Seal Survey Carlingford Lough

Assessment of Abundance and Distribution of Harbour and Grey Seals in an Irish Sea Lough – Phase 2

2017-18

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1.0 Introduction

1.1 Context

On foot of planning permission (Ref: P/2013/0434/F) to develop a car ferry crossing between Greenore, county Louth, and Greencastle, county Down, a programme of seal counts prior to and during the operation of the ferry was conditioned by the planning authority to the permission granted. Details of the ferry route are provided in Appendix 1, and the survey method agreed with the planning authority in Appendix 2.

1.2 Scope

The scope of this report is confined to (i) describing Carlingford Lough; (ii) the target species; and (iii) presenting the findings of the survey, specifically:

Four sets of five boat-based counts covering harbour seal post-pupping (July) and moulting (August and September), grey seal breeding (October/November), and grey seal moulting (January to April) to assess harbour and grey seal populations, productivity, and distribution in the outer part of Carlingford Lough. Adults and pups were assessed; sub-adults (>1 year old) and pups counted in after end July were included with adults; males and females were not separated; adults were not aged.

1.3 Description of Carlingford Lough

Carlingford Lough is a drowned glacier-cut valley formed at the end of the last ice age. The mouth of the Lough, the area under study, is relatively shallow (less than 3 metres) due to the deposit of moraine and the decreased erosive force of the glacier meeting the sea, a feature typical of a fjord, while the inner part of the Lough is relatively deep (up to 30 metres) (Baxter, 2009). A shipping channel has been dredged to 8 metres to facilitate access for shipping.

At high water (MHWS) two islands (skerries) remain exposed, Green Island, essentially a shingle bank on dipping limestone, running north to south near Greencastle, and Blockhouse Island, a limestone reef, running east to west near Haulbowline lighthouse. At low water (MLWS) several reefs of dipping limestone are exposed, along with several individual boulders and outcrops to the west of Blockhouse Island. A large basalt intrusion (The Black Rock) and several smaller ones (eg Earl's rock) are exposed to the north of Greenore Point. Several reefs are also exposed at Mill Bay and further north (eg Carriganean). Extensive sandflats are exposed in this area, consisting of creeks and pans and a deeper channel from which the White Water and Causeway Water delta over the sand and mudflats. Further to the north-west a sandbank, the Killowen Bank, extends out into the Lough bounding a shallow inlet to rock outcrop at Carrigaroan.

On both north and south shores extensive aquaculture is practiced, primarily oyster cultivation using trestles and bags between the high and low water marks – see Appendix 3. The area is also marked by considerable recreational activity, particularly in the summer, involving swimming, kayaking, sailing, boating, jet skiing, and related activities. Cargo ships regularly pass through the channel to Warrenpoint port and Greenore port, typically with several passes per day in all seasons.

Because the large body of water narrows between Greenore Point and Greencastle, ebb and flow tidal velocities can be significant, reaching 5 knots per hour. The Lough is fed by several rivers; these in turn attract migratory fish such as trout and salmon. Significant numbers of mackerel are regularly caught off Greenore point during the summer.

The benthos consists of a mosaic of habitats including deep holes, tidal rapids supporting biogenic *Modiolus modiolus*, coarse gravel with cobbles and boulders, mud and sand flats, rocky outcrops and other rocky substrates supporting extensive growths of *Lamanaria* and *Fucus* species as well as green algae.

According to the JNCC Marine Habitat Classification system, the intertidal rock habitats are dominated by the habitat type "*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid-eulittoral rock" merging into "*Fucus serratus* on moderately exposed lower eulittoral rock".

These habitats support a rich ecosystem including red and brown algae, soft corals, hydroids, bryozoans, large sponges, anemones, mussels, brittle stars, crustaceans, and other invertebrates. Fish include pollack, spurdog, flounder, rockling, dogfish, conger, wrass, mackeral, and ray.

The Lough is relatively protected by the mountains to the north and south and is probably in the rain shadow of Slieve Foye, though on occasion squalls can blow up, particularly in easterly airflows. Surface temperatures typically range from about 6 ^{o}C to about 17 ^{o}C between summer and winter. Water quality is generally good despite the discharge of untreated sewage into the Lough at various locations. According to the AFBI SMILE project "Organic-rich anoxic sediments with a high sulphide content can be found in the waters near the tidal limit, but water quality within the main Lough is good and it is not thought to be eutrophic. Nitrogen inputs associated with fresh water (concentrations of N decline seawards down the Lough) can feed or limit the algal growth within the Lough. Nutrient enrichment and algal bloom development within the Lough are low compared with some other coastal sites, and it has been suggested that plankton blooms are associated with localised enrichments, and a net export to the Irish Sea occurs with the ebbing tides."

The Lough is designated as a Special Protection Area by both the UK and Irish governments and is a Ramsar site. Terns (mainly common terns, historically roseates) breed on Green Island with variable success. Protected habitats on the county Louth shoreline are included in a Special Area of Conservation and include the sand and mudflats, Atlantic Salt Meadow, Salicornia and Zostera beds, and vegetation of stony banks and drift lines.

Given the above facts the outer part of the Lough should be a suitable ecosystem for grey and particularly harbour seals.

