating compounds (i.e. those pollutants that do not break down easily and are passed from mother to calf during weaning and stored in fat tissue).

- Electromagnetic disturbance to cetaceans from cables is a possibility. There are theories that cetaceans navigate using vibrations in the earth's magnetic field. Crystals of magnetite, which react to a weak magnetic field, have been detected in the brains and skulls of some whales and dolphins. Possible impacts of power cables on cetaceans are not well understood, but there is circumstantial evidence that existing interconnector power cables have influenced cetacean migration.

- There is potential for collision between marine mammals and the shipping required for survey, installation and maintenance work.

10.5. Potential Significance of Effects

Assessment Criteria

The assessment of effect significance has been undertaken based on the criteria below. These take into account the information available to inform the assessment of significance. Due to the strategic nature of this assessment, it has not been possible to quantify the magnitude of impacts, and the assessment of significance is therefore based primarily on the sensitivity and importance of receptors.

Table 10.5.1: Significance of Events

Significance Level	Determining Criteria
Major	Affect an entire population/habitat causing a decline in abundance and/or change in distribution beyond which natural recruitment would not return that population/habitat, or any population/habitat dependent upon it, to its former level within several generations of the species being affected.
Moderate	Damage or disturbance to habitats or populations above those experienced under natural conditions, over one or more generation, but which does not threaten the integrity of that population or any population dependent on it.
Minor	Small-scale or short-term disturbance to habitats or species, with rapid recovery rates, and no long term noticeable effects above the levels of natural variation experienced in the area. The impacts are not sufficient to be observed at the population level.
Negligible/No Impact	Minimal impact from the work. Very minor damage, if any or to species/habitats of low ecological importance, or with immediate recovery rates.

10.5.1. *Effect Significance Mapping*

Mapping has not been carried out due to the mobile nature of cetacean and pinniped populations, the lack of baseline data, and the lack of understanding about how the respective species will be impacted by renewable marine energy devices because the technology is in its infancy.

It is considered that there would be too many assumptions made to make any such exercise significant or useful. However, it should be noted that the area north of Herm and the Humps is a particularly sensitive site in terms of seals hauling out and breeding.

10.5.2. *Results of Significance Assessment*

10.5.2.1. Significance of Installation Effects

Collision risk: Vessels involved in the installation of both wave and tidal devices and export cables are likely to be either stationary or travelling considerably slower than navigating vessels whilst involved with construction activities and therefore the collision risk during construction is likely to be lower than that posed by commercial traffic. This impact is temporary in nature, and is therefore considered to be of moderate potential significance, reducing to minor after appropriate use of mitigation, if the site specific Environmental Impact Assessment (EIA) identifies this as necessary. Appropriate mitigation could include not undertaking unnecessary boat movements, avoidance of sensitive migration routes and breeding/feeding areas/seasons, ensuring high visibility of vessels and machinery, and potentially the use of acoustic deterrent devices, though there is some concern that this technique may cause adverse impacts in itself.

Also skippers of vessels should be issued with a Code of Conduct in respect of interaction with Marine Mammal species. Such Codes aim to ensure that there is adequate distance between vessels and species, and that mothers are not separated from their calves or pups, therefore avoiding distress to these animals.

Physical disturbance: This would be the most significant for breeding seals, hauled out on the coast and intertidal banks and otters during the breeding season, as both species could exhibit flight reactions temporarily abandoning their young, causing a more significant reaction during the breeding season. This impact has therefore been assigned a major significance level for breeding seal colonies, and a moderate significance level for non-breeding colonies, which reduces to a minor residual significance assuming protected sites and breeding seasons are avoided during construction.

Marine noise: Seals and cetaceans could both be generally expected to be able to hear piling noise up to a distance of 80km and behavioural responses could be expected up to 20 km (Tomsen, *et al*, 2006). In addition, physiological impacts on both seals and cetaceans could include temporary or permanent hearing damage or discomfort. Permanent hearing damage may be a concern at a distance of 400m from any pile driving activities for seals and 1.8 km for harbour porpoise (Tomsen, *et al,* 2006). However, these characteristics are likely to vary according to the site characteristics (e.g. shielding effects of islets and islands, and water depth). In very close proximity to devices there is also a potential risk of injury or death of marine mammals.

This is therefore considered to be an effect of potentially major significance, although use of appropriate mitigation, where appropriate, could be expected to reduce this impact to minor. Appropriate mitigation could include: use of “soft start” techniques whereby piling noise is increased gradually to allow mammals the chance to move away from operations and avoiding installation during sensitive periods. Marine Mammal observers could also be used to ensure no sensitive animals are in the vicinity before works begin.

10.5.2.2. <u>Significance of Operation Effects</u>

Collision risk: Ecological impacts resulting from mammal interactions with devices can be expected to range from: no impacts, to the potential removal or injury of individuals, and, if rates are sufficiently high, to the decline in population numbers. Collision risk during device operation therefore has the potential to be of major significance. However, the behavioural response of mammals, and therefore the actual collision impact is impossible to assess, and further research is needed to understand this issue. Possible mitigation measures to avoid/reduce any significant impacts include avoidance of sensitive areas such as feeding or breeding areas, migration routes, or constrained areas that may be used for transit by marine mammals; measures to increase the visibility of devices, or use of protective netting and grids.

