Manx Marine Environmental Assessment

Ecology/ Biodiversity

Marine Mammals - Cetaceans

Whales, dolphins & porpoise in Manx Waters.

Bottlenose dolphins in front of Douglas lighthouse. Photo: Manx Whale and Dolphin Watch.

MMEA Chapter 3.4 (a)

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Manx Marine Environmental Assessment

1.1 Edition: October 2018 (partial update)

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Whales, dolphins & porpoise in Manx Waters.

Summary

- Historic scientific opinion suggests that cetaceans are scarce in Manx waters; however there had been limited systematic surveying to endorse this.
- Recent dedicated survey work (since 2007) has shown that five cetacean species can be considered frequent in Manx waters: Harbour porpoise, Risso's dolphin, Minke whale, Bottlenose dolphin and Common dolphin.
- All species of cetacean (whales, dolphin and porpoise) are protected under Isle of Man Legislation and International conventions to which the Island is signatory.
- Cetacean species are part of what is known as 'Royal fish', and when beached, theoretically The Queen (as Lord of Mann) can claim ownership. The Department of Environment, Food and Agriculture has responsibility to handle and investigate stranded cetaceans due to their protected status.
- The majority of strandings are harbour porpoise, with 39 reported between 2005 and 2016.
- Harbour porpoise are the most abundant cetacean species and are present in Manx waters throughout the year, though more regularly seen in the summer.
- Harbour porpoise have been seen throughout Manx waters and there are definite hotspots including at the Irish Sea front and off the Ledges, Port St Mary.
- Risso's dolphins show marked spatial and temporal distribution in Manx waters, being present only between March and September and with 90% of sightings on the east coast of the Island.
- A Risso's dolphin photo-identification catalogue (established 2007) is currently based on 62 encounters, with a minimum population size of 91 individuals. Several of the individuals have been seen again in different years, suggesting a degree of seasonal residency to Manx waters.
- This consistent and prolonged residency, as well as the frequent presence of calves within groups (31.0% of groups contain calves), suggests that Manx waters may represent Critical Habitat for Risso's dolphins.
- Minke whales also show a high degree of seasonality to Manx waters, being present between June and the end of November.
- Bottlenose dolphins are mainly seen in Manx waters between October and March, although are becoming seen more frequently during the summer.
- The Bottlenose dolphin photo-identification catalogue (established approx. 2010) currently contains a minimum of 76 different individuals. Comparison of images to a similar catalogue in Cardigan Bay, Wales, has confirmed movement of individuals between the two areas.
- The temporal distribution of Common dolphins in Manx waters matches that of Common dolphins throughout the UK, being seen mainly between May and September.

- The most likely negative anthropogenic impact from any coastal and offshore development would be from anthropogenic noise, particularly from construction activities and device operation.
- It is also possible that species which seasonally migrate in and out of Manx waters are negatively affected by activities elsewhere.
- The use of acoustic detection devices and the continuation of effort-based surveys from land and sea will help increase the knowledge of spatial and temporal distributions and population estimates of all cetacean species in Manx waters.

Introduction

Whales, dolphins and porpoises are collectively known as cetaceans. Ten species have been confirmed recorded in Manx waters since 2006. Of these, the most regularly sighted cetacean is the harbour porpoise which remains resident in Manx waters; others including Bottlenose dolphin, Common dolphin, Risso's dolphin and Minke whale are occasionally sighted and the remaining are considered rare visitors.

Cetaceans are very mobile and can range widely with some undertaking large seasonal migrations, leaving and entering Manx waters in the process, often hidden from view beneath the waves. Other species are more localised in their distribution, keeping close to the Manx coast and are often observed from the Manx coastal path.

This chapter provides an introduction to the species found on the Isle of Man, the survey work of Manx Whale and Dolphin Watch with valuable input from the Manx public with sighting records made to www.mwdw.net; and the data on Manx cetaceans that is currently available and improving through recent effort based survey work. The chapter also refers to recent research collaborations and initiatives with organisations neighbouring jurisdictions (UK and Ireland).

An initial summary of current risks and the potential effects of any future development in Manx waters is also provided with reference to work being undertaken elsewhere. A few initial generic mitigation measures are also suggested and while not intended to be fully comprehensive it is hoped to assist in any future discussions. A few key recommendations for survey work and improvements in data accessibility and sharing between local organisations, the Isle of Man Government and externally is also presented.

Cetaceans in Manx waters

Both historical and more recent scientific opinion suggests the Irish Sea, in terms of cetacean presence, can only really be noted for resident Bottlenose dolphins in Cardigan Bay and for mixed species, predominantly Common dolphins and Minke whales, in St Georges channel in the south. Of the 20 or so species seen with some regularity in the British Isles and Ireland, only eight are considered as frequently seen in the Irish Sea (Shaw 1990). These are Harbour porpoise (*Phocoena phocoena*), Bottlenose dolphin (*Tursiops truncatus*), Risso's dolphin (*Grampus griseus*), Common dolphin (*Delphinus delphis*), White-sided dolphin (*Lagenorhyncus acutus*), Long-finned pilot whale (*Globicephala melas*), Killer whale (*Orcinus orca*) and Minke whale (*Balaenoptera acutorostrata*).
Historically, records of cetaceans around the Isle of Man have been scarce. The first documented mention was in 1587, at the Great Enquest of Rushen, during which a man was fined for "concealing a porpos fish" (Craine 1942), which at the time was considered a crime as all porpoises were the property of the crown. All of the other historical records come from strandings, for example of a Sei whale (*Balaenoptera borealis)* (Sargeant 1925), of a Risso's dolphin (Bruce 1939) and of a Bottlenose dolphin (Bruce 1940).

However, as far back as 1917, in a pamphlet written by PMC Kermode (Sargeant 1925), the presence of cetaceans in Manx waters was recognised. It was noted that the porpoise is seen close to shore every year, the common rorqual (Minke whale) was seen often and that the Grampus or common killer (Risso's dolphin) and the lesser killer (dolphin species) were well known to fishermen.

Furthermore, it was appreciated that the presence or absence of cetaceans was a good indicator of the abundance of fish and other marine life. The same author also noted that most cetacean knowledge had come from strandings and that all cetacean sightings should be reported (Bruce 1939). Bruce *et al*. (1963) also wrote the last comprehensive marine fauna of the Isle of Man, which contained records of the lesser rorqual (minke) (*Balaenoptera acutorostrata*), the Sei whale (*Balaenoptera borealis*), bottle-nosed whale (*Hyperoodon ampulatus*), harbour porpoise (*Phocaena phocaena*), Risso's Dolphin (*Grampus griseus*), Bottle-nosed dolphin (*Tursiops truncatus),* white-beaked dolphin (*Lagenorhynchus albirostris*). However, as it remained for more than half a century, there was no means to formally report cetacean sightings.

More recently, with increasing anthropogenic pressures and the realisation of the effects such pressures could be having on the marine environment, scientific studies on the Irish Sea have been carried out. The majority of studies looking into cetacean status in the Irish Sea concluded that they were at best scarce, with the majority of sightings being in the southern Irish Sea (Evans *et al*. 1986; Shaw 1990; The Irish Sea pilot by DEFRA, Vincent 2004).

Over the years there have been few references to the cetaceans occurring in Manx waters. Evans (1996) gave a brief overview of cetaceans in the Northern Irish Sea and stated that the coastal waters of the region were relatively unimportant for cetaceans. Evans (1996) records the occurrence of harbour porpoise around the Isle of Man and common dolphins to the south-west of the Isle of Man. Evans (2001) also mentioned cetaceans in Manx waters in a paper assessing cetacean presence in Liverpool Bay and adjacent waters in the northern Irish Sea. Again, Evans (2001) says that these waters were not considered rich areas for cetaceans compared to other parts of the United Kingdom. However, Risso's dolphins and Harbour porpoise were reported to occur all round the Island, Bottlenose and Common dolphins off the south-west coast and Minke whales offshore.

Both historically and more recently, there is an absence of formal records of cetaceans in Manx waters. However, this does not equate to there being evidence of absence. There is a great deal of anecdotal evidence of cetaceans around the Isle of Man, from fishermen, marine users and casual observers of the sea. The creation of Manx Whale and Dolphin Watch (MWDW) in 2006 gave local people and visitors to the Island and Manx waters, a means to report cetaceans that previously had not existed.

Protection of cetaceans in Manx waters

All species of whales, dolphins, porpoises are protected under the Wildlife Act 1990. As indicated under Schedule 5 of that Act: Whales (All Species) Cetacea.

Under the act they are protected from being killed, injured or taken. They are also protected from any actions which damage or destroy places used by these species for shelter and protection or which disturbs an animal occupying a place of shelter or protection. The sale and possession of these species is also an offence.

The Agricultural (Miscellaneous Provisions) Act 2008 provided additional protection to marine protected species by making intentional and reckless disturbance of cetaceans an offence.

This strengthening of the Wildlife Act with respect to marine species is significant in relation to disturbance. An ongoing education programme for boat users has been used to attempt to reduce wildlife disturbance, included regular press releases and also the WiSe training of commercial boat operators. The WiSe Scheme has been used in the UK and overseas to improve boat operators' knowledge of marine species behaviour and protection status. See http://www.wisescheme.org/ for further details and links local boat operators who have received training under the scheme.

Manx Whale & Dolphin Watch

The non-governmental organisation of Manx Whale and Dolphin Watch (MWDW) was set up initially as a website and went online in June 2005. Since then, the number of people that

have registered to the website has been increasing rapidly, now including over 400 people, about 0.5% of the population of the island. In 2007, Manx Cetacean Surveys were started, the first ever systematic boat surveys carried out in Manx waters. The surveys again depend on a dedicated group of volunteers, over fifty being registered as boat-based volunteers.

As a community project the organisation is volunteer led and funded by donations. Project support has on occasion been received from DEFA & DfE (Department for Enterprise), for individual projects and to support survey work and the public sightings scheme.

Strong collaborations between MWDW and other non-government organisations on the Island notably Manx Wildlife Trust, Manx Basking Shark Watch, Manx Birdlife and other organisations that make up the Manx Biological Recording Partnership. In the absence of a Manx Biological Records Centre, cetacean biological records are maintained by MWDW with agreements to share data between the partner organisations of the Partnership.

Volunteer training and supervision in the survey methods of MWDW is provided by experienced members of MWDW in accordance to the principles of JNCC.

Current data collected

Public sightings

Public sightings are reported to MWDW by one of three methods: either directly to the website, by e-mail or very occasionally by phone. The majority of sightings are reported directly to the website at the following link (upon registration to the site). Sightings reported by experienced reporters are not usually verified, unless the sighting is of a very unusual nature, in terms of species, large group size or unusual behaviour for that species. Any sightings received y inexperienced reporters require a process of systematic verification. This is done by asking a series of non-leading questions, either by phone or e-mail. Once confident that the information is reliable, particularly in terms of species, it can then be verified. If species can't be verified specifically the report is noted as an unidentified. Sightings, once verified, are then noted on the recent sightings page of the website and the data is entered into the MWDW database.

All sightings reported to MWDW are by their nature opportunistic, from the coast or seen from 'platforms of opportunity' e.g. by boat. These sighting reports are recorded by chance and are not part of a dedicated survey for cetaceans. Such sighting reports therefore usually lack information on effort, duration spent looking for cetaceans and what the environmental conditions were including sea state, visibility and wind direction. Opportunistic sightings data also lacks negative reports with since observers are highly unlikely to report when no cetaceans have been seen.

This makes sightings data collected opportunistically a weaker form of data than sightings which have effort related to them e.g. data collected as part of a dedicated survey. However,

these sightings do have inherent value. The data they create is useful to determine presence/absence of a species in Manx waters and can derive useful information regarding vague temporal and spatial trends for a species in Manx waters.

One example of this is the spatial and temporal distribution of Risso's dolphins in Manx waters, derived predominantly from opportunistic sightings. We now know that Risso's dolphins have only been seen in Manx waters between March and October and that they are predominantly seen on the east coast of the island. Another example would be the highly temporal nature of bottlenose dolphins in Manx waters, sightings only ever being reported between late August and March. This temporal regime is completely opposite to the temporal nature of Bottlenose dolphins in Cardigan Bay, leading to the idea that these may in fact be the same dolphins. Currently this is 'unconfirmed speculation' however long term continued research and data collection and data sharing will hopefully enable data to confirm or refute the trends e.g. by applying statistics.

Table 1. The number of public sightings of cetaceans from 2006 to 2015 from MWDW data.

Year	Number of sightings
2006	357
2007	460
2008	295
2009	280
2010	285
2011	264
2012	280
2013	227
2014	243
2015	205

Effort based surveys from land

Effort based dedicated surveys for cetaceans from land have been carried out by MWDW since 2006. Surveys take place at seven sites around the island and are illustrated in Figure 1.

