

# The status of the harbour seal (*Phoca vitulina*) in Ireland

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## ABSTRACT

The status of Ireland's harbour seal population and its relationship with that of Britain and Western Europe are poorly understood. Prior to 2003, limited research efforts and poor co-ordination of survey methods fell short at providing an accurate assessment of overall distribution and population size on a regional or national scale. However, in August 2003, the Republic of Ireland's harbour seal population was assessed by means of a geographically extensive survey conducted during the annual moult, providing an up-to-date minimum population estimate and a reliable baseline for future surveys. Trends on a national scale could not be assessed due to absence of a reliable historic population estimate; however there is some evidence of local decreases and increases in harbour seal numbers in Northern Ireland and southwest Ireland respectively. Research effort to date on aspects of the ecology of the harbour seal in the Republic of Ireland is reviewed and current research and management priorities highlighted.

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## HARBOUR SEAL ABUNDANCE AND DISTRIBUTION

### **Minimum estimate of the Irish harbour seal population**

The population of harbour seals (*Phoca vitulina vitulina*) in Ireland was first enumerated by Lockley (1966) who based his minimum estimate of 1,000 on data collected incidentally, during surveys of grey seals (*Halichoerus grypus*), in the autumns of 1964-65. Further harbour seal specific surveys were carried out in northern Ireland by Venables and Venables (1960), Nairn (1979) and, more recently, by Wilson and Corpe (1996). The first harbour seal census of the island of Ireland was undertaken in July 1978 (Summers *et al.* 1980). Based on a combination of boat and aerial surveys, this

gave a minimum estimate of 1,248 but absolute abundance was considered to be 1,500 to 2,000 individuals. Additional information in the Republic of Ireland was collected by Warner (1983, 1984) and haulout counts were conducted by the National Parks and Wildlife Service (NPWS) of the Department of Environment, Heritage and Local Government at some well-known sites in the intervening years (Table 1). However, these counts have varied in location, consistency, timing and methodology and could not provide complete national or island-wide perspectives on population size and distribution.

Population monitoring in Northern Ireland has indicated a consistent decline in the breeding population along the County Down coastline (Wilson and Montgomery-Watson 2002;

**Table 1.** Harbour seal population estimate surveys conducted in Ireland

<b>Date</b>	<b>Survey method</b>	<b>Survey area</b>	<b>Survey period</b>	<b>Estimate</b>	<b>Type of estimate</b>	<b>Reference</b>
1964-1965	Boat and land based counts at some but not all haulout sites	All Ireland	Late moult Sept/Oct	841	Minimum count*	Lockley (1966)
1956/57	Boat and land based counts at known haulout sites	Northern Ireland coast	Breeding June	365	Minimum count	Venables and Venables (1960)
1976	Boat based count at known haulout sites	Strangford Lough Co. Down	Breeding June/July	256	Minimum count	Nairn (1977)
1978/1979	Aerial, boat and land based counts at known haulout sites	All Ireland	Breeding July	1248	Minimum count	Summers <i>et al.</i> (1980)
1979	Boat and land based counts at some but not all haulout sites	Republic of Ireland	Breeding July	698	Minimum count*	Warner (1983)
1984	Boat and land based counts at some but not all haulout sites	Republic of Ireland	Breeding/Moult July/August	1116	Minimum count *	Warner (1984)
1989	Boat and land based counts at some but not all haulout sites	Republic of Ireland	Breeding June/July	2170	Minimum count*	Harrington (1990)
1978-present	Boat and land based counts by NPWS	Regional/local counts <i>e.g.</i> Bantry Bay	Breeding /Moult June-Sept	NA	Minimum counts	Lyons (2004)
2002	Aerial (using thermal imagery)	Northern Ireland	Moult August	1083	Minimum count	Duck (2006)
2003	Aerial ( using thermal imagery and slide film SLR) and land-based counts (using thermal imagery)	Republic of Ireland	Moult August	2905	Minimum count	Cronin <i>et al.</i> (2007)