Marine noise: The two key unknowns in determining the level of impact of operation marine noise are: the response of mammals to different noise levels, and, the small amount of noise data available does not give an accurate indication of the range of frequencies and sound levels that may be emitted by devices and arrays. Therefore, it has not been possible to assess into the significance of effects from masking prey location, social interaction and navigation, and habitat exclusion from operation noise in this REA. When further noise measurement data is available for a range of commercial scale devices, studies into such impacts (and potential for device noise to act as a sensory cue to marine mammals allowing them to detect, and avoid collision with, the wave or tidal device) could be carried out more meaningfully than is possible at present.

Barrier to movement: There is potential that device arrays may form a barrier to the visual migration and transit patterns of marine mammals, either because of the collision risk, aversive reactions to operation noise or perceptions of devices and associated infrastructure. This is particularly relevant in constrained areas (bays) where loud noise sources may prevent transit, effectively trapping individuals. This impact is therefore considered to be of major potential significance, where it occurs in constrained areas. Mitigation could reduce such impacts to minor residual significance through avoidance of constrained areas which are important mammal transit areas.

Habitat exclusion: Devices may exclude mammals from a suitable habitat (both marine and foraging habitats, and in the case of seals, terrestrial breeding habitats) by providing a physical or perceptual barrier, or producing noise that results in avoidance behaviour. Devices could also potentially block or partially block migration routes. Based on discussions with developers in Scotland (see Scottish Marine SEA), typical array sizes are likely to be 4 km^2 for wave and 0.5 km^2 for tidal arrays. Whilst it is considered likely that alternative foraging areas will generally be available to marine mammal species, there is potential for devices to reduce key feeding areas or feeding "hotspots" and this is therefore considered to be moderate significance impact. Where appropriate, impacts could be mitigated by siting devices away from key breeding and feeding areas. Residual effects are due to be minor.

Decrease in water flow: Seals are thought to use small-scale hydrodynamic vibrations and flow vortices in the water column to track the wake of prey organisms swimming through the water column. Effects of changes in water flow is estimated to be of negligible significance, as tidal energy devices could result in a reduction in tidal flow energy around the turbine structure, against which seals may still be able to detect variations caused by prey species.

Changes in suspended sediment levels and turbidity: Given that the wave and tidal turbines will be placed in high energy environments, any sediment re-suspended into the water column during turbine and cable operation will be rapidly dispersed and will have a negligible impact on background suspended sediment and turbidity levels. This conclusion will of course have to be re-assessed on a case-by-case basis for specific developments. Seals have been identified as having a high sensitivity to reductions in visibility, whilst the cetaceans in the study area have a moderate sensitivity to this impact. Given the fact that the hydrodynamic regime in the high energy environments where devices will be deployed is likely to result in rapid dispersal of increased suspended sediment levels, both potential and residual effects are considered likely to be of negligible significance.

Contamination: The quantities and toxicities associated with sacrificial anodes and anti-foulant coatings are generally expected to be extremely small, and it is therefore considered that this potential effect will be of negligible significance.

The potential for hydraulic fluids through accidental storm or collision damage, or vessel fuel and/or cargo through collision damage could potentially present an impact of major significance if it occurred. Assuming the device is designed to minimise this risk (devices which use hydraulic systems will normally be designed such that at least two seal or containment failures are required before a leaking fluid reaches the sea), and avoidance of high traffic density areas of potential collision risk, it is considered that there is a very low likelihood of such a leakage or incident occurring, and residual effects are also therefore likely to be negligible.

Electric and Magnetic Fields (EMF): Whilst there is no apparent evidence that existing electricity cables have influenced the migration of cetaceans, this is also another area which is not understood and further research would be needed to inform the assessment of the potential effects. Anecdotal evidence indicates that migration of harbour porpoise in the Baltic Sea necessitates several crossings over operating sub-sea High Voltage Direct Current cables in the Skagerrak and Western Baltic Sea without any apparent effect on its migration pattern (Basslink, 2001).

There is no evidence that seals are sensitive to electromagnetic fields. It is therefore considered that operation of electricity cables will have a negligible impact on seals and cetaceans.

Haul out sites: It is not possible to assign a significance rating to this impact as it is currently not known whether it constitutes a positive or negative effect.

Increased Foraging Opportunities: It is not possible to assign a significance rating to this impact as it is currently not known whether it constitutes a positive or negative effect.

Table 10.5.2: Potential Significance of Effects – Marine Mammals

Potential Effects	Device Characteristics	Receptor	Potential of Significant Effects	Likely Impact Extent	Source	Confidence
Collision Risk (construction)	All wave and tidal devices	Seals and cetaceans	Moderate	Installation area	Specialist collision risk study	Low
Physical Disturbance	All devices and cables	Seal colonies (Breeding and moulting) Seal colonies (non breeding/moulting)	Major Moderate	900m (from seal hauled out and breeding colonies)	Estimate based on expert knowledge	High
Marine Noise (construction)	Piled devices	Seals and cetaceans	Major	20km	COWRIE specialist noise study	High
Increased suspended sediment and turbidity (reduced visibility)	Piled devices and cables	Seals and cetaceans	None	Negligible	Estimate based on expert knowledge	High
Collision risk (operation)	All wave and tidal devices	Seals and cetaceans	None	Within array area: Wave: 0.24 – 2 km^2. Tidal: 0.35 – 4 km^2	Specialist collision risk study	Low
Marine Noise (operation)	All wave and tidal devices	Seals and cetaceans	Unknown	16m	COWRIE specialist noise study	Low
Barrier to movement	All wave and tidal devices	Seals and cetaceans	Major (constrained areas)	Unknown	N/A	Low