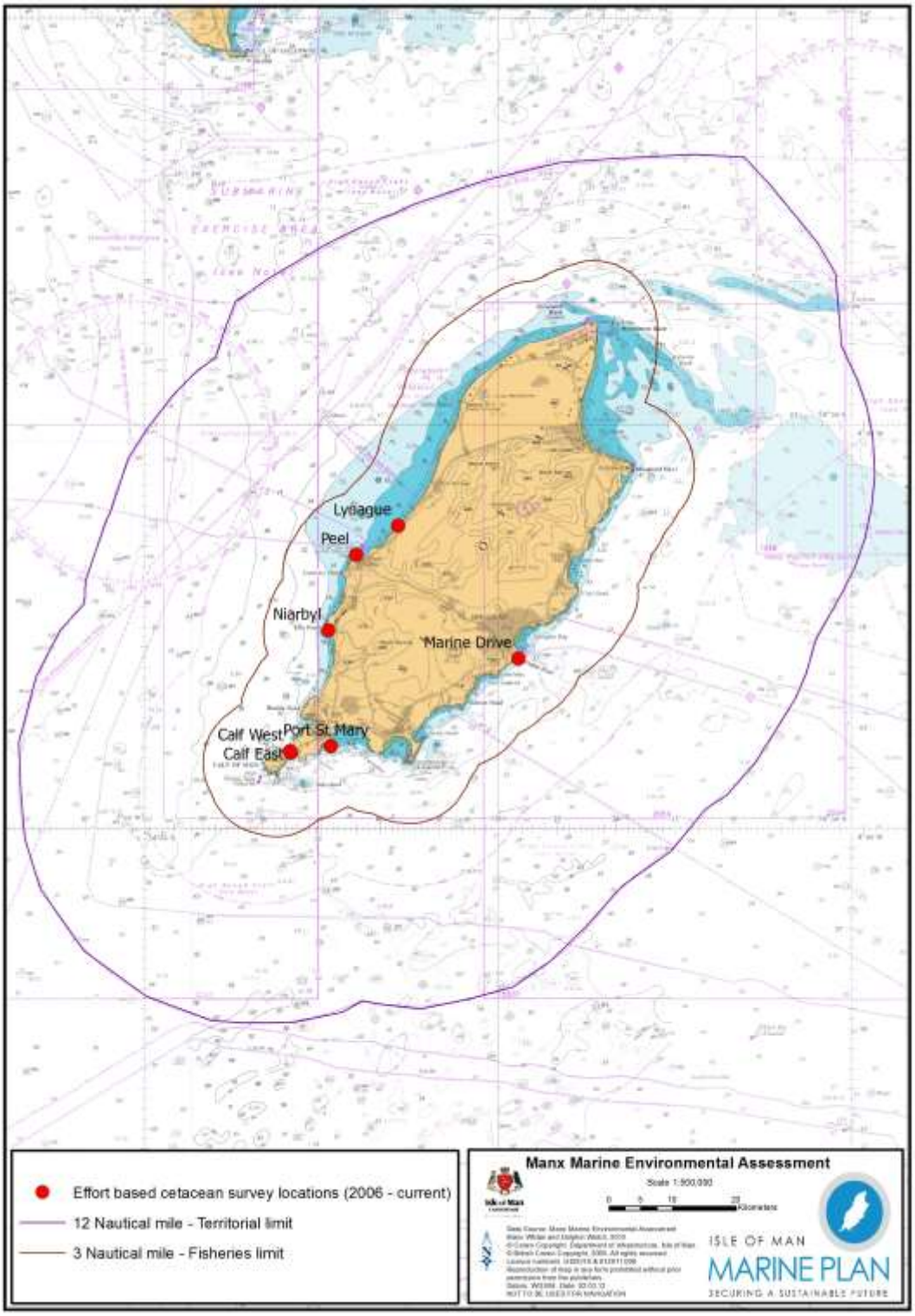

Figure. 1. MWDW Effort based survey locations, (2006 – current).

Marine Drive (Latitude 54º 8.418, Longitude 4º 28.282), Port St Mary (54º 4.072, 4º 44.202), Calf East (54º 3.768, 4º 47.578), Calf West (54º 3.845, 4º 47.630), Niarbyl (54º 9.830, 4º 44.408), Peel (54º 13.574, 4º 42.029) and Lynague (54º 15.005, 4º 38.471).

A lack of resources has thus far prevented any dedicated surveying in the north of the island. However this is an opportunity and following the successful designation of the Ramsey Marine Nature Reserve a focus to marine mammal observation in the north may be gained.

Surveys take place at all times of year and are carried out when the sea state is 3 or less (Beaufort Scale 3 or less). Two observers are used for each survey at each site. Two types of data are collected, effort and sightings. Effort data is recorded once every 15 minutes and records time, wind direction, sea state, swell and visibility. Each fifteen minute period is known as an interval. Sightings information is recorded once per fifteen minute interval per group of cetaceans seen. This includes species, total number of individuals in the group, group composition, behaviour, direction of movement and distance and angle of the group from the observers.

This type of surveying allows for direct comparison between, for example, frequency of sightings between sites or frequency of sightings between months. This in turn can be used to infer spatial and temporal distribution of cetacean species inshore in Manx waters, at least around the south of the island.

Effort based surveys at sea:

MWDW has carried out boat based surveys in Manx waters since 2007 and Figure 2 below shows the locations where cetaceans have been observed during these effort-based surveys at sea.

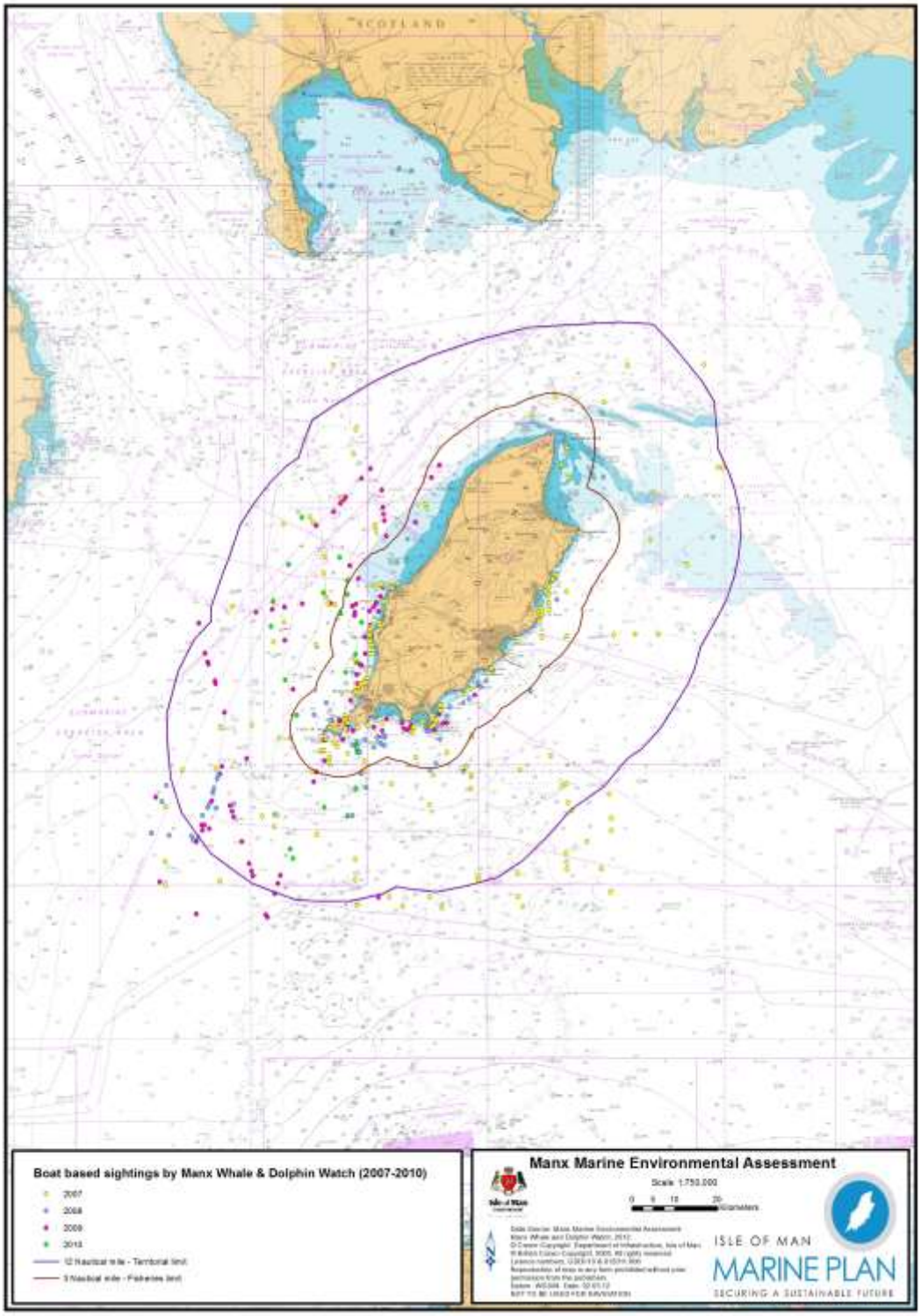

Figure 2. Locations where cetaceans were observed during effort based boat surveys (2007-2010).

Surveys are carried out following standard line transect distance sampling protocol (Buckland *et al*. 2001). This methodology was designed to allow estimation of abundance of biological populations which are statistically sound, something that had previously not been achieved with cetaceans.

Line-transect surveys follow a series of systematic, pre-designed lines throughout the research area, called transects, which are selected randomly for each survey. For the method to be statistically strong, three assumptions have to be met (Buckland et al. 2001):

1) That all objects on the transect line are detected. Statistically this is written as g (0)=1, where g is distance from the transect line and 1 represents a probability of 100%
2) Objects are detected before responding to the vessel
3) Distances and angles are measured accurately.

The first assumption is met using double platform surveying. This uses two sets of observers, one set, known as the primary observers, at the highest point of the vessel, the second set, known as the secondary observers on a lower point, usually the deck. The two sets of observers must remain independent, so neither knows there has been a sighting until they spot the animals themselves. This allows the proportion of sightings missed by the primary observers to be calculated. If $g(0)\neq1$, the abundance estimates gained from the primary observers sightings data can be recalculated to allow for the missed sightings.

In order to meet the third assumption, two pieces of equipment are used to measure distance and angle of the sighting from the vessel; a distance stick and an angle board. Accurately measuring the distance and angle of a sighting from a vessel allows calculation of the perpendicular distance of the sighting from the transect being followed. This is calculated using trigonometry ($D=RSineA$, where D is the perpendicular distance, R is the distance from the vessel and A is the angle from the vessel).

This in turn allows the second assumption to be tested, whether the animals are responding to the vessel. Perpendicular distance and frequency of sightings when plotted should show a negative sigmoidal relationship, known as the probability detection function, whereby there are more sightings at low perpendicular distances. If this is not the case, it suggests animals are reacting to the vessel, positively or negatively, which will skew the overall number of sightings and hence the abundance estimate gained from these sightings.

The data gained from distance sampling using line transects is statistically analysed using a computer based programme called DISTANCE 4.0 to produce an abundance estimate. The calculation is based upon two relationships; firstly, the probability detection function, mentioned above and secondly the fact that bigger groups are more detectable at higher distances than smaller groups. Using these two relationships and the distance travelled when on transect, DISTANCE calculates a density of animals for a particular species, which when multiplied by the research area, gives rise to an abundance estimate.

The survey area consists of all Manx waters up to 12 miles offshore, split into eight roughly equally sized boxes, each of which could be completely surveyed in a day. Within each box are four separate routes. The box and route for each survey are chosen randomly.

A typical survey consists of around 100 nautical miles, consisting of 50 nautical miles on transect. Surveys are only carried out in a sea-state of Beaufort scale 3 or less (10mph or less of wind) and when visibility is 2km or more. When not on transect, effort and sightings information are still recorded, using the same observer configuration as during line transect surveying. The information recorded when not on transect can be used to derive relative abundance between areas and to assess temporal and spatial distributions of cetacean species in Manx territorial waters.

Live and Dead Strandings of Cetaceans

Cetacean species are part of what is known as 'Royal fish', and when beached, theoretically The Queen (as Lord of Mann), has similar rights as in the UK and can claim ownership:

> ***CUSTOMARY LAWS ACT 1422***
> ***5 Royal Fish***
> *Alsoe if any Porpus, Sturgeon, or Whale, be taken within the Heads of Man, they be the Lord's by his Prerogatives.*

The Department of Environment, Food and Agriculture has responsibility to handle and investigate stranded cetaceans due to their protected status. DEFA aim to respond record all stranded protected marine species (seals, cetaceans, basking sharks and turtles), with support from the Manx Wildlife Trust since 2013.

As much information as possible is gathered about the stranded animal, including species, morphometric measurements, any obvious trauma or cause of death and photographs. Where possible, a basic post mortem is carried out either in situ, or at the DEFA laboratory, with assistance from a local vet with a specialism in marine mammals. Details for cetaceans are submitted to the UK Cetacean Strandings Investigation Programme (CSIP).

Seal strandings are also recorded, see Chapter 3.4b Seals for more information.

The UK Cetacean Strandings Investigation Programme (CSIP) is based at the Institute of Zoology in London and strandings information for the Isle of Man is presented in their recent report (Deaville *et al*. 2016).

Between 2004 and 2008 marine strandings were recorded on an ad hoc basis with a more formal system being introduced in 2008, along with increased capacity to attend strandings, which led to more strandings being recorded. In 2013 Manx Wildlife Trust took on the role, on behalf of DEFA, and have attended all reported strandings. Between 2005 and 2016 54 cetacean strandings were recorded around the Isle of Man. This included 39 harbour porpoises, 4 Minke whale, 1 Risso's dolphin and 7 unidentified cetaceans. One of the porpoises was live stranded at Derbyhaven and was successfully returned to the sea by a team of members of the public, DEFA officers and a local vet.

For further information please see: http://ukstrandings.org/.

