Report on the Analysis of Cetacean Data from around the Isle of Man

By Tom Felce and Eleanor Stone

Introduction

Since 2006, the Manx Whale and Dolphin Watch website has been collecting opportunistic sightings of cetaceans from members of the public. This has resulted in 369 recorded sightings in 2006 and 506 in 2007 (up to the end of November). Through raising awareness of cetaceans around the island the number of people watching the sea has increased, leading to the increased number of sightings in 2007. At least eleven different cetacean species have been seen over the two years. All of these species are classed as at least 'threatened' on the IUCN Red List of endangered species. In addition to the opportunistic sightings, several volunteers have been doing effort based watches, at various locations around the island. This has resulted in a total of 178 hours of watching and 166 sightings. In 2007 the Manx Cetacean Surveys were started, carrying out dedicated cetacean boat surveys, throughout Manx waters, for the first time. Despite the poor weather, 2588.4 kilometres were travelled, with 118 sightings of cetaceans, 44 of Atlantic Gray seals and 44 of basking sharks. This report presents and discusses more in-depth results of these three aspects of data collection, to give a more detailed description of the distribution of megafauna around the Isle of Man. Alongside this, these results can be used to develop the concept of a 'Whale Trail' around the Island.

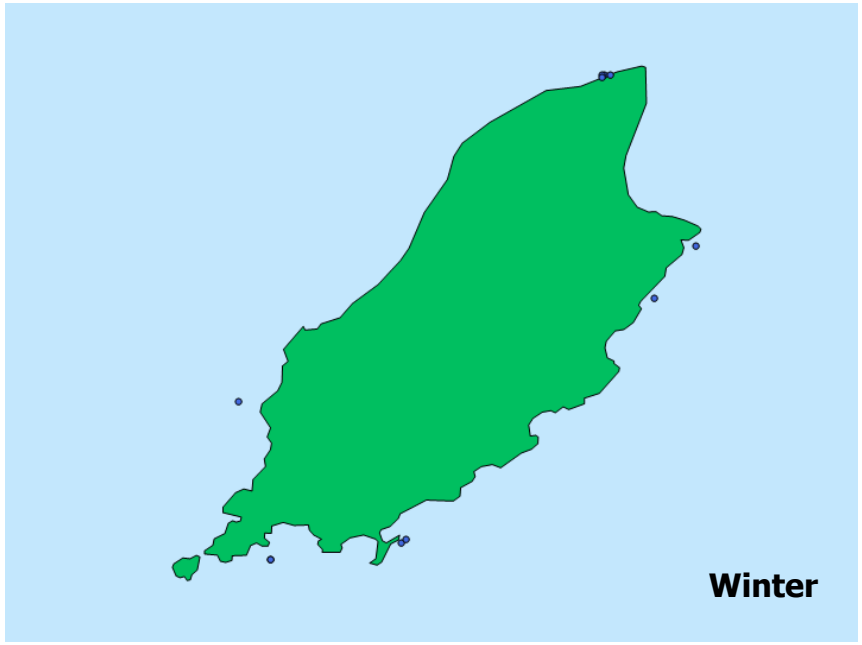
1. Opportunistic Sightings

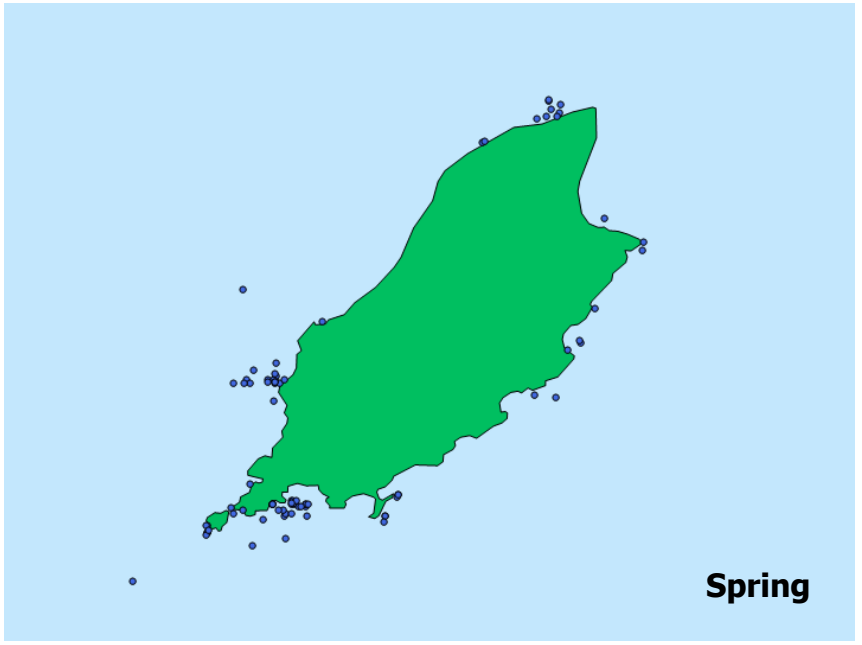
The number of sightings reported by members of the public over the two years has resulted in a large data set, charting the movements of the different species throughout the year. This can be looked at either on a species by species level or on a month by month level.

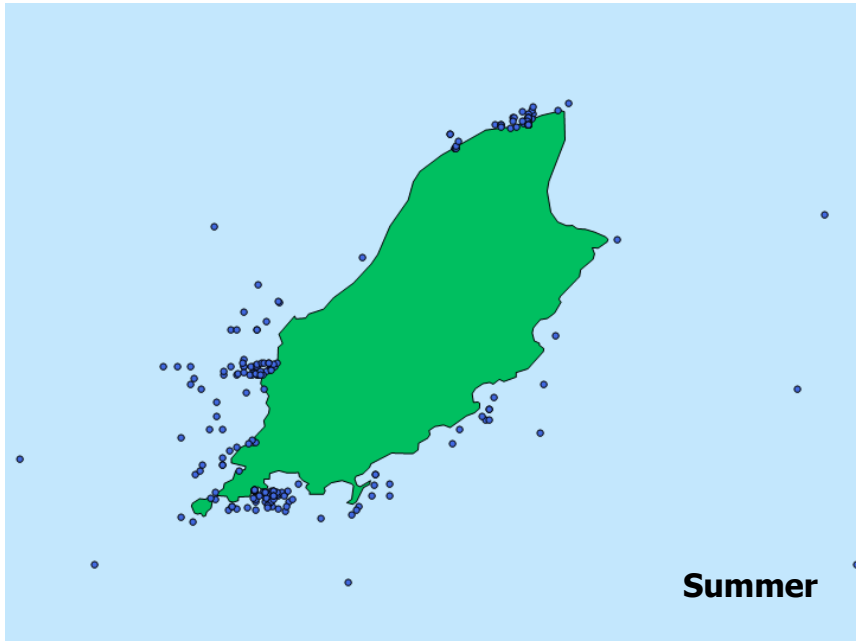
Whilst this type of data is very useful for qualitative representation of the presence and distribution of species, because it is not effort related, a couple of points need to be taken into consideration during analysis. Firstly, a lack of sightings could just as easily be because no one was watching, rather than an actual lack of animals. Secondly, the sea conditions are not taken into account so periods of bad weather (e.g. during winter) could mean animals were missed, rather than not being present. However, the sheer number of sightings means that patterns of movement are beginning to emerge, as can be seen from the figures below. Nevertheless, it should also be remembered that the more data that is collected, over the years, the clearer these patterns will become.

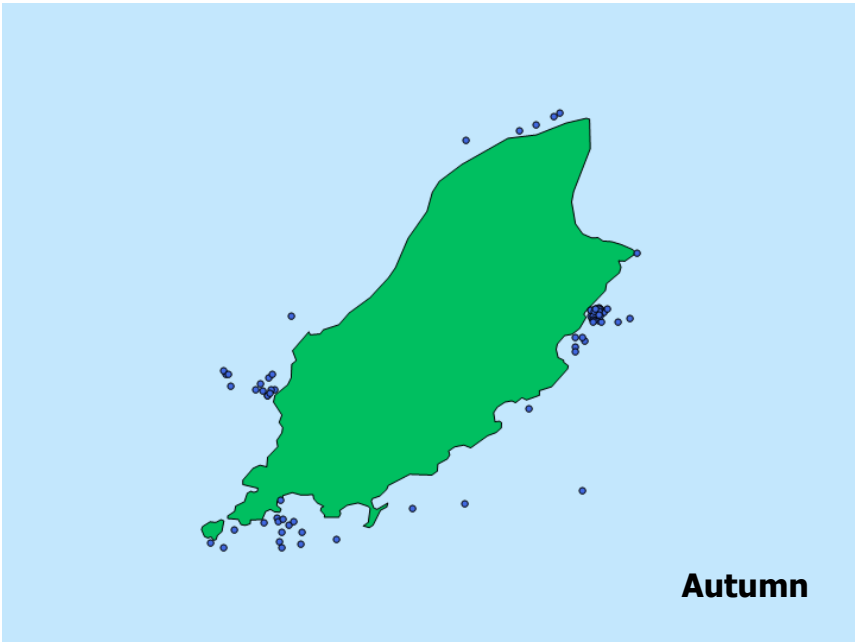
a) Species by Species

By plotting the sightings of each of the main species individually, the patterns of movement of these species throughout the year can start to be understood. The predominantly sighted species have been Harbour Porpoise, Minke Whale and Risso's Dolphin. In the figures below, the year has been divided into 'Spring' (March-May), 'Summer' (June-August), 'Autumn' (September-November) and 'Winter' (December-February).