Potential Effects	Device Characteristics	Receptor	Potential of Significant Effects	Likely Impact Extent	Source	Confidence
Habitat exclusion	All wave and tidal devices	Seals and cetaceans	Moderate	Within array area Wave: 0.24 – 2km² Tidal: 0.36-4km²	Discussions with developers	Mode rate
Decrease in water flow	All tidal devices	Seals	None	500m	Modelling for MCT and Seagen	Low
Contamination from anti-foulant paints and sacrificial anodes	Devices using anti-foulants and sacrificial anodes	Seals and cetaceans	Minor	Negligible	Calculations based on discussions with developers	Mode rate
Accidental contamination (hydraulic fluids or vessel fuel/cargo)	Devices using hydraulic fluids	Seals and cetaceans	Major	Impossible to quantify	Discussions with developers	Very low
EMF	Export	Seals and cetaceans	None	Negligible	COWRIE	Mode rate
Haul out	Devices with surface structures	Seals	Unknown	Within array area Wave: 0.24 – 2km² Tidal: 0.36-4km²	Discussions with developers	Very low
Increased foraging opportunities	All wave and tidal devices	Seals and cetaceans	Unknown	Within array area Wave: 0.24 – 2km² Tidal: 0.36-4km²	Discussions with developers	Very low

10.6 Likelihood of Occurrence

Based on the information currently available to inform the assessments of impacts of marine renewable energy development on marine mammals the likelihood of such impacts is difficult to determine.

The waters around Guernsey are rich in terms of their biodiversity and sustain a large flora and fauna, throughout the food chain from planktonic life to predators. It is highly likely that marine mammals will be present in the areas being considered for the licensing of marine renewable energy devices and they are therefore potentially vulnerable to impacts associated with interactions with the devices. This is particularly true for construction, noise and collision effects during device operation. These have both been identified as being of potentially major significance, although given the lack of data associated with these technologies and marine mammal behaviour it is difficult to ascertain the full extent of any impact and likelihood of occurrence.

10.7 Mitigation Measures

Where potentially significant impacts have been identified for a specific receptor, the following mitigation measures are appropriate for avoiding or reducing effects impacts.

Table 10.7.1 Possible mitigation measures – Impacts on marine mammals

Effect	Mitigation measure
Physical Disturbance	• Avoid sensitive sites/species • Avoid installation during sensitive seasons
Increased Turbidity	• Minimise depth of piling • Use cable and device installation methods that minimise sediment resuspension • Release sediment in appropriate tidal conditions to minimise effect • Carry out work in appropriate tidal conditions to minimise effect
Collision risk	• Design device for minimal impact • Do not site devices in particularly sensitive areas – e.g. migration routes, feeding, breeding areas • Increase device visibility, or use of acoustic deterrent devices • Use of protective netting or grids
Barrier to movement	• Avoid sensitive areas
Habitat Exclusion	• Avoid sensitive sites/species
Disturbance of contaminated sediments	• Avoid device placement in areas of known sediment contamination • Use installation methods that minimise disturbance of sediments • Carry out work in appropriate tidal conditions to minimise effect

Effect	Mitigation measure
Contamination from anti-foulants and sacrificial anodes and grout	• Design devices to minimise leakage of pollutants • Use of non toxic anti-foulants • Minimise use of anti-foulants • Minimise use of sacrificial anodes • Use low toxicity grout • Minimise contact of grout with water • Minimise quantity of grout used • Design devices to minimise risk of leakage of pollutants • Risk assessments and contingency planning • Design to reduce risk • Avoid shipping routes
EMF	• Cable export design to minimise EMF fields
Marine Noise	• Minimise use of high noise emission activities such as impact piling • Avoid installation during sensitive periods • "Soft starting" piling activities – gradually increasing noise • Use of Marine Mammal Observers • Underwater noise during operation may be beneficial in alerting species to the presence of the device, reducing the risk of collisions. This requires further research • Consideration should be given to whether any surface platforms have moving parts that could cause injury.

*There are a number of issues and concerns with regard to the use of Acoustic Deterrent Devices (ADDs) which would need to be considered should ADDs be recommended for use to mitigate potential collision impacts. The interaction of such devices with marine mammals is not well understood and may be based on the delivery of painful doses of noise into the marine environment – which has issues both in terms of animal welfare and deliberate disturbance. Furthermore there is a lack of understanding on the efficacy of these devices or "pingers" as they are also known. Effectiveness may vary between individuals, populations and species) and, in respect of extended periods of deployment, how receptors may become habituated to such devices. COWRIE is currently commissioning work on acoustic deterrent devices in an attempt to further understand this issue.