\*not all haulout sites were covered due to bad weather and/or limited resources

Wilson *et al.* 2002). Furthermore, research by the Environment and Heritage Service Northern Ireland estimated a minimum population of 1,083 harbour seals in 2002 (Duck, 2006). While this survey set an effective baseline for the region, with little known about the population inhabiting the rest of the island these important findings have been difficult to place into a wider context. A significant effort was made in 2003 to address the shortfall in population data by means of a national census programme for the harbour seal in the Republic of Ireland that could act as a definitive population assessment and as a tool for ongoing monitoring. The census was funded by the NPWS. The primary objectives of this programme were to obtain an up-to-date harbour seal population estimate for the Republic of Ireland and for individual haulout sites and to contribute important information to the understanding of current harbour seal distribution throughout Ireland.

Considerable efforts have been made in establishing the most appropriate census times to obtain reliable harbour seal population estimates (Thompson *et al.* 1989, 1997, Huber 1995, Jeffries *et al.* 2003, Adkinson *et al.* 2003, Hayward *et al.* 2005). While breeding season counts provide reliable estimates of abundance as well as valuable pup production data, Härkönen *et al.* (1999) concluded that in non-stable age-structured populations the influence of the differential haulout behaviour on estimating abundance is likely to be greater during the breeding period than during the moult period. Reijnders *et al.* (2003) recommended future use of moult count data to obtain a reliable and consistent index of population abundance of harbour seals in the Wadden Sea, while Thompson *et al.* (1997) suggest that counts made during the August moult provided more reliable population estimates for harbour seals hauling out on rocky shores in the UK. Indeed large-scale surveys of harbour seal populations occurring in rocky shore habitats in the northeast Atlantic and northeast Pacific are generally conducted during the annual moult (Reijnders *et al.* 1997, Huber *et al.* 2001, Small *et al.* 2001, Duck *et al.* 2005). Consideration of background data on harbour seal distribution for the Republic of Ireland (Lockley 1966,

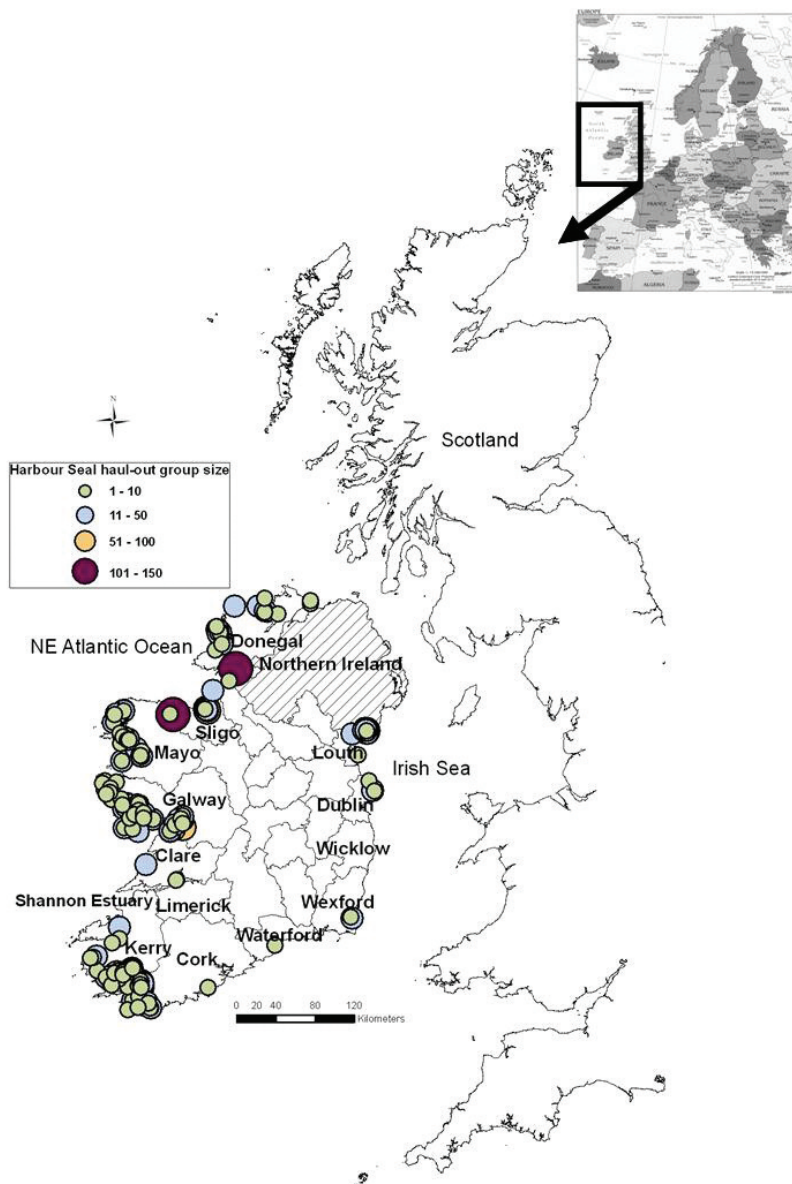
Summers *et al.* 1980, Warner 1983, 1984) and the predominance of rocky shore haulout habitat, suggested that the harbour seal moult represented the best single period from which to derive estimates of population size across the range of known haulout sites.