1.4 Harbour Seals

Harbour seal (*Phoca vitulina concolor*) adults measure 140-185cm and weigh 8-16kg at birth and up to 130kg as adults. Harbour seals divide their time between foraging at sea and hauling out on to rocky shores or inter-tidal sandbanks to rest, or to give birth and to suckle their pups. They feed on various fish, including herring, sand eels, whiting, flatfish, shrimps/crabs and squid. Adults are thought to be faithful to favoured haul-out areas from year to year while young animals wander extensively; adults may travel up to 50km to feed and remain at sea for several days. Haul out/nesting sites vary with season, weather, feeding opportunities, disturbance, and other factors. Hunting is poorly understood. Females give birth to a single pup typically in June; pups can swim and dive when just a few hours old (MacDonald, 1993).

The ICUN has classified the Western Atlantic Harbour Seal as "least threatened" though its population trend is "unknown".

1.5 Grey Seals

Grey seals (*Halichoerus grypus grypus*) show marked sexual dimorphism with males up to 210cm in length and females up to 180cm weighing 235kg and 155kg respectively.

Grey seals are found in a few locations in the Irish Sea mainly hauling out on exposed rocky coasts and sometimes on sand banks; they feed on sand eels and cod but are opportunistic “probably take whatever fish are most abundant”. They will often take offal discarded from fishing boats and harbours (author’s observation). About two-thirds of greys seals' time is spent at sea hunting and feeding (Lyons, 2004).

At low tide they haul out sometimes separately, sometimes in groups, especially when moulting in spring. In autumn they breed, typically starting in late September and finishing in November. Grey seal pups are typically born in large colonies or rookeries of tens to many thousands of cows and weigh about 14kg at birth and have soft white fur and remain on land where they suckle from their mother for about 21 days (Anderson, 1990).

The Western European population of grey seals has been increasing in recent years and has been classified by the ICUN as “least threatened”.

1.6 Diet in Carlingford Lough

A study (Wilson, 2012) undertaken by Tara Seal Research in August/September 2009/10 examining seal scat during the harbour seal moulting season found “The diet was found to consist principally of small gadoid fish, such as cod, haddock and whiting, and also flatfish such as flounder and plaice, and dragonet. All these types of fish have relatively low energy density. The remains of relatively high energy fish, such as herring, sand eel, mackerel and garfish, were occasionally found.”

1.7 Previous Surveys

A preliminary survey (Wilson, 2012) was undertaken by Tara Seal Research over the years 2008 to 2011 assessing abundance of harbour and grey seals, and harbour seal productivity. This was the basis of the methodology, both operational and statistical, that was requested by DAERA, the competent authority. Prior to the 2008-11 survey, surveys were undertaken by both NPWS (south of a notional border separating the north and south of the Lough) and NIEA (north of that border).

2.0 Methodology

2.1 Reconnaissance of haul outs prior to survey

Prior to the start of the survey, and in October and February, all haul out sites were checked from both the north and south shore using a 20 – 60x terrestrial telescope on various tides to understand haul out patterns. Particular attention was paid to the possibility of grey seals pupping; grey seal pups have distinctive white coats and stay on shore for several weeks after pupping so would be easily picked out on the dark background of Blockhouse and Green islands.

In addition to this possible haul outs to the north and south of Carlingford Lough were checked. A large haul out of up to 60 harbour seals and 10 – 15 grey seals is present in Dundalk Bay along the Castletown river channel (author's observation) (Lyons, 2004).

During surveys, effort was made to ensure that the survey boat approached haul out sites obliquely, at slow speed (<5 knots) while observing the response of seals to the approach. High visibility clothing was avoided, as well as any unnecessary movement on the boat. All surveys started out at Greenore mainly following an anticlockwise route; this significantly improved photography as the sun was to the east and south during most surveys, behind the survey boat.

Counts were made from the count points listed below where possible; in two cases, Carrigroan and Mill Bay it was impossible to reach the actual count points on low tides because they were exposed (Mill Bay) or the water was too shallow (Carrigarean) – however despite this it was possible to make good counts at these locations on all occasions. To obtain accurate counts it was often necessary to move several tens or hundred meters either side of the actual count point to observe animals obscured by rocks, sand banks, oyster trestles or other seals. Several sites were checked from the shore either immediately before or after counts (eg Carrickbrada, "Seal Rock" and Carrigaroan).

As each haul-out was approached several wide angle shots were taken to capture all animals; subsequently, on approach, detailed shots were taken of each animal or group of animals moving in a right to left arc with a GPS enabled camera using a 100-400mm lens. On some occasions a segment of video was taken to back up photography and a dictaphone was used to supplement photography with a verbal description. A second observer was used during the most challenging counts (August/September). Distances were verified using a laser range finder. At the end of each count results were compiled and verified.

2.2 Equipment

- Canon EOS 6D GPS-enabled
- 100 – 400mm IS EF Canon lens
- Monarch 10 x 42 binoculars
- Leica 20 – 60x Televid terrestrial telescope (from land)
- Viking 6x25 7 deg Laser Range Finder
- Roland R2 dictaphone/throat mic
- Canon Legria 41x optical HD video camera
- eTrex Vista GPS unit
- 6.1m Tornado RIB equipped with Yamaha 115 hp outboard and a Garman GPS 451s

2.3 Detailed description of count points and haul outs

2.3.1 Ballyedmond

This haul out consists of a sandy creek leading to a rocky outcrop (Carrigaroan), but enclosed by the Killowen sand bank, making seal access and flight difficult. Aquaculture activities now span most of the area to the north and east. The focus of seal activities is at Dickies Rock, apparently a nursefy area.