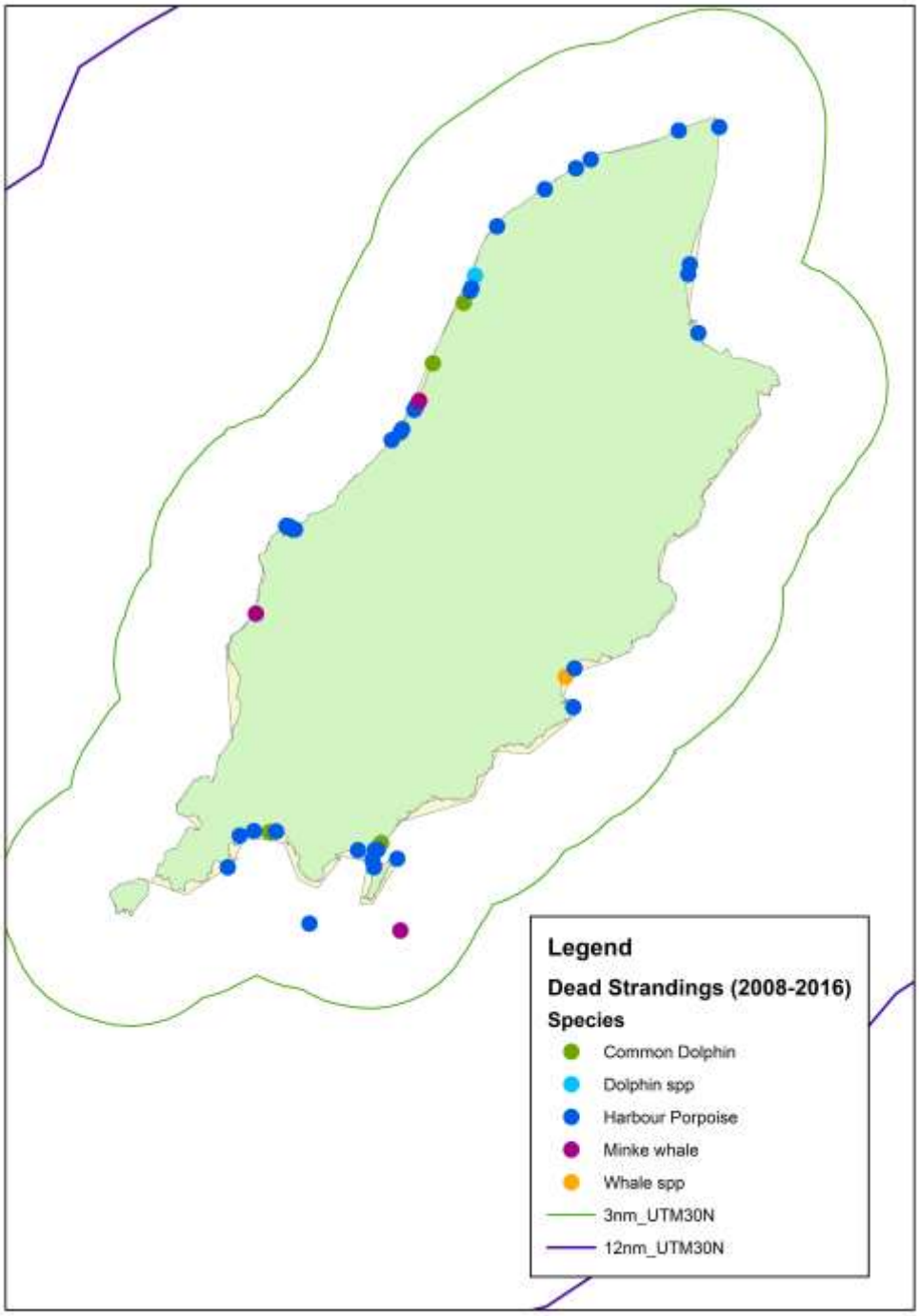

Figure 3. The distribution of stranded cetaceans recorded by DEFA and Manx Wildlife Trust between 2008 and 2016

Awareness Raising and Media Coverage

Raising awareness of cetaceans in Manx waters is best achieved through the public sightings scheme of MWDW and engagement with the local media. The simple act of reporting a sighting to a website gives that person a sense of ownership of that sighting and therefore of cetaceans in Manx waters. Furthermore, knowing that the majority of these sightings are reported by the Manx public, from land, encourages other people to go out and look for cetaceans around the coast. Many islanders are not aware that cetaceans can be seen in Manx waters, thinking that whales and dolphins are purely a tropical taxon. Public sightings schemes are a very cost effective way of changing this perception.

MWDW recognise that many keen observers of cetacean sightings don't have access to the internet and we encourage them to contact us directly to discuss how we can best collate their records.

The public are kept updated with current knowledge about cetaceans in Manx waters and activities through the News page of the MWDW website and other social media including Facebook. This may contain stories about exciting recent sightings, what species can be expected to be seen at the time of year and how to identify them and any upcoming events that may be of interest to the reader. The website itself is in the process of being updated. It will include a species identification guide, merchandise, such as species ID guides on lanyards, photos, postcards etc., an "About Us" section, a cetacean and grey seal blog and an idea called "Diary of a Dolphineer", whereby one of MWDW's volunteers keeps an online diary describing their experiences. This will be on top of what the website currently offers.
MWDW are also hoping to start a newsletter, which will be available electronically from the website and in paper form at various outlets throughout Peel where the organisation is based. MWDW is also going to start writing regular articles in the Manx Wildlife Trust's newsletter, released three times a year. MWDW are hoping that several other Manx magazines/journals will publish cetacean related articles.

The organisation currently does a number of public talks all round the island. In 2011, talks were performed at ten venues, including for Women's Institutes, retirement groups and other social groups. These talks are often attended by over 40 people, hence the talks reaching potentially up to 400 to 500 people each year.

MWDW are going to start holding volunteer training days, whereby members of the Manx public are invited to come and learn how to carry out effort-based surveys from land. It is hoped that the people attending the courses will then be able to carry out their own land based surveys, independently of MWDW. This will not only get people actively involved in the conservation of cetaceans through research, but will significantly increase the spatial coverage of land based surveys.

BBC's Miranda Krestovnikoff and the MWDW volunteers during filming for, 'The One Show' in Manx waters. Photo: L Hanley 2010.

Awareness of cetaceans in Manx waters is also increased through the media, particularly through radio. MWDW was interviewed around ten times in 2011, on range of subjects that tend to be topical. For example, an interview was conducted in November 2011 about the presence of Bottlenose dolphins in Manx waters, following a recent spate of sightings of the species. The lack of time lapse between interview and output is a particular strength of radio. Regular online cetacean related news stories through websites such as BBC North-West, iomtoday and WelcometoIsleofman.com further help to raise awareness and understanding of cetaceans in Manx waters, at least on a local scale.

Raising awareness of cetaceans in Manx waters nationally and internationally has proven to be more challenging. Since 2008, there have been nine articles solely about Manx cetaceans on the BBC's national online news website. MWDW has also been the lead feature on BBC North-West's current affairs programme "Inside Out" and the national BBC programme "The One Show", in which MWDW had a ten minute slot.

Prior to the formation of MWDW presentations on cetaceans were occasionally provided on the Island, as part of the DAFF marine lecture series and at the now closed Port Erin Marine Laboratory.

National and International Links

MWDW has had yearly presence at the European Cetacean Society annual meeting since 2007 and has had poster presentations in 2008 and 2009. The conference is attended by the most eminent marine mammal scientists in Europe and contact has been made with other cetacean organisations throughout Europe through attendance of the conference. MWDW

has also appeared at two of Countryside Council for Wales annual meetings and had a poster presentation at one.

Manx Whale and Dolphin Watch are in regular contact with most of the leading research organisations in the British Isles. These include Sea Watch Foundation (SWF), Whale and Dolphin Conservation Society (WDCS), Hebridean Whale and Dolphin Trust (HWDT), Irish Whale and Dolphin Group (IWDG), Sea Trust in Pembrokeshire, Friends of Cardigan Bay and the Cornwall Wildlife Trust. Data collated by MWDW is made available to SWF for inclusion in their national cetacean sightings database.

Information and data regarding Marine Strandings is provided to the UK's Cetacean Strandings Investigation Programme (CSIP).

Boat based data

Since mid-2007, there have been a total of 41 boat surveys conducted, with survey coverage of 4789 kilometres. There have been a total of 366 sightings during these surveys, including cetaceans, basking sharks and pinnipeds. The species composition of these sightings is as follows:

Table 2: Species composition of boat based sightings. Source MWDW.

Species	No of sightings	No. of individuals	Adults	Juveniles
Bottlenose Dolphin	1	4	4	0
Basking Shark	82	98	90	8
Common Dolphin	3	32	30	2
Common Seal	1	1	1	0
Grey Seal	48	123	123	0
Harbour Porpoise	176	355	347	8
Minke Whale	24	28	26	2
Risso's Dolphin	24	74	64	10
Unidentified Cetacean	7	9	9	0
Total	366	724	694	30

Surveys have been conducted in all months except January and February. The temporal spread of effort is as follows:

Table 3: Temporal spread of effort and sightings. Source MWDW.

Month	Distance (km)	No. of sightings	Sightings/km
January	0	0	0
February	76.7	3	0.039
March	114.1	5	0.044
April	424.8	15	0.035
May	333.5	25	0.075
June	1300.5	140	0.108
July	1145.9	72	0.063
August	263.4	36	0.137
September	526.7	38	0.072
October	508.6	22	0.043
November	94.7	9	0.095
December	0	0	0

Table 4: Spatial spread of effort and sightings. Source MWDW.

Box	Distance (km)	No of Sightings	Sights/km
1	287	24	0.0837
2	140	5	0.0357
3	392	15	0.0383
4	438	43	0.0982
5	725	86	0.1186
6	318	35	0.1100
7	214	36	0.1682
8	226	7	0.0309

For the purposes of boat surveys, Manx waters were split into eight survey "boxes", each box taking up one days worth of surveying. The distances covered in each box represent only the distance travelled whilst on line transects within each box. Box 1 represents the north eastern corner of Manx waters, box 5 the south western corner and box 8 the north western corner.

Effort based data from land

A total of 842 hours and 30 minutes of effort based watches from land have been carried out at seven sites around the island since 2006. The seven survey sites are shown previously in Figure 1.

Table 5: Yearly spread of effort from land based surveys. Source MWDW.

Year	No. of intervals	Time
2006	246	61hrs 30
2007	168	42 hrs
2008	253	63hrs 15
2009	222	55hrs 30
2010	1425	356hrs 15
2011	1056	264 hrs

The overall temporal spread of effort is as follows:

Table 6: Temporal spread of effort of land based surveys. Source MWDW.

Month	No of intervals	Time
January	25	6hrs 15
February	58	14hrs 30
March	73	18hrs 15
April	376	94hrs
May	615	153hrs 45
June	948	237hrs
July	500	125 hrs
August	455	113 hrs 45
September	108	27 hrs
October	104	26hrs
November	49	12hrs 15
December	59	14hrs 45

There were a total of 630 cetacean positive intervals, This represents 18.7% of all intervals. The species composition of these sightings is as follows:

Table 7: Species composition of land based sightings. Source: MWDW.

Species	No. of intervals	No. of groups	No. of individuals
Bottlenose Dolphin	13	3	190
Fin Whale	3	1	3
Harbour Porpoise	471	257	561
Minke Whale	44	30	34
Risso's Dolphin	80	33	144
Short-beaked Common Dolphin	19	11	31

The months with the highest sighting rates for cetaceans were July and August, with around 25% of intervals being cetacean positive (see Figure 4).

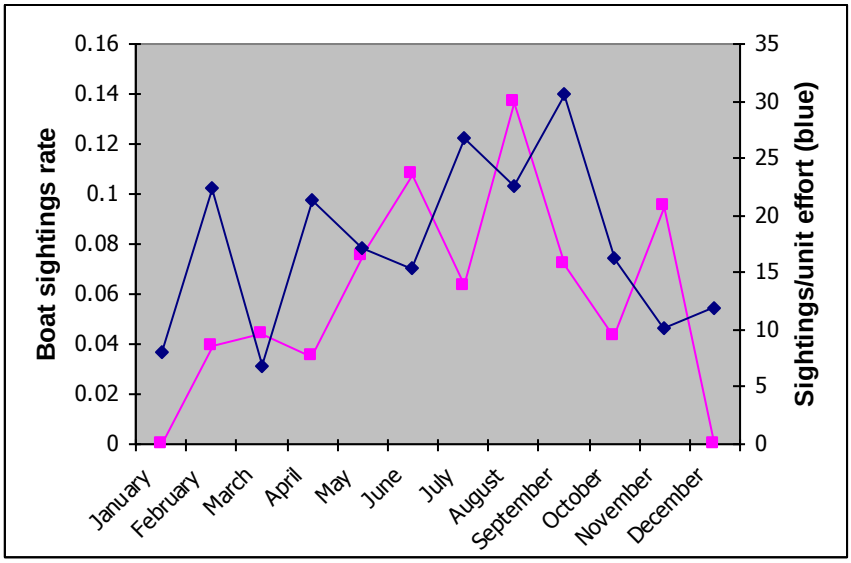

Figure 4: Sightings rates from land based and boat based surveys.

August has a very high sightings rate in both land based and boat based surveys. Interestingly, there appears to be a movement of cetaceans offshore in June, with an unexpectedly low sightings rate from land based surveys and a high sightings rate from boat based surveys. Conversely, there appears to be a movement of cetaceans inshore in July, with the opposite pattern of sightings rates as in June. More effort is required to test whether this is just an artefact or not.

Opportunistic sightings

There have been a total of 1968 sightings reported to the website between June 2006 and the end of 2010. The temporal breakdown of these sightings, by month, can be seen below:

Table 8: Number of opportunistic sightings per month. Source: MWDW.

Month	No.of Opportunistic sights
January	44
February	58
March	70
April	227
May	276
June	407
July	322
August	205
September	112
October	118
November	87
December	42

As would be expected from both boat based and land based surveys, the peak months in terms of numbers of sightings are between May and August. There was found to be no significant correlation between the number of opportunistic sightings reported to the website and the sightings rate per month obtained from effort based surveys from land (Spearman's Rank Correlation Coefficient, Rs=0.576, $p \geq 0.05$).