A well established technique for counting harbour seals from the air was utilised, which had proven cost-effective for national scale surveys in the UK (SMRU unpublished data). This helicopter-based thermal imaging technique developed by the Sea Mammal Research Unit, (SMRU), University of St. Andrews, Scotland (Hiby *et al.* 1993, 1996), has been used for monitoring harbour seal populations in the UK since 1988 and it was adopted for the harbour seal survey of Northern Ireland in 2002 (Duck 2006). As it was the first trial of the technique in the Republic of Ireland a decision was made to attempt to validate count data acquired by aerial means and investigate errors in ground counting harbour seals among a range of monitoring sites, 12 harbour seal haulout sites along the Irish coast were chosen for 'ground-truthing', *i.e.* to be surveyed by shore-based observers prior to and simultaneously with the aerial survey. Discrepancies between real-time counts and ground counts occurred at all ground-truthing sites, possibly caused by observer fatigue or difficulties in viewing thermal imagery from habitats experiencing high land temperatures, suggesting caution when carrying out real-time counts. Post-survey re-checking of thermal imagery would be likely to improve count accuracy. Collated and revised aerial and ground count figures yielded a 2003 minimum population estimate in the Republic of Ireland of 2,905 harbour seals, with 31.7%, 31.6%, 33.6% and 3.1%, of the national minimum population estimate occurring in the northwest, west, southwest and southeast/east of the country respectively (Fig. 1) (Cronin *et al.* 2007).

The estimate of 2,905 animals in the Republic of Ireland, when combined with a near identical survey of Northern Ireland in 2002 (Duck 2006), gives an all-Ireland minimum population of 3,988 harbour seals. Although this estimate is more than 3 times the 1978 estimate (1,248) (Summers *et al.* 1980), the figures are not directly comparable due to different timing and

survey techniques. The 1978 survey was carried out during the breeding season and did not cover the entire coastline of Ireland. The 2003 estimate should instead be considered as a more reliable baseline figure against which future estimates can be compared to assess population trends. The current status of the harbour seal in Ireland is therefore unknown and will not be possible to assess until a longer term dataset is available. Repetitive national scale surveys using similar methodologies and survey design would enable an accurate comparison of estimates and ensure reliable assessment of trend and status.

Although it is impossible to ascertain population trend on a national scale, there are indications of an increase in numbers of harbour seals on a regional scale. Counts of harbour seals at haulout sites in southwest Ireland have been conducted by NPWS rangers during April to October from 1985 to 1999 and during August and September from 2000 to present and have shown an 8% and 13% annual increase in the Kenmare River and Bantry Bay respectively (Heardman *et al.* 2006). This may reflect a national trend but in the absence of an historic national population estimate directly comparable to the 2003 estimate it is not



**Fig. 1.** Distribution and size range of harbour seal (*Phoca vitulina*) haulout groups recorded in the combined aerial/ground survey of the Republic of Ireland August 2003.

possible to ascertain this. Heardman *et al.* (2006) suggest the evident increase in harbour seal numbers in southwest Ireland may be attributed to lack of persecution following the 1976 Wildlife Act which affords protection to the species in Ireland. Prior to such, a bounty system operated in an attempt to reduce the impact of seal predation on fish stocks (Hayden and Harrington 2000). Both the harbour and grey seal are protected in Ireland under the Irish Wildlife Acts (1976 and 2000) and under the EC Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora). The harbour seal is listed as an Annex II species under the Directive, requiring the designation of Special Areas of Conservation (SACs), to protect listed species and their habitat. In the late 1990s the NPWS proposed all of the known breeding sites of the two species as SACs.