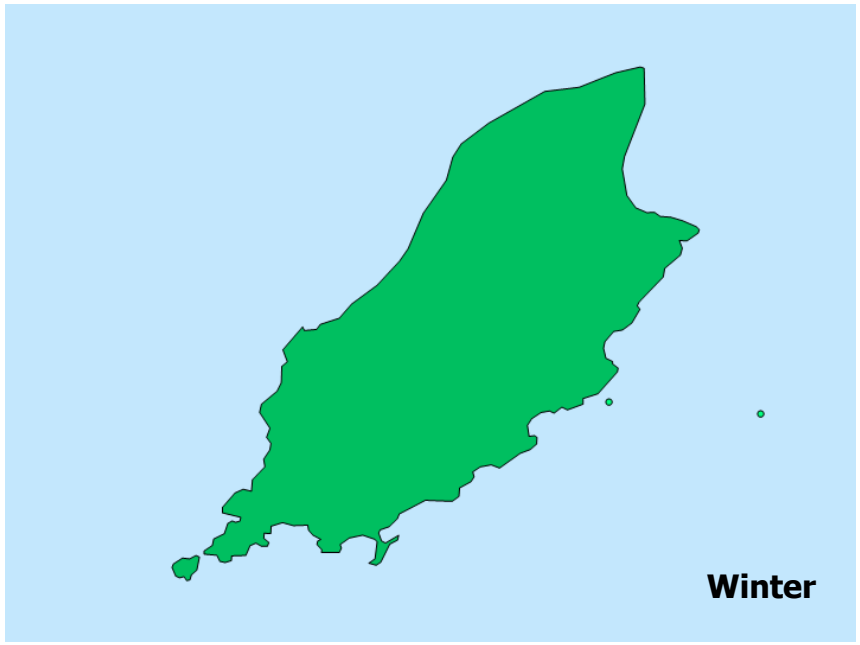


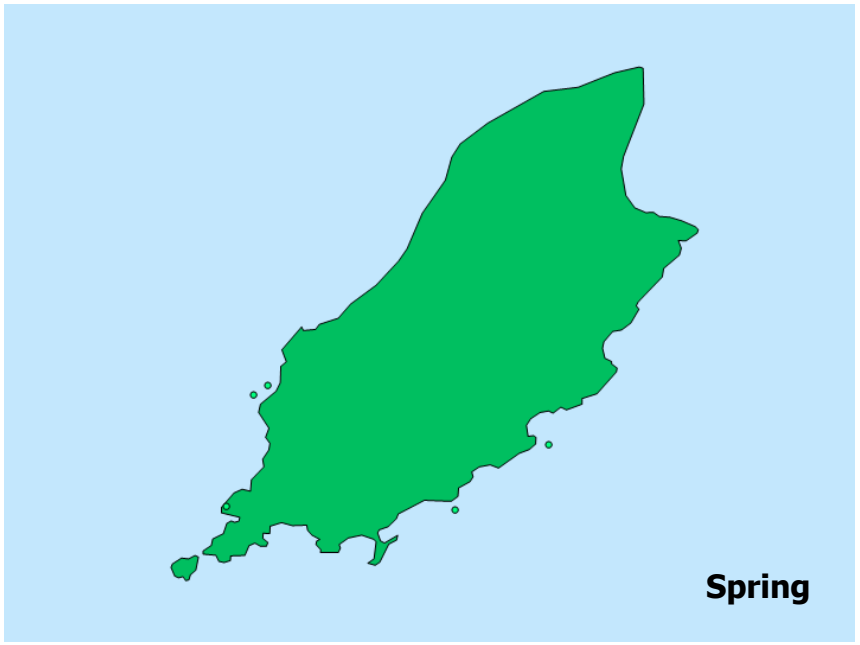


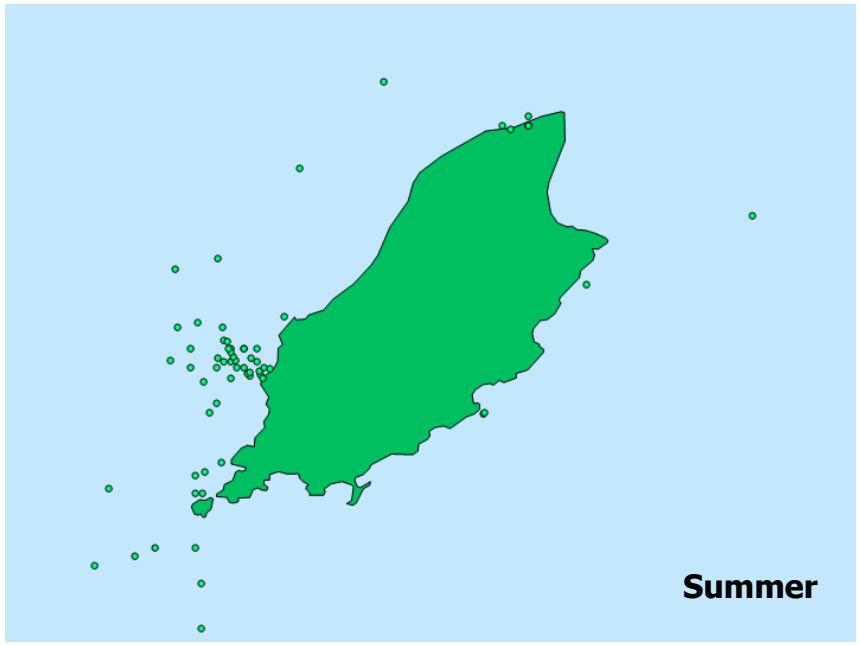


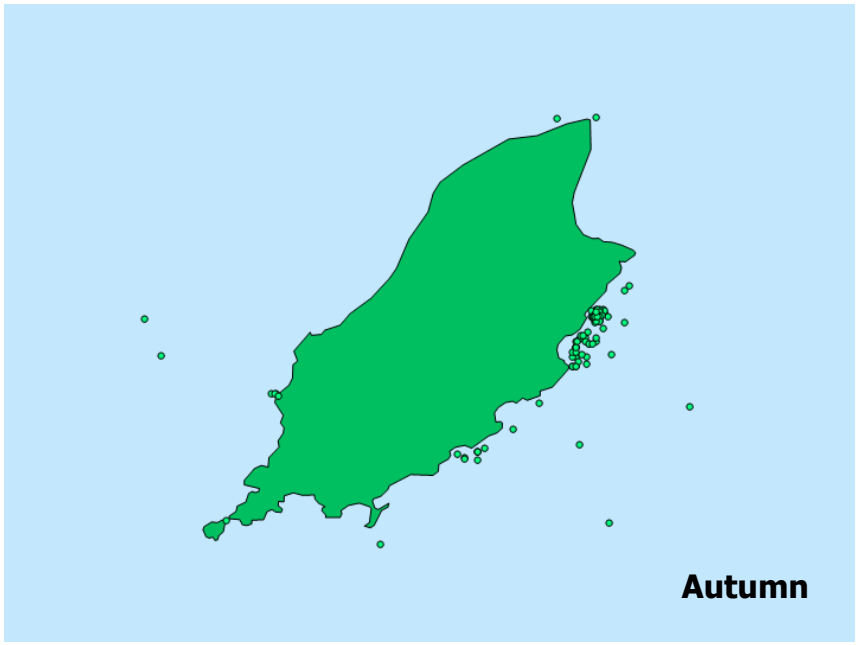


Harbour Porpoise

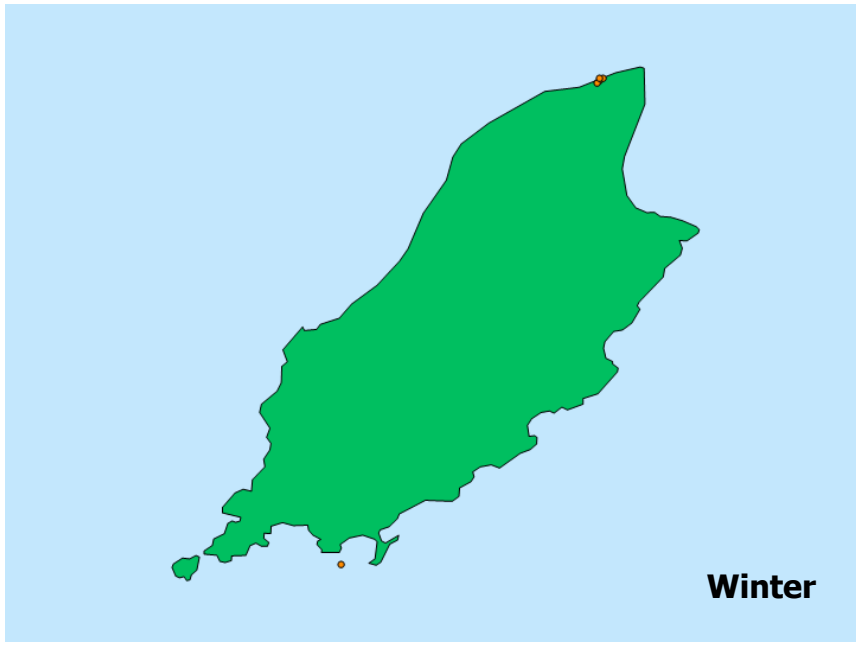


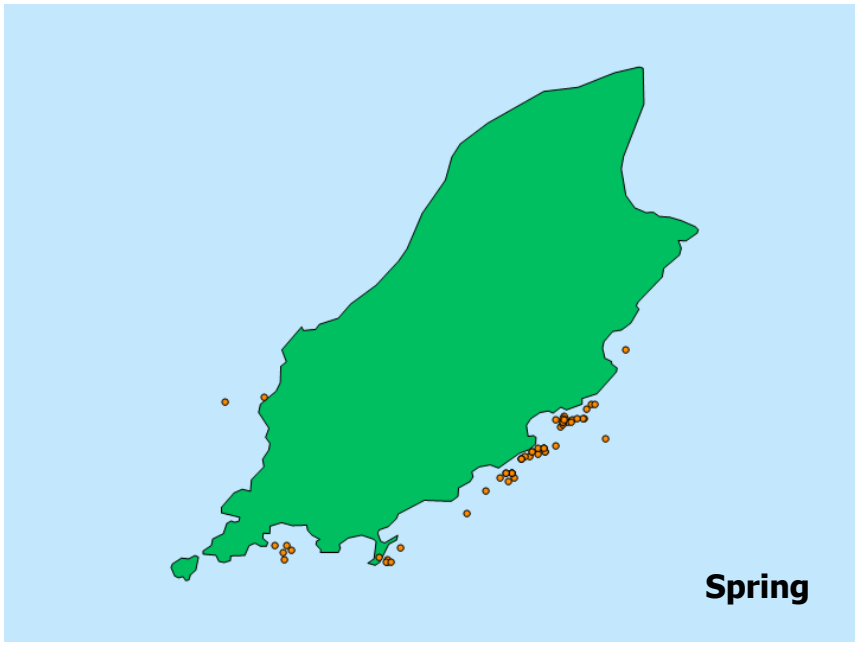


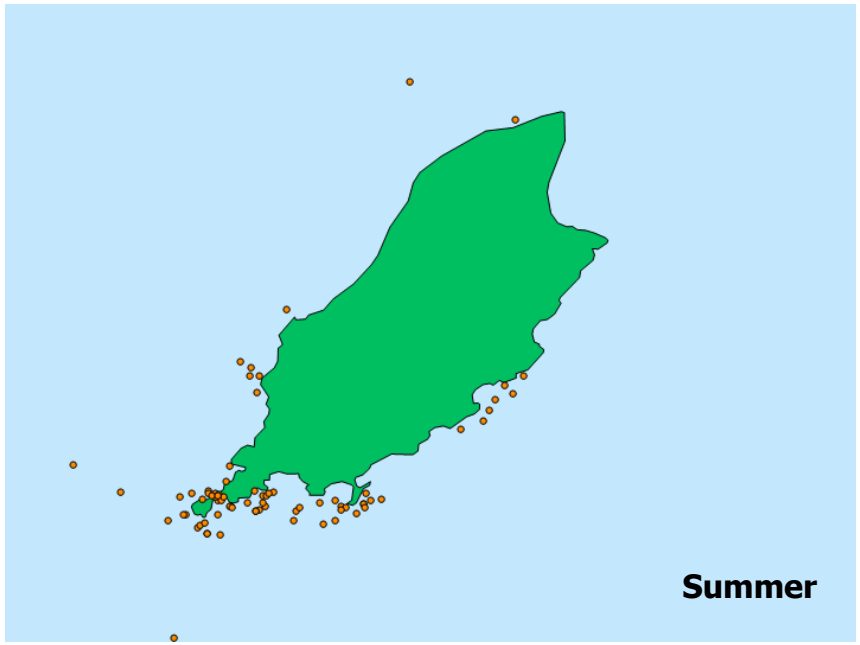


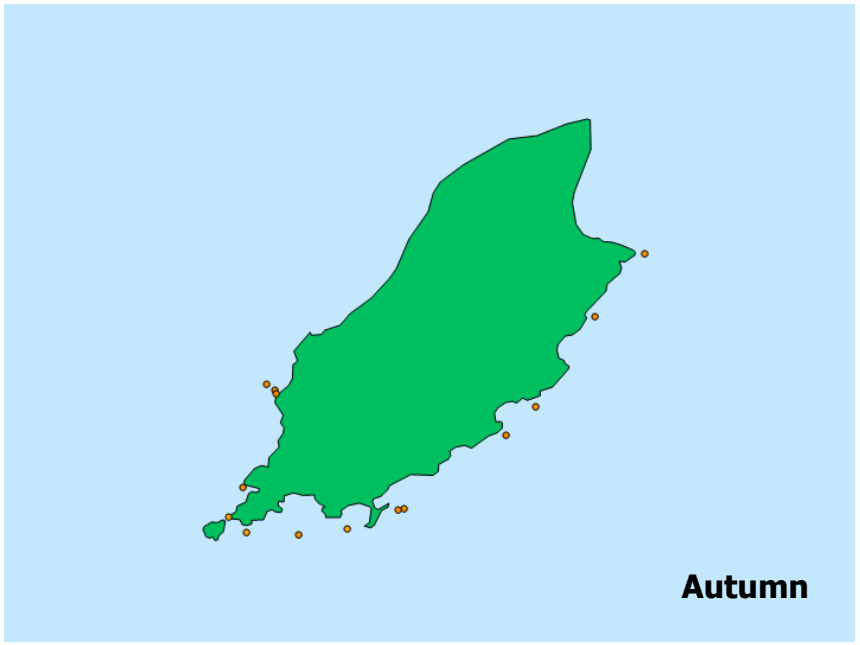


Minke Whale









Risso's Dolphin

For all species, the greatest number of sightings is during the summer, when the waters are getting to their warmest and productivity is at its highest. The fewest number of sightings for all species is during the winter. Although this can partly be explained by the poorer weather and therefore less people watching, it is likely that it is also due to a true reduction in the number of animals around the island in the winter months. During this time, the waters are at their coldest and it is not unusual for marine mammal species to move seasonally due to sea temperature changes.

The Harbour Porpoise – our most universal and consistent cetacean

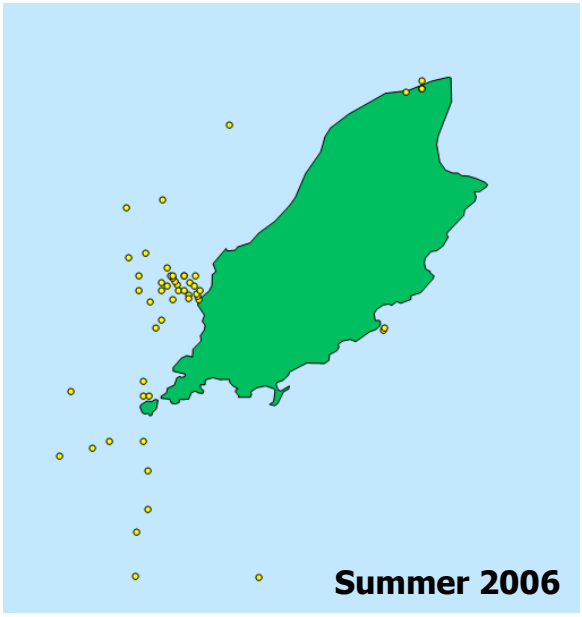
Harbour porpoise sightings are high also in both spring and autumn, suggesting they are virtually year round residents in Manx waters. Their distribution around the island is relatively uniform, indicating they can utilise all Manx waters throughout the year. The exception to this is the central western coast (between Peel and Jurby) in which none of the predominant three species were seen. This is thought to be as a result of the nature of the coast in that area, leading to a very limited numbers of places that people are able to watch from. The apparent hotspots at Dalby, Port St Mary and just south west of the Point of Ayre are areas where regular volunteers carry out frequent watches. This demonstrates the value of effort based watches – the more you sit and watch, the more you will see!