Table 10.7.2 – Reducing risks

Effect	Development Phase	Mitigation Measure
Physical Disturbance	Survey & Installation Operation and Maintenance Decommissioning	• Avoid sensitive sites and species • Avoid during sensitive seasons
Increased Turbidity (reduced visibility)	Survey and Installation Operation and Maintenance Decommissioning	• Minimise depth of piling, or avoid piling if possible. • Use cable and device installation methods that minimise sediment re-suspension. • Release sediment in appropriate tidal conditions to minimise effect. • Carry out work in appropriate tidal conditions to minimise effect.
Collision Risk	Survey and Installation Operation and Maintenance Decommissioning	• Issue Code of Practice to all vessel skippers working in area. • Design device for minimal impact. • Do not site devices in particularly sensitive areas – e.g. migration routes, feeding, breeding areas. • Increase device visibility, or use acoustic deterrent devices. • Use of protective netting or grids.

Effect	Development Phase	Mitigation Measure
Barrier to movement	Survey and Installation Operation and Maintenance Decommissioning	• Issue Code of Practice to all vessel skippers working in area. • Avoid sensitive sites.
Habitat Exclusion	Survey and Installation Operation and Maintenance Decommissioning	• Avoid sensitive sites and species.
Disturbance of contaminated sediments	Survey and Installation Operation and Maintenance Decommissioning	• Avoid device placement in areas of known sediment contamination, • Use installation methods that minimise disturbance of sediments. • Carry out work in appropriate tidal conditions to minimise effect.
Contamination from anti-fouling paints and sacrificial anodes and grouts	Survey and Installation Operation and Maintenance Decommissioning	• Design devices to minimise leakage of pollutants. • Use of non-toxic anti-foulants. • Minimise use of anti-foulants. • Minimise use of sacrificial anodes. • Use low toxicity grout. • Minimise contact of grout with water. • Minimise quantity of grout used.

Effect	Development Phase	Mitigation Measure
Accidental contamination (hydraulic fluids)	Survey and Installation Operation and Maintenance Decommissioning	• Design devices to minimise risk of leakage of pollutants. • Risk assessment and contingency planning. • Design to reduce risk. • Avoid shipping routes.
Electromagnetic fields	Survey and Installation Operation and Maintenance Decommissioning	• Cable export design to minimise EMF fields.
Marine Noise	Survey and Installation Operation and Maintenance Decommissioning	• Minimise use of high noise emission activities such as impact piling and avoid installation during sensitive periods. • "Soft starting" piling activities – gradually increasing noise produced to allow mammals to move away from activities. • Use of Marine Mammal Observers. • Underwater noise during operation may be beneficial in alerting species to the presence of the device, reducing the risk of collisions. This requires further research.

Hauling-out	Survey and Installation Operation and Maintenance Decommissioning	• Consideration should be given to whether any surface platforms have moving parts that would cause injury.

10.8 Confidence and Knowledge Gaps

In general, only a low confidence can be based on the significance of impacts on marine mammals – both cetaceans and seals. This is due to both a limited understanding of mammal distribution at sea and of the possible interactions, and implications of interactions with devices.

Baseline Data

<u>Distribution</u>

The Bailiwick of Guernsey has a small colony of Atlantic Grey Seals which are frequently observed in its waters. The colony is situated on the Humps off the north coast of Herm, and comprises approximately 3-8 individuals, although this number can vary. Guernsey is on the southernmost limit of the Atlantic Grey Seal's range, along with Jersey and Brittany, hence the reason for the small number. However, individual seals are often observed around Guernsey's coastline, including Portelet, Moulin Huet, Cobo, Pembroke, Beaucette, etc. There is little information held about the breeding status of seals, although pups are often found (normally around 1-3 cases per annum) apparently abandoned by their mothers on Guernsey beaches, probably separated by autumn and winter storms. These pups are usually medivac'd to seal rescue centres in the UK.

Research into the at-sea foraging ranges has not been carried out, but it is known that seals generally feed in most areas around Guernsey waters, particularly areas where there is an abundance of target prey species, including mackerel, bass, and other roundfish.

Atlantic Grey Seals have been tagged and tracked using satellite telemetry and are known to regularly migrate from the west coast of Scotland to the Channel Islands and Brittany (Sea Mammal Research Unit, University of St. Andrews). Atlantic Grey Seals are known to travel up to 70 miles in one day and are therefore highly mobile.

Existing information on the distribution on cetaceans is of considerably lower resolution than that for seals. The main databases are held by the Guernsey Biological Records Centre but distribution maps have also been plotted for the species by the Groupe d'Etude des Cetaces du Cotentin (GECC) in an ecological study for the creation of an offshore windfarm commissioned by ENERTRAG dated July 2009.

Abundance

Abundance estimates of Atlantic Grey Seals are of comparatively high quality and precision. However, population estimates for cetaceans in Bailiwick waters are of a much lower resolution due to the highly mobile nature of these species. Whether groups of cetaceans recorded during one sighting are the same as those recorded in another sighting report is open to speculation. However, it is known that there is a population of 20+ Bottlenose Dolphins regularly observed east of Sark, and Common Dolphins are regularly observed in Bailiwick waters in large groups of 20+ individuals, and on some occasions 100+ individuals.

Use of Tidal Streams by Seals and Cetaceans

Many seal and cetacean species (particularly seals, harbour porpoises and bottlenose dolphins) transit through, and forage in, narrow coastal waterways that are subject to strong tidal flows. This is because these are often areas of high productivity due to mixing of different water layers and therefore represent good opportunities for foraging. These areas are also likely to be important for the deployment of tidal devices. A better understanding of the foraging biology of these species in high flow areas would therefore be valuable to understanding how these species and devices might interact.