#### **Harbour seal terrestrial distribution**

The increasing trend in harbour seal numbers in the southwest of Ireland could also be a result of possible shifts or changes in the distribution of the harbour seal in Ireland. In 1978-84, the harbour seal population in the Republic of Ireland was found to be concentrated in the west and northwest of the country (Summers *et al.* 1980, Warner 1983, 1984) while County Down held almost half of the all-Ireland population at this time (Nairn 1979). The southwest was not identified as important an area for harbour seal haulouts in the 1978 breeding season (Summers *et al.* 1980) as it was during the 2003 moult (5.2% and 33.5% of the national population estimates respectively). The species is generally considered to be site-specific (Pitcher and McAllister 1981, Brown and Mate 1983) nevertheless seasonal variations in site-use have been described (Thompson 1989; Thompson and Harwood 1990, Matthews and Kelly 1996, Thompson *et al.* 1997) and it is likely that different sites are favoured for breeding compared to moulting (Cronin 2007) and therefore caution must be exercised in comparing these data.

Harbour seal haulout distribution during the 2003 moult season in the Republic of Ireland was predominantly along the western seaboard of Ireland. However, there were

noticeable gaps in harbour seal distribution along the coasts of Clare, the Shannon Estuary, north Kerry and much of southern counties Cork and Waterford, Wexford and Wicklow (Fig. 1), as was also the case in 1978 (Summers *et al.* 1980). Haulout sites for harbour seals in Ireland have tended historically to be found among sheltered inshore bays and islands, coves and estuaries (Lockley 1966, Summers *et al.* 1980). In this respect the indented coastline of western Ireland provides more favoured haulout habitat for the species than the south and east coasts which are generally less indented, with more exposed sandy beaches and less of the typical harbour seal haulout habitat evident on the west coast.

#### *National monitoring programme*

In some areas across the species' geographical range the numbers of harbour seals are increasing (Small *et al.* 2003, Thompson *et al.* 2005, Waring *et al.* 2006, Heardman *et al.* 2006, Jemison *et al.* 2006). However declines in abundance have also been observed in many areas and have been attributed to recruitment failure, competition for resources, disturbance and disease (Frost *et al.* 1999, Thompson *et al.* 2001, Matthews and Pendleton 2006, Lonergan *et al.* 2007). Predicting the potential long-term effects of disease such as Phocine Distemper Virus (PDV) on harbour seal populations requires information on pre-epizootic population trajectories (Harding *et al.* 2002, Lonergan and Harwood 2003). In light of a recent suspected outbreak of PDV amongst harbour seal populations in the Baltic Sea (CWSS, 2007) and the fact that it has been over 5 years since the last national harbour seal survey, urgency exists to establish the current population estimate. Moreover, there is recent evidence of a general decline in most of the large harbour seal colonies around Britain, between 2001 and 2006, the population in Orkney and Shetland declined by 40% indicating substantially increased mortality or very low recruitment over this period (Lonergan *et al.* 2007). These declines are more than 4 times the current threshold for possible corrective action defined under the OSPAR international convention. The convention states that 'taking into account natural population dynamics and trends, there should be no decline in harbour seal population

size of >10% as represented in a 5-year running mean or point estimate within any 11 sub-units of the North Sea' (OSPAR 2006). The widespread decline in harbour seal numbers around Britain ranging from Shetland to the Wash suggest that the causes may be present over a large part of the North Sea (Loneragan *et al.* 2007) and is a cause for concern. It is possible that harbour seal numbers in Ireland have declined since the 2003 census and highlights the necessity for another harbour seal census in the immediate future.