2.3.2 Seal Rock

Identified as “Black Rock” on the Admiralty maps, this is a basaltic intrusion separated from the main mudflats and reefs by a deep channel. The name seal rock referred toin the 2008-11 report is otherwise unknown (ie. not marked on any map or known as such locally).

2.3.3 Carriganean

The haul out is about 200 metres south of Carriganean rocky outcrop and sand bank along a relatively shallow sandy creek. Again there is considerable aquaculture activity in the vicinity.

2.3.4 Mill Bay

This refers to the many rocky outcrops immediately to the west of the pier at Greencastle. The White Water channel runs alongside these rocks. On some tides there is a section of exposed sand along the river channel.

2.3.5 Green Island

Two count points Vs and Vn refer to Green Island and its associated rocky outcrops of dipping limestone. The north part features many nooks and crannies while the south is more open. The permanently exposed part of the island is essentially a shingle bank. The results from the north and south count points are summed for simplicity.

2.3.6 Blockhouse Island

This is a very exposed rocky island with the remnants of several man-made structures “blocks” on view.

2.3.7 Blockhouse Reefs

This refers to dipping limestone and single rocks/boulders immediately to the south and east of Blockhouse Island and including Goose Rock, Haulbowline Rocks and Long Rock. There are no reefs.

2.3.8 Greenore

This refers to Cooley Long Rock and Carrickbrada dipping limestone and a few single rocks in the immediate vicinity. Carrickbrade was not counted in the 2008-11 surveys. This area is several kilometres from Greenore.

2.4 Count Methodology – Targets vs Actual

The count methodology followed the count points and transects set forth in the 2008-11 survey (Wilson, 2012). Given the relatively narrow windows for each set of counts, finding days when tide and weather were suitable during daylight hours was challenging. Calm sea with a sea state of 0 or 1 produced the best conditions for photography from a moving boat and it was possible to achieve this on most outings especially for the first two sets of counts.

Criterion	Target	Actual
Weather	Relatively calm (slight sea state) and dry conditions	Sea state < or = 2 on all counts except two winter counts when sea states of 3 were encountered. On one occasions winter squalls required a short pause in survey. On one count significant fog developed in the outer part of the lough.
Tide	Count to straddle low tide	All counts straddled low tide by at least 30 minutes either side.
Approach distance	Minimum 150 metres	Yes – typically 200+ metres
Count periods	Harbour seal pupping	Dates achieved are 1, 2, 6, 16, 17 July
	Harbour seal moulting	Dates achieved 29 Aug, 1, 17, 18, 26 Sept
	Grey seal pupping	Dates achieved 30 Oct, 2, 29 Nov, 2, 3 Dec
	Winter to early spring	25, 26 Mar, 5, 7, 23 May

2.5 Statistical methodology

The statistical methodology (used by Wilson (2012)) was requested by the competent authority and is based on a seminal paper by Oseliuk et al (Olesiuk, 1989) adapting Robson and Whitlock's bounded count method "The bounded count estimate is based on the premise that each animal in the population has some finite probability of being counted, such that it is theoretically possible, albeit highly unlikely, that all individuals would be counted during a census. Generally, however, the counts represented only a proportion of the actual population, with the proportion depending on tidal conditions, weather, the timing of censuses, the number and competence of observers, etc." It should be noted that this method is validated for Pacific harbour seals (*Phoca vitulina raichardsi*) in British Columbia at the end of the pupping season, but has been widely adapted in other studies involving harbour seals post-pupping (Cadhla, 2010), including Wilson's preliminary series of surveys 2008-11 (Wilson, 2012). The methodology assumes that on any count a certain unknown number of animals will not be counted and estimates this number. The average proportion of seals hauled out Pav is thus calculated using the following equation:

$$Pav = Cx/[Cmax + (Cmax - Cmax\text{-}1)]$$

where Cx= mean, Cmax = maximum count, and Cmax-1 = second highest count. Abundance is then calculated from Cx/Pav. Other parametric tests to estimate overall population are not normally applicable as the dataset is inherently non-normal given that an unknown number of animals is not counted on any given count. The method is not validated for estimating grey seals or harbour seals outside of the post-pupping/moulting period.

3.0 Results

3.1 Abundance

All planned counts were successfully completed in good conditions and tides, and without incident. Tables summarising results is provided in appendix 5. Because considerable experience of the specific conditions in Carlingford Lough had been built up by the survey team from the previous survey and other MMO work in the area it was found that the key success factor clear calm weather. Generally, the initial boat-based count was the main, supplemented by analysis of photos on crowded haulouts, produced the best results.

3.1.1 Harbour Seals Post-pupping – July

The proportion of harbour seals hauled out (Pav) was 63% with an estimated population (Cx/Pav) of 344 adults and a maximum count of 23 pups from an observed range of 116 (164 – 280).

Figure 1 Harbour seals with recently born pups

Grey seals ranged from 17 to 88 animals mainly in the Blockhouse/Greenore area. Occasional sub-adults/juveniles were observed, and were included with the adults for the purposes of estimating abundance.