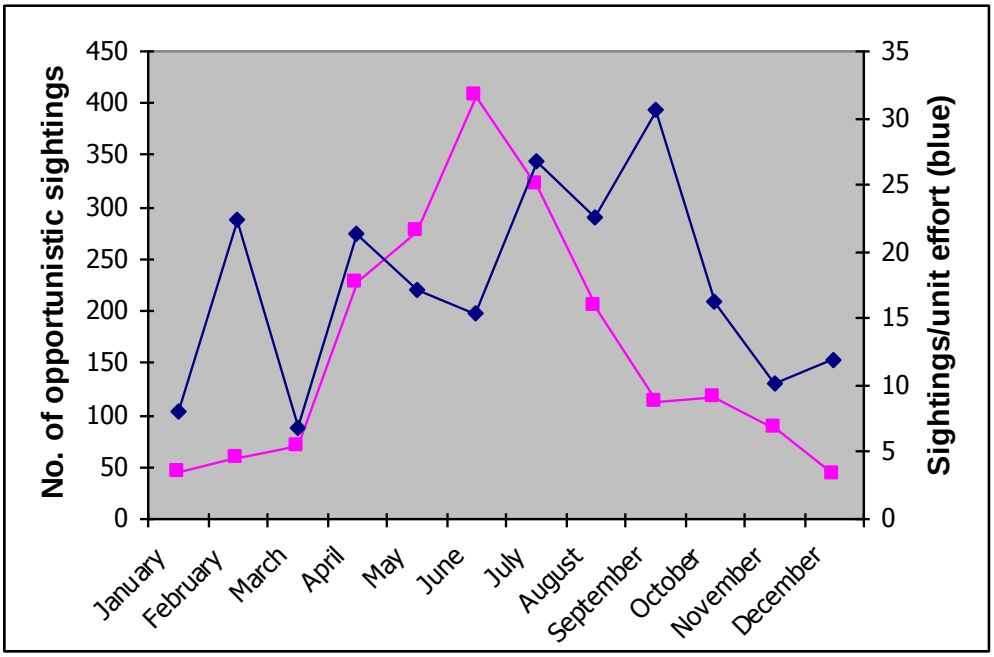

Figure 5: Sightings rate per month for opportunistic and land based data.

The species composition of opportunistic sightings reported to MWDW website is shown below:

Table 9: Species composition of opportunistic sightings. Source: MWDW.

Species	No. of sightings	% of total sightings
Bottlenose Dolphin	116	4.96
Common Dolphin	70	4.00
Harbour Porpoise	1015	49.30
Minke Whale	288	16.00
Risso's Dolphin	364	19.66
Other species	115	6.08

Spatial Distribution – from public sightings

In terms of spatial distribution, cetacean sightings are reported to the website from all around the island, although there is a definite bias in terms of number of sightings towards the south and west of the island, particularly between Port St Mary and Niarbyl. Although there are fewer sightings reported from the north of the island, this could simply be an artefact caused by the north of the island being less accessible and there being less people looking out for cetaceans.

The most frequently seen species

Harbour Porpoise

The harbour porpoise is by far the most frequently seen cetacean in Manx waters. Harbour porpoise account for 52% of opportunistic sightings, 75% of cetacean positive intervals from land-based surveys and 75% of boat-based cetacean sightings. Figure 6 shows opportunistic sightings of harbour porpoise from public sightings data (2006-2010).

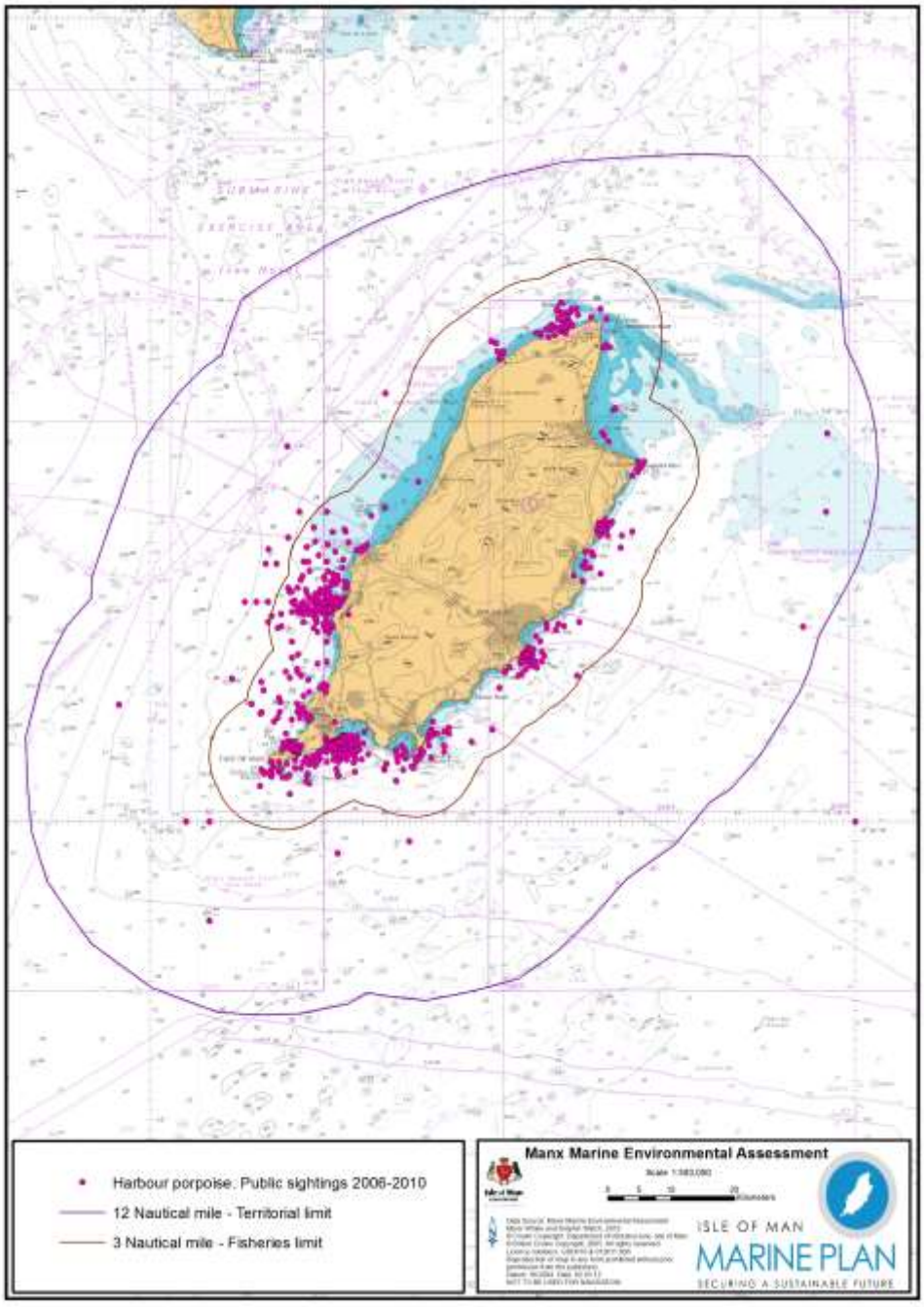

Figure 6. Opportunistic sightings of harbour porpoise from public reports to MWDW (2006-2010).

Although there have been sightings of Harbour porpoise in all months throughout the year, there is a level of seasonality in terms of frequency of sightings. In the winter months (October to March inclusive), there are only 21 sightings of porpoise from 92 hours of surveys from land (0.23 sightings per hour) whereas in the summer, this increases to 447 sightings from 750.5 hours of surveying (0.60 sightings per hour). Furthermore, there are only 155 Harbour porpoise sightings reported to the website during winter, compared to 860 sightings during the summer.

This pattern of seasonality however is not repeated to such an extent from boat surveys; in the winter months, 0.030 sightings/km were recorded, which increases to 0.038 sightings/km in the summer months. This is perhaps suggestive of a level of offshore movement by Harbour porpoise in Manx waters. Although seasonal migration has been suggested for Harbour porpoise in both north-west Scotland (Evans et al. 2003) and elsewhere in temperate Europe, too few surveys have taken place in British waters during winter months to know whether this is a true effect or due to the difficulty of surveying in the winter.

It was estimated from boat based line transect surveys that the density of Harbour porpoise in Manx waters is 0.207/km² (0.137-0.312/km², coefficient of variance 21.09%). This equates to an abundance estimate of 928 Harbour porpoise in Manx waters at any one time. This compares favourably with studies on porpoise density in the Hebrides (Boran et al. 1999), an area of high productivity, which found porpoise density over a seven year period to be 0.33/km² on average. A density of around 0.2km² was also found in Cardigan Bay (Baines et al. 2002).

Sightings of Harbour porpoise have been reported throughout Manx waters, both inshore and offshore and there is no apparent change in distribution between the seasons. There are however definite hotspots for Harbour porpoise in Manx waters. The waters around the Irish Sea front (forming between the Calf of Man and Dublin during the summer months) have very high sighting frequencies, as high as 0.3 sightings/km². Several studies have shown that cetaceans, particularly Harbour porpoise, associate with this frontal system (Jones 1984; Weir and O'Brien 2000).

Table 10: Sighting rates of Harbour Porpoise from land based surveys. Source: MWDW.

Site	No. of intervals	% of intervals HP +ve	% of cetacean +ve intervals that are Harbour Porpoise +ve
Calf East	640	12.7	72.3
Calf West	312	8.0	64.1
Lynague	129	0.0	0.0
Marine Drive	670	8.1	60.0
Niarbyl	756	12.8	69.8
Peel Castle	223	0.0	0.0
Port St Mary	640	33.0	85.4

There are also differences in sighting frequencies in inshore waters. Port St Mary, for example, has almost twice the percentage of porpoise positive intervals as any other site within the land based survey (see Table 10). This is likely to be a result of the high level of bathymetric complexity found at Port St Mary, creating many niches for a range of potential prey items for Harbour porpoise. Conversely, Lynague, a site of very little bathymetric complexity has never had a sighting of Harbour porpoise. The high level of suspected foraging behaviours at Port St Mary (50% of intervals in which porpoise were seen) further supports this theory.

The presence of calves in a number of Harbour porpoise sightings further highlights the importance of Manx waters for this species. Of the 258 different groups of Harbour porpoise seen during land based surveys, 61 (24%) were reported to contain calves. The actual percentage is likely to be higher than 24%, as porpoise calves are very easily missed during surveys, the dorsal fin being less than 50cm tall. It is likely that these calves are born in Manx waters as the calves themselves are not very mobile and hence are unlikely to be able to swim into Manx waters after birth.

The future deployment of C-POD's (acoustic devices that detect click trains made by cetaceans) will further increase our understanding of Harbour porpoise in Manx waters. The devices themselves detect continuously and hence still collect data outside of daylight hours and in all states of sea. Analysis of the click train data collected by the C-PODs deployed at different sites around the island, will allow further understanding of how often porpoise use an area and whether there are seasonal differences in usage of an area for example.

Risso's Dolphin

Risso's dolphins are the second most frequently seen cetacean in Manx waters, but accounting for 18% of opportunistic sightings, 13% of cetacean positive intervals from land based surveys and 10% of boat based cetacean sightings.

Risso's dolphins show a high level of seasonality to Manx waters, being seen almost exclusively between March and September. 95% of all sightings reported to the website and all sightings from land and boat based surveys occur between these months. This pattern of seasonality is repeated elsewhere in Britain and Ireland.

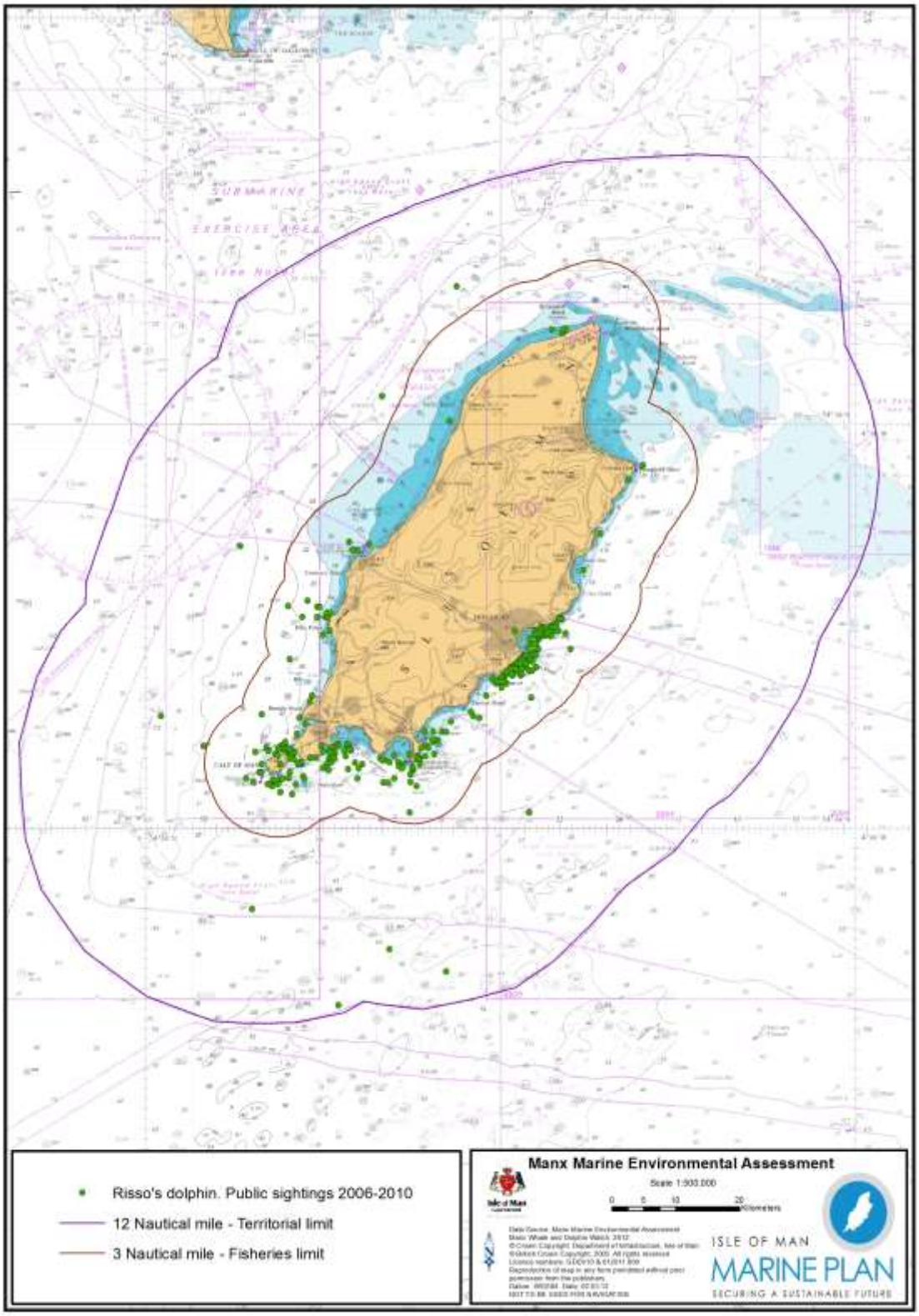

Figure 7. Opportunistic sightings of Risso's dolphin from public reports to MWDW (2006-2010).

