

HARBOUR SEAL PILOT MONITORING PROJECT, 2010

June 2011

INTRODUCTION

Two species of seal (*Phocidae*) commonly breed in Ireland: the Harbour seal (*Phoca vitulina*) and the Grey seal (*Halichoerus grypus*). Ireland's current minimum population estimate for Harbour seal numbers 2,905 seals, based on a robust baseline assessment carried out in August 2003 (Cronin *et al.*, 2004; Cronin *et al.*, 2007). A scientific evaluation of ongoing monitoring methods for populations of seal species (Cronin & Ó Cadhla, 2008) was commissioned by the Scientific Unit of the National Parks & Wildlife Service (NPWS). This report outlined monitoring options for Ireland's seal populations based on data and experience obtained during the national seal population assessments and other scientific considerations. This information, together with the results of seal monitoring work carried out by regional staff since 2003 and the potential operational capacity for annual seal monitoring were also considered by NPWS in the development of monitoring strategies for Harbour seal and Grey seal by mid-2009. With regard to monitoring Ireland's Harbour seal population, it was decided to pursue a twin-track strategy targeting the annual moult season (August-September approximately) when the highest numbers of Harbour seals gather ashore. It consists of the following two components:

1. A national aerial survey using thermal imaging within the 6-year Habitats Directive Article 17 reporting cycle, in order to produce an updated minimum estimate of the national population size.
2. Annual monitoring on the ground by NPWS regional staff at key regional haul-out sites in order to deliver recurrent data on approximately 40-50% of the national population.

Both components are designed to complement each other, permitting the two-way 'truing' of aerial and ground-count data in years when both survey elements coincide and placing the data gathered by either monitoring component into an appropriate context. It is envisaged that annual monitoring data from selected sites may be pooled to investigate ongoing regional or local population status & trends.

Upon finalisation of coherent NPWS seal monitoring strategies in 2009, the first surveys to reassess regional populations of Harbour seal commenced in August-September 2009 and reported out in 2010 (NPWS, 2010). The project undertook to test monitoring survey feasibility and data collection methods for the species at a range of well established haul-out sites and to resolve any logistical or methodological problems encountered. Survey effort is now being pursued annually on a pilot basis to 2012 after which the project and its results will be subject to further review.

This report presents findings from the second year of the Harbour seal pilot project in which annual monitoring counts are carried out by regional staff at a selection of moult haul-out sites in southern and western Ireland. Support was given by members of the Scientific Unit. Under the monitoring programme developed and first tested in 2009, it was intended that:

- i. Each selected regional Harbour seal site would be surveyed on three separate sample dates during the moult season (August-September);
- ii. Where possible, a series of hourly counts of seals at each site would occur within two hours of Low Water (i.e., LW \pm 2hr), to include a count at the time of Low Water;
- iii. Counts of Harbour seals at all haul-out sites would occur in the afternoon where possible.

This work aims to be co-ordinated in its approach via a standard survey protocol, accounting for environmental (e.g., weather, tides) and behavioural variability which greatly affect Harbour seal site-use and haul-out group size.

METHODS

Following the 2009 field season, survey guidelines and the standardised datasheet were refined slightly for continued field use in 2010 (Appendices I, II). As in 2009, the 2010 study area remained limited to a maximum of fourteen coastal locations (Fig. 1) in order to continue survey operations while also delivering

data on key colonies containing different seal habitats and haul-out group sizes. While counts of Harbour seals were the main survey target, additional data on the prevailing environmental conditions, group composition, seals in the water, Grey seals and any disturbance events encountered were also sought from recorders (see Appendix II).

In 2010, NPWS personnel (Appendix III) set out to visit selected monitoring sites three times between the 9th August and 12th September while allowing for suitable weather conditions and tidal requirements (see Appendix I). Where possible, surveys were carried out from an established shore-based vantage point giving a clear unrestricted view of all animals in the haul-out group using suitable optical equipment (i.e., telescope and binoculars). However, in the case of larger bays in Counties Cork and Kerry (e.g., Bantry Bay, Kenmare River) which contain numerous small haul-out sites not easily accessed or viewed from land, provision was made to conduct surveys by boat. This has been the preferred method of population monitoring at these important locations for a number of years (Heardman *et al.*, 2006). Considering the complex expansive area to be covered in such cases, individual haul-out sites are normally surveyed once within the optimal Low Water \pm 2hr period, as close to the time of Low Water as possible.

Based on data gathered in 2009 and given their importance on regional and national scales (Cronin *et al.*, 2004; Heardman *et al.*, 2006; Cronin, 2007), Bantry Bay and Kenmare River were prioritised for full survey coverage (i.e., n=3 replicate surveys) in 2010 if necessary ahead of adjacent survey sites in Roaringwater Bay and Dunmanus Bay, Co. Cork which hold comparatively smaller numbers of Harbour seals (Cronin *et al.*, 2004; NPWS, 2010). Similarly, Westport Bay which contains the principal accessible moult haul-out aggregations within Clew Bay was prioritised for full coverage if necessary ahead of Roonagh, Co. Mayo.