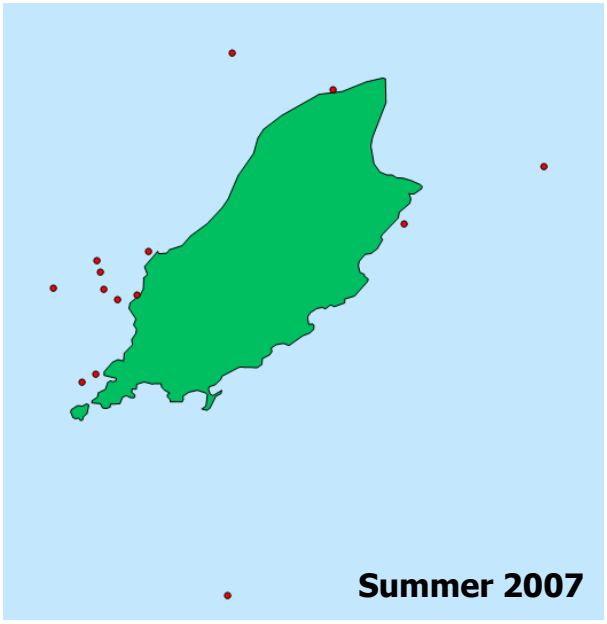
The large number of sightings of harbour porpoise and their ubiquitous seasonal and geographical distribution shows that Manx waters are clearly very important for this significant species. Harbour porpoise are top level predators and by observing their numbers and distribution over time, the status of the whole marine ecosystem can be monitored.

The Minke Whale – an Irish Sea front indicator

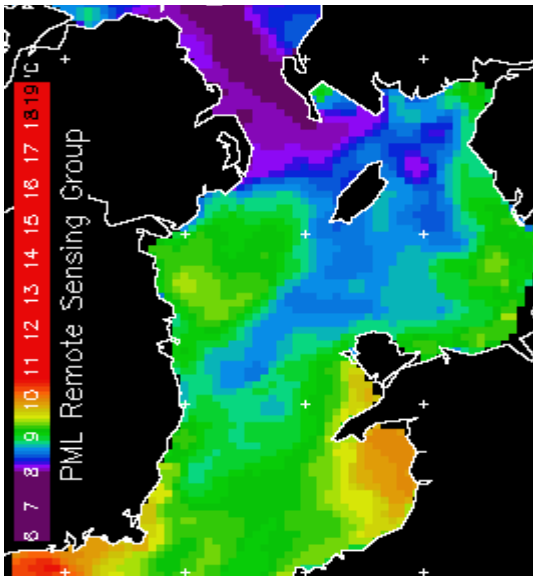
Minke whales show an increased number of sightings in the summer and the autumn, with fewer numbers in the spring. Baleen whales depend directly on high levels of primary productivity which, around the Isle of Man, increase during the summer with the warming of the waters and formation of the Irish Sea Front between the Isle of Man and Ireland. During the summer therefore, the majority of minke whale sightings are on the south and west coast of the island. In the autumn, it is believed that the whales follow the herring round to their east coast spawning grounds. This is illustrated by the change in distribution of minke whales in the autumn, with the majority of sightings being on the east coast, especially around the Laxey Bay area.

At this point, it is worthwhile to discuss briefly the difference between the minke whale sightings in 2006 and those in 2007. It is well recognised that the summer of 2007 was extremely poor and unusual and this had a large impact on the number of minke whale sightings. The figure below shows the difference in the number of sightings in the two summers and it can be seen that the number was significantly reduced in 2007.

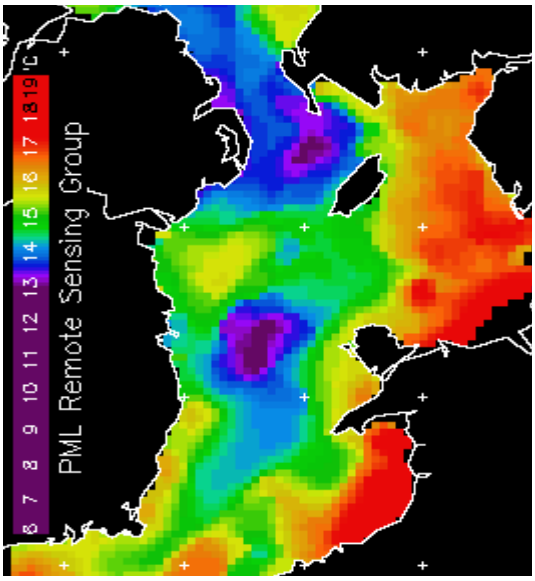




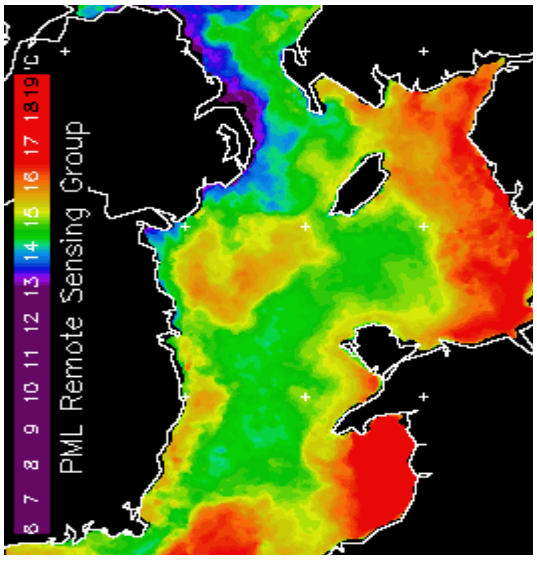
By looking at satellite images of the sea surface temperature in the Irish Sea (see figures below), it is possible to give an explanation for this dramatic reduction. In these images, the blues and purples represent cold waters, the yellows and greens warmer waters and the reds the warmest waters. When waters of significantly different temperatures meet between the Isle of Man and Ireland, the Irish Sea front forms, an area of high primary productivity.



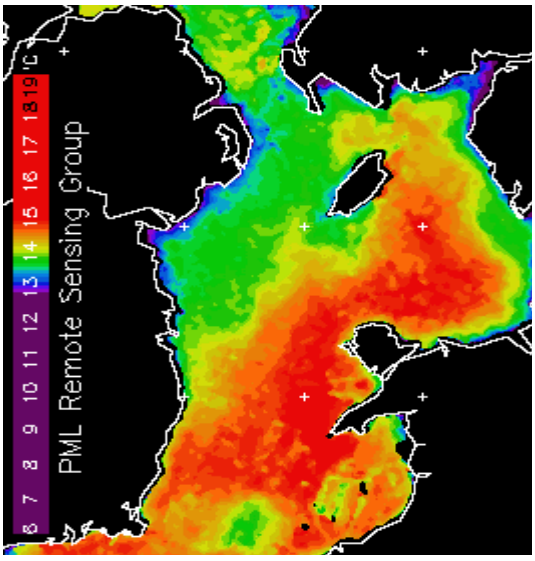
a) April 2006



b) August 2006



c) July 2007



d) October 2007

Figures a) and b), from 2006, show that by April, the Irish Sea front has formed and that this persists right through into August. In contrast, figures c) and d), from 2007, show that even in July the front has not formed and that it is not until October that a weak front forms. This is a likely explanation for the reduction in minke whale sightings in the summer of 2007.

The reasons for the unusual weather in 2007 are not known, but clearly changes in the status of the sea have an effect on the presence and movements of marine species. This shows that conservation of the sea as a whole is vital for the conservation of marine mammals. It also demonstrates the importance of studying marine mammals over a long period of time, to ensure that results aren't based on one atypical year.

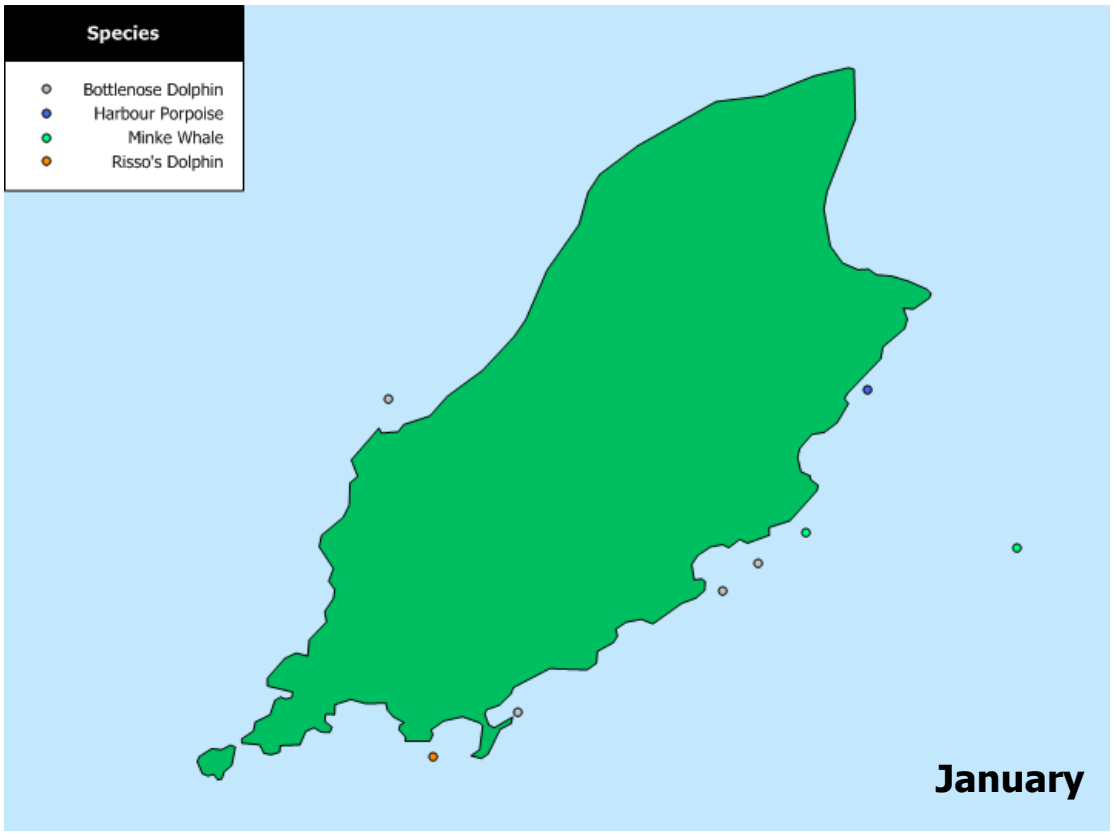
The Risso's Dolphin – an elusive, offshore species?

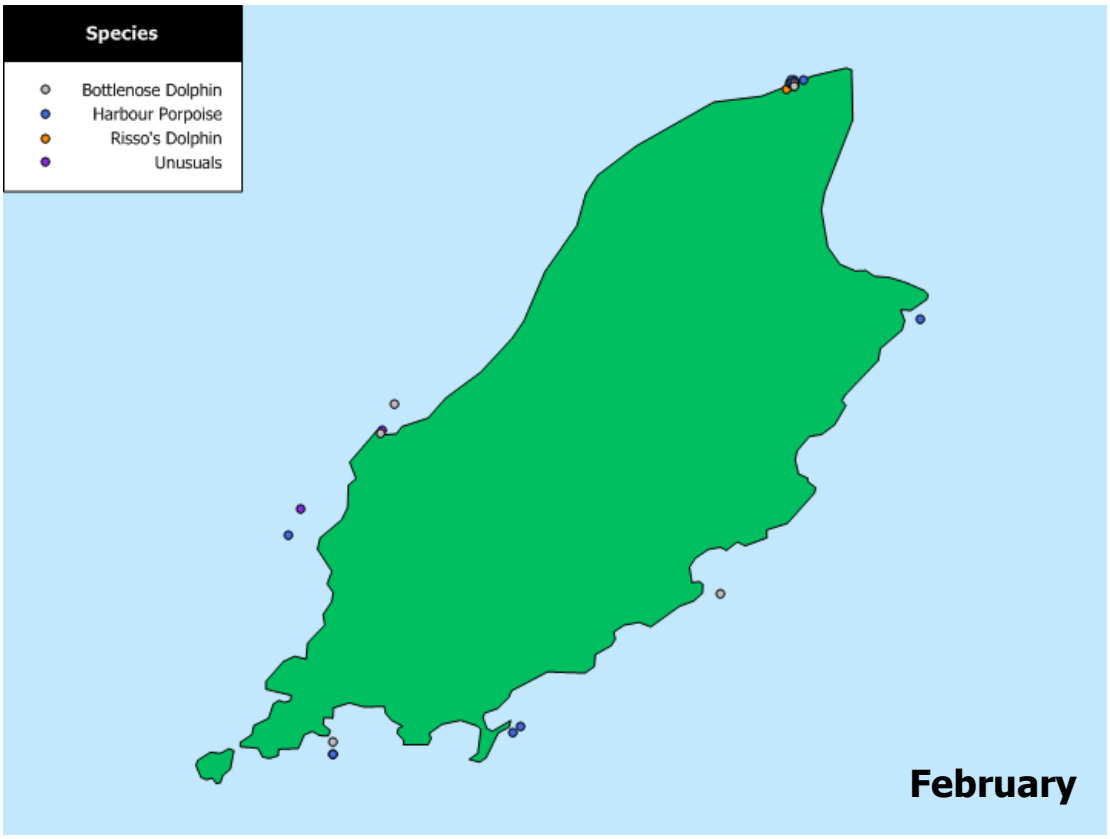
Risso's dolphins are seen extremely frequently in both spring and summer, possibly surprising for a species renowned for its offshore nature. However, due to the deep water surrounding the Isle of Man, Risso's dolphins can come very close in to shore. Needless to say, this is also the reason the minke and other larger whales can be seen so close to land.