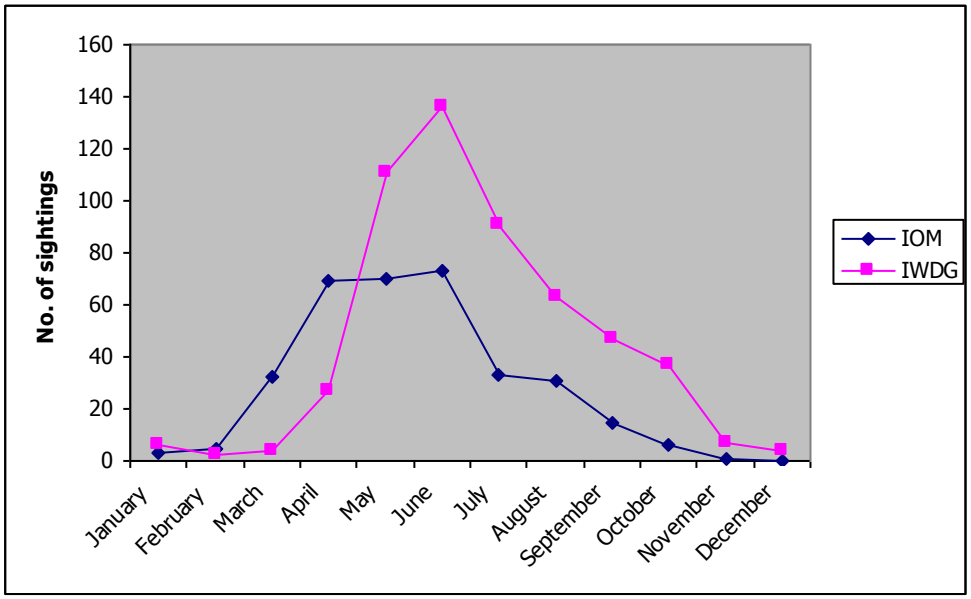

Figure 8: Seasonality of Risso's dolphins to Manx and Irish waters. Data: MWDW and IWDG.

The distribution of Risso's dolphins in Manx waters is also quite marked, with over 90% of all sightings on the east coast, around the Calf of Man or to the south west of the Calf. There is also a temporal aspect to the spatial distribution of Risso's dolphins in Manx waters, having a more southerly distribution between July and September compared to between March and June. The most likely cause of these two spatial patterns is the distribution of prey, namely Cephalopoda. Cephalopod species found in the Irish Sea, and known from stomach contents analysis to be a prey item of Risso's dolphins in British waters include, *Loligo forbesi* (Santos *et al*. 1994)and the curled octopus, *Eledone cirrhosa* (MacLeod *et al*. 2014). It is likely therefore that Risso's dolphin distribution closely follows that of *L. forbesi* and other cephalopod species in Manx waters.

Photo identification and the data derived from it enable conclusions to be drawn about the life-history of individuals and about the population as a whole. A photo-identification catalogue has been created for Risso's dolphins, based on 62 encounters, both from land and boat.

The catalogue currently contains 45 well-marked individuals (those that can be recognised from images of either side of the fin), 36 individuals recognisable from the left hand side of the fin only and 46 individuals recognisable from the right hand side only, giving a minimum population size of 91 individuals (as some left hand side and right hand side only individuals may be the same). A discovery curve for the catalogue suggests that not all individuals in the population have been photographed and recognised, as new individuals are still being added to the catalogue.

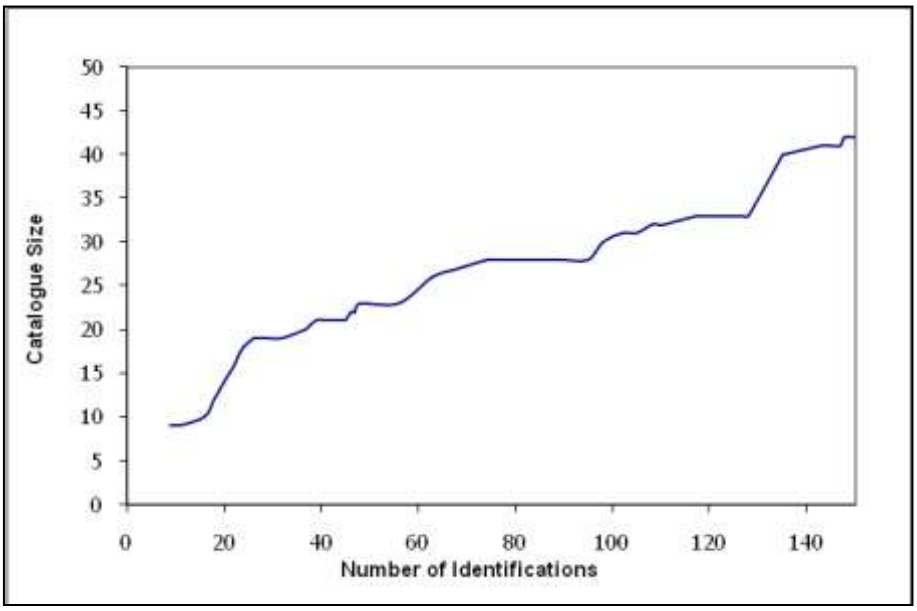

Figure 9: Discovery curve for Risso's Dolphin catalogue.

A number of individuals (n=18, 19.8%) have been encountered in different years suggesting seasonal residency of some individuals to Manx waters. A lack of encounters generally is the most likely reason that not more individuals have shown the same residency pattern to Manx waters.

Risso's dolphins have been shown to live in complex societies, in which some individuals, particularly adult males, show very strong associations, whereas others have pair only or no associations, particularly juveniles (Hartman *et al*. 2008). Some individuals in the Manx catalogue have been seen together in more than 65%, sometimes as much as 90% of encounters, suggesting there are close associations between certain individuals. However, far more encounters are needed to make any strong inferences about the social structure of Risso's dolphins in Manx waters.

Comparison of images taken in Manx waters with those taken in north Wales (courtesy of Sea Watch Foundation and the Whale and Dolphin Conservation) and Pembrokeshire (courtesy of Friends of Cardigan Bay) have shown that there is definitely movement of individuals between these three geographical regions (per comms.).

The population/sub-population of Risso's dolphins living in the northern Irish Sea is one of only two groups of Risso's to be found regularly in inshore waters, the other being in the Azores. The Irish Sea group is unusual because of the shallow waters that the population inhabits, Risso's dolphins elsewhere tending to favour deep (>1000m) waters. It has also been suggested that there is enough genetic variation between Risso's dolphins stranded in the British Isles and from those stranded elsewhere, to consider the British Isles population as a separate management unit (Gaspari *et al*. 2007).

Critical habitat is the habitat that is necessary for the survival or recovery of the species and/or areas of consistent and prolonged seasonal occupancy. The frequent observations of

groups containing calves (31%), the presence of calves with foetal folds (less than 1 month old) and re-sightings of the same calves within a season, suggests that Manx waters are an important ground for the up-bringing of new-borns and a possible breeding area. Furthermore, there are individuals within the catalogue that have been re-sighted not only several times within a season (prolonged seasonal occupancy) but also between a number of years (consistent seasonal occupancy). Manx waters therefore seem to be of high importance to Risso's dolphins in the Irish Sea and there is enough evidence to suggest it may be a Critical habitat for this population.

Minke Whale

The Minke whale is the third most frequently seen cetacean in Manx waters, comprising 15% of opportunistic sightings, 7% of cetacean positive intervals from land and 10% of boat based sightings.

Minke whales, like many other cetacean species seen in Manx waters, show high seasonality to the area, being present between June and the end of November, with only 8% of all sightings reported outside of these months.

There is also a very clear spatial aspect to the distribution of Minke whale sightings in Manx waters. In the summer (June to August), virtually all sightings are on the west coast of the island, whereas in the autumn (September to November), most sightings are on the east coast. The driving factor behind both temporal and spatial patterns appears to be the distribution of herring, a recognised food source of Minke whales, in Manx waters.

There are two known herring stocks in the Irish Sea, known as the Mourne stock, near the east coast of Northern Ireland and the Manx stock. The Manx herring stock are known to spawn on the east coast of the island, in September to October (Bowers 1969), hence the presence of Minke whales on the east coast during these months. During the summer months, the Manx stock and Mourne stock are found together off the west coast of the island (Bowers 1980), hence the presence of Minke whales in this area between these months. Both temporally and spatially, Minke whales seem to mirror the Irish Sea herring in Manx waters.

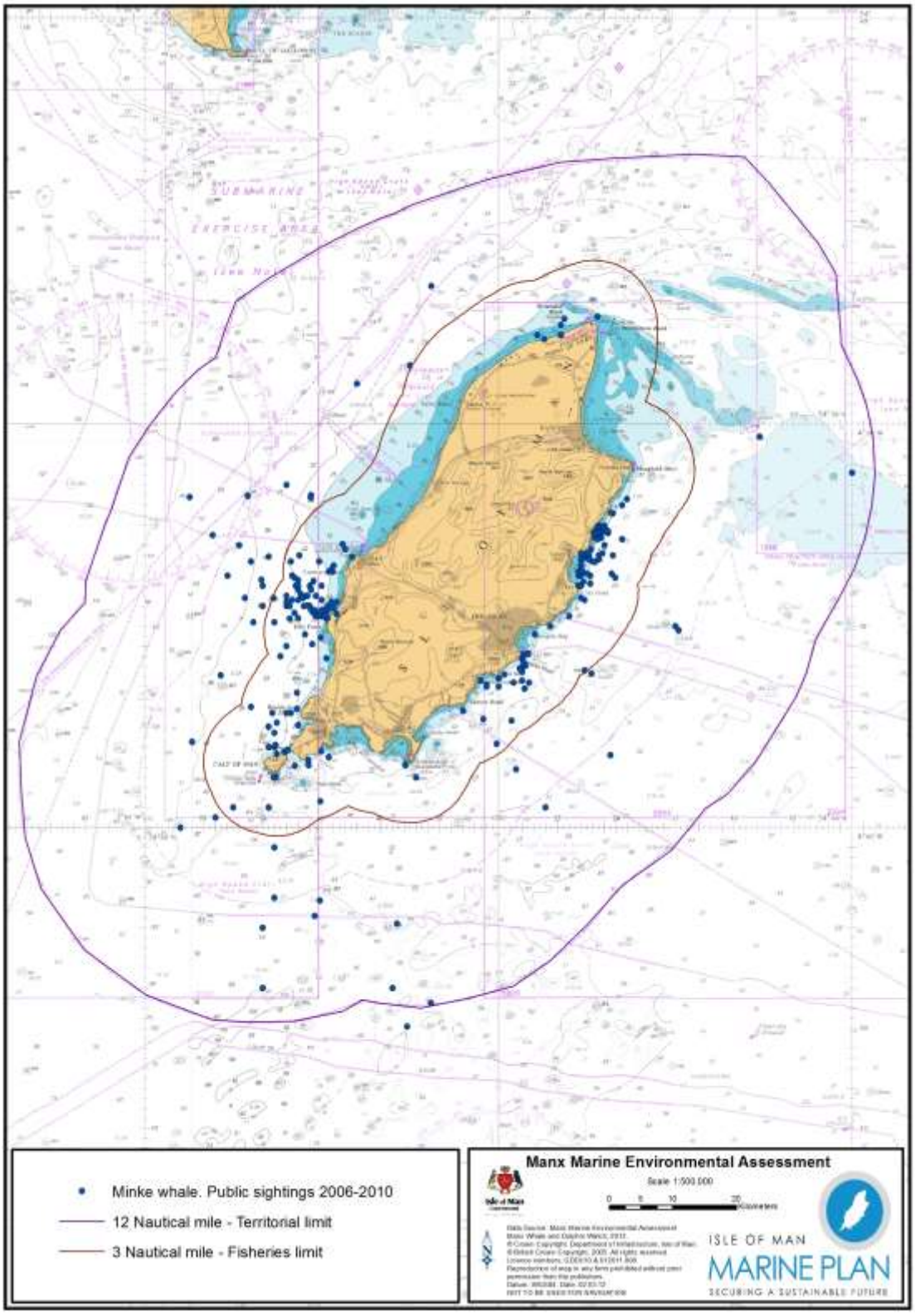

Figure 10. Opportunistic sightings of Minke whale from public reports to MWDW (2006-2010).