Recent research suggests hotspots (key foraging locations for multiple top marine predator species) are spatially quite limited (Scott *et al*. 2005). Some of these locations may only be obvious or represent critical habitat on a seasonal basis, but are essential for the transfer of food resources through multiple trophic levels. Identifying the locations of hotspots and determining what level of change will affect their unique properties may be a very efficient method to greatly increase the certainty in the environmentally sound deployment of the offshore renewable industries.

Foraging Mechanisms and Prey Detection

Unlike odontocete cetaceans, mysticetes and seals do not produce echolocation sounds to locate their prey and the mechanisms of prey detection are poorly understood. It is likely that passive listening is used by both groups and seals may also use their vibrissae to sense small hydrodynamic vibrations and flow vortices produced by their prey. Disruption or masking of these signals would make species particularly vulnerable to disturbance from marine renewable energy devices. A better understanding of how seals and baleen whales find prey would be required to assess and understand the impacts of tidal and wave energy devices on the foraging success of these species.

Potential Interactions with Devices

Whilst information exists on how whales, dolphins and porpoises interact with moored gear, moving vessels and construction vessels, knowledge of their interactions with underwater turbines in strong currents is severely limited. For tidal energy generation this is clearly a significant knowledge gap. Likewise the noise and potential surface barrier effect produced by wave generators remains to be investigated. It is likely that not all seals will behave in the same way around marine renewable energy devices. For example, some age/gender groupings may be more vulnerable to collisions or disturbance than others. It would therefore be valuable to invest further research effort in understanding at-sea seal distribution by these groupings when better information becomes available on how seals and renewable devices might interact.

Odontocete cetaceans use passive listening, echo-location and other vocalisations to locate and capture prey. The mechanisms that mysticete whales and seals use to find prey is less understood but it is likely that passive listening plays an important role. All marine mammals also use sounds to communicate and most probably to detect predators. Therefore, noise produced by marine renewable devices have the potential to impact these species either through masking of the noise they are listening to or through physiological damage to their hearing.

A variety of marine mammal species have been shown to respond to man-made sounds in the ocean. These impacts could manifest themselves through changes in behaviour such as area avoidance or attraction, physical damage of hearing, panic responses or changes in fecundity or survival.

To determine what acoustic impact marine renewable energy devices may have, a first stage is to determine whether these devices emit sound energy at frequencies audible to the species of concern. More information is therefore required on the likely levels of sound outputs from these devices. Currently only noise measurements for a single type of wave and tidal device are available and this does not give sufficient indication of the range of acoustic signatures of devices. In addition, further information on the levels of background noise in the areas where the devices are likely to be located is also required. These acoustic outputs then need to be considered in relation to the hearing sensitivities of the species of concern. Audiograms exist for the seals and some of the odontocetes found around the UK but currently for none of the mysticete cetaceans.

Identified data gaps, and opportunities for filling the data gaps are given in the table overleaf.

Table 10.8.1: Data Gaps – Marine Mammals

Data Gap	Unknown	Potential to Fill Data Gap
Seals distribution and abundance.	• Fine-scale at-sea distribution over most areas. • Why areas of high tidal flow are favoured by many species, and three dimensional uses of these areas.	Individual project related site specific survey.
Cetaceans distribution and abundance.	• Fine-scale distribution in most areas. • Winter distribution, and seasonal movements and population trends not understood.	
Capacity of key senses in seals and small cetaceans and abilities to detect devices.	• Mysticete (baleen whale) hearing unknown. • Sensory abilities of large whales. • How all species use their senses to detect and catch prey. • Whether outputs from devices will mask biologically relevant cues. • How much warning information devices will produce. • How moving structures (e.g. turbines) will be perceived by echo locating species. • Impact of environmental circumstances (e.g. darkness, turbid water, background noise) on perception distances and hence escape options. • Severity of sensory abilities (such as echolocation) being comprised by other activities such as foraging, social interaction, etc. (Collision with nets suggests confusion/distraction occurs).	Observation/monitoring of appropriately sited demonstration devices deployed in the field.

Data Gap	Unknown	Potential to Fill Data Gap
Collision risk – behavioural response of seal and cetacean species to marine renewables.	• Reaction distances to devices. • Precise responses on detection of devices (attraction/avoidance/evasion, etc.) • Confusion – Interactions between multiple devices on avoidance/evasion options. • Illogical behaviour – how marine mammals will perceive then respond to new structures in the marine environment. • Behavioural responses of animals once devices are detected. • Surfacing options when animals at or past their aerobic diving limits. • Impacts of buoyancy constraints on vertical manoeuvring options.	Escape options modelling: desk-based modelling of avoidance options given the sensory and mobility of the different species and the upstream sensory cues put out by marine renewable devices. Observation/monitoring of appropriately sited demonstration devices deployed in the field.
Physiological impacts	• Magnitude of collisions required to cause significant injuries. • Relative vulnerabilities of different parts of the body in different species. • Post-mortem signs in/on carcasses following injury. • Signature of any non-lethal signs in living animals following collisions.	Observation/monitoring of appropriately sited demonstration devices deployed in the field.

10.9 Residual Effects

The table in this section summarises the overall significance of the potential effects identified for marine mammals in the study area, and indicates how the residual effects might be reduced through the application of appropriate mitigation. As previously stated the assessment of significance has been limited by a number of factors which need to be borne in mind when reading the significance tables and accompanying mapping.