3.1.2 Harbour Seals Moulting - August/September

The proportion of harbour seals hauled out (Pav) was 72% with an estimated population (Cx/Pav) of 297 adults over an observed range of 202 (91 – 293) was recorded.

Grey seals ranged from 39 to 74 animals with a max count of 74 recorded on the 29th July of which 26 hauled out on the western side of Green Island

3.1.3 Grey seal Pupping – October/December

Harbour seals ranged from 49 to 91 animals while grey seals range from 24 to a maximum of 88 during these months. Almost all of the latter were sub-adults with no mature males seen at all. One heavily pregnant female was observed on the 30th October at blockhouse island. No evidence of grey seal pupping was observed.

3.1.4 Grey Seal Moulting – January/April

Harbour seal ranged from a low of 105 to a maximum count of 190 with numbers steadily growing through the spring and early summer while grey seals were 55 to 125 animals.

3.2 Distribution

The overall distribution pattern saw harbour seals occupying the inner less exposed parts of the Lough around Mill Bay, Green Island North and "Seal Rock" while grey seals occupied the more exposed outer parts around Blockhouse Island and reefs.

There was a noted concentration of common seals on the north of Green Island during August. A small increase in harbour seals using Carrickbrada rock (Greenore) in spring was an exception. Seal rock, Carrigarean and Green Island were the main pup haul outs. Carrigarean was the only sandy haul out in all tides, all of the others being rocky. A table detailing distribution is provided in Appendix 4; the cumulative distribution over all counts is summarised in the following table.

Table 1 Cumulative distribution 2017-18

Place name	Ballyed mond	Seal rock	Carrige nean	Mill bay	Green island	Blockhouse Island	Blockhouse reefs	Green ore
Harbour seals	23	257	972	622	793	33	13	461
Harbour seal pups	7	22	14	2	22	0	0	0
Grey seals	0	5	2	52	223	432	277	208

The cumulative distribution graph shows a north south distribution with greys preferring the more exposed south and harbour seals preferring the inner more protected parts and that Green Island is the most important haul out overall.

Table 2 Cumulative distribution 2015-16

Place name	Ballyed mond	Seal rock	Carrige nean	Mill bay	Green island	Blockhouse Island	Blockhouse reefs	Green ore
Harbour seals	7	340	482	588	841	47	29	221
Harbour seal pups	0	83	54	29	112	4	5	16
Grey seals	0	9	10	42	138	200	207	232

Distribution between phase 1 and phase 2 is similar with the increase in harbour seals primarily being recorded at the Carrigenean and Greenore sites.

3.3 Disturbance

There was a constant low level of disturbance stemming from aquaculture activities and shipping, with container and bulk vessels traversing the survey area several times per day serving Warenpoint and Greenore ports. There was also a significant level of disturbance caused by shellfish collectors, mainly periwinkles but also possibly mussels. While disturbance was not directly observed the absence of seals in the immediate vicinity of the winkle collectors suggested disturbance. On a few occasions, leisure activities caused some disturbance, notably kayaking around Green Island, and Blockhouse Island (a party of 20 on one occasion), diving, fishing from open boat, lobster pot

collection, and sailing close to Green Island and Blockhouse Island. A single jet ski caused major disturbance over the whole area from Blockhouse to Green Island to Carlingford on one occasion.

The survey vessel triggered alarm behaviour on a few occasions, with some haul outs being more susceptible to disturbance than others, notably Carrigarean (where the approach usually has the sun behind the boat, which makes observation of the approaching vessel more difficult for seals) and the south-west side of Green Island for harbour seals, and Blockhouse Island for grey seals. Note that grey seals typically approached the survey vessel and some may have been more curious than alarmed. Other haul outs such as the rocks around Mill bay, Greenore and Seal Rock were less susceptible to disturbance. Overall, the survey boat triggered this response on four occasions out of 160 possible, or at a rate of 2.5%. On all occasions it was possible to compete the count before animals entered the water.