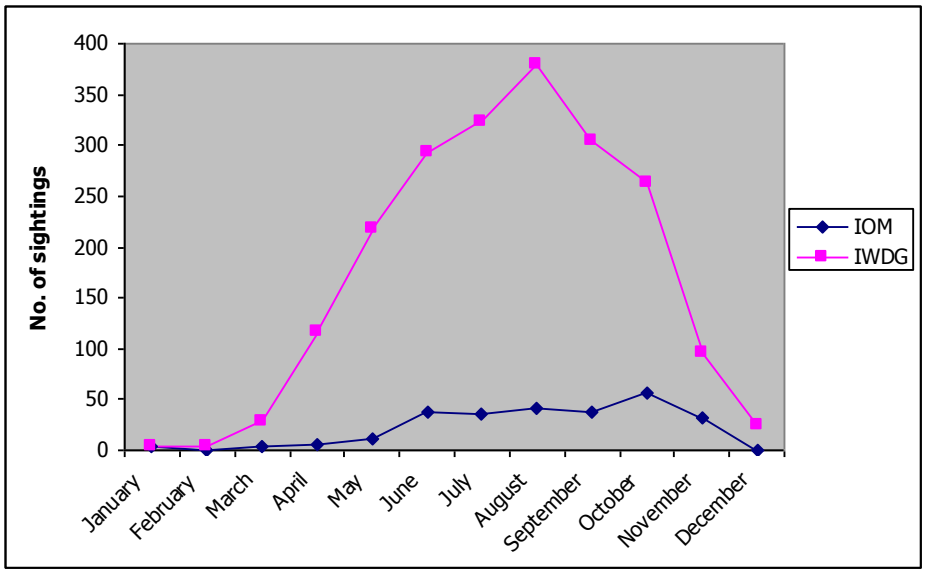

Figure 11: Seasonality of Minke Whales in Manx (IoM) and Irish (IWDG) waters.

Since 2006, the number of sightings reported to the website has decreased dramatically from 96 sightings in 2006 to only 23 sightings in 2010 and 25 sightings in 2011. It is hoped that this decrease of sightings is simply representative of a change in the distribution of the Manx herring stock upon which the Minke whales feed.

A photo-identification catalogue has been created for Minke whales in Manx waters, currently consisting of 5 individuals. It is hoped that the Minke whale photo-identification catalogue will prove a useful tool in determining whether the same individuals frequent Manx waters and will be able to give rise to a rough estimate of how many Minke whales take advantage of the Manx herring stock.

Bottlenose Dolphin

Bottlenose dolphin account for 6% of opportunistic sightings, 2% of cetacean positive intervals from land and less than 1% of boat based cetacean sightings. Bottlenose dolphins show no real pattern in terms of distribution of sightings in Manx waters.

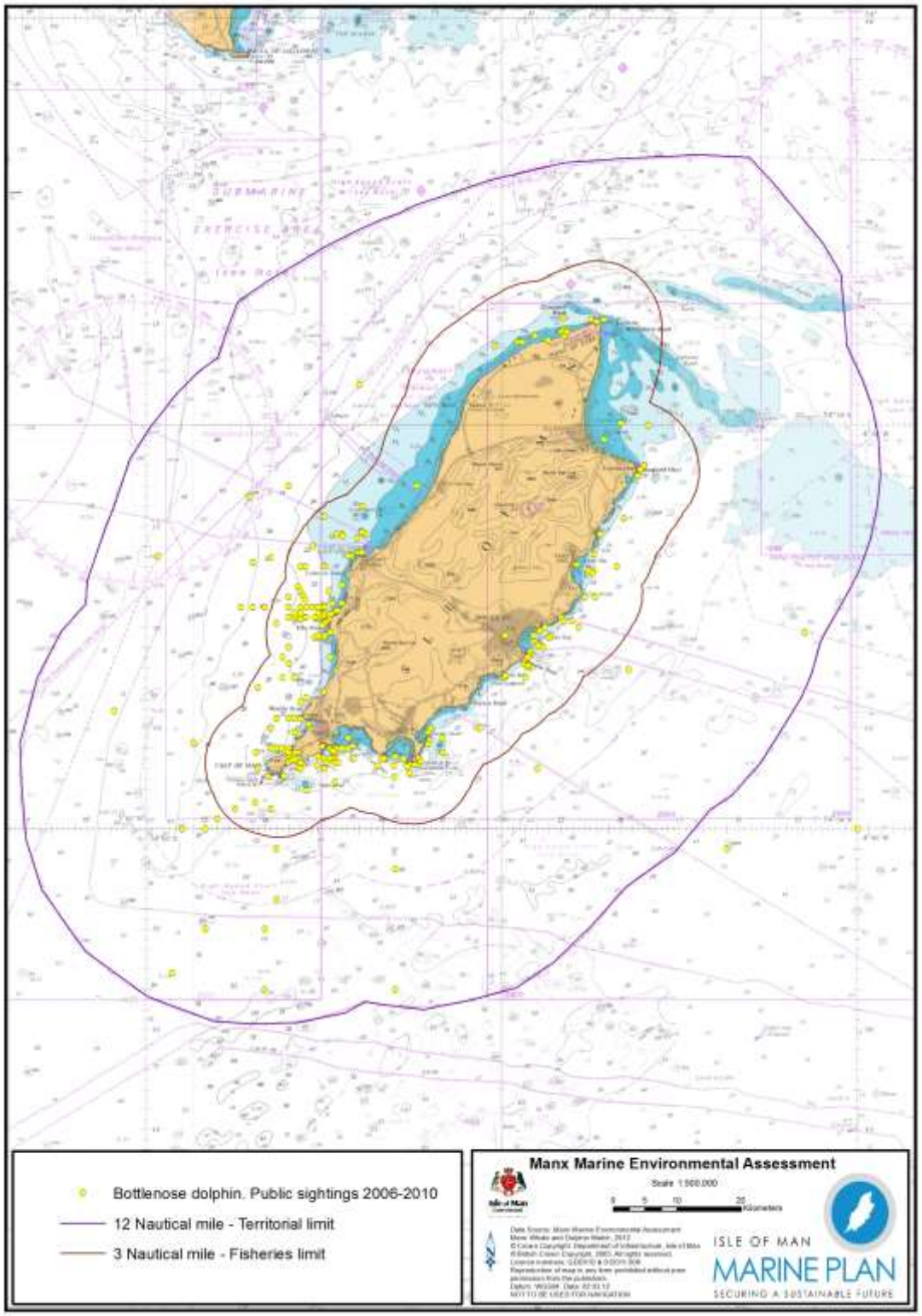

Figure 12. Opportunistic sightings of Bottlenose dolphin from public reports to MWDW (2006-2010).

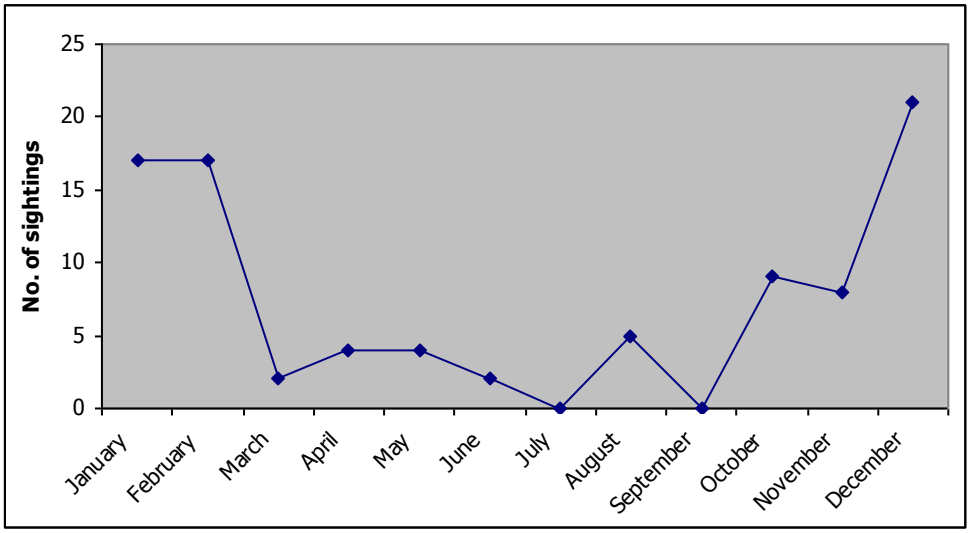

Figure 13: Seasonality of Bottlenose dolphins in Manx waters.

However, Bottlenose dolphins do show a very clear temporal pattern in terms of presence in Manx waters, with 73%of sightings being reported between October and March. For a cetacean species inhabiting temperate seas in northern Europe, this winter peak in sightings is unusual. Bottlenose dolphins in British waters are seen most frequently between April and September, although this does vary between areas (Evans et al. 2003). There is evidence to suggest that this pattern of temporal distribution is changing however, with more sightings being reported in the summer months in recent years (31 sightings in 2012 and 2013 compared to only 17 sightings between 2006 and 2011). A recent press release by Sea Watch Foundation (May 22nd 2013) suggested that the Bottlenose dolphins, normally resident to Cardigan Bay during the summer, are shifting their range to the north, in response to increased pressure from boat traffic in Cardigan Bay.

A photo-identification catalogue has also been created for Bottlenose dolphins and currently consists of 48 well-marked individuals, 20 individuals with only small nicks, 8 individuals recognisable from the right hand side only and 5 individuals recognisable from the left hand side only. Comparison of images with the catalogue compiled by Sea Watch Foundation in Cardigan Bay has shown that there is definitely movement of individuals between the two areas (pers. comm.). It is possible that some of the individuals from Cardigan Bay, where dolphins are mainly seen between April and September (Bristow and Rees 2001), move out of Cardigan Bay in the winter months to areas such as the Isle of Man.

Unlike in Cardigan Bay however, where group sizes typically vary between 3 and 12 individuals, the average group size of Bottlenose dolphin sightings in Manx waters is 30 individuals, with 20% of sightings containing at least 50 individuals. It seems therefore that Manx waters provide a vital winter and more recently occasional summer, habitat for Bottlenose dolphins resident to the Irish Sea.

Common Dolphin

Common dolphins account for 4% of opportunistic sightings, 3% of cetacean positive intervals from land based surveys and 1% of boat based sightings.

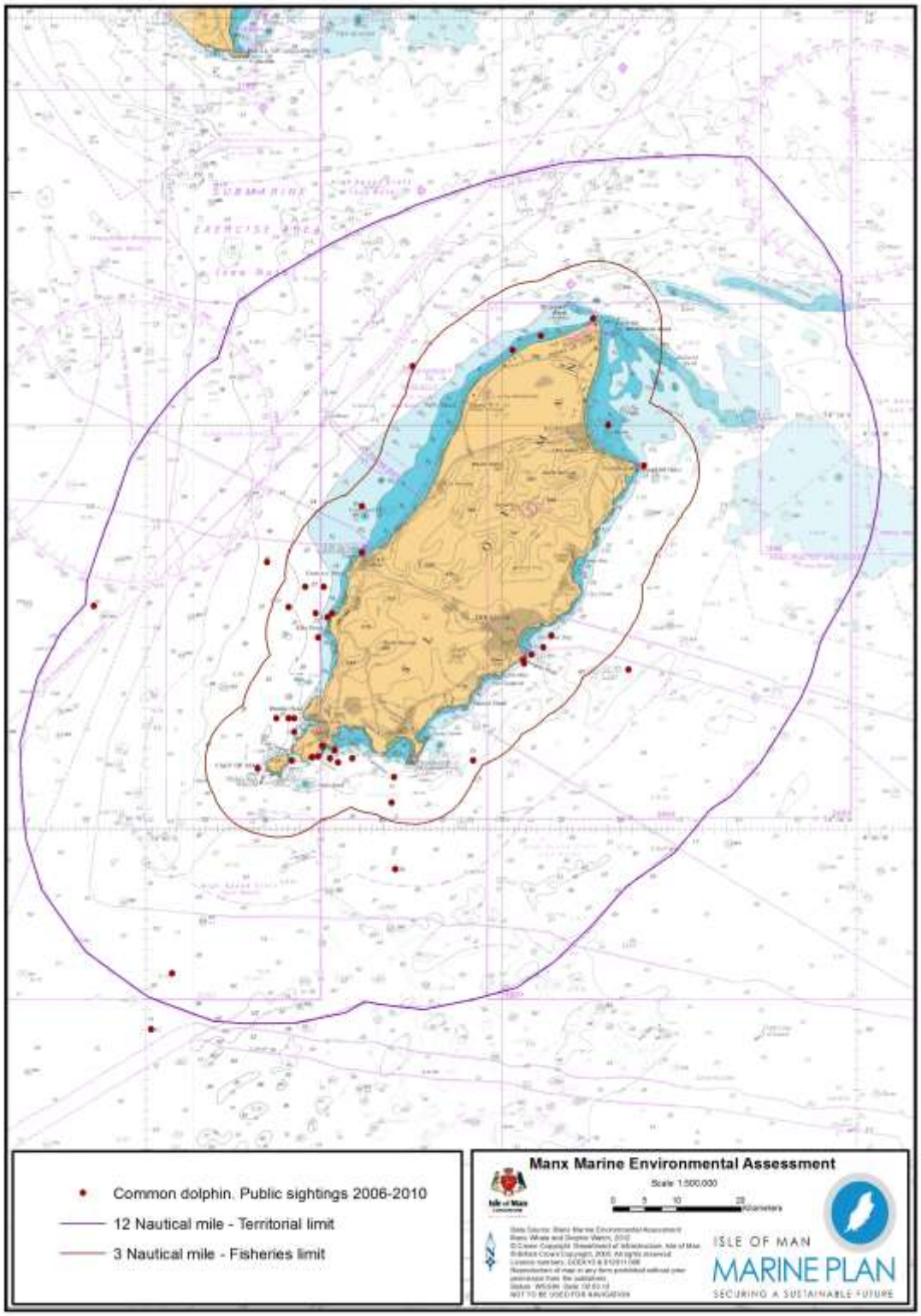

Figure 14. Opportunistic sightings of Common dolphin from public reports to MWDW (2006-2010).