The significance assessment applies the precautionary principle approach to assessment of impacts and therefore, for the most part, presenting the maximum potential effects. However, confidence in the significant assessment is limited by the following factors:

- With the exception of Atlantic grey seals hauled out on land, there is limited spatial distribution information for marine mammal populations in the study area. It therefore has not been possible to map significance of the majority of impacts identified.

- There is very limited information on the sensitivity of marine mammals, and behavioural responses of marine mammals to wave and tidal devices.

Table 10.9.1: Potential and Residual Significance of Effects – Marine Mammals

Potential Effect	Device Characteristics	Development Phase	Receptor	Potential Significance of Effects	Industry Good Practice Mitigation	Likelihood of Occurrence	Residual Significant Effects	Confidence
Collision risk (Construction)	All wave and tidal	CD CC	Seals and Cetaceans	Moderate	Avoid key seasons and areas; high visibility of vessels	High	Minor	High
Physical disturbance	All devices and cables	CC CD	Seal colonies (breeding/moulting) Seal colonies (breeding/non-moulting)	Major Moderate	Avoid key seasons and areas	High	Minor	High
Marine Noise (construction)	Piled devices	CC CD	Seals and cetaceans	Major	Use of "soft start" techniques; MMOs	High	Minor	Low

Potential Effect	Device Characteristics	Development Phase	Receptor	Potential Significance of Effects	Industry Good Practice Mitigation	Likelihood of Occurrence	Residual Significant Effects	Confidence
Increased suspended sediment and turbidity (reduced visibility)	Piled devices and cables	CD CC OD	Seals and cetaceans	None	None identified	High	Negligible	High
Collision risk (operation)	All wave and tidal	OD	Seal and Cetaceans	Major	Avoid key areas; high visibility of devices	Unknown	Unknown	Very Low
Marine noise (operation)	All wave and tidal	OD	Seals and Cetaceans	Unknown	None identified	Unknown	Unknown	Very Low
Barrier to movement	All wave and tidal	OD	Seals and Cetaceans	Major (constrained areas)	Avoidance of key areas	Unknown	Unknown	Low
Habitat exclusion	All wave and tidal	OD	Seals and Cetaceans	Moderate	Avoidance of key areas	High	Minor	Moderate

Potential Effect	Device Characteristics	Development Phase	Receptor	Potential Significance of Effects	Industry Good Practice Mitigation	Likelihood of Occurrence	Residual Significant Effects	Confidence
Decrease in water flow	All tidal	OD	Seals	None	None identified	High	None	Low
Contamination from anti-fouling paints	Devices using anti-foulants and sacrificial anodes	OC	Seals and Cetaceans	Minor	Device design; use of low toxicity chemicals	Low	None	Moderate
Accidental contamination (hydraulic fluids or vessel fuel/cargo)	Devices using hydraulic fluids	CC CD OD	Seals and Cetaceans	Major	Device design to minimise risk	Very low	None	Low
EMF	Export cables	OC	Seals and Cetaceans	None	None identified	Low	None	Low
Haul out	Devices with surface structures	OD	Seals	Unknown	None identified	Unknown	Unknown	Very Low

Potential Effect	Device Characteristics	Development Phase	Receptor	Potential Significance of Effects	Industry Good Practice Mitigation	Likelihood of Occurrence	Residual Significant Effects	Confidence
Increased foraging opportunities	All wave and tidal	OD	Seals and Cetaceans	Unknown	None identified	Unknown	Unknown	Very Low

CD = Construction/decommissioning impact – devices

CC = Construction/decommissioning impact – cables

OD = Operation impact – devices

OC = Operation impact -cables

10.10 Recommendations for Survey and Monitoring

Introduction

Marine ecosystems are by their very nature incredibly intricate and complicated. Mankind's understanding of marine ecology is still in its relative infancy, and establishing cause and effect in marine systems is notoriously difficult. Establishing whether marine renewable energy devices will have an impact on marine mammal populations will be particularly challenging. This is primarily due to the highly mobile nature of marine mammal species and it is therefore difficult to determine with any accuracy the frequency of impact such devices would have on cetaceans and pinnipeds. Secondly, other variables such as prey availability, climate change and other anthropogenic effects (e.g. noise from shipping, chemical pollution of the oceans from industrial activities) affect these species. Unless marine renewable energy devices have a high level of impact, then it will be difficult to differentiate between the impact these devices have in comparison to other factors.

Measures of population size remain an important context within which to view any of the interactions. For example, one fatal collision per annum may be insignificant when contrasted with a growing and large marine mammal population. However, it could be much more significant for a smaller population which is in decline and is listed as an endangered or threatened species within international legislative and conservation frameworks.

It is important to emphasise that all the marine mammals listed in this document are European Protected Species, which are afforded legal protection under various laws. Therefore measures of population size, reproductive output and survival remain significant and valid monitoring goals. Targeted survey and monitoring of marine mammals associated with a specific development will need to be determined and part of the EIA and consenting process, but some suggested aspects that this would need to take account of are given below. In each case, it is important that the surveying protocols and post-construction monitoring techniques and methodologies agreed upon need to be both scientifically and statistically robust.