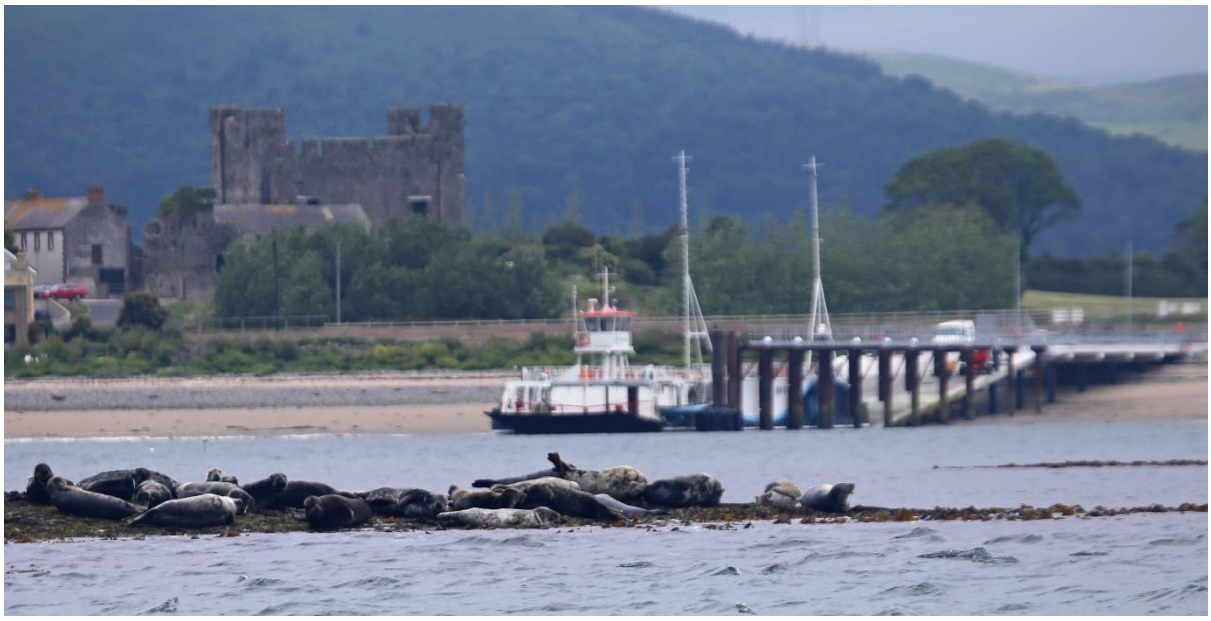

Figure 2 Grey seal haulout at south of Green Island, ferry in background

4.0 Discussion

4.1 Abundance

Up until the series of surveys from 2008-11 (Wilson, 2012) count data from Carlingford Lough may have significantly underestimated numbers partly because the effort was undertaken from each side of the border independently, and partly because most counts were either shore based or aerial.

4.1.1 Harbour Seals

The bounded count statistical method used to estimate abundance was developed for the harbour seals pacific sub-species in the Straits of Georgia, British Columbia in a mosaic of habitats including tidal islets, reefs, boulders, and sandbars. Though there are slight differences between the lifecycle, and diet of each sub-species, and significant differences in climate and tidal dynamics, the method has been widely used in a number of contexts and may be sufficiently robust estimate for comparative purposes.

Table 3 harbour seal estimates 2008 - 17

	Harbour seals	
Date	adult	pup
July 2008	178	54
Aug/Sept 2008	350	nc
July 2011	187	43
Aug/Sept 2011	376	nc
July 2015	222	29
Aug/Sept 2015	359	nc
July 2017	344	23
Aug/Sept 2017	297	nc

The data shows a regular increase in the estimated July population of harbour seals from 178 to 222 to 344 adults over ten years. The estimated August population shows an apparent slight decline in harbour seals in August/September from 350 to 376 to 359 to 297, an apparent decline, though Irish harbour seals (Cronin, 2013) are known to have more extended moulting than the north pacific sub species. However, a slight decline in the ration of adults to pups was seen from 2008 (178/54) to 2015 (222/29) to 2017 (344/23) which may be of some significance, though assessing pup numbers is notoriously difficult even in good conditions. Numbers of adults dropped precipitously in November/December but rebounded progressively from March. This pattern was observed in other harbour seal surveys (Thompson, 1997).

4.1.2 Grey seals

Grey seals are thought to range more widely than harbour seals and to spend more time in the water hunting and feeding, though specific animals are known to be highly individualistic in their behaviour. During the survey it was noted that some distinctive animals (notably males) regularly used the same haul out over a succession of counts. The statistical method used in relation to harbour seals is not applicable so it is challenging to get an estimate of absolute abundance in Carlingford Lough, however given the relatively small numbers, a visual comparison with data gathered in the previous survey should be sufficient for the purposes of this study.

Table 4 Grey seal counts

Year	July					Aug/Sept				
2008	Nc*	nc	nc	nc	nc	21	34	38	18	15
2009	12	10	16	20	30	nc	nc	nc	nc	nc
2011	8	8	47	39	nc	40	44	32	28	15
2015	23	17	52	40	60	64	48	35	73	57
2017	53	53	17	88	64	74	58	56	39	65

*nc = no count

The data shows no discernible annual pattern, with July numbers ranging from 8 to 88 individuals, and August ranging from 15 to 74, though the overall trend would appear to suggest an increase in grey seal numbers over ten years which may reflect a known increase in the overall population over that period (ICUN). Numbers declined in winter and spring with no large males seen in November. A single pregnant female was seen in October; no grey seal pups were observed, though there were several yearlings. Overall this may be interpreted as representing a small sedentary population and a larger transitional population coming and going stochastically.

4.1.3 Distribution

Harbour seals primarily occupied the inner part of the Lough, “Seal Rock”, Carrigenean, Mill Bay and Green island. During August/September they had a pronounced preference for the north part of Green Island. An exception to this was that on occasions harbour seals would gather at Carrickbrada in the Greenore count area.

Grey seals primarily occupied the outer more exposed parts of the outer Lough at Blockhouse Island and reefs and the Cooley Long Rock.