The temporal pattern of common dolphin sightings in Manx waters matches that of common dolphin sightings throughout the UK, being seen almost exclusively between May and September. In the Celtic Sea and the Hebrides, the species moves onto continental shelf waters in the summer and then back offshore in the winter (Evans et al. 2003).
Common dolphin populations in the British Isles as a whole seem to be decreasing in numbers and this pattern may be repeating itself in Manx waters, with less than 5 sightings a year in the last three years, compared to nearly fifty sightings in 2006. It is too early to know yet whether 2006 was just an unusual year for common dolphins in Manx waters.

The use of photo identification on common dolphins is uncommon, as they are very hard to photograph and highly gregarious, making photographing all individuals in a group, or even most individuals, highly difficult. However, given the current plight of common dolphins throughout the British Isles, it is important to gain as much knowledge about common dolphin numbers and population biology as possible, which can be achieved through photo identification. The common dolphin catalogue currently consists of 10 well-marked individuals, and 1 each recognisable from the left had side only and right hand side only, although this was based on only one encounter.

Other species

Several other species have also been reported to Manx Whale and Dolphin Watch, including Orca, fin whale, humpback whale and long-finned pilot whale. With the exception of one sighting of a humpback whale, for which there is photographic evidence and one sighting of a fin whale, reported by a very experienced observer, the species identification for these sightings has been classed as "probable" or "possible" as opposed to "definite". There is no reason however that some of these species, particularly Orca and humpback whale, would not occasionally enter Manx waters, as they are known herring feeders.

Existing anthropogenic threats to Cetaceans and initial considerations for future marine development.

Anthropogenic Noise

Sound is an important sensory modality for many marine animals including marine mammals. In the marine environment, other senses such as sight, touch, smell and taste have serious limitations in terms of range or speed of transmission. Among cetaceans, a wide band of acoustic frequencies are used, from very low frequencies used by the blue whale (*Balenoptera musculus*), of around 18 Hz, to the porpoises, which produce frequencies at 120 – 150 Hz (Nowacek *et al*. 2007).

This broad range of frequencies intersects with many human derived sounds such as vessel noise, sonar and seismic signals. Sound travels almost five times quicker through water than through air and low frequency sounds can travel 10's of kilometres without losing much energy.

There are at least four primary concerns for animals exposed to elevated noise levels: permanent threshold shifts (PTS), temporary threshold shifts (TTS), acoustic masking and behavioural disturbance. Both PTS and TTS represent actual changes in the ability of an individual to hear, usually at a particular frequency, whereby the individual is less sensitive at one or more frequencies post-exposure to sound.

Masking represents when extraneous noise covers or "masks" a desired signal, making the latter more difficult to detect. This may lead to problems with feeding for example. Behavioural responses are noticeable changes in the activity of an animal in direct response to sound, for example the abandoning of an important activity (feeding) or the abandoning of a location in response to sound. If these behavioural responses occur repeatedly, this will cause detrimental effects on the individual.

The potential impacts of wind farms, both during construction and operational phases, include noise production, increased amount of boat traffic, disturbed bottom sediments, destruction of flora and fauna and habitat loss. The most significant potential impacts originating from wind farms appear to be related to noise production (Simmonds and Dolman 2007). Noise is produced throughout the life of a wind farm, including during construction, operating and decommissioning phases and from the associated vessel traffic. Pile driving is a particularly intense noise and has the potential to disrupt the behaviour of marine mammals at relatively large distances.

Carstensen *et al*. (2007) used a BACI (Before, After, Control, Impact) type monitoring programme to assess the impact of wind farm construction at Nysted, in the Danish Baltic

Sea, on Harbour porpoise. Substantial effects on porpoise echolocation activity were found from construction generally (medium term response) and from specific ramming activities (short term response). The data showed that porpoise either avoid the construction area completely during pile driving or stay in the area, but echolocate much less frequently. Furthermore, it was found that ramming activities had significant, though short term, impacts, with increases in waiting times (length of time with no echolocation clicks recorded) at all recording stations, again suggesting either displacement or a behavioural change.

Diederich *et al*. (2007) also found a significant decrease in echolocation activity from baseline during the construction period. The strongest indicators of this trend were daily intensity (fraction of the day containing porpoise clicks) and waiting time, suggesting it was the presence of animals more than their behaviour that is being affected by noise during construction. The effects on waiting times and daily frequencies lasted throughout 2004, the year of construction and first year of operation, suggesting displacement of individuals from the site over relatively long time periods. This could either be due to very slow recovery from construction or that operating wind farms also cause displacement of individuals.

The effects of wind farm noise on cetaceans are not just limited to the immediate vicinity of the site itself. Negative effects of pile driving during construction on porpoise acoustic activity have been found up to 17.8 kms away from a wind farm site. The duration of these negative effects does decline with distance, with no effects being found past 23 kms. Furthermore, porpoise acoustic activity declined by 100% until 1 hour after pile driving and stayed significantly below normal activities for 72 hours after piling, at a distance of 2.6 kms from the construction site. Since recovery time of porpoise activity was longer than most pauses between drives, the negative effects lasted throughout the study period (Brandt *et al*. 2011).

One potential source of noise which could negatively impact cetaceans is noise coming from aircraft. Several studies have systematically proven behavioural responses to passes by aircraft (Patenaude *et al*. 2002; Richter et al. 2006; Smeltea *et al*. 2008). However, these studies all used aircraft flying at low altitudes (<500 metres) and involved repeated passes and/or circling by the aircraft, scenarios that are very unlikely in Manx waters. The only area that this may present a problem to cetaceans is at the seaward end of the runway at Ronaldsway Airport. However, the presence of Risso's dolphins in this area on regular occasions during the summer suggests that aircraft noise is not problematic to the species.

Marine construction activities, explosions in particular, have significant potential to produce physical damage and behavioural disturbance to cetaceans. Results from studies on whether explosions cause behavioural responses or TTS's are somewhat contradictory. Very little, if any, behavioural response was elicited by sperm whales (*Physeter macrocephalus*) in response to underwater explosions (Madsen and Moehl 2000). However, a series of experiments on two captive Bottlenose dolphins and one captive Beluga (*Delphinapterus leucas*), using simulated explosions did elicit behavioural responses (Finneran *et al*. 2000).
Seismic exploration produces short duration broadband impulse sounds with high peak source levels. While most of the high frequency sounds produced during seismic surveys is

out of the frequency range of most porpoises and dolphins, they may overlap with the vocalisations and the hearing range of baleen whales. Hence these animals are likely to be the most susceptible to this type of noise.

Studies on bowhead whales (*Balaena mysticetus*), for example, found that individuals showed negative behavioural responses, such as longer intervals between blows, in response to controlled airgun blasts. Avoidance behaviour, i.e. leaving the observation area, was also noted, in response to sound levels between 152dB and 178dB (Ljungblad *et al*. 1988). There have also been studies showing behavioural responses by odontocetes to airgun noise, for example Common dolphins in the Irish Sea. This study however also suggested tolerance to seismic activity at distances over 1 kilometre (Goold 1996).

There are two basic types of military sonar; passive sonar is used simply to listen to and receive sound. Active sonar detects objects by examining echoes of produced sounds. It is active sonar which is of concern to cetaceans. Military sonar often produces intense sounds and range from low frequencies right through to high frequencies. There have been instances of potential connections between the use of military sonar and mass stranding events. These typically involve beaked whales (for example Frantzis 1998), but may also involve delphinids, as demonstrated by a mass stranding of Common dolphins in Cornwall in 2008. Potential effects of military sonar on cetaceans may include disorientation, decompression sickness (similar to the "bends" in humans), behavioural responses and interference with vocalisations.

Pollution

Marine mammals, as top trophic level predators, are particularly susceptible to high levels of contaminants in the marine environment, through bioaccumulation. Previous work found elevated levels of DDT and organochlorines in stranded dolphins and porpoises in Cardigan Bay, derived not from local pollution but from elevated levels in their food sources (Morris et al. 1989).

Furthermore, an apparent "hotspot" has been identified in Liverpool Bay, in terms of high concentrations of mercury and lead (Law *et al*. 1991). It is likely therefore that Risso's dolphins and Bottlenose dolphins, known to inhabit both Cardigan Bay and Manx waters regularly, have elevated levels of contaminants in their tissues. It is unlikely however that the source of the contaminants was the Isle of Man, as there is no industry that discharges heavy metals. Industry around Liverpool bay is the most likely source, particularly from chlor-alkali plants (Law *et al*. 1992).

By-catch

Interactions between cetaceans and fisheries have occurred for many centuries and are likely to become more frequent due to increasing human populations and an increase in the reliance of humans on marine protein. By-catch can cause significant changes to the demography of marine mammal populations and if particularly intense and long-term, can

result in near or actual extinction of a species, for example the Vaquita (*Phocoena sinus*) in the Gulf of California.

Global cetacean by-catch has been estimated at perhaps 100,000 individuals per year (Read *et al*. 2006), particularly from gill-nets and other bottom set nets. This was calculated from actual US fisheries by-catch figures and then multiplying this figure by a factor calculated from what percentage of world fisheries, in terms of effort, the US contributed. In the Irish Sea, Harbour porpoise and Common dolphin are particularly vulnerable to by-catch (Tregenza *et al*. 1997).

The level of by-catch in Manx waters is likely to be very low, as there is no commercial set net fishery and because the main fishery, scallop, is unlikely to have any cetacean by-catch as dredging is done at slow speed (~1 knot). Marine mammals are highly mobile however, so it is possible that cetaceans that spend some time in Manx waters could be by-caught elsewhere, particularly Harbour Porpoise and Common dolphin. Sightings of Common dolphin in Manx waters are becoming less frequent, a pattern being repeated throughout the British Isles, making this of particular concern.

Over fishing

A sixteen year time series (1994-2009) found a significant increase in the abundance of jellyfish in the Irish Sea (Lynam *et al*. 2011). Such an increase in abundance is likely to be caused either by a structural change in the ecosystem or by climactic changes or both.

The Irish Sea herring fishery was once of great economic importance to the Isle of Man and Eire and at its' peak caught 10kt per year, The fishery was closed in 1978 due to management concerns and restrictions on all fleets targeting herring continued throughout the 1980s. The fishery itself ceased in the early 1990s (ICES 2009).

The almost complete removal of the main planktivore in the ecosystem, herring, created a potential niche expansion for other planktivores. Jellyfish, being able to grow and reproduce were the benefactors of the structural change in the ecosystem, hence the recent increase in abundance. Sprat are now the dominant planktivore, by biomass, in the Irish Sea, indicative of how heavily the Irish Sea herring stock was overfished.

Aggregate Extraction

Although there is currently no aggregate extraction in Manx waters, the activity is worth mentioning due to its' potentially negative impacts on cetaceans.

It is the physical damage to the seabed caused by aggregate dredging and the resulting adverse effects on the biodiversity and/or structure of the ecosystem post-dredging that is of concern. Although this will only directly affect benthic organisms, it may also affect, for example, fish species that spawn on the benthic substrate, which consequently could affect animals such as cetaceans at the highest trophic levels.

Boyd et al. (2005) found that fauna at a site described as being dredged at a high intensity, remained perturbed 4 years after the last dredge had taken place. The effects therefore could be long lasting and could potentially lead to displacement of a cetacean species from a dredged area.

Vessel disturbance

The effect of boat traffic on cetaceans is a particularly well studied area of marine mammal science. Potential negative impacts of boat traffic on cetaceans could include physical damage (particularly from propellers), acoustic disturbance and basic harassment of animals. Such impacts may lead to behavioural changes, such as longer time lapses between surfacing events, or displacement, temporary or permanent.

Results from studies looking at the effects of boat traffic on dolphin species are somewhat inconclusive. A study on Bottlenose dolphins in Shark Bay Australia over a five year period, found a significant decline in abundance of individuals once the level of boat operators in the area increased from one to two. No such decline was seen in an adjacent area over the same time period which had never had any boat operators (Bejder *et al*. 2006).

Over a much shorter time period, Bottlenose dolphins in Milford Sound, New Zealand, were found to show displacement from the fjord during times of heavy boat traffic (Lusseau 2005). Furthermore, experimental approaches by power boats in Jervis Bay, Australia, to bottlenose dolphins, showed that individuals changed their surfacing behaviour and direction of movement when approached (Lemon *et al*. 2005).

Conversely, a study on bottlenose dolphins in Cardigan Bay, Wales, found that the species generally displayed a neutral response to most boat types, except to kayaks, to which animals negatively reacted and tourist boats, to which animals reacted positively (Gregory and Bowden 2001).

A study on minke whales, fin whales and humpback whales (*Megaptera novaeangliae*) in the waters of Cape Cod found that each species reacted differently to boat traffic over time. Minke whales initially showed positive interest to vessels, which over time changed to indifference. Fin whales initially reacted negatively, which changed to indifference, whereas humpback whales, which initially were disinterested, became more interested in boat traffic. The whales seemed to react to three kinds of stimuli; underwater sound, light reflectivity and tactile sensation (Watkins 1986).