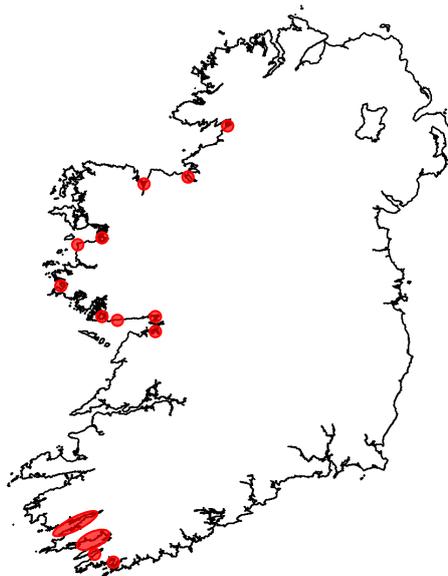


Figure 1. Map of coastal locations (in red) surveyed for Harbour seals during August-September 2009 and 2010.

RESULTS

The 2010 study reaffirmed the feasibility of NPWS regional staff carrying out co-ordinated monitoring counts at a selection of key haul-out sites for Harbour seal during the annual moult. Overall data collection methods were implemented satisfactorily in the field by the various participants involved (Appendix III). Application by recording personnel of the specific Tide and Time of Day guidelines (Appendix I) was possible in most cases and overall the weather conditions recorded by surveyors were quite favourable for conducting counts of Harbour seals (i.e., no precipitation, wind strength \leq Beaufort Force 3-4). Returned datasheets were mostly received in digital (i.e., Word) form and comparatively few difficulties in field recording were apparent in the review of survey data or in communications with participating staff.

As in 2009, a total of fourteen coastal locations in southern and western Ireland were surveyed (Fig. 1), many of which contain multiple sites at which moulting Harbour seals have been shown to haul out ashore

(Cronin *et al.*, 2004). In addition to boat-based surveys of inner Bantry Bay and Kenmare River, opportunistic land-based sampling was conducted again at Adrigole Harbour, Co. Cork (n=1 survey), and Illaunsillagh, Co. Kerry (n=2 surveys) with the addition in 2010 of Cove Harbour (West Cove), Co. Kerry (n=2 surveys). These more remote sites, which tend to contain smaller numbers of Harbour seals, fall outside the area normally possible for boat-based coverage in Bantry Bay and Kenmare River respectively within the available c.4.5-hour survey period but the additional data are nevertheless useful when such recording effort is possible.

A total of 39 surveys were carried out across a good range of Harbour seal habitats (NPWS, 2010) within the August-September moult period (Table 1), one survey less overall than in 2009. Three monitoring sites (i.e., Roaringwater Bay, Adrigole Harbour, Roonagh) saw reduced survey effort over the moult period compared with 2009. However, survey effort across the prescribed period in 2010 was higher in the key national locations of Bantry Bay and Kenmare River, and at Illaunsillagh, Co. Kerry. Similar to coverage performed in 2009, eight surveys of four locations (Roaringwater Bay, Dunmanus Bay, inner Bantry Bay and Kenmare River) were carried out by boat. Wherever possible these were timed to concentrate recording effort around the critical 2-hour period either side of Low Water and thereby deliver the maximum numbers of Harbour seals ashore. An additional boat-based survey of Roaringwater Bay was carried out on 11th October. The remaining 31 surveys were carried out from vantage points on land.

Table 1. Locations surveyed for Harbour seals during August-September 2010 and summary count data associated with each location. [n/a = not applicable, i.e., where full recounting of seals at individual haul-out sites within the 2-hour period either side of Low Water (LW) was not possible]

County	Location name	2010 No. of surveys carried out	Re-sampling within tidal cycle (i.e., LW ± 2hr)	2010 Max. count of Harbour seals	Tidal state during maximum count
Cork	Roaringwater Bay	1*	n/a	95	LW±0.5hr
	Dunmanus Bay	1	n/a	26	LW-2hr to -1hr
	Adrigole Harbour ¹	1	n/a	36	LW-1hr
	Bantry Bay (inner)	3	n/a	308	LW-0.5hr to +2hr
Kerry	Kenmare River	3	n/a	324	LW-2hr to +1.5hr
	Illlaunsillagh ²	2	n/a	32	LW to +1hr ^a
	Cove Harbour/West Cove ²	2	n/a	31	LW to +1hr ^a
Galway	Kinvara Bay	3	✓, ✓, ✓	113 ^r	LW
	Oranmore Bay	3	✓, ✓, ✓	122	LW-2hr
	Loughaunbeg, Inverin	2	n/a, ✓	34	LW
	Cashla Bay (inner)	2	✓, ✓	77	LW+2hr
	Mannin Bay	3	n/a, n/a, n/a	63	LW-2hr
Mayo	Roonagh	1	✓	53	LW+1hr
	Westport Bay	3	✓, ✓, ✓	118	LW+2hr
	Moy estuary	3	✓, ✓, ✓	102	LW+2hr
Sligo	Ballysadare Bay	3	✓, ✓, ✓	285 ^r	LW+2hr
Donegal	Donegal Bay (inner)	3	n/a, ✓, ✓	143 ^r	LW-2hr

¹ This site lies in outer Bantry Bay. ² This site lies in the outer Kenmare River.

* A second survey of this site took place on 11th October outside the main survey period.

^a = approximation

^r = restricted visibility may have led to underestimation for one or more scheduled counts.