4.1.4 Disturbance

Apart from the disturbance caused by the survey boat (see methodology) the main source of disturbance was people gathering periwinkles or other shellfish. Typically, seals would enter the water in the vicinity of the collector and haul out elsewhere. This was not directly observed during the survey but was observed from the shore during the reconnaissance visits. Other possible causes off disturbance were kayaking around Green Island and other boating activities straying too close to the seals. Shipping and fishing boats appeared to cause little disturbance and for the most part seals seemed habituated to aquaculture activities except at Ballyedmond and Carrigerean, where activity may have increased in recent times. A single jet-ski caused havoc on one occasion. Harbour seals were most susceptible to flight at Carrigerean, Seal Rock and the west side of Green Island. Grey seals were most susceptible to flight along Blockhouse reefs where the survey vessel must pass within about 180 metres of haul-outs.

5.0 Conclusions

The July post-pupping population of harbour seals in Carlingford Lough has shown a significant increase over ten years almost doubling from 178 to 344 animals. Pup productivity appears to show an apparent decrease from 55 to 23 over the same time period. This may represent a decline in pup numbers though it is equally possible that it is an artefact of counting; harbour seal pups can be very difficult to assess accurately due to their small size and the fact that they may be obscured by other animals, and that mothers may choose to pup and nurse pups in the more inaccessible locations in the lough. The data gathered to date are not sufficient to determine the possible significance of this possible decline given the challenges in assessing pup numbers.

Grey seal numbers showed an increase from July to August/September, however it is suggested that the apparently aleatory nature of the grey seal data suggests a combination of a small sedentary population and a larger transient population. There is some evidence for an increase in grey seal population over 2008 – 2016. Grey seal breeding was not observed and all large grey males left the area from Oct/Nov; however, a pregnant grey female was observed in October.

Both species saw a significant decrease in numbers in winter and spring with numbers starting to increase again from March.

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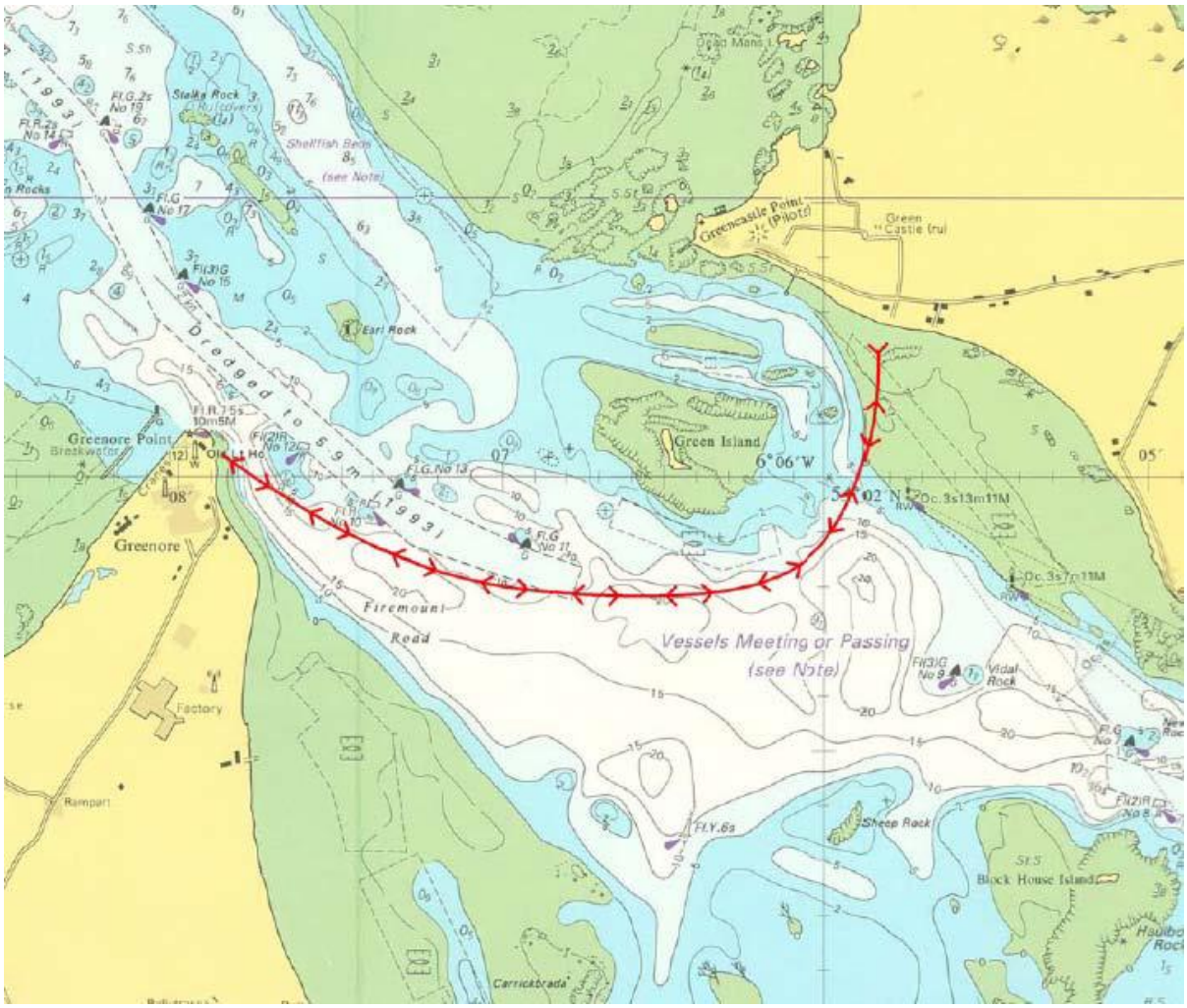
Appendices