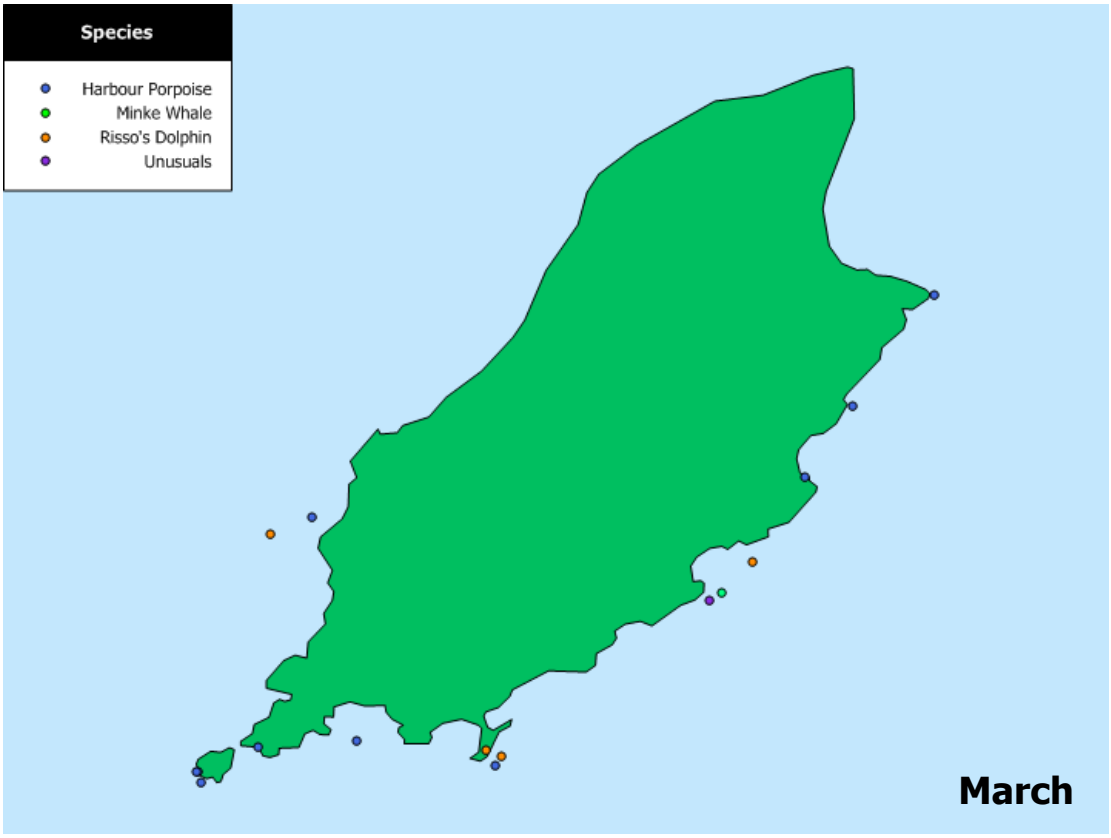
The distribution of Risso's dolphins also changes throughout the year. In the spring, the majority of sightings are on the east coast, in the Douglas Bay/Marine Drive area. In the summer, the animals appear to move further south, with the most sightings being between Langness and the Calf. It is likely that this is due to a change in distribution of the Risso's dolphin's diet (predominantly octopus, squid and cuttlefish), however further study needs to be done before this can be clarified.

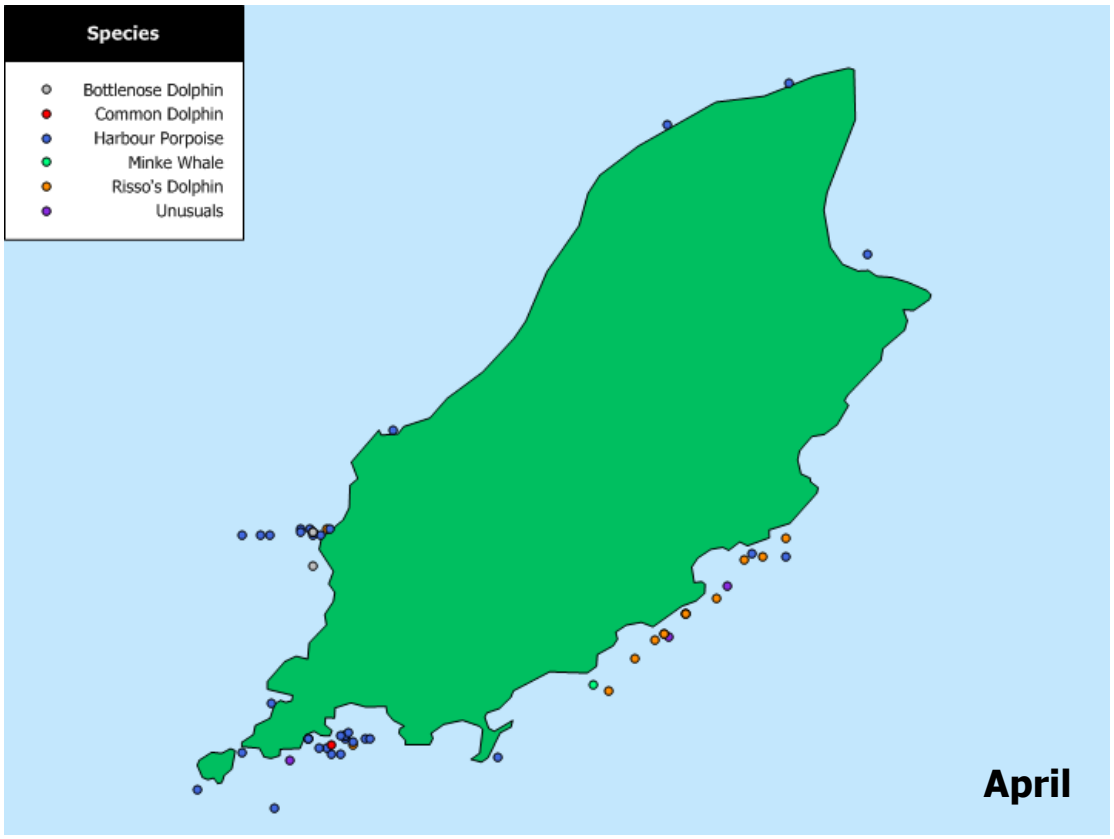
b) Month by Month

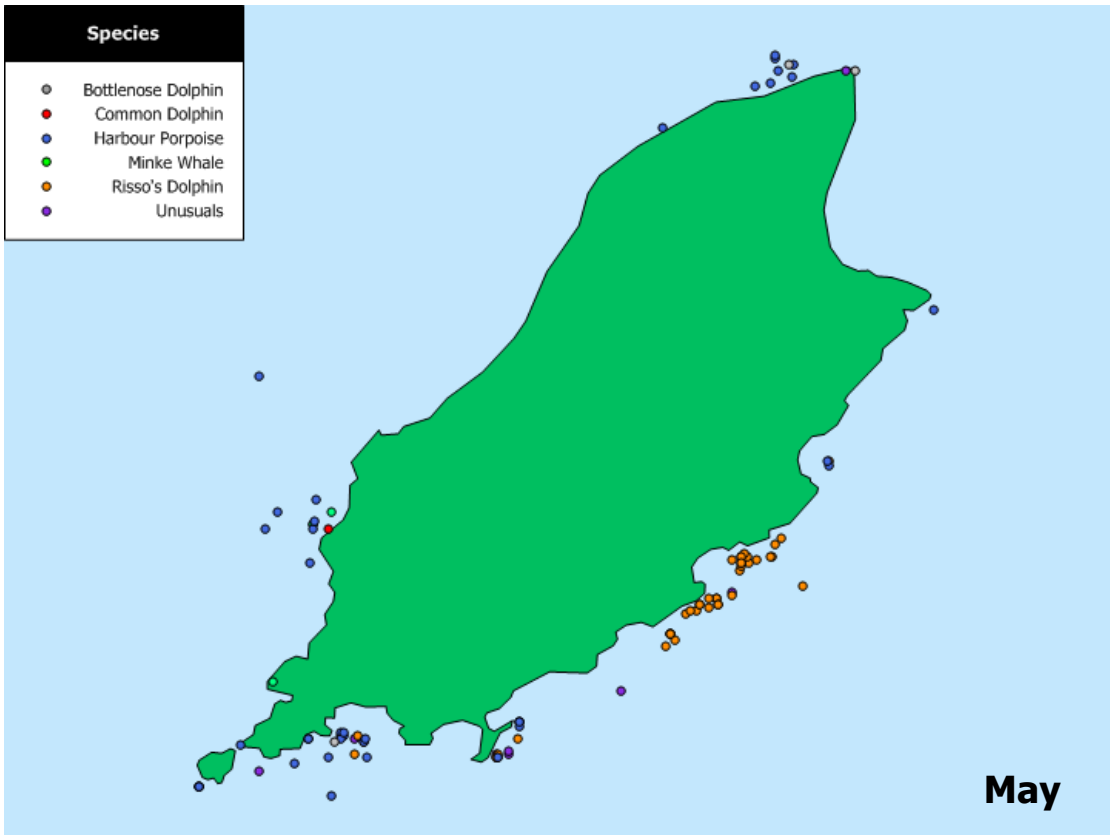
Alternatively, the sightings of all species seen each month can be plotted. This gives an indication of what species are likely to be seen in each month through the year, and in what locations it would be best to go to watch for them. Over time, and with the addition of more effort based land watches, this could be used in the creation of a 'Whale Trail'. The figures below show which species have been seen, and where, in the different months of the year. It should be noted here that sightings in December 2007 have not been included. 'Unusuals' include all other species that have been seen, and include Atlantic White Sided Dolphin, White Beaked Dolphin, Killer Whale, Humpback Whale, Sei Whale, Fin Whale and unidentified species.