Maximum numbers of Harbour seals recorded during the 9th Aug-12th Sept survey period are shown in Table 1 and Figure 2. In the southwest, sites in Roaringwater Bay, inner Bantry Bay and Kenmare River reiterated their importance on both regional and national scales (Cronin *et al.*, 2004; Heardman *et al.*, 2006; NPWS, 2010). In the western region higher maximum figures were again recorded in Kinvara Bay, Oranmore Bay, Westport Bay and the Moy estuary. However, maximum numbers of Harbour seals recorded at Cashla Bay were notably lower in 2010 while those at Roonagh were notably higher. In the northwest, Harbour seal count data obtained from Ballysadare Bay and inner Donegal Bay continued to demonstrate these sites' importance on both regional and national scales. In both cases, recorded maximum counts were lower than in the previous year. In inner Donegal Bay this may have been compounded to an extent by the restricted visibility of haul-out groups in the survey area (see below).

Overall, the combined data collected across all sites in 2010 again delivered information on a significant proportion of Ireland’s Harbour seal population based on the species’ observed distribution and minimum estimate from August 2003 (Cronin *et al.*, 2004) and also results from the first year of pilot population monitoring in 2009 (NPWS, 2010).

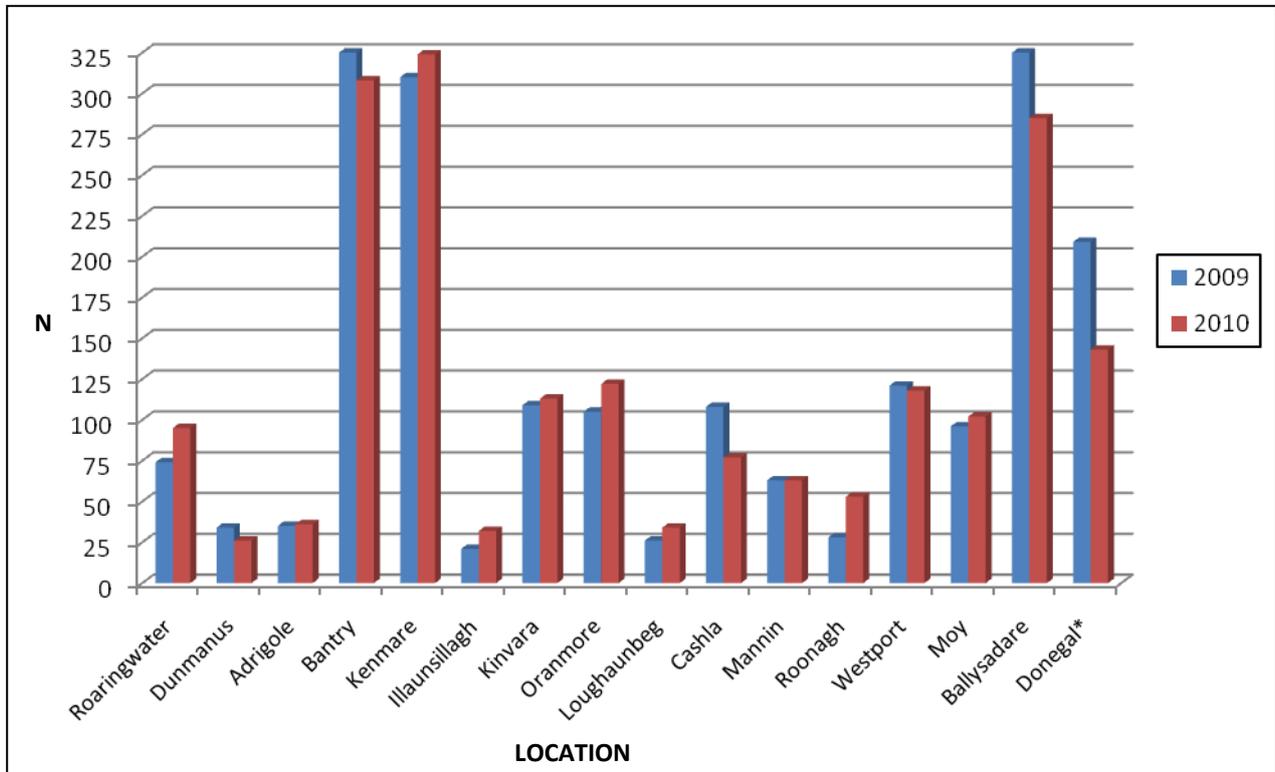


Figure 2. Harbour seal count data recorded at pilot study locations during the annual moult in 2009 and 2010. The maximum count (N) recorded for each of the 14 principal monitoring locations is shown, along with data from two additional sites within Bantry Bay (Adrigole) and Kenmare River (Illlaunsillagh) respectively. [* Restricted visibility in inner Donegal Bay in 2010 may have resulted in underestimation].

Similar to that observed in 2009 (NPWS, 2010), a preliminary examination of the prevailing tidal state at each location during which the maximum number of Harbour seals was recorded indicates no strong pattern of association between the two variables and the highest numbers of seals at a site could be found at any stage of the target LW \pm 2hr period (Table 1). Dates in 2010 on which the maximum numbers of Harbour seals were recorded at each location were also highly variable within the survey period (Fig. 3) and the date of the maximum count in 2009 and 2010 was weeks apart at a number of sites (e.g., Bantry Bay, Oranmore Bay, Mannin Bay, Ballysadare Bay; Fig.3). The data thus continue to rule out a clear geographic (i.e., region/location) or temporal pattern (i.e., date) of association. The sample sizes in these cases remain small however (n=13 and n=28, respectively) and a continuation of survey effort will be required to perform robust statistical analyses on the monitoring dataset.