Appendix 1: Proposed Ferry route

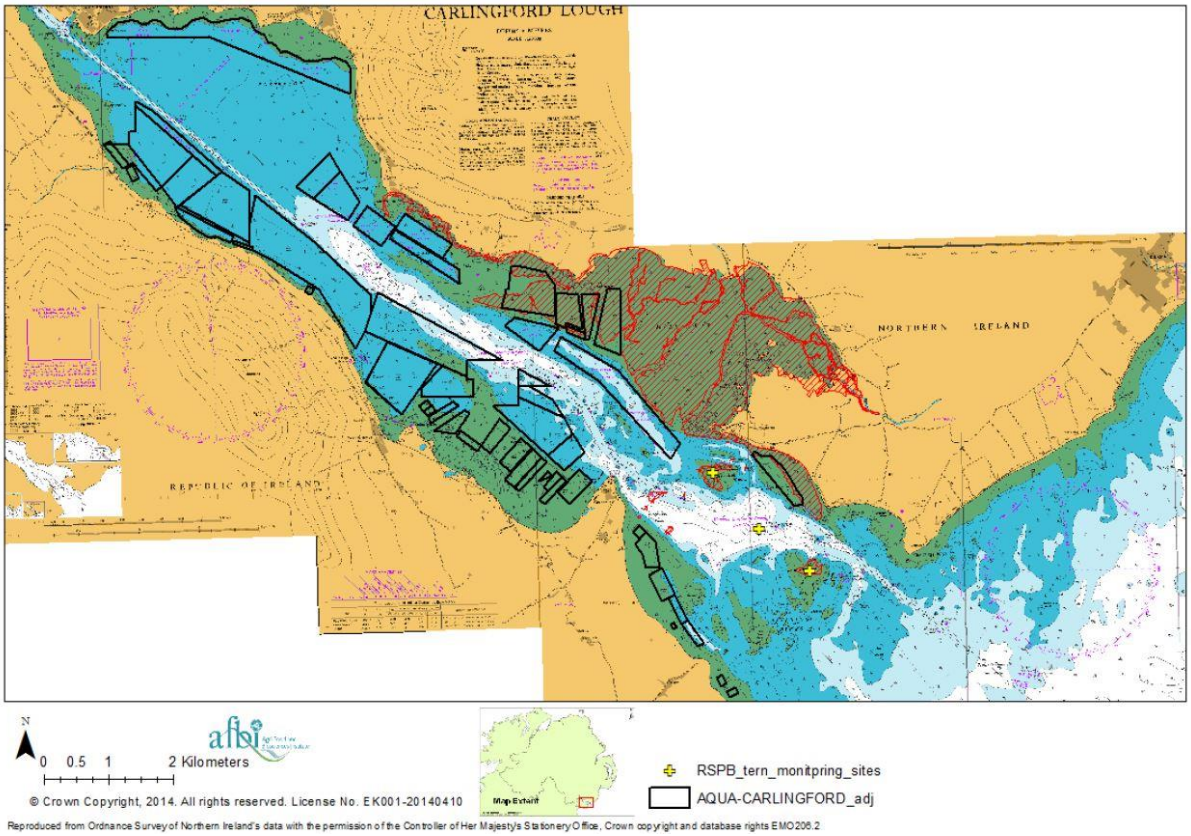


Appendix 2: Proposed Methodology

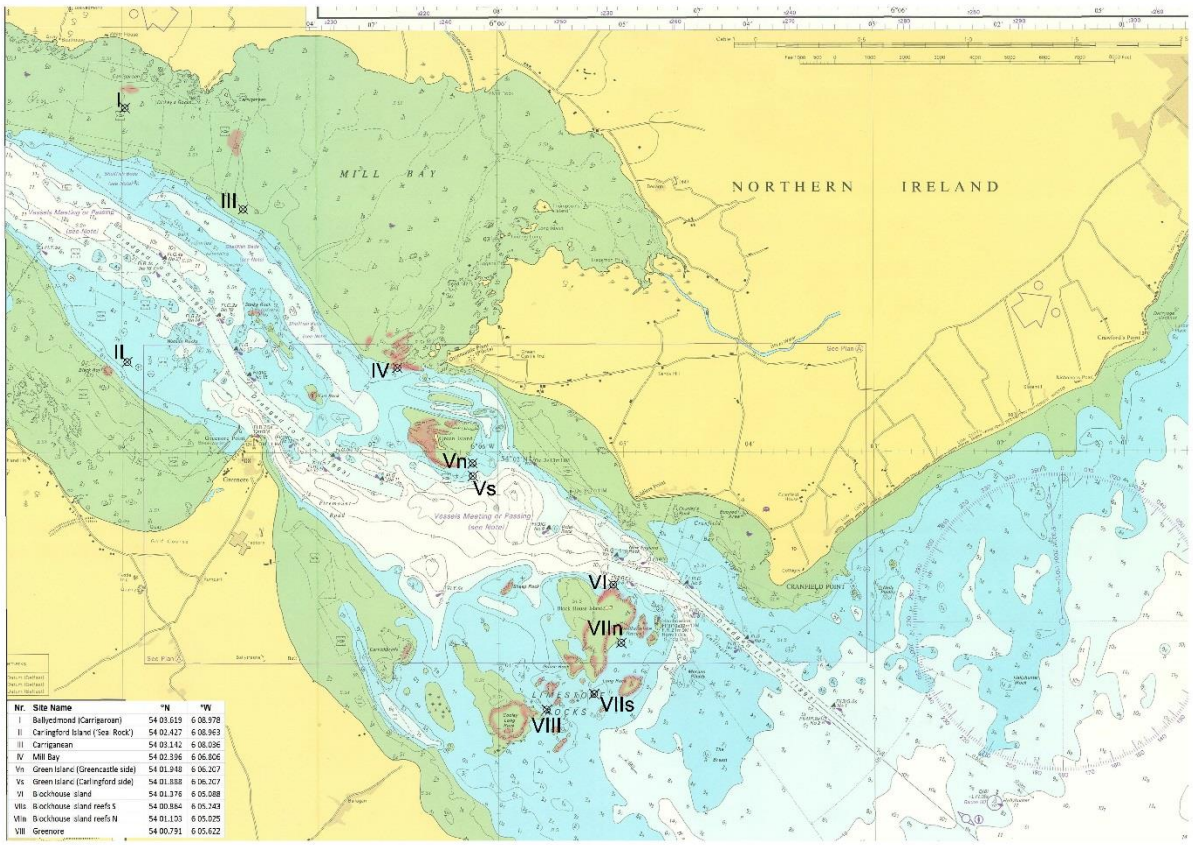
Date	Target	Counts
June 2015	Reconnaissance	
July 2015	Pupping harbour seals	5
August – September 2015	Moulting harbour seals	5
August – September 2015	Moulting harbour seals - assistant	
End September	Report harbour seals	
November 2015	Pupping grey seals	5
January – April 2016	Moulting grey seals	5
June 2016	Reconnaisance	
July 2016	Pupping harbour seals	5
August – September 2016	Moulting harbour seals	5
August – September 2016	Moulting harbour seals - assistant	
November 2016	Pupping grey seals	5
January – April 2017	Moulting grey seals	5

The proposed methodology for phase 1 is provided above. The target for phase 2 is the same number of counts in the same time frames after the ferry has started operating. Sea trials were first carried out in June 2017 with full operation during July 2017.

Appendix 3: Aquaculture concessions Carlingford Lough



Appendix 4: Seal haul outs Carlingford Lough



Appendix 5: Abundance and Distribution Summary Data

Harbour seals										
Place name	Ballyedmond	Sealrock	Carrigean	Mill bay	Green island south	Green island north	Blockhouse Island	Blockhouse refs n	Greenore	Total
01/07/2017	4	24	46	81	29	19	3		19	225
02/07/2017		32	72	59	43		9	3	16	234
06/07/2017	4	29	35	30	39		6	3	13	159
16/07/2017		23	67	50	63	61		6	7	277
17/07/2017	3	32	29	88	31				4	187
29/08/2017	6	8	122			151			2	289
01/09/2017	6	15	31	41		191				284