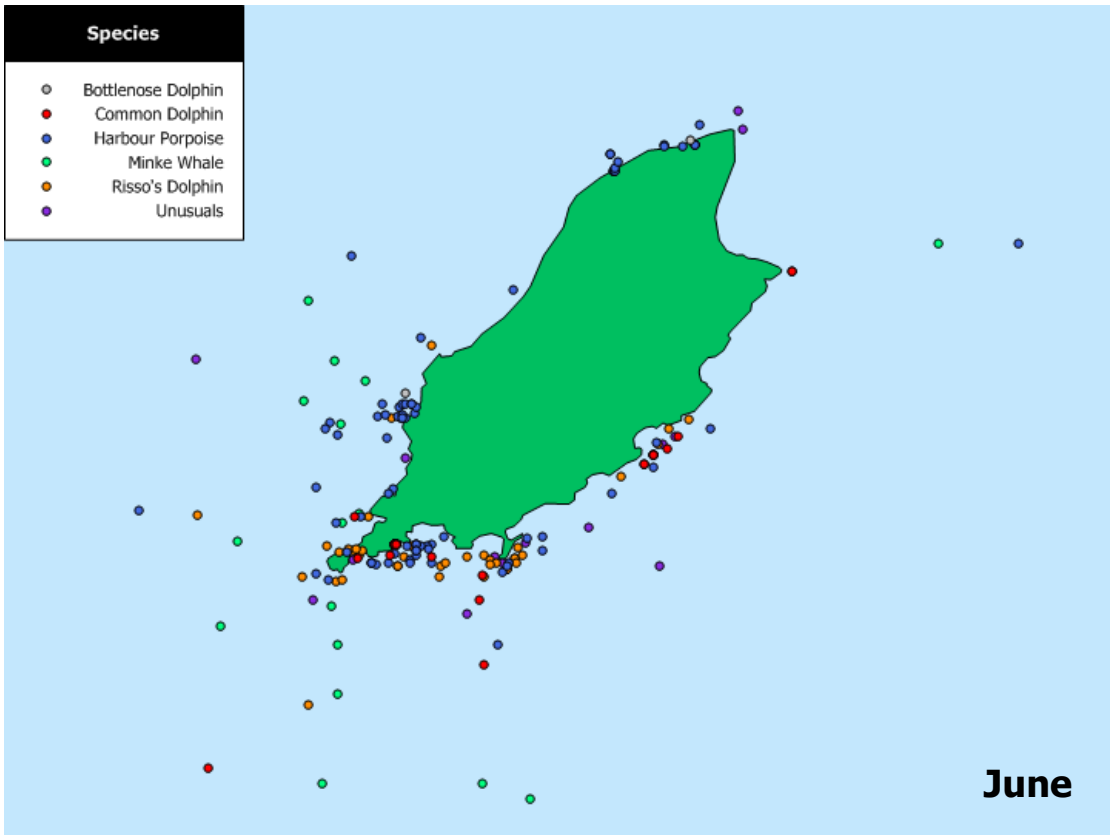


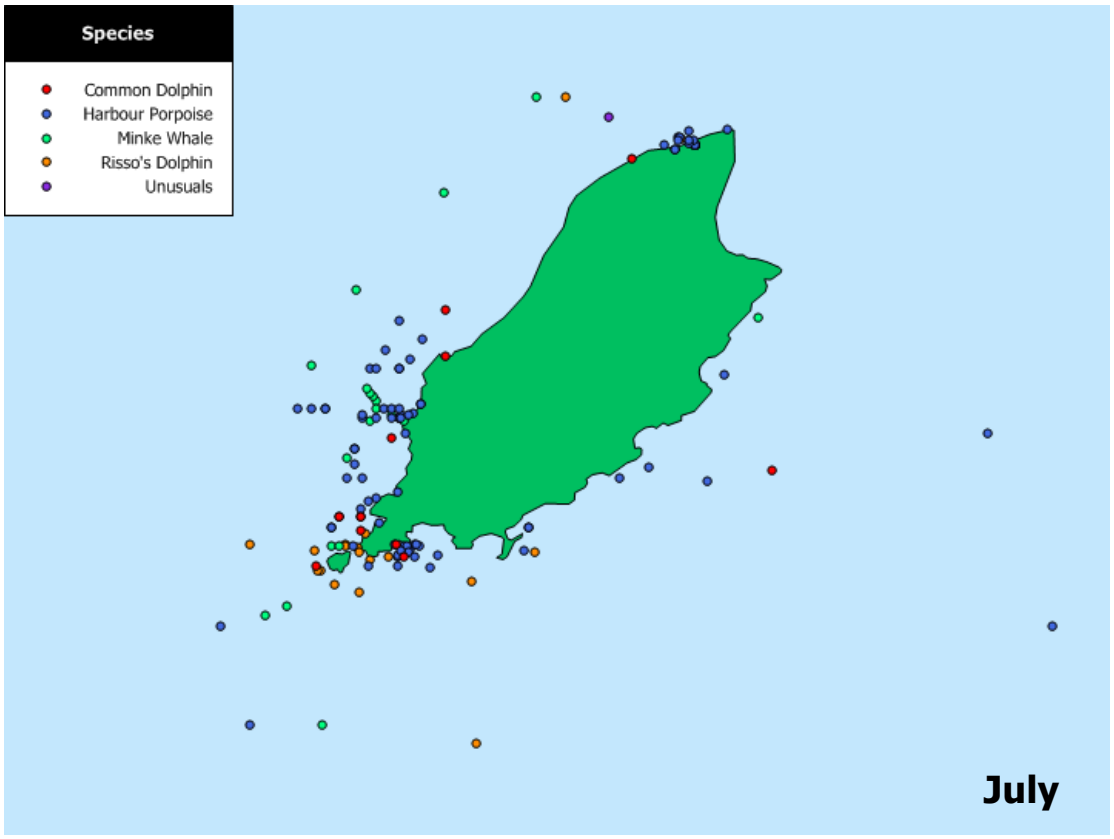

Species
Bottlenose Dolphin
Harbour Porpoise
Risso's Dolphin
Unusuals
February

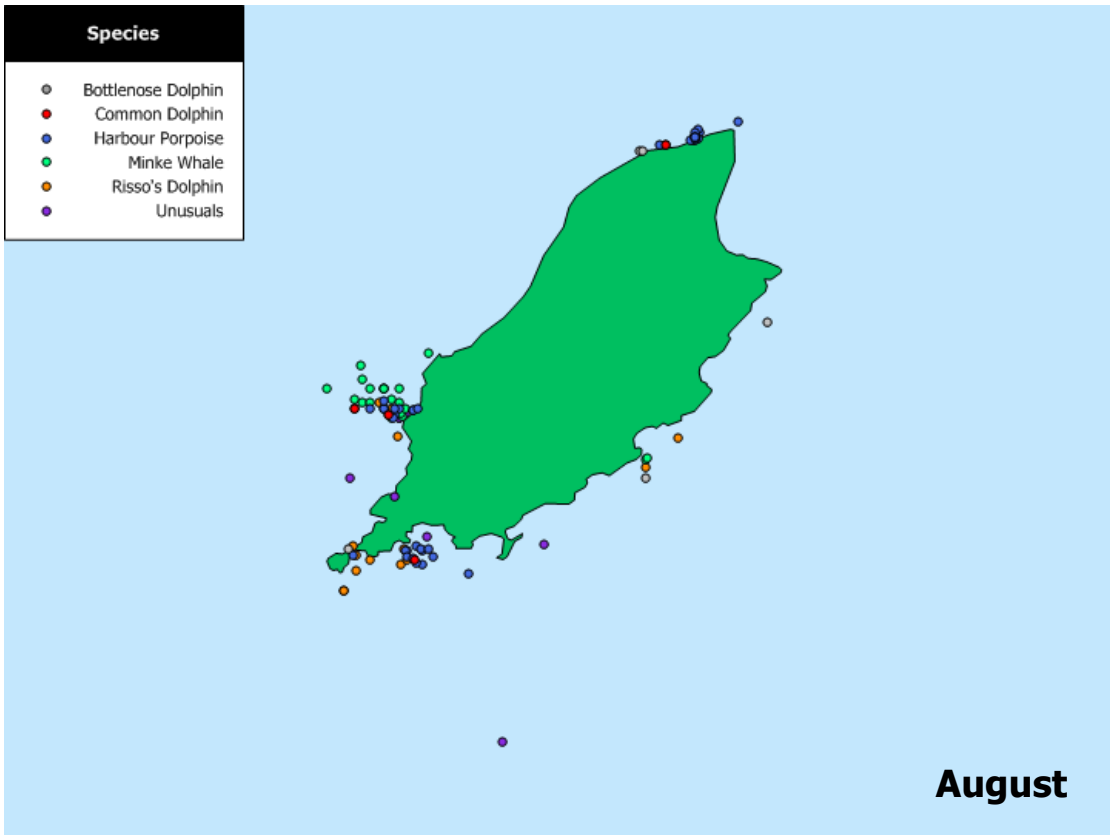

Species
Harbour Porpoise
Minke Whale
Risso's Dolphin
Unusuals
March

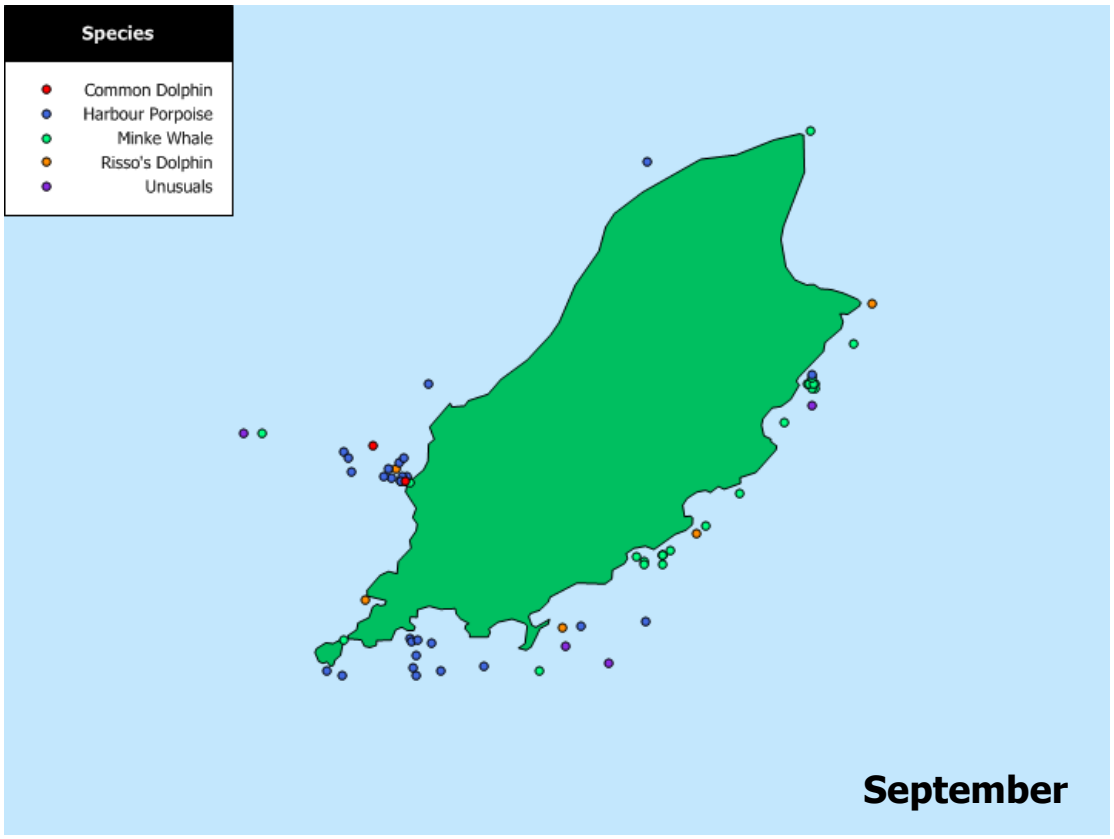

Species
Bottlenose Dolphin
Common Dolphin
Harbour Porpoise
Minke Whale
Risso's Dolphin
Unusuals
April

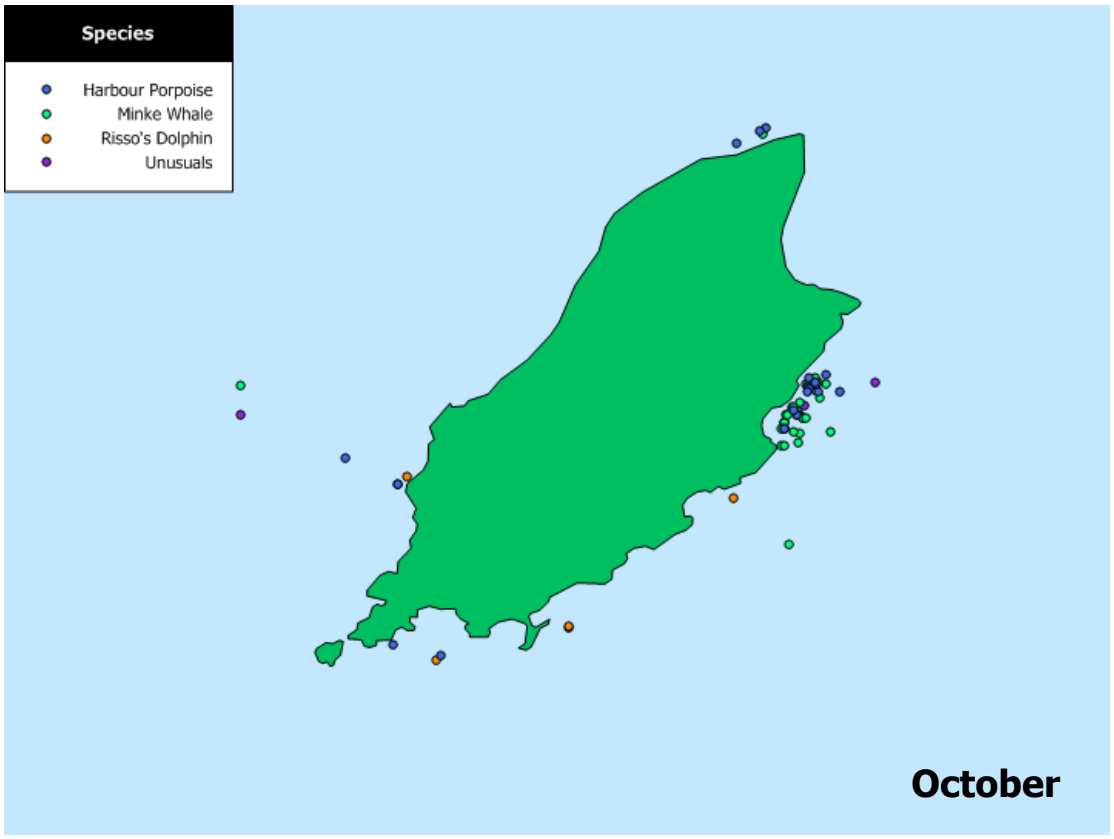

Species
Bottlenose Dolphin
Common Dolphin
Harbour Porpoise
Minke Whale
Risso's Dolphin
Unusuals
May