To satisfactorily fulfil Ireland's obligations under the EC Habitats Directive, to report on the status of Annex II species every 6 years, reliable estimates of population size, trends, distribution and range are essential. At present we have a 'one point' estimate of minimum population size for the harbour seal obtained in 2003. However, as this is not reliably comparable with previous estimates (*e.g.* Summers *et al.* 1980) due to differences in survey timing and methods, no estimate of trend and therefore status of the species is possible. It is critical that surveys are repeated as frequently as is financially viable to maximize our power to detect trends. Replicate counts within a survey region have been used to obtain more precise population estimates and periodic replicate surveys have been used to examine trends (Pitcher 1990, Frost *et al.* 1999, Adkison *et al.* 2003, Jeffries *et al.* 2003, Small *et al.* 2003). Studies on trend analyses of harbour seal count data suggest that even surveying annually (with 2-3 replicate surveys) it will take at least 5 years to robustly estimate annual trends greater than 5%, but as changes of more than 5% per annum are unusual in stable seal populations then realistically it will take even longer than 5 years (Adkison *et al.* 2003, ICES 2003). Adkison *et al.* (2003) suggest that a commitment to obtain 10-12 consecutive annual surveys with 2-4 replicates will provide the opportunity to estimate robust site-specific trends and increase power over a broader range of trends.

If this is not financially or logistically feasible in Ireland, then a combination of annual regional and less frequent (2-5 year intervals) national coverage is preferable. Replicate counts could be obtained at 'index' sites. These

sites would ideally be conducted at 7-10 haulout sites of a relatively significant size nationally. Counts at the 'index' sites carried out throughout the annual cycle would provide important data on the influence of covariates on seal haulout behaviour at these sites and potentially providing information on pup production and breeding season population estimates. Index sites are useful adjuncts to, not replacements of, national aerial surveys. Index site counts provide the opportunity to simultaneously collect covariate information, useful for enhancing aerial survey design and accuracy of population estimates. The influence of environmental covariates on estimates of population trend has been shown to be substantial and thus biologically significant (Frost *et al.* 1999, Olesiuk 1999, Adkison *et al.* 2003, Small *et al.* 2003) and it is recommended that covariates are integrated into abundance estimates (Boveng *et al.* 2003) and trend analyses (Small *et al.* 2003) to produce more accurate trend estimates required for the management of harbour seals. The use of mean or maximum counts by site without covariate correction can lead to a substantial bias and low power in trend determination (Adkison *et al.* 2003). Statistical modelling of harbour seal count data as well as haulout behaviour data obtained using telemetry technologies can improve our understanding of the effects of covariates on harbour seal haulout behaviour and potentially improve the accuracy of population estimates (Boveng *et al.* 2003, Cronin 2007). Such an approach would be useful in a long-term national monitoring programme as the influence of covariates can vary both spatially and temporally; incorporating such information into final analyses will provide covariate-adjusted counts as well as enabling the identification of optimal timing for subsequent surveys.

#### **Total abundance estimates**

The population estimate obtained during a survey can only be considered a minimum population estimate because a fraction of the population will be at sea and not available for counting. Minimum population estimates are sufficient for assessing long-term population trends, however an assumption must be

made that the proportion of animals at sea during the count does not vary between years or geographical areas (Thompson and Harwood 1990). Alternatively, the proportion of the population at sea during surveys can be estimated and the count corrected to obtain an estimate of 'absolute abundance'. Such estimates are necessary for incorporation into ecological models and assessing predation pressure by seals on commercially important fish stocks.

Determining the variation in harbour seal haulout behaviour over time and what factors influence this allows the approximation of what proportion of the population is ashore during counts. This information can be used to devise a correction factor for counts at haulout sites, improving the accuracy of population estimates. A variety of approaches has been used to estimate this proportion, including telemetry (Yochem *et al.* 1987, Thompson *et al.* 1989, 1997, Ries *et al.* 1998, Huber *et al.* 2001, Simpkins *et al.* 2003, Sharples 2005, Boveng *et al.* 2003, Sharples *et al.* 2009), a bounded count method (Olesiuk *et al.* 1990), time lapse photography (Stewart 1984, Thompson and Harwood 1990) and photo-identification of individuals (Moran 2004). The average proportion of seals hauled out during peak haulout times has generally been estimated to lie between 0.50 and 0.75, however values of 0.40 and 0.88 have been reported from telemetric and bounded count approaches respectively (Olesiuk *et al.* 1990, Sharples 2005, Sharples *et al.* 2009).