In general, numbers of Harbour seals at locations that were monitored consistently through the two-hour period either side of Low Water tended to increase from the figure recorded two hours before Low Water (i.e., LW-2hr). However, the outcome of repeated counting thereafter until two hours after Low Water (i.e., LW+2hr) continued to be variable in 2010 between (a) individual sites and (b) individual survey dates. Twenty-one surveys were conducted in this way across nine locations (Table 1). Examples of summary data collected are given below for Oranmore Bay, Westport Bay and Ballysadare Bay (Fig. 4).

As in 2009, a number of locations showed declines in the numbers of Harbour seals ashore as a result of local disturbances via human activity which were observed by members of the survey team. Participants in the monitoring surveys also noted any apparent weather-related anomalies in distribution and count data, issues with regard to the visibility of hauled out seals, and other noteworthy features.

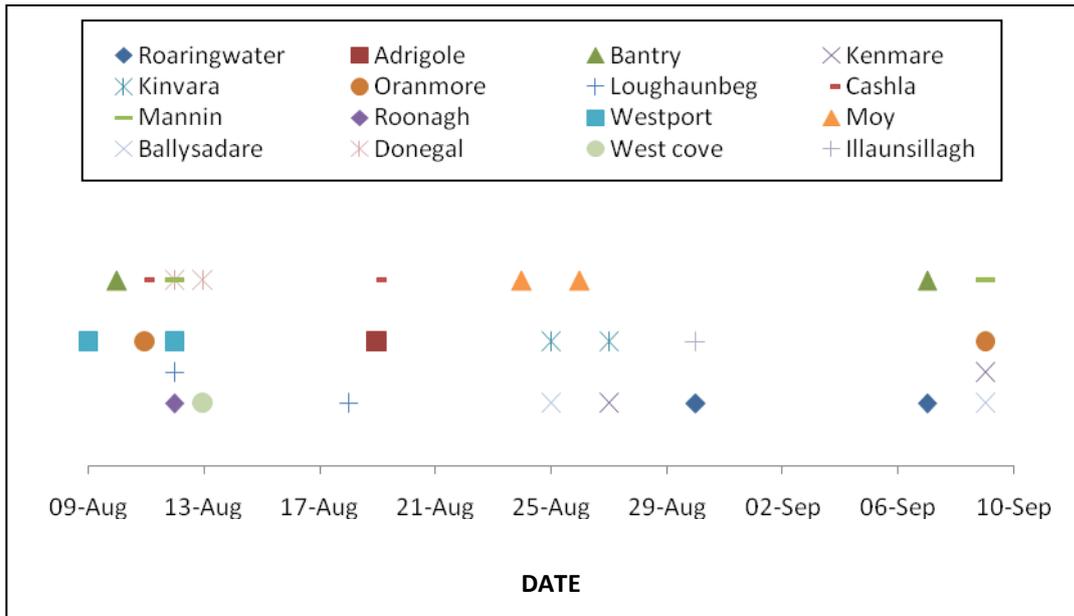


Figure 3. Distribution of dates in August-September 2009 and 2010 during which the maximum counts of Harbour seal were recorded at selected pilot study locations. Only sites at which two or more counts were performed in either year are included.