Baseline Survey

For specific developments, baseline data will need to be collected to inform the project EIA, and as a baseline against which impacts can be monitored. At its simplest, this is the marine mammal species (including any age/gender bias) that use the areas likely to be impacted prior to the development of the sites. Marine systems in temperate latitudes are variable seasonally but also from one year to another so the study therefore needs to be historically grounded to determine whether it is representative. It is suggested that baseline surveys should be used to collect the following data:

- Composition and abundance of species using area (literature and field studies).
- Assessment of total population size for impact assessment.
- Tidal, diurnal and seasonal abundance in site.
- Patterns of animal movement in site (especially sites in constricted waterways).
- Background measurement of ambient underwater noise.

Monitoring

The specifics of a programme to assess and mitigate impacts will depend greatly on the nature of the location, species involved and devices employed. It is suggested that monitoring surveys should be undertaken to collect the following data:

- Assessment of how animals interact with device(s).
- Re-evaluation of tidal, diurnal and seasonal use of the site.
- Re-evaluation of species abundance and patterns of animal movement in and around the site.
- Measurement of underwater noise around the device(s).

SMRU have been developing a monitoring protocol, covering both data collection and data analysis for marine turbine development areas. These studies are ongoing in Eday, Orkney; and in Strangford Narrows, Northern Ireland, with the aim that the protocols can be developed into an industry standard and will be applicable at any other location.

References

Basslink, (2001), Draft Integrated Impact Assessment Statement, June 2001.

Boran, J.R., Evans, P.G.H. and Rosen, M. (2001) Behavioural Ecology of Cetaceans. Pp. 191-236. In: Marine Mammals: Biology and Conservation (Editors P.G.H. Evans and J.A. Raga). Kluwer Academic/Plenum Press, London. 630pp.

Boran, J.R., Evans, P.G.H., Reid, J.B. and Northridge, S. (1999) Cetaceans in northeastern Atlantic waters, using diverse sightings sources to monitor distribution and relative abundance. Pp. 81-87. In: European Research on Cetaceans - 13. (Editors P.G.H. Evans and E.C.M. Parsons). European Cetacean Society, Valencia, Spain. 436pp.

Cresswell, Walker *et al*, A Report on the Whales and Dolphins and Seabirds of the Bay of Biscay and the English Channel. Organisation Cetacea 2001 (ORCA No.1)

Cresswell, Walker *et al*, The Annual Report of Organisation Cetacea No.2

Evans, P.G.H. and Hammond, P.S. (2004) Monitoring Cetaceans in European Waters Mammal Review, 34, 131-156.

Evans, P.G.H. and Nice, H. (1996) Review of the effects of underwater sound generated by seismic surveys on cetaceans. Report to UKOOA.. Sea Watch Foundation, Oxford. 50pp.

Faber Maunsell & Metoc, Scottish Marine SEA (2007): Environmental Report Section C Chapter 9: Marine Mammals: pp: 1-42.

Gavet M (2000), The Bailiwick of Guernsey Sea Mammal Report, La Societe Guernesiaise Report and Transactions, Vol XXIV, Part IV, pp840-848

Gavet M (2001), The Bailiwick of Guernsey Sea Mammal Report, La Societe Guernesiaise Report and Transactions, Vol XXV Part I, pp27-37

Gavet M (2002), The Bailiwick of Guernsey Sea Mammal Report, La Societe Guernesiaise Report and Transactions, Vol XXV, Part II, pp240-255

Gavet M (2003), The Marine and Cetacean Sections Report for 2003, La Societe Guernesiaise Report and Transactions, Vol XXV, Part III, pp 446-454

GECC Etude d'impact – Expertise Mammalogique en vue de la creation d'un parc eolien offshore sur la zone de Flammanville. Etude realise pour ENERTRAG. (2009)

Gill, A.B., (2005) Offshore renewable energy: ecological implications of generating electricity in the coastal zone, Journal of Applied Ecology http://www3.interscience.wiley.com/journal/118735261/abstract?CRETRY=1&SRETRY=0

Gordon, J; Gillespie, D; Potter , J; Frantzis, A; Simmonds, M.P; Swift, R; Thompson, D; A Review of the Effects of Seismic Surveys on Marine Mammals (2003/04) http://www.pelagosinstitute.gr/en/pelagos/pdfs/Gordon%20et%20al.%202004,%20Review%20of%20Seismic%20Surveys%20Effects.pdf

Harris, R.E., Miller, G.W., and Richardson, W.J. (2001) Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. *Marine Mammal Science* 17: 795-812

Harwood, J. and B. Wilson, et al (2001). "The implications of developments on the Atlantic Frontier for Marine Mammals". Continental Shelf Research **21**: 1073-1093.

Hastie, G.D., Wilson, B., et al. (2004). "Functional mechanisms underlying cetacean distribution patterns: hotspots for bottlenose dolphins are linked to foraging". Marine Biology **144**: 397-403.

Loaring, K (1996) The Bailiwick of Guernsey Sea Mammal and Shark Report for 1996, La Societe Guernesiaise Report and Transactions 1996, Vol XXIV Part I, pp 64-65

Loaring K (1997) The Bailiwick of Guernsey Sea Mammal Report for 1997, La Societe Guernesiaise Report and Transactions 1997, Vol XXIV, Part I, pp 216

Loaring K (1998) The Bailiwick of Guernsey Sea Mammal Report for 1998, La Societe Guernesiaise Report and Transactions 1998, Vol XXIV, Part III, pp 400

Loaring K (1999), The Bailiwick of Guernsey Sea Mammal Report for 1999, La Societe Guernesiaise Report and Transactions, Vol XXIV, Part IV, pp 618

MacLeod, K., (2006). Quarterly newsletter for project SCANS-II: Small Cetacean in the European Atlantic and North Sea. Issue 7. June 2006.