Recent telemetry efforts in southwest Ireland are providing data on the haulout behaviour of tagged individuals that potentially can be used to derive a correction factor for count data and obtain an estimate of absolute abundance of harbour seals in Ireland (Cronin *et al.* 2008). Such an approach would require more information than is currently available as to date only a small number of animals has been tagged ( $n=27$ ) and effort concentrated in one area in southwest Ireland; moreover information on haulout behaviour during the moult is not available due to moult-associated tag loss. If future national surveys are carried out

during this period, telemetry techniques that overcome moult-associated tag loss should be explored.

## HABITAT USE AND FORAGING ECOLOGY

Harbour seal use of terrestrial haulout sites in southwest Ireland has been investigated since 2003 using photo-identification techniques and telemetry, providing information on site fidelity and haulout behaviour (Cronin and McConnell 2008). Statistical modelling of telemetry and year-round count data has provided a means of determining the effect of covariates on the seals' haulout behaviour (Cronin *et al.* 2010) and will prove useful in the timing and planning of population surveys. There was a seasonal influence on haulout behaviour, time ashore being a maximum during post-moult in October and decreasing to a minimum in February. Absence from the haulout sites during winter may suggest an increase in foraging effort or relocation to more offshore foraging areas, corresponding to longer at-sea duration. Winter activity patterns of harbour seals tagged in Scotland and Alaska suggest that they spend less time in inshore waters at this time of year (Thompson *et al.* 1989, Rehberg and Small 2001, Sharples 2005). A strong tidal influence on haulout behaviour was evident in southwest Ireland, and seals hauled out more frequently at low tide and variation was evident between individuals in the influence of time of day on haulout behaviour. There was overall large variation in patterns of behaviour over the tagging period between individuals and between tidal periods for each individual. This cautions against making inferences on the haulout behaviour of the 'population' based on the behaviour of a small number of tagged individuals, increasing the sample size of tagged seals, with a more balanced age and sex ratio and including as many covariates as possible in the analysis would help to achieve this

The recent telemetry efforts have also provided heretofore unavailable information on harbour seal use of Irish waters. The telemetry data indicate that foraging trips generally extended no further than 20 km from the haulout sites

and over half of these trips were less than 5 km. These findings are mostly concurrent with those found in other parts of the species' geographical range; however they do suggest that harbour seals in southwest Ireland may display an even more local foraging distribution than in other parts of their global range (Cronin *et al.* 2008). Data from satellite tagged harbour seals in the UK (including Strangford Lough in Northern Ireland) suggest most foraging trips are within 40 km of haulout sites but longer distance trips to foraging areas up to 200 km and 850 km from haulout sites have been recorded in the UK and US respectively (Rehberg and Small 2001, Sharples *et al.* 2005, Cunningham *et al.* 2009, SMRU unpublished data). Seals mainly foraged on the seabed in southwest Ireland; however mid-water dives were also conducted. This correlates with the findings of a diet element of the study which suggests that seals in southwest Ireland are feeding on a combination of benthic and pelagic species. The fine-scale information resulting from the at-sea behaviour of the seals provides a means of identifying foraging areas offshore. Extending tagging efforts to other significant haulout sites on other parts of the Irish coast and modelling the telemetry and population data using recent techniques (Matthiopoulos *et al.* 2004) will contribute to spatially explicit population foraging distribution information.