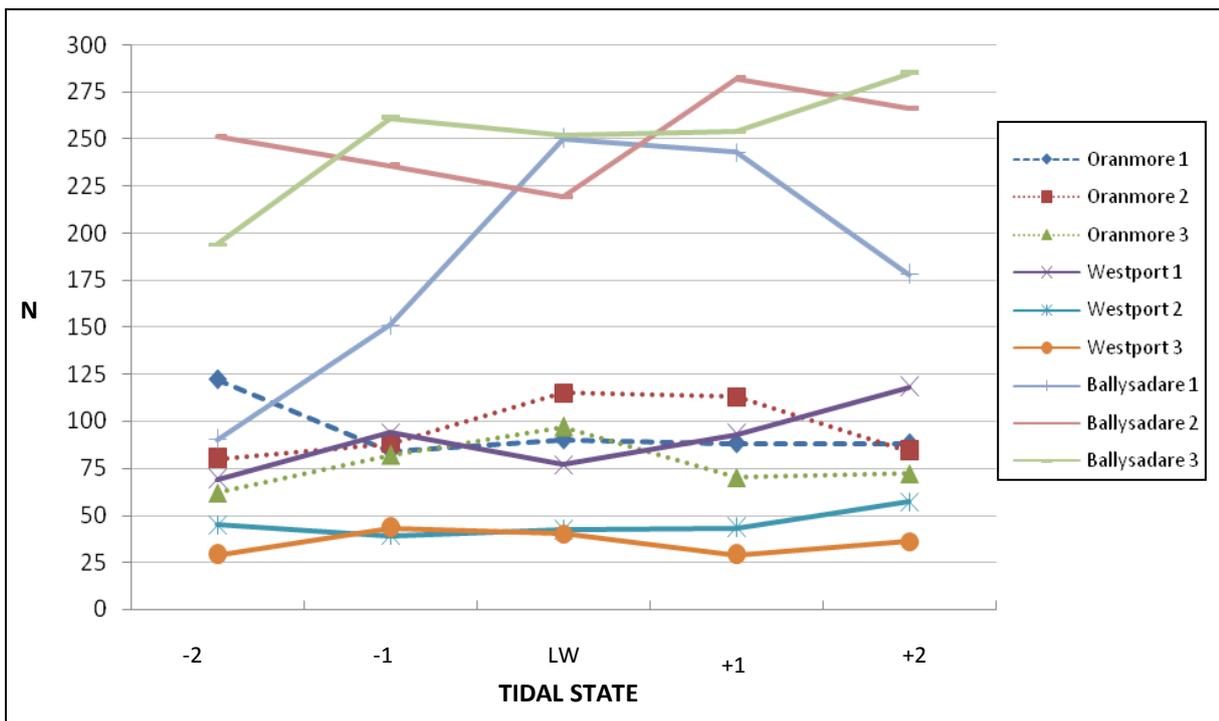


Figure 4. The distribution of Harbour seal count data at three pilot study locations in August-September 2010, shown according to the prevailing tidal state. The total count (N) for each tidal state is shown where survey coverage took place within 2 hours of Low Water (LW).

Roaringwater Bay

	Year - 2009	Year - 2010
# of land-based surveys	-	-
# of boat-based surveys	3	1 ^a
Max. Harbour seal count	74	95
Date of maximum count	7 th Sept	30 th Aug
Disturbance	None observed	Leisure industry
Discussion	Data recorded on 30 th August delivered a higher count of Harbour seals than has previously been recorded in the bay. Approximately 50% of the animals recorded were situated at Aghillaun, adjacent to the mouth of the Ilen river. A disturbance event involving a wildlife tour vessel was also recorded; it resulted in Grey seals evacuating a commonly used haul-out site (i.e., Toorane Rocks). Given the maximum Harbour seal count obtained in 2010 at this location, additional surveys during the moult season would be worthwhile.	

Dunmanus Bay

	Year - 2009	Year - 2010
# of land-based surveys	-	-
# of boat-based surveys	1	1
Max. Harbour seal count	34	26
Date of maximum count	25 th Aug	31 st Aug
Disturbance	Not recorded	None observed
Discussion	The principal sites for Harbour seals were again found in the inner reaches of the bay at Carraigphillip and Mucklagh Rocks although 10 Harbour seals were also recorded on the larger Cold Island. In recent years, surveys by regional staff recorded 27 and 29 Harbour seals on 15 th Sept 2007 and 18 th Sept 2008, respectively.	

Adrigole Harbour, Bantry Bay

	Year - 2009	Year - 2010
# of land-based surveys	3	1
# of boat-based surveys	-	-
Max. Harbour seal count	35	36
Date of maximum count	19 th Aug	26 th Aug
Disturbance	Fishing activity Leisure/Recreation	Not recorded
Discussion	In recent years 23 and 27 Harbour seals have been recorded on 28 th Aug 2007 and 10 th Sept 2007, respectively during surveys by regional staff.	

Bantry Bay (inner)

	Year - 2009	Year - 2010
# of land-based surveys	-	-
# of boat-based surveys	2 ^b	3
Max. Harbour seal count	332	308
Date of maximum count	10 th Aug	7 th Sept
Disturbance	Survey team	Leisure/Recreation
Discussion	In recent years, regular surveys by regional staff recorded 303, 268 and 329 Harbour seals on 7 th Sept 2006, 10 th Sept 2007 and 15 th Sept 2008, respectively. Summary data gathered in August-September at this location since 2000 suggest that the numbers of seals ashore may fluctuate considerably between years, while a noticeable peak exceeding 400 animals was recorded in 2003. Localised disturbance of Harbour seals (i.e., evacuation of the haul-out site) due to sea kayak activity was recorded in Glengarriff Harbour in 2010.	

^a A second survey took place on 11th October, outside the main survey period.

^b A third survey took place on 9th October, outside the main survey period.

Kenmare River

	Year - 2009	Year - 2010
# of land-based surveys	-	-
# of boat-based surveys	2	3
Max. Harbour seal count	310	324
Date of maximum count	9 th Sept	27 th Aug
Disturbance	None observed	Fishing activity Survey team
Discussion	The 2009 and 2010 maximum counts represent the highest numbers of Harbour seals recorded by NPWS personnel at this survey location. In recent years 239 and 285 Harbour seals were recorded by regional staff on 12 th Sept 2007 and 16 th Aug 2008, respectively. Disturbance to certain local haul-out groups within Kenmare River was recorded on a number of occasions. These were attributed to the presence nearby of small inshore fishing vessels and, on one date, to the survey team itself which recorded unusual levels of agitation among the hauled out animals, possibly as a result of other vessel approaches.	

Illocsillagh, outer Kenmare River

	Year - 2009	Year - 2010
# of land-based surveys	1	2
# of boat-based surveys	-	-
Max. Harbour seal count	21	32
Date of maximum count	11 th Sept	30 th Aug
Disturbance	Not recorded	None observed
Discussion	A total of 20 Harbour seals were also recorded at this site on 12 th Sept 2007. Background site-specific data are quite limited for this haul-out site which is situated in the outer Kenmare River (north shore). However, figures are similar to those recorded in August-September 2003, 2004 and 2005 by Cronin (2007).	

Cove Harbour (West Cove), outer Kenmare River

	Year - 2009	Year - 2010
# of land-based surveys	-	2
# of boat-based surveys	-	-
Max. Harbour seal count	-	31
Date of maximum count	-	13 th Aug
Disturbance	-	None observed
Discussion	Background site-specific data are limited for this haul-out site, the westernmost site used by Harbour seals within Kenmare River. The 2010 maximum count is similar to figures recorded in August-September 2003, 2004 and 2005 by Cronin (2007).	