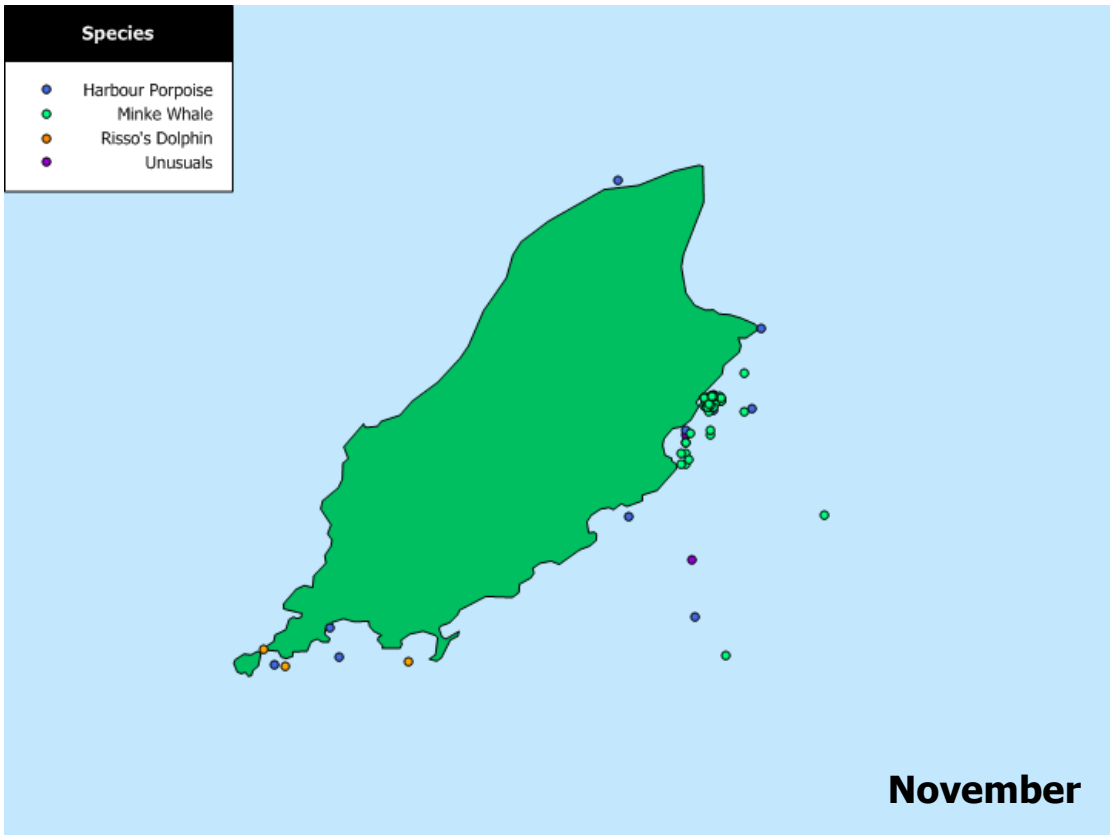

Species
Bottlenose Dolphin
Common Dolphin
Harbour Porpoise
Minke Whale
Risso's Dolphin
Unusuals
June

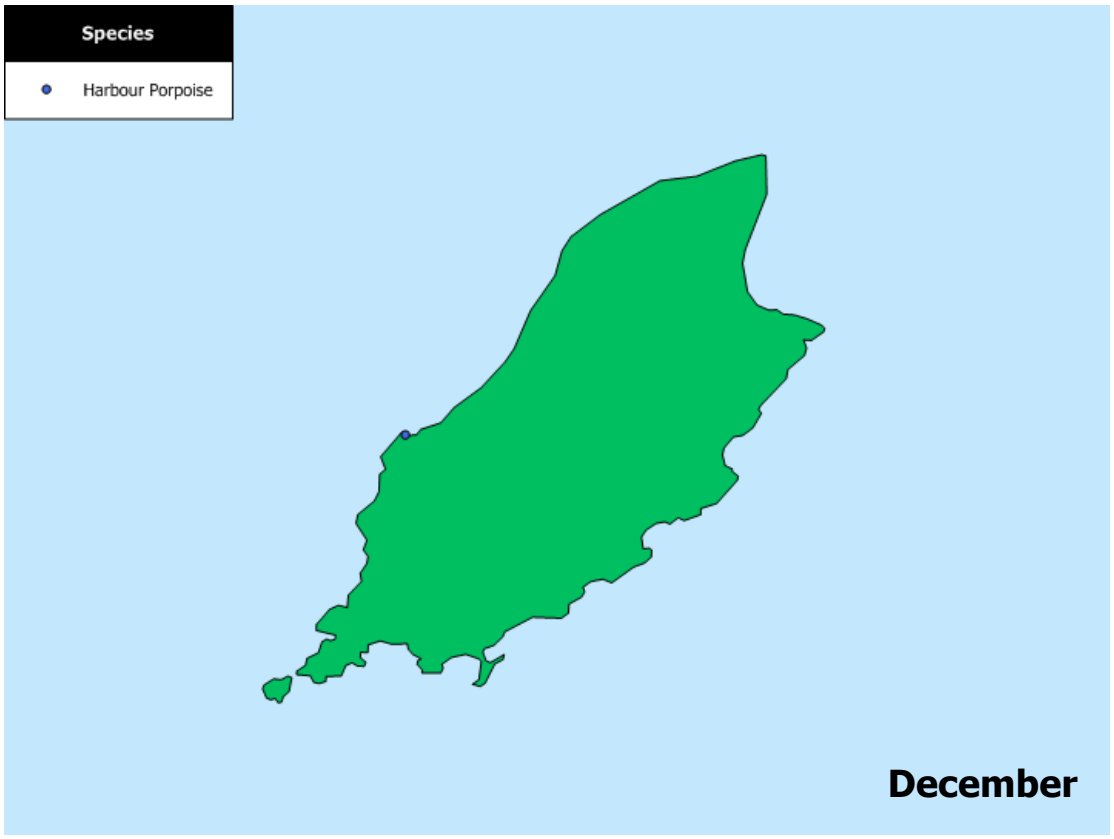

Species
Common Dolphin
Harbour Porpoise
Minke Whale
Risso's Dolphin
Unusuals
July


Species
Bottlenose Dolphin
Common Dolphin
Harbour Porpoise
Minke Whale
Risso's Dolphin
Unusuals
August


Species
Common Dolphin
Harbour Porpoise
Minke Whale
Risso's Dolphin
Unusuals
September


Species
Harbour Porpoise
Minke Whale
Risso's Dolphin
Unusuals
October


Species
Harbour Porpoise
Minke Whale
Risso's Dolphin
Unusuals
November



These distribution maps indicate that, from April through to September, there are a high number of sightings, from all around the island. The exception to this is between Peel and Jurby, which, as discussed earlier, is an area where people cannot readily watch from. In October and November, there are still a moderate number of sightings, the majority of which are minke whales on the east coast. Although the numbers of sightings in December through to March are a lot less, there have still been sightings of at least four different species of cetacean during this time.

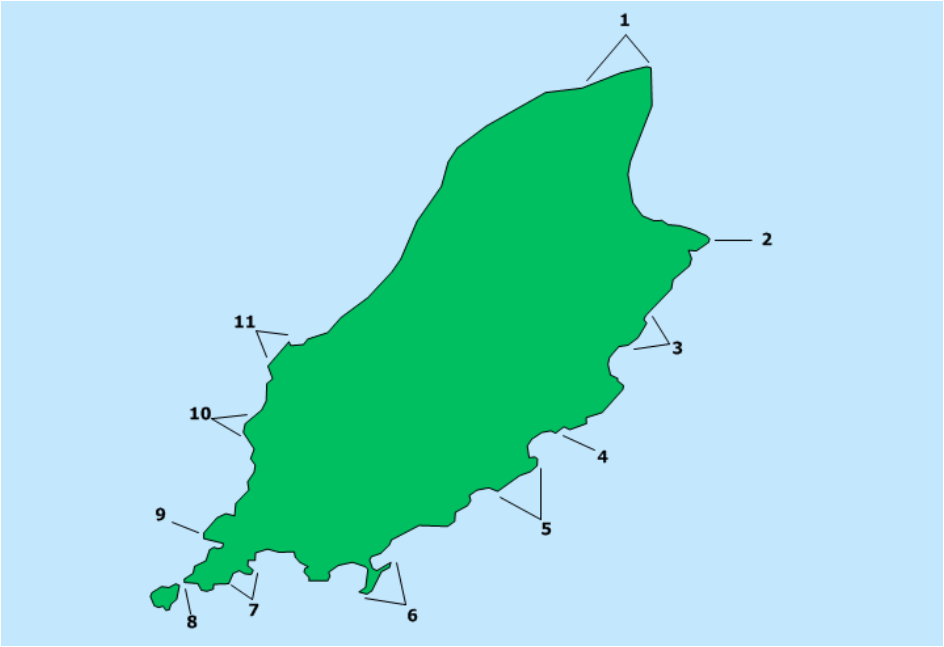
The number of sightings in each month are summarised in the table below.

	Harbour Porpoise	Minke Whale	Risso's Dolphin	Bottlenose Dolphin	Common Dolphin	Unusuals
January	1	2	1	4	0	0
February	10	0	4	7	0	2
March	10	1	4	0	0	1
April	38	0	14	2	1	2
May	39	3	42	3	1	13
June	88	17	42	2	37	15
July	93	26	20	0	11	4
August	40	25	14	5	4	8
September	27	29	6	0	2	5
October	20	37	5	0	0	6
November	32	39	3	0	0	3
December	1	0	0	0	0	0

This table highlights the high number of harbour porpoise sightings throughout the year, the general increase in number of sightings in the spring/summer months, especially for common and Risso's dolphins, and the persistence of minke whales right through till November.

c) Duration of Sightings

When considering the significance of different areas around the island for marine mammals, it is also important to examine the length of time animals spend in the different regions. The figure below illustrates the main areas of sightings, each of which are numbered.



The table below summarises the average duration of sightings of each species, at each of these numbered areas. It also includes the number of sightings of that species, as durations based on a small number of sightings are not necessarily representative and should be treated with caution. Overall, the durations of sightings are impressive. The fact that animals are spending considerable amounts of time within an area indicates that they are probably feeding.

Nevertheless, the table shows that animals do spend longer in some regions when compared with others. For example, all species spend an average of over 25 minutes per sighting in region 5 (Douglas Head to Little Ness). In contrast, region 9 (Bradda Head) is utilised for much shorter periods of time. This would

have implications when designing a whale trail, as the longer animals spend in a region, the more likely people will be able to see them.

	Average Duration of Sightings (mins) n = Number of Sightings			
Area	Harbour Porpoise	Minke Whale	Risso's Dolphin	Others
1	7.1 (n=68)	30.7 (n=13)	37.4 (n=8)	53.3 (n=15)
2	5.6 (n=5)	9.3 (n=4)	(n=0)	15 (n=3)
3	16 (n=43)	36.8 (n=80)	3.6 (n=4)	3.7 (n=3)
4	28 (n=9)	8.5 (n=2)	53.6 (n=15)	6.8 (n=5)
5	27.1 (n=21)	29.8 (n=12)	35.8 (n=26)	37.3 (n=11)
6	11.5 (n=21)	14 (n=4)	19 (n=38.3)	2.4 (n=16)
7	14.9 (n=88)	13.9 (n=4)	13.8 (n=32)	29.8 (n=26)
8	10.9 (n=10)	3 (n=3)	19.8 (n=13)	65 (n=4)
9	5.8 (n=15)	8 (n=5)	2.2 (n=5)	1.7 (n=3)
10	23.5 (n=37)	21.2 (n=15)	10.1 (n=8)	15 (n=10)
11	14.1 (n=39)	15.8 (n=26)	23.3 (n=4)	14.8 (n=7)

2. Effort Based Watches

Effort based watches allow more accurate comparisons between different sights, as they take into account the length of time of watching per sighting. Over the two years, 178 hours of effort based watches have been carried out, resulting in 166 sightings. The breakdown of species of each of these sightings is given in the table below.

Species	Number of Sightings	Number of Individuals
Harbour Porpoise	114	272
Minke Whale	29	36
Risso's Dolphin	6	20
Common Dolphin	13	32
Unusuals	4	7
Total	166	367

As with the opportunistic sightings, the harbour porpoise is the most frequently sighted cetacean, with high numbers of minke whale sightings also, and surprisingly few Risso's dolphin sightings. This discrepancy is most likely due to the fact that a large percentage of Risso's dolphin opportunistic sightings are on the east coast, an area where no effort based watches have been carried out.

Effort based watches have taken place in 6 different areas round the island; The Ayres, Maughold Head, Port St Mary, The Calf, Dalby and Peel. Effort is recorded in 15 minute intervals, so in order to compare the number of sightings in each location, the percentage of cetacean-positive intervals can be used. These percentages are given in the table below.