Research on harbour seal diet in Ireland has been limited to studies conducted in County Down, Northern Ireland in the late 1990s (Wilson *et al.* 2002), in Galway Bay in western Ireland 2001-2004 (Gillieran, in prep.) and in Bantry Bay and the Kenmare River in southwest Ireland since 2006 (Cronin *et al.* 2008, Kavanagh, 2008). The studies suggest that harbour seals are opportunistic feeders as a wide variety of prey species was found in the diet of seals on both the west and southwest coasts, including 16 teleost species and two species of cephalopods, and there was evidence of seasonal and geographical variation in the diet. These findings concur with studies on the diet of harbour seals in other parts of their range (Rae 1973, Pierce *et al.* 1991, Brown and Pierce 1998). Overall the most common species of prey consumed by harbour seals in Ireland

were whiting (*Trisopterus* sp.), dragonet (family *Callionymidae*), sandeels (family *Ammodytidae*) and sole (family *Soleidae*). All commercially important species that appeared in the diet other than sole did so in relatively small numbers and were generally smaller than landed size.

## CONSERVATION CONCERNS

### Disease

Epizootics of PDV affected European harbour seal populations in 1988 and 2002 and harbour seal abundance has fluctuated in the Northeast Atlantic due to outbreaks of this disease (Dietz *et al.* 1989, Harding *et al.* 2002). There was a relatively recent suspected PDV outbreak in the Kattegat and Skagerrak Seas (CWSS 2007). It is known that harbour seals in Ireland were affected by outbreaks of PDV in 1988-89 and 2002 (CWSS 1991, Reineking 2002, Barrett *et al.* 2003). Yet, in spite of apparent local increases in seal deaths and changes in haulout counts at a few sites in western Ireland (Gillieran, J., NUIG, pers. comm.) and confirmed pathology from an animal found on the Aran Islands (Kennedy, S., DARDNI, pers. comm.), in the absence of consistent monitoring of regional haulout groups in the Republic and a reliable up-to-date population estimate, it was not clear if the disease caused a significant decline in population size in the Republic or indeed around the island of Ireland as a whole.

### Fisheries interactions

A number of dedicated marine mammal and fishery interaction observer programmes have operated in the waters around Ireland in an attempt to address marine mammal by-catch, mostly operating offshore and off the south coast. Of these, a small number of harbour seals (3) have been reported to have been entangled in gill (tangle) nets (BIM, unpublished data, Rogan, E. UCC, pers. comm.). Stranding programmes have primarily focused on recovering small cetaceans for post-mortem examination. Only a small number of harbour seals (<5) have been examined, and in one of these, cause of death was reported to be from entanglement in fishing gear (Rogan, E. UCC, pers comm.).



The physical and operational interactions between seals and the fishing industry is a problem in Ireland. In spite of a general reduction in several traditional static-net fisheries in Irish waters, the problem of seal predation on and damage to commercially exploited fish species continues to be demonstrated, particularly in select estuarine and aquaculture situations along the western seaboard (Rogan and Ó Cadhla 2003, Ó Cadhla, O., CMRC, pers. comm). Whilst several studies in the last decade (BIM 1997, 2001, Kiely *et al.* 2000, Rogan *et al.* 2001, Arnett and Whelan 2002) have concentrated research efforts on evaluating the degree of operational interaction between grey seals and fisheries, the scale of interaction by harbour seals on commercial fishing and aquaculture is unclear and economic loss due to damage is not currently quantified. Fishermen and other commercial operators may obtain a Section 42 licence from the NPWS to shoot harbour and grey seals acting as pests in such operations. However the number of seals approved for removal in such situations is generally low (1-2 seals per annum) and anecdotal evidence gathered by UCC suggests that removal by shooting may not be operating as an effective solution in such cases (Ó Cadhla, O. CMRC, pers. comm.). The physical and biological interactions between seals and fisheries will be addressed as part of a 7-year study recently funded under the Beaufort research initiative on an ecosystems approach to fisheries management in Irish waters (2008-2013).

## RESEARCH AND MANAGEMENT PRIORITIES

No long term national plan or funding commitment is in place in the Republic of Ireland to monitor the status of the Irish harbour or grey seal populations despite the fact that under the EC Habitats Directive member states are obliged to monitor the conservation status of Annex II species and report on this every 6 years. The 2003 harbour seal census and subsequent 2005 grey seal census were

significant milestones in providing reliable baseline population estimates