Kinvara Bay

	Year - 2009	Year - 2010
# of land-based surveys	3	3
# of boat-based surveys	-	-
Max. Harbour seal count	109	113
Date of maximum count	25 th Aug	27 th Aug
Disturbance	Recreation activity	Survey team
Discussion	Data gathered on the first survey conducted on 11 th August were incomplete until approximately 2 hours after Low Water. This was due to the restricted visibility of seals on the principal site Goormeen Rock for the single observer present, an issue that was flagged in 2009. This was resolved when a second recorder came on-site to cover the west side of the skerry. Disturbance, resulting in a small number of seals entering the water, was recorded on this date due to the second observer having to access a suitable vantage point by passing in sight of some hauled out seals. Two Harbour seals carrying wounds in the head-neck area were also noted. This site will continue to require co-ordinated surveying from both the east and west sides of the bay in order to obtain an accurate estimate of all Harbour seals occurring in the bay.	

Oranmore Bay

	Year - 2009	Year - 2010
# of land-based surveys	3	3
# of boat-based surveys	-	-
Max. Harbour seal count	105	122
Date of maximum count	9 th Sept	11 th Aug
Disturbance	None observed	None observed
Discussion	Data recorded at this location on 11 th August delivered a higher count of Harbour seals than has previously been recorded in the bay. The site requires surveying from both the north and southeast sides of the bay in order to confirm full coverage and ensure an accurate estimate of all Harbour seals occurring in the bay.	

Loughaunbeg, Inverin

	Year - 2009	Year - 2010
# of land-based surveys	2	2
# of boat-based surveys	-	-
Max. Harbour seal count	26	34
Date of maximum count	18 th Aug	12 th Aug
Disturbance	None observed	None observed
Discussion	Background site-specific data are limited for this comparatively exposed haul-out site situated in outer Galway Bay (north shore). The 2009 maximum was recorded in poor survey conditions (NPWS, 2010).	

Cashla Bay (inner)

	Year - 2009	Year - 2010
# of land-based surveys	2	2
# of boat-based surveys	-	-
Max. Harbour seal count	108	77
Date of maximum count	19 th Aug	11 th Aug
Disturbance	None observed	None observed
Discussion	While a considerably lower maximum count of Harbour seals was recorded for this site than in 2009, the 2010 total continued to exceed previous known data for the site.	

Mannin Bay

	Year - 2009	Year - 2010
# of land-based surveys	3	3
# of boat-based surveys	-	-
Max. Harbour seal count	63	63
Date of maximum count	9 th Sept	12 th Aug
Disturbance	None observed	Unknown source
Discussion	Principal sites for Harbour seals continue to be found in the Salt Lough, Mannin Rocks and in inner parts of the bay. This requires access for counting from more than one side of the bay in order to obtain an accurate estimate of all Harbour seals occurring there. This has resulted in incomplete coverage of the prescribed tidal conditions and fewer counts over the c.4.5-hour period in 2009 and 2010. The use of two co-ordinating observers would facilitate more comprehensive data collection at this location.	

Roonagh

	Year - 2009	Year - 2010
# of land-based surveys	3	1
# of boat-based surveys	-	-
Max. Harbour seal count	28	53
Date of maximum count	12 th Aug	11 th Aug
Disturbance	Recreation activity	Recreation activity
Discussion	Data recorded at this location on 11 th August delivered a higher count of Harbour seals than has previously been recorded at this location. As in 2009, disturbance resulting in some seals entering the water was recorded on the survey date. Again this was due to people walking recreationally in the area.	

Westport Bay

	Year - 2009	Year - 2010
# of land-based surveys	3	3
# of boat-based surveys	-	-
Max. Harbour seal count	121	118
Date of maximum count	12 th Aug	9 th Aug
Disturbance	None observed	None observed
Discussion	Hauled out seals were concentrated in the northern part of the bay among islets lying between Pigeon Point, Inishraher and Inishgowla South. If seals are distributing themselves on the west side of islets as the tide ebbs, obtaining an exact count of Harbour seals can be difficult from even the best vantage point (i.e., Pigeon Point).	

Moy estuary

	Year - 2009	Year - 2010
# of land-based surveys	3	3
# of boat-based surveys	-	-
Max. Harbour seal count	96	102
Date of maximum count	24 th Aug	26 th Aug
Disturbance	Fishing activity Leisure industry	Fishing activity
Discussion	The maximum count of Harbour seals obtained at this location in 2010 approached the peak figure recorded by means of aerial thermal imaging in 2003 (n=108; Cronin <i>et al.</i> , 2004). As in 2009 disturbance, resulting in minor evasive movement of agitated Harbour seals and some Grey seals entering the water, was recorded on two survey dates. This was due to the close approach of passing small fishing/angling boats.	

Ballysadare Bay

	Year - 2009	Year - 2010
# of land-based surveys	3	3
# of boat-based surveys	-	-
Max. Harbour seal count	337	285
Date of maximum count	25 th Aug	9 th Sept
Disturbance	Recreation activity	Recreation activity
Discussion	An elevated vantage point on the east side of this large bay is commonly used to survey the bay using a high magnification telescope. However if significant numbers of seals are distributing themselves on the west side of more distant sandbanks as the tide ebbs, obtaining an exact count of seals of both species can be difficult from the eastern side of the bay alone. This scenario occurred during spring tides on 9 th September. The use of two co-ordinating observers would facilitate more accurate data collection whereby a second observer covers the west side of the bay and liaises with the main observer. Two disturbance events, resulting in significant numbers of seals entering the water, were recorded on one date. These were due to (i) the close approach of a leisure boat and (ii) the approach of two horse riders accompanied by a dog. Numbers of grey seals utilising this haul-out location during the August-September monitoring period (n _{peak} = 65, 71, 56) are also noteworthy.	