Area	Effort Time (hours)	Percentage of Cetacean-Positive Intervals
The Ayres	3.25	84.6
Maughold Head	23	3.2
Port St Mary	19	67.1
The Calf	20	11.2
Dalby	103.25	28.3
Peel	7.5	13.3

Although The Ayres would initially appear to have an extremely high percentage of cetacean-positive intervals, it should be noted that this is based on only 3.25 hours of effort and therefore may not be accurately representative. Port St Mary clearly also has a high rate of cetacean sightings, and Dalby has a moderately high rate. These percentages indicate that, on average, you would have 40 minutes of sightings per hour at Port St Mary and seventeen minutes of sightings per hour at Dalby. Maughold Head has an extremely low percentage of cetacean positive intervals, and in fact there have only been 3 sightings there.

Effort based watches also allow the analysis of the tidal effects on the presence of cetaceans. From the effort based watches carried out so far, the percentage of cetacean-positive intervals in the different tidal states has been calculated:

27% = Cetacean-positive 'Ebb' intervals
43% = Cetacean-positive 'Flood' intervals
43% = Cetacean-positive 'Slack' intervals

Although the data set is not yet large enough to carry out statistical analyses on these results, initial figures would indicate that there is an increase in cetacean presence during the flood and slack periods of the tidal cycle.

By continuing effort based watches, and watching from more sites round the island, the most reliable areas and times to find cetaceans will become clear.

Firstly, this will give a true indication of cetacean hotspots around the island, signifying which areas need to be monitored more carefully. Secondly, it could be used in the creation of a whale trail to distinguish areas which are consistently good for finding cetaceans.

3. Boat based Surveys

a) Effort

Overall, 2588 kilometres were completed during the 2007 boat trips, 1937km on dedicated surveys and 651km on press and media trips, comprising the following effort types.

Effort Type	Dedicated Surveys (km)	Press Trips (km)
Casual Watch (no dedicated observers)	35.3	55.1
Dedicated Search (2 dedicated observers on fly-bridge, no independent observer)	956.1	554.9
Line Transect (2 dedicated observers on fly-bridge, 1 independent observer)	938.7	23.8
Photo Identification	7.6	16.8

b) Sightings

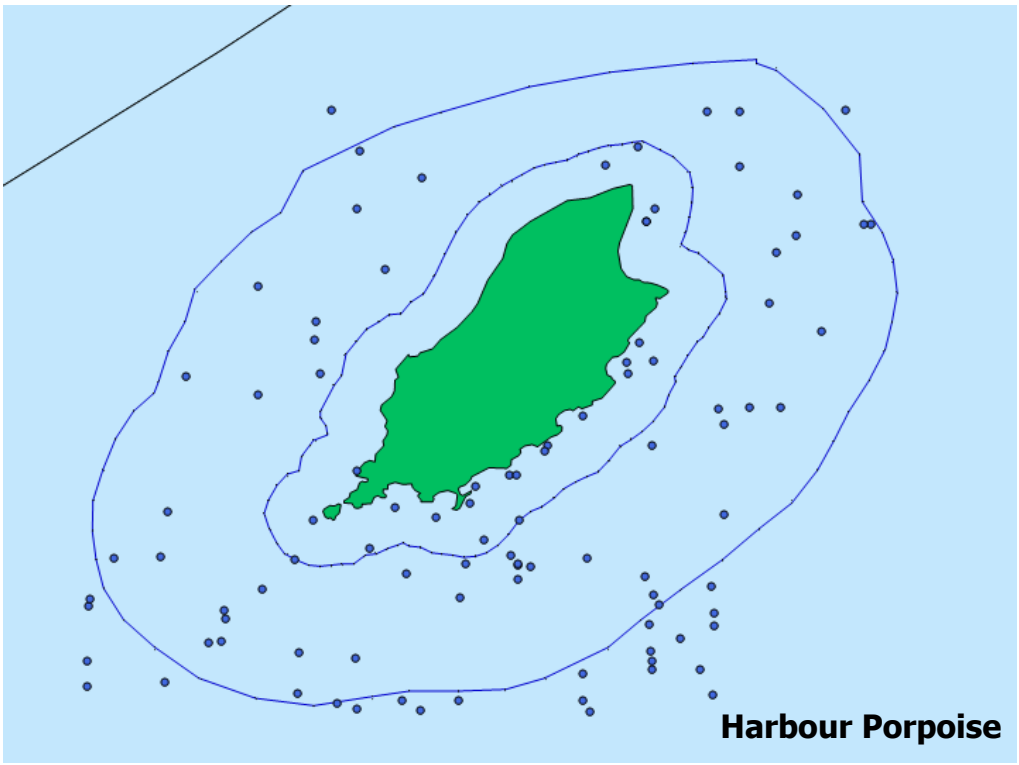
The poor weather limited the number of boat surveys that could be carried out in 2007 and subsequently has limited the size of the data set that the surveys produced. Nevertheless, there were still 206 sightings, of 391 individuals. This equates to a sightings rate of 0.08 sightings per kilometre, or 12 kilometres travelled for every sighting. However, sightings rate changes significantly depending on boat speed and sea state. Therefore, using sightings collected only

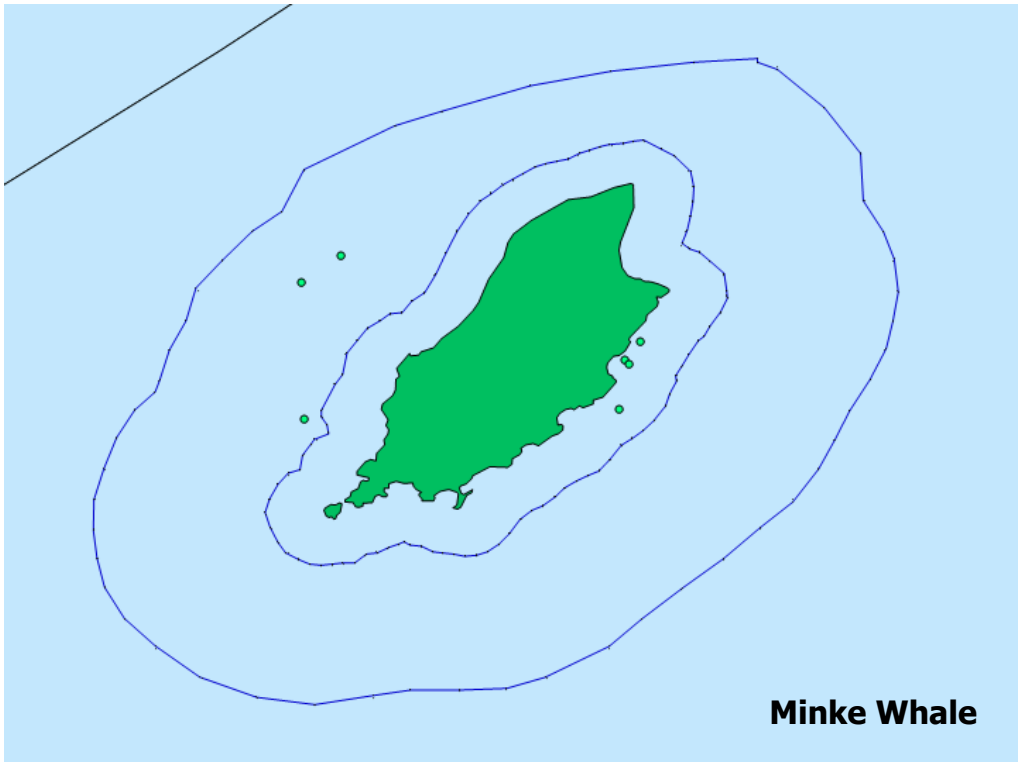
when on transect is perhaps a better indicator of sightings rate, as this is always done in low sea states and slow boat speed. This results in a sightings rate of 0.10 sightings per kilometre, or one sighting every 10 kilometres.

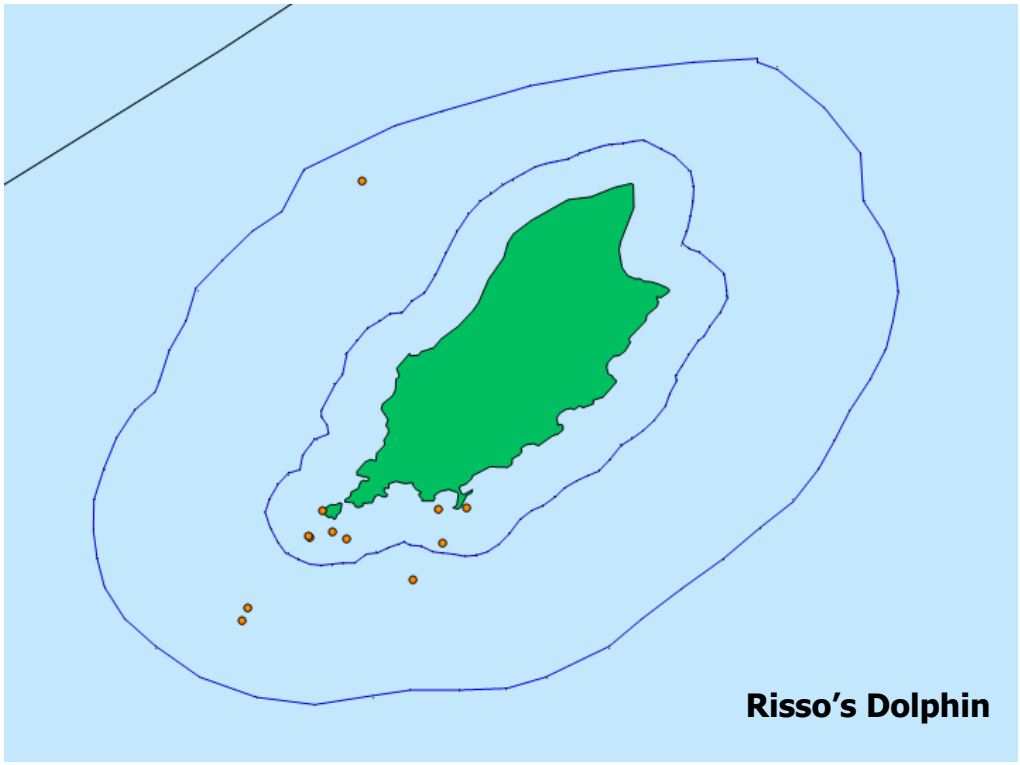
The species breakdown of these sightings is shown in the table below.

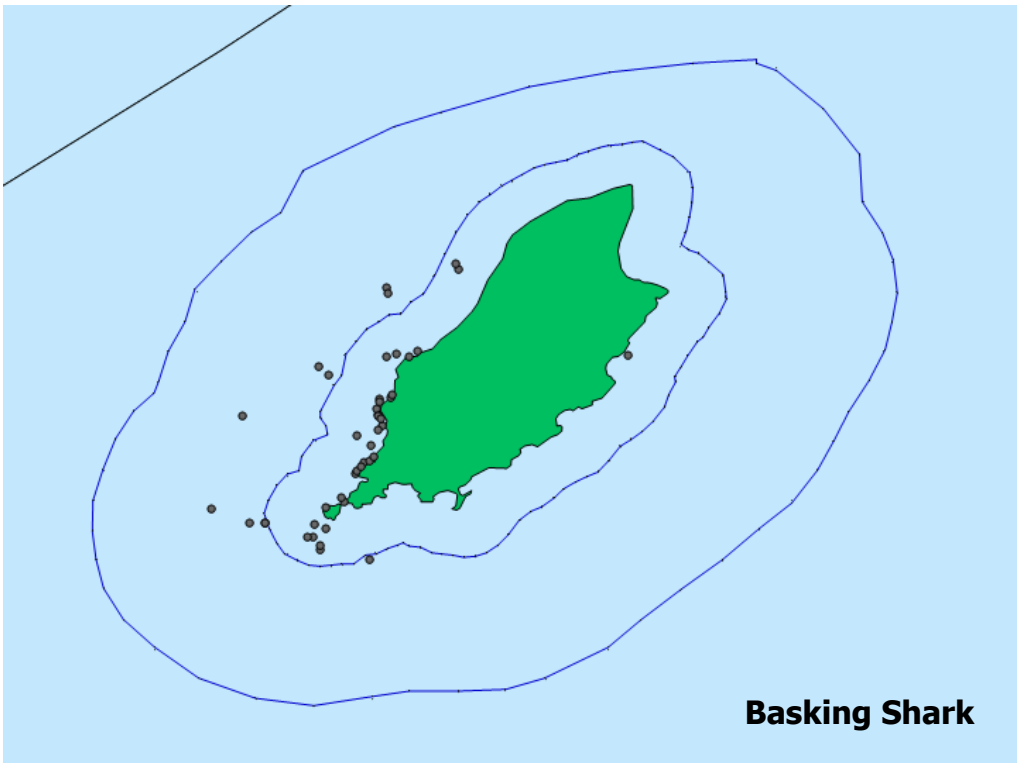
Species	Number of Sightings	Number of Individuals
Harbour Porpoise	98	168
Minke Whale	7	11
Risso's Dolphin	12	36
Atlantic Gray Seal	44	119
Basking Shark	44	55
Unidentified Cetacean	1	1

The distribution of the principal cetacean sightings around the island can be seen in the figures below. Additionally, the distribution of basking shark sightings is also shown. The blue lines represent the 3 and 12 mile limits around the island.