Marine Conservation Society offshore wind farm advice for Scoping Study for an Environmental Impact Assessment (2002)

Matthiopolous, J., McConnell, B., Duck, C. and Fedak, M. (2004). Using satellite telemetry and aerial counts to estimate space use by grey seals around the British Isles. *Journal of Applied Ecology* 41: 476-491.

Mendes, S.W. Turrel, et al. (2002). "Influence of the tidal cycle and a tidal intrusion front on the spatiotemporal distribution of coastal bottlenose dolphins". Marine Ecology Progress Series **239**: 221-229

Northridge, S.P., M.L. Tasker, et al (1995). "Distribution and relative abundance of harbour porpoises (*Phocoena phocoena* L.), white-beaked dolphins (*Lagenorhynchus albirostris* Gray), and minke whales (*Balaenoptera acutorostrata* Lacepede) around the British Isles". ICES Journal of Marine Biology **52** (1): 55-66.

Perrin, W.F., Bernd Wursig, Thewissen J.G.M., Encyclopedia of Marine Mammals Second edition.

Petersen, J.K, and Malm, T - Offshore Windmill Farms: Threats to or Possibilities for the Marine Environment, AMBIO - A Journal of the Human Environment (see link below) http://ambio.allenpress.com/perlserv/?request=get-abstract&doi=10.1579%2F0044-7447(2006)35%5B75%3AOWFTTO%5D2.0.CO%3B2&ct=1

Reeves, R.R, Stewart, B.S., Clapham, P.J., Powell, J.A., Sea Mammals of the World (2002) A&C Black

Reid, J.B., P.G.H. Evans, et al. (2003). Atlas of cetacean distribution in north-west European waters. Peterborough, Joint Nature Conservation Committee: 1-82.

Royal Haskoning, (2005). Strangford Lough Marine Current Turbine Environmental Statement. [Confidential report – restricted access]

Scott, B.E., Sharples, J. Ross, O. and Camphuysen, K. (2005). Hotspots: Marine top predator foraging habitat predicted from a detailed understanding of temporal and spatial oceanographic processes. ICES ASC 2005 CM O: 39, pp. 22.

SMRU (Sea Mammal Research unit) Website: http://smub.stand.ac.uk/Current Research.htm/scos.htm Scientific Advice on Matters Related to the Management of Seal Populations, 2005. UK Special Committee on Seals, Advice. 2005.

Stockin, K., Vella, A. and Evans, P.G.H. (editors) (2005). Common dolphins: current research, threats and issues. Proceedings of workshop held at the European Cetacean Society 18th Annual Conference, Kolmården, Sweden, 1 April 2004. ECS Newsletter No. 45 - Special Issue. 39pp.

Suryan, R.M., Harvey, J.T. (1999). Variability in reactions of Pacific harbour seals, Phoca vitulina richardsi, to disturbance. *Fishery Bulletin* 97: 332-9.

Thomson, F., Ugarte, F. and Evans, P.G.H. (editors) (2005). Estimation of G(0) in line-transect surveys of cetaceans. Proceedings of workshop held at the European Cetacean Society 18th Annual Conference, Kolmården, Sweden, 28 March 2004. ECS Newsletter No. 44 - Special Issue. 46pp.

Thompson, D., Hammond, P.S., Nicolas, K.S., Fedak, M.A. (1991). Movements, diving and foraging behaviour of grey seals *Halichoerus grypus*. *Journal of Zoology* 224: 223-232.

Thompson, P.M., Grellier, K., and Hammond, P.S. (2000). Combining power analyses and population viability analyses to compare traditional and precautionary approaches to managing coastal cetaceans. *Conservation Biology* 14: 1253-1263.

Thomsen, F., Ludemann, K., Kafermann, R., and Piper, W. (2006). Effects of offshore wind farm noise on marine mammals and fish. Biola, Hamburg, Germany on Behalf of COWRIE Ltd.

Tougaard, J., Carstensen, J., Henriksen, O.H., Skov, H., & Teilmann, J. (2003). Short term effects on the construction of wind turbines on harbour porpoises at Horns Reef. Technical report to Techwise A/S. Hedeselskabet.

UK Special Committee on Seals (2005). Scientific Advice on Matters Related to the Management of Seal Populations: 2005.

Waring, G.T., Palka, D.B. and Evans, P.G.H. (2008). North Atlantic Marine Mammals. Pp. 763-771. In: Encyclopedia of Marine Mammals (Editors W.F. Perrin, B. Würsig and J.G.M. Thewissen). Academic Press, San Diego. 1,450pp

Wilson, B., Batty, R.S., Daunt, F., and Carter, C. (2006). Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Scottish Association for Marine Science, Oban, Scotland, PA37 1 QA.

Würsig, B. and Evans, P.G.H. (2001) Cetaceans and humans: influences of noise. Pp. 555-576. In: Marine Mammals: Biology and Conservation (Editors P.G.H. Evans and J.A. Raga). Kluwer Academic/Plenum Press, London. 630pp.