Donegal Bay (inner)

	Year - 2009	Year - 2010
# of land-based surveys	3	3
# of boat-based surveys	-	-
Max. Harbour seal count	209	143
Date of maximum count	12 th Aug	13 th Aug
Disturbance	Shellfish aquaculture	Shellfish harvesting Recreation activity Aircraft
Discussion	The maximum count of Harbour seals obtained during monitoring in 2010 was significantly lower than that recorded in 2009. While principal moult sites for Harbour seals in inner Donegal Bay continued to be found on sandbank-mudflat habitat within the estuary adjacent to Rooney's Island and Inishpat, the movement of seals along sandbanks made some animals difficult or impossible to observe from the vantage point used as the tide fell. To avoid this scenario in future, it is recommended that Rooney's Island is used as the standard observation point if possible. Disturbance events, resulting in significant numbers of Harbour seals entering the water, were recorded on two survey dates. These were due to shellfish harvesters occupying shorelines adjacent to the hauled out seals, quad bike activity on the sandflats and the approach of a low-flying aircraft.	

DISCUSSION

The aim of this ongoing initiative is to explore an effective regional monitoring programme that could deliver monitoring data for a modest proportion of the Irish Harbour seal population and its protected sites while being logistically and safely achievable using established best practice. Such monitoring would be expected to deliver sufficiently robust data to complement full national assessments of population status in accordance with the 6-year reporting cycle for the European Commission.

Application of the survey guidelines and the majority return of results in digital format by recorders in 2010 indicated satisfactory progress and there appear to be few difficulties with the field recording methodology. Quality control of the dataset generated did indicate some recording discrepancies, however, which indicated some room for improvement. This would suggest that following field surveys future Harbour seal monitoring data might be entered by recorders from field datasheets into a standard digital spreadsheet format (e.g., coded Excel data form whose fields match those in the survey form). This possibility may be explored at a later stage of the project.

At a number of land-based survey locations, coverage of the full period two hours either side of Low Water was not achieved in 2010, resulting in a reduced number of haul-out counts on the survey date from the five count target. While there may be situations where this is unavoidable, e.g., due to limited time or human resources available, the absence of full standardised coverage at particular locations may confound the survey results with respect to natural variability in the number of seals hauling out ashore and explanatory environmental covariates (e.g., time of day, weather, disturbance events). In this manner the high degree of variability in count data may be added to and the potential for investigation of count-covariate relationships obscured.

Ireland's first national survey during the moult season showed that Harbour seals were widely scattered among more than 200 distinct haul-out sites (Cronin *et al.*, 2004). The vast majority of these sites contained fewer than 50 seals. Many sites can only be surveyed effectively by aerial or boat-based means since they are not easily viewed from land. However the locations surveyed repeatedly by boat- or land-based methods in 2009 and 2010, many of which are designated as Natura 2000 sites (i.e., Special Areas of Conservation) for Harbour seal, were selected carefully due to their accessibility and importance based on local population estimates.

Indications from the data gathered in 2010 are that the fourteen locations surveyed again returned a significant proportion of the national population with some recording higher numbers of Harbour seals than in 2009. However data generated so far by the pilot study should not be over-interpreted since there

are many factors which may influence the number of seals recorded ashore at a particular location, not least observer experience, the visibility of animals in the haul-out group at different tidal states and various key explanatory variables (e.g., tidal state, tidal amplitude/height range, the proportion of the population available for counting, habitat preferences of individual seals). While efforts have been made to minimise the observer effect by the production of survey guidelines and standardised recording practices, it should be remembered that the number of seals recorded by an observer at a moult site is always a minimum estimate since these animals are mobile and the entire Harbour seal population inhabiting an area does not haul out ashore consistently or at the same time. Cross reference with the forthcoming aerial thermal imaging survey in August 2011 will enable some of these issues to be examined further at locations where simultaneous Harbour seal counts are conducted from the air and from the ground.

The thirty-nine surveys conducted between 9th August and 12th September comprise a good result given the ongoing pilot nature of this study and some unsettled weather conditions during the summer of 2010. Weather conditions during surveys and the maximum counts of Harbour seals recorded in 2010 were favourable in most cases, including when they are framed against survey efforts in 2009. There were a few locations in 2010, however, where restricted visibility from the vantage point used (e.g., Ballysadare Bay, inner Donegal Bay) or the reliance on a single observer on particular dates introduced a level of uncertainty in the estimation process. While the particular position, group density and behaviour of Harbour seals at an individual site on a specific date cannot be controlled, site-specific measures are proposed above for the resolution of such difficulties into the future.

It is envisaged that continued replication of standardised site monitoring effort will assist in the understanding of Harbour seal population size and distribution in the southwest/west of Ireland. It will also permit investigation of the various explanatory variables influencing the recorded data, and also improve estimates of local and regional population size into the future. From a site management point of view, the incidence of disturbance to Harbour seals continues to be an important feature at some locations where Harbour seals commonly haul out ashore in proximity to human activity (e.g., recreational vessel use, leisure activities, fishing practices). The monitoring surveys conducted in 2010 were again an effective means of logging the incidence and observed causes of such events.