Minke Whale


Risso's Dolphin



Unfortunately there are not enough sightings of minke whales or Risso's dolphins to make any significant conclusions from this small data set. On the other hand, there are many more sightings of harbour porpoise and basking sharks and it is therefore worthwhile to comment on their distribution. As with the opportunistic sightings, harbour porpoise are seen in high numbers all around the island. Interestingly, although there were sightings of porpoises beyond the 3 mile limit along the North West coast of the island (Peel to Jurby), there were none close to shore. This seems to substantiate the lack of opportunistic sightings in this area, although more effort is needed before this absence can be fully established.

It can be seen that a huge majority of the basking shark sightings were on the west coast. There were also some off the south of the island, but only one on the east coast. This one sighting was unusual for two other reasons; it was late in November and was of a very small (approximately 4 metre long) shark. It is also interesting to note that 80% of sightings were within the 3 mile limit, despite this representing a small percentage of the area surveyed. The reason

behind this apparent preference for the coastal waters of the west coast of the island is, as yet, unknown.

c) Harbour Porpoise Abundance Estimate

The high number of porpoise sightings made it possible to derive the first abundance estimate for harbour porpoise in Manx waters. The statistical program which calculates this abundance, DISTANCE, requires as minimum the following information:

- The total distance travelled on transects, in kilometres
- The shortest distance from the transect line of each sighting, known as perpendicular distance
- The size of group of each sighting of porpoise
- The size of the research area, in km^2

The total distance covered is derived using a formula that can calculate the distance between two latitude/longitude positions. Perpendicular distance is calculated from the distance each sighting was from the boat and the angle of the sighting from the boat, using trigonometry. This distance is important because there is a statistical relationship between the likelihood of a sighting and its distance away from the transect line, known as the probability detection function. Furthermore, bigger groups are more detectable than smaller groups at greater distances, hence the need to know the size of groups. The DISTANCE statistic uses these two relationships and the distance travelled to derive a density of animals which, when multiplied by the research area, gives an abundance within that area.

Therefore, the density of porpoises within Manx waters (an area of $4492km^2$) was 0.18 per km^2 (Coefficient of Variance = 24.5, 95% intervals = 0.11-0.29). This means that there is an average density of 0.18 porpoise per km^2, which statistically, may vary by 24.5%, to a confidence level of 95%. This confidence

level has been historically chosen by statisticians to represent statistical significance, i.e. that the results have not happened purely by chance. This density therefore equates to an estimated abundance of 814 animals (95% intervals 501-1322). Therefore, there are between 501 and 1322 harbour porpoise within Manx waters.

This statistic has been derived using the Half-normal Cosine model and a strip width of 700 metres. At greater distances than this, porpoise may be missed due to their size and manner of surfacing, hence these sightings are excluded as outliers. Furthermore, only data collected during sea states of zero and one were used to derive the estimate. In sea states two and above, the detectability of porpoise becomes unreliable, particularly at distances above three hundred metres. With more kilometres of effort on transect, this number will become more precise.

d) Photo Identification of Risso's Dolphins

During boat surveys, we also carried out photo identification (ID) of Risso's dolphins, under a license from the Department of Agriculture, Fisheries and Forestry. Photo identification is an incredibly useful tool in the long term study of cetacean populations as it provides information on the number of different animals using an area, the social associations within a population and the site fidelity and long term use of an area.

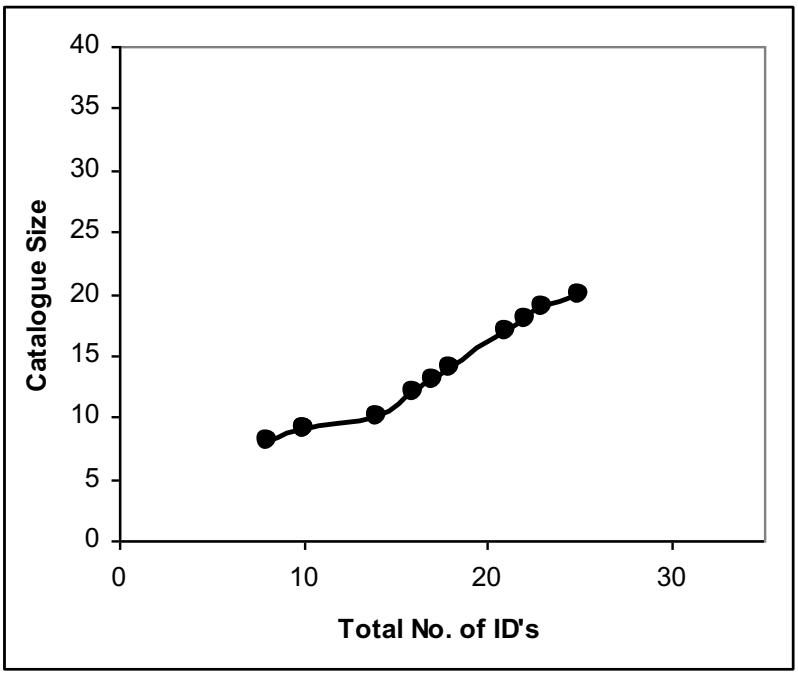
During the boat based surveys, we had 6 encounters with Risso's dolphins. From analysing the photographs taken, it is known that at least 27 different animals were photographed during boat surveys. Along with photographs from opportunistic sightings from volunteers, a catalogue of different individuals has been created. This is split into 'Well marked' animals (those which could be identified from a photo of either side of its fin, i.e. with nicks out of the edge of

the fin) and 'Lefts' and 'Rights' (those which can only be identified from one side, by scars on that particular side).

To date, there are 20 'well marked', 5 'left' and 7 'right' animals in the catalogue. Fin shots of these identified individuals can be seen in Appendix 1. Since it is possible that some of the 'left' and 'right' animals may in fact be the same individual, it is only possible to say that there are a minimum of 27 different animals that have been photographed (i.e. the number of 'well marked' plus the greatest of the 'left' or 'right'). For this reason, the majority of analysis work on the photo ID is using the 'well marked' figures only.

Photo ID can provide a crude estimate of the size of a population, by using the number of 'well marked' individuals. Since not all individuals are well marked, it is possible to calculate a percentage of animals that are 'well marked', out of all the animals photographed. Currently, this percentage is 40%. Since there are 20 'well marked' animals in the catalogue, and this represents 40% of all animals, it can be extrapolated that there are a minimum of 50 individuals in the population. Whilst this figure does represent approximately one third of the current estimation of Risso's dolphins in the whole Irish Sea, it should be remembered that this is only based on 10 encounters in total.

In reality, the number of Risso's dolphins utilising Manx waters is believed to be much higher. This is because only 5 of the 'well marked' individuals have been re-sighted, and each of these 5 has only been seen twice. This means that nearly all the animals being photographed are 'new' and the catalogue is still growing. One easy way to chart this over time is to look at a 'discovery curve', as shown below.



Each time an individual is identified (whether for the first time or as a re-sight), the 'Total No. of ID's' increases. The 'Catalogue Size' only increases if the identification is of a new animal which is put in the catalogue. Therefore, when the curve is still rising, there are still new individuals within the population being discovered. Only when the curve flattens off can it be surmised that all individuals within that population have been photographed.

From this Risso's dolphin discovery curve, it is clear that we are still photographing new, different individuals and that the total number of animals using Manx waters is likely to be a lot higher than the current estimate. Over time, not only will the true number of individuals using Manx waters become more refined, but also it can be seen whether the same individuals are seen year after year, which areas some individuals may favour and whether there are strong social associations between certain individuals.

We anticipate that photo ID catalogues will also be created for bottlenose dolphins and minke whales. Additionally, it is hoped that all the catalogues of cetaceans using Manx waters can be compared with others from around the

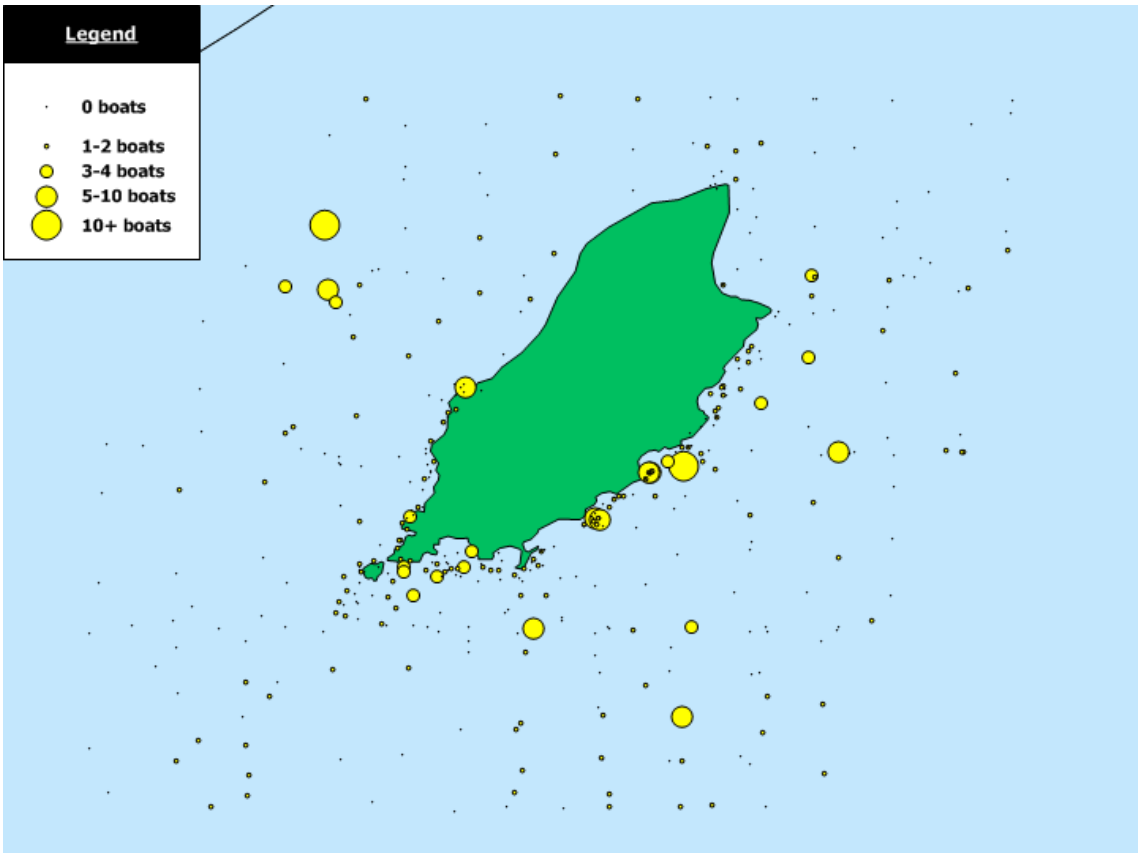
British Isles, to give a broader understanding of the movement of these animals through British waters.

e) Sea Surface Temperature

At the start and end of each transect line, sea surface temperature was measured to add to the overall database of sea surface temperatures in Manx waters. Over time this could be used to monitor changes in sea temperature.

f) Boat Counts

Whilst on the boat surveys, the number of other boats seen was recorded. All boats forward of our vessel were counted, whenever a 15 minute effort interval was recorded. Although the different types of boats were noted, at present the data set is too small to look at these different types separately. The figure below, therefore, shows the total numbers of boats in different locations around the island.



In general, there were not a large number of boats recorded, with a high number of instances of no boats at all. There were only two instances of there being more than 10 boats at one time, and only 8 instances of their being 5-10 boats. It can also be seen that, as yet, no clear pattern of distribution of boats is emerging, although there does appear to be slightly more boats off the east coast than off the west coast. Nevertheless, with the well documented effects that increasing boat traffic can have on the presence of cetaceans, it is important to continually monitor the number and distribution of boats around the island.

Conclusions

The results presented here demonstrate, for the first time, the extent of the presence and distribution of cetaceans around the Isle of Man. They show that there are very high numbers of harbour porpoise all around the island and that they utilise nearly all Manx waters. There are also significant numbers of minke whales and Risso's dolphins, species not often seen so close to land. These two species appear to have specific patterns of movement throughout Manx waters during the course of the year. In addition to these, there are also a large number of sightings of other cetacean species, most notably bottlenose dolphins and common dolphins. In total, at least 11 different cetacean species have been seen around the Isle of Man in the last two years; an incredible number. This indicates the current good health status of Manx waters, that it is able to support such great biodiversity.

All these cetacean species are on the IUCN Red list of Threatened species, meaning that it is vital that they are effectively monitored and conserved in areas where they are abundant. The results from the last two years have given us an indication of the significance of Manx waters for these animals, but they also show that further study is needed to accurately determine their degree of importance and the most effective management strategies for these charismatic animals.

Appendix 1 : Risso's Dolphin Individuals within photo ID catalogue

a) 'Well Marked' Individuals

Number 1

2

3

4

5

6

7(right)

7(left)

8

9

10(right)

10(left)

11

12

13

14

15

16

17

18

19

20(right)

20(left)

b) 'Right' Individuals

R1

R2

R3

R4

R5

R6

R7

c) 'Left' Individuals

L1

L2

L3

L4

L5