17/09/2017		23	54	44		33		1	49	204
18/09/2017		22	56			67			51	196
25/09/2017		8	26	2		36			17	89
30/10/2017		3	32	4		5	2		14	60
02/11/2017		2	22				2		23	49
29/11/2017										0
02/12/2017		2	28	18	2		2		20	72
03/12/2017			28	10	2		3		11	54
25/03/2018			48	24					30	102
26/03/2018		1	45	39					34	119
05/05/2018		12	42	36		8	1		38	137
07/05/2018		19	42	15		42	3		41	162
23/05/2018		9	56	89					30	184
Totals	23	257	972	589	209	573	31	13	421	3088

Harbour seal pups										
Place name	Ballyedmond	Sealrock	Carrigenean	Mill bay	Green island south	Green island north	Blockhouse Island	Blockhouse refs n	Greenore	Total
01/07/2015	3	3	5	2	5	1				19
02/07/2015		5	2		1					8
09/07/2015	2	3	4		6					15
15/07/2015		1	1		3	4				9
28/07/2015	2	12	2		7					23
Total	7	24	14	2	22	5	0	0	0	74

Grey seals										
Place name	Ballyedmond	Sealrock	Carrigenean	Mill bay	Green island south	Green island north	Blockhouse Island	Blockhouse refs n	Greenore	Total
01/07/2015					33		2	17	1	53
02/07/2015					32			19	2	53
09/07/2015								15	2	17
15/07/2015		1			17	10		53	5	86
28/07/2015		1			13			45	5	64
07/08/2015			2		26		7	8	31	74
12/08/2015					22		27	5	4	58
30/08/2015					14		3	4	35	56
06/09/2015					23	1		2	9	35
08/09/2015					18		1	30	14	63
03/11/2015		1					80	2	5	88
10/11/2015		1		6				12	14	33
22/11/2015										0
24/11/2015							63	4	9	76
03/12/2015							19	1	4	24
01/03/2016							102	13	9	124
02/03/2016		1					49	9	9	68
15/03/2016				42			4		9	55
17/03/2016				4			26	16	12	58
14/04/2016					14		4	21	16	55
Total	0	5	2	52	212	11	387	276	195	1140