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REFERENCES

- Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & O’Keeffe, C. (2004). *Harbour seal population assessment in the Republic of Ireland: August 2003*. Irish Wildlife Manuals No. 11. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin. 34 pp.
- Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & O’Keeffe, C. (2007). An assessment of population size and distribution of harbour seals in the Republic of Ireland during the moult season in August 2003. *J. Zool.* 273(2): 131-139.
- Cronin, M. & Ó Cadhla, O. (2008). *NPWS phocid monitoring methods and interval assessment. Recommendations for monitoring of the harbour seal (Phoca vitulina vitulina) & grey seal (Halichoerus grypus) populations in the Republic of Ireland*. Report commissioned by the National Parks & Wildlife Service. Coastal & Marine Resources Centre, University College, Cork. 47pp.
- Cronin, M. A. (2007). *The abundance, habitat use and haul-out behaviour of harbour seals (Phoca vitulina vitulina) in southwest Ireland*. Unpublished PhD thesis, National University of Ireland, University College Cork. 262 pp.
- Heardman, C., O’Donnell, D. & McMahon, D. (2006). The status of the harbour seal *Phoca vitulina* L. in inner Bantry Bay, Co Cork and inner Kenmare River, Co. Kerry: 1964-2004. *Ir. Nat. J.* 28(5): 181-191.
- NPWS. (2010). *Harbour seal population monitoring 2009-2012: Report No. 1. Report on a pilot monitoring study carried out in southern & western Ireland, 2009*. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin. 11pp.
- Ó Cadhla, O., Strong, D., O’Keeffe, C., Coleman, M., Cronin, M., Duck, C., Murray, T., Dower, P., Nairn, R., Murphy, P., Smiddy, P., Saich, C., Lyons, D. & Hiby, A.R. (2007). *An assessment of the breeding population of grey seals in the Republic of Ireland, 2005*. Irish Wildlife Manuals No. 34. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin. 60pp.
- Ó Cadhla, O. & Strong, D. (2007). Grey seal moult population survey in the Republic of Ireland, 2007. Report to the National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland. 22pp.

Appendix I – Guidelines for the Pilot Study, 2010

HARBOUR SEAL SURVEY 2010 GUIDELINES

Recording Methods:

Please complete the recording form digitally and return as an e-mail attachment. Otherwise return by post. Please complete all boxes on the form (enter n/a for not applicable).

Locations and Sites

Each Survey Location/Bay is a discrete coastal area with a complex of one or more 'haul-out sites' used by individual groups of seals (e.g., Bantry Bay, Moy Estuary). Where a number of haul-out sites are covered, please assign a distinct site letter (a, b, c, etc) and 6-figure grid reference (e.g., H231890) to each one. In such cases, a copy of the relevant OS 1:50,000 Discovery map(s), showing the location of all haul-out sites (marked by letter) and your vantage point for the count (marked VP) is very useful. Where possible, vantage points should be standardised (i.e., the same as in 2009) to facilitate comparison between survey dates and other data.

Frequency of counts during each survey

Counts should cover a minimum period of two hours either side of Low Water (i.e., Low Tide). The ideal is to record five hourly counts at each site, starting at two hours before Low Water (i.e., Low Water –2 hrs) or earlier. Finish at Low Water +2 hrs. It would be useful if observers could spend the approx. 4hr period (2 hours before and after Low Water) at the site since information on the number of animals hauled-out at various tidal stages is very important.

Time of Day for survey

Wherever possible, counts should be performed on days when Low Water occurs approximately in the middle of the day or early afternoon (i.e., counting done between 10.00-16.00hrs approx).

Weather

Environmental conditions prior to/during the count can have a very important influence on the sites used by seals and the number of seals ashore at the time. Wherever possible, counts should be performed in good weather (i.e., no precipitation, wind strength \leq Beaufort Force 3-4). The more precisely you can record weather the better, particularly regarding wind conditions, precipitation type/intensity, cloud cover and even local temperature.

Young seals and adults

Please record all pups and young seals as Juveniles (Juv). Adults should be counted separately. Where relevant, note whether the haul-out site contains both species but record counts of Grey Seals separately. If possible record whether Grey Seals are Adults or Juveniles.

Seals in the water

Any Harbour Seals or Grey Seals seen in the water upon your arrival at the site should be noted. These may (i) move away, (ii) remain nearby or choose to haul out ashore after which they will either be (i) excluded from the next survey count or (ii) included in it, respectively.

Disturbance

Record any disturbance at the time of each count (or in the period between counts) as this will help explain changes, if any, to hourly counts. In the lower part of the form record the type of disturbance and response of the seals (if any).

Contacts

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Appendix III - Participants in the Pilot Study, 2010

Northwest

Tim Roderick
Fiona Farrell
Oliver Ó Cadhla
Lee McDaid
Carl Byrne

West

Raymond Stephens
Helen Carty
Rebecca Teesdale
Jacinta Murphy
Oliver Ó Cadhla
Dermot Breen
Aonghus O'Donaill
Ger O'Donnell
Eoin McGreal
Leonard Floyd
James Kilroy

Southwest

Clare Heardman
Declan O'Donnell
Paddy Graham
Danny O'Keeffe
Michael O'Sullivan
Oliver Ó Cadhla