The author reports that the primary cause of reaction was the sound produced by vessels. Most background ambient noise was ignored. Most negative reactions occurred when the noise was loud, unexpected, changeable or perceived as coming from a threatening source. The author also reports habituation to vessel noise, although the rate of habituation could not be quantified (Watkins 1986).

There are likely to be a number of factors that affect the likelihood and the effect of cetaceans reacting to vessel traffic. These may include the "openness" of the marine environment in which the animals are living (depth, open ocean or enclosed bay), vessel type, whether the benefits of living in an area of heavy vessel traffic in terms of food outweigh the costs of disturbance, whether individuals have habituated to vessel traffic and what the typical level of boat traffic is in a area.

The worst possible effect of disturbance by boat traffic is a loss of abundance of a species in an area due to displacement. The level of significance of a potential decline in abundance depends on the type and size of the population undergoing such a decline. It would be devastating, for example, on a small genetically isolated population, such as the newly described species, the Burrunan dolphin (*Tursiops australis*), endemic to south Australian coastal waters (Charlton-Robb *et al*. 2011).

Likely anthropogenic impacts in Manx waters and the Irish Sea

The noise created by wind farms, both during construction and operation, is an obvious concern in the Irish Sea. Once built, a wind farm may have a positive effect on the area, the piles themselves acting as reefs, which will attract fish. It is likely that there will be more wind farm developments in the future, as the United Kingdom seeks to reach its' European directive of producing 20% of energy through renewable means by 2020. Whilst there may be some localised benefits of individual developments, there are also concerns, especially regarding their construction. The cumulative & in combination impacts of several developments within the relatively confined northern Irish sea, are also yet to be fully assessed or understood.

Aircraft noise is unlikely to have any negative impacts on cetaceans in Manx waters as there are very few places where aircraft are close enough to the sea to cause disturbance to individuals. Furthermore, studies showing that there was a negative impacts caused by aircraft noise only found a negative reaction to repeated passes by aircraft, a very unlikely situation in Manx waters.

There is currently no seismic exploration occurring in Manx waters. However, there is fairly regular seismic activity in the Irish Sea as a whole. Marine mammals are highly mobile and most species show seasonality to Manx waters and hence spend parts of the year elsewhere in the Irish Sea. Therefore, it is more than likely that species and individuals found in Manx waters are affected by anthropogenic activities occurring outside Manx waters. There are definite matches between the Manx catalogue and the Cardigan Bay catalogue of Bottlenose dolphins. It has also been shown that dolphins, which have been photographed in Manx waters, have also been seen in the waters around North Wales. The situation is very much the same with underwater construction.

The amount of and even the occurrence of the use of military sonar in Manx waters or the Irish Sea as a whole is unknown, as the military are currently not required to state when

and where it is used. Globally, the military have been put under more pressure to consider the usage of military sonar in relation to marine mammals, for example to avoid the use of sonar in areas which are likely to have high levels of marine mammal abundance at particular times of year. The potential link between the use of military sonar and mass strandings, for example of Common dolphins in Cornwall in 2008, has hopefully made the military aware of this potential impact in the Irish Sea.

There is very little chance of by-catch in Manx waters, as the only commercial fisheries that are currently in operation are those of shellfish and scallop. Pot fisheries, for shellfish clearly have no by-catch potential and scallop dredges are too slow to be of a problem to cetaceans. There is also a two vessel seine fishery for herring, operating from Northern Ireland, though there is little evidence to suggest this type of fishery has a particular cetacean by-catch problem.

Depending on how far common dolphin and Harbour porpoise seasonally migrate (although it is only certain that common dolphin migrate seasonally), it is possible that individuals that spend some time in Manx waters will be present in areas where more dangerous fisheries operate, such the use of gill nets off the south west of Cornwall. However, by-catch is very unlikely in Manx waters.

Historic over-fishing of herring in particular, has certainly happened in Manx waters and the Irish Sea in the past and undoubtedly had detrimental effects on marine mammal populations. However, there are very few commercial fisheries in the Irish Sea that are competing with cetaceans currently. As mentioned earlier, there is a pair of vessels operating out of Northern Ireland that have a quota for herring, but their take will be minimal compared to the herring stock as a whole. It is possible however that over-fishing is still happening in some areas where Manx cetaceans seasonally reside.

The level of boat traffic that frequents Manx waters is relatively low compared to many areas where negative impacts of boat traffic on cetaceans has been reported, for example bottlenose dolphins in Milford Sound (Lusseau 2006). All of the tourist vessel operators in Manx waters base their trips on sightings of basking sharks and pinnipeds and are not specifically looking for cetaceans. It is unlikely that the number of boat operators will significantly increase, as there is not enough potential custom to require more operators. It is unlikely therefore that disturbance by boat traffic is of particular concern to cetaceans in Manx waters.

Initial considerations for handling impacts

Mitigation measures against potential anthropogenic impacts

The majority of the potential negative anthropogenic impacts in Manx waters are impossible to mitigate against, either because the effect is historical (in the case of pollution and over-fishing), or because the impact is most likely happening outside Manx waters, but to

individuals that seasonally reside in Manx waters (in the case of by-catch or seismic exploration) or because the organisation causing the impact does not have to disclose that the activity is being undertaken (in the case of military sonar).

The best mitigation against other potentially disturbing activities, such as wind farm construction or aggregate extraction, is to ensure that these activities are not taking place in areas where and at times when there are high relative abundances of cetaceans as a whole or of a particular species. For example, if there were plans to construct a wind farm off the south west of the Isle of Man, it would be recommended that between June and September, when the Irish Sea front, an area associated with unusually high cetacean abundance, is in place, should be avoided in terms of construction.

It has been found that Risso's dolphins and bottlenose dolphins migrate between Welsh waters and Manx waters within a year, Risso's dolphins in April and September, bottlenose dolphins, throughout the winter, but particularly in October and late March. Again, it would be recommended that wind farm construction should be avoided at these times of year, so as to avoid disruption of these migrations. Depending on the location & methods of construction, it would most likely be recommended that there would be an obligation to have marine mammal observers on board during construction. Mitigation measures such as the 'soft start' method would also be advised.

Tagging, genetic sampling and photo-identification

Tagging (Bio logging)

Tagging of cetaceans in Manx waters or those of the British Isles as a whole, though not illegal, is fraught with difficulties in terms of animal welfare, public perception and logistics. Although such tagging is carried out on basking sharks and pinnipeds (seals).

As a methodology, tagging of cetaceans is carried out in the Americas. It tends to be carried out on relatively large species, such as fin whales or right whales, but has also been attempted on rehabilitated bottlenose dolphins and pilot whales. Due to both ethical and logistical reasons, the tagging of cetaceans in Manx waters is unlikely. MWDW are unlikely to be granted a licence to tag cetaceans in Manx waters. Furthermore, tags are very expensive and MWDW does not have the capital to deploy enough to tags to create a usable dataset.

Genetic sampling

Genetic sampling from live cetaceans in Manx waters or the British Isles is again not carried out, partly due to difficulties with animal welfare and also because of the difficulty in biopsy sampling from quick moving individuals. It is unlikely that genetic sampling of live cetaceans will happen in Manx waters.

Genetic sampling from stranded animals however is carried out, as the stranded nature of the individual removes both ethical and logistical difficulties. Such data can prove extremely useful, for example in showing whether a population or sub-population is genetically isolated, making that population much more vulnerable. Genetic sampling from stranded individuals was responsible for suggesting that Risso's dolphins in the British Isles are genetically dissimilar to dolphins from for example the Mediterranean Sea (Gaspari et al. 2007).

Photo-identification

Photo identification of cetaceans is currently carried out under licence from DEFA, the licence itself being reviewed and if necessary updated on a yearly basis. The licence limits the amount of time that we can spend with each group of cetaceans and also has recommendations regarding the method of approach to groups and as to how to behave as a vessel during such encounters.

Photo-identification is currently being carried out on Risso's dolphins, bottlenose dolphins, common dolphins and minke whales. The number of individuals identified in each catalogue is as follows:

Risso's dolphin - 45 well marked individuals (recognisable from either side of the dorsal fin, **36** lefts (those recognised from the left hand side of the fin only) and **46** rights.
Bottlenose dolphin - **48** well marked, 20 small nicked, **3** lefts and **8** rights
Common dolphin - 10 well marked, **1** left and **1** right
Minke whale - 5 well marked.

There is also 1 humpback whale that has been photographed and is recognisable.

MWDW has also been centrally involved in the creation of a catalogue of Risso's dolphins using images captured throughout the Irish Sea, as well as the Hebrides and Cornwall. This has required data sharing agreements to be drawn up with Sea Watch Foundation (SWF), Whale and Dolphin Conservation Society (WDCS) and the Hebridean Whale and Dolphin Watch (HWDT). Images have also been shared with the Irish Whale and Dolphin Group (IWDG), although this has not required such agreements. These agreements run on a year by year basis and can be updated if deemed necessary.

Images of bottlenose dolphins have also been shared with SWF, HWDT and Cardigan Bay Marine Wildlife Centre (CBMWC, West Wales). The data sharing agreement with HWDT also covers images of bottlenose dolphins. No such agreement was required with SWF or CBMWC.

Images of minke whales have been shared with IWDG and again, no data sharing agreement was required.

The data shared includes the image, date the image was taken and the photographer. If matches are found between individuals from two different catalogues, further information such as group size and geographical position may be shared. It is hoped through sharing of

such images and information, that a greater understanding of the ecology of these species may be gained.

Data Availability

Table 11. Data availability (MWDW).

Dataset	Years	Format	Ownership	Availability
Opportunistic sightings	2006-2011	Excel spreadsheet	MWDW & IOM government	Open to all
Land based surveys	2006-2011	Excel spreadsheet	MWDW&IOM government	Open to all
Boat surveys	2007-2011	Excel spreadsheet	MWDW&IOM government	Open to all
Photo ID images	2007-2011	Images	MWDW&IOM government	Open to all
Photo ID data	2007-2011	Excel spreadsheet	MWDW&IOM government	Open to all

The data collected by MWDW has already been shared with SWF, including all opportunistic sightings and boat based data, for inclusion in the national database run by SWF. Photo-ID images have also been shared with SWF, WDCS, HWDT and IWDG, in the case of the first three organisations, using a data sharing agreement. A very simplified form of data has also been shared with CENTRICA.

Data still to be analysed

Data from both opportunistic sightings and boat based surveys needs updating to include the data collected in 2012. Land based data collected between 2006 and 2011 is yet to be fully analysed, but this is in the process of being completed and reported upon by Tom Felce (MWDW).

Knowledge gaps

Due to a combination of being flat and hence having few vantage points and there being very little effort, boat or land based, there is a definite knowledge gap regarding cetaceans in the north of the island. On the east coast, this gap extends from Marine Drive up to Point of Ayre, on the west coast, from Peel to Point of Ayre.

Due to a lack of encounters with Risso's dolphins, there is currently no knowledge of the group dynamics and type of social associations seen within the (sub-) population of this species seen in Manx waters.

There is also no current abundance estimate for Minke whales in Manx waters. A high number of boat based sightings in 2011 may have created a large enough sample size for such an estimate to be derived.

Initial recommendations for monitoring

MWDW recommends the continuation of effort based surveys on land and at sea, as this represents the best current method of estimating abundance, actual or relative, of cetaceans in Manx waters and also allows analysis of temporal and spatial distributions on cetaceans in Manx waters. It is hoped that several more sites, in the north of the island, may be added to the list of sites currently surveyed during land based surveys.

MWDW hope to start monitoring cetacean distributions through the use of C-PODs. These are devices that detect porpoises and dolphin through the click trains produced by these taxa. C-PODs, once deployed, detect continuously and are therefore the only current method to detect cetaceans at night and during times of rough weather. Such data can be used to look at, for example, detection frequency between sites or between months or whether cetaceans show any diurnal patterns. MWDW hope to deploy C-PODs at Niarbyl and to the south of the Calf Sound and if funding can be found, at Port St Mary and either side of the Point of Ayre.

To improve the number of encounters with particularly Risso's dolphins, but also potentially common dolphins and bottlenose dolphins, MWDW are looking into purchasing a RIB, which being trailer carried, will not be restricted by the tide in terms of going to sea. It is expected that this will significantly increase the number of encounters with dolphin species, hence allowing analysis of social patterns and also showing whether individuals show residency to Manx waters.

It is also hoped that more boat based data will be collected by getting volunteers on both tourist boats operating out of Peel and also on the Sailing for the Disabled vessel, "Pride of Mann 2".

Marine Mapping (Geographic Information Systems – G.I.S)

To date, this report will be the first attempt to map cetacean sightings using GIS. GIS itself has massive potential, both in terms of mapping and analysis, sharing of spatial and temporal distributions of cetacean sightings in Manx waters. Such potential needs resources, both in terms of time and money. MWDW currently has no access to GIS, but would recommend that this situation is changed; such is the potential of GIS to increase our understanding of cetaceans in Manx waters.

Furthermore, GIS, combined with other software, can be used as a predictive tool, whereby in areas of very little current data on cetacean presence and distribution, predictions can be made, which can be shown to be statistically robust.

GIS is also a very powerful tool when looking at cetaceans over very small spatial scales, for example at Port St Mary. A very specific example would be analysing whether porpoises seen from land at Port St Mary, tend to be seen feeding in areas of higher bathymetric complexity.

Marine data management i.e. standardising and verifying datasets and creating metadata has also been identified as a key area where further resources, training and support are required. Improved data management and GIS to agreed standards (e.g. consistent with other organisations) would help enable greater sharing of information between MWDW, Isle of Man Government, and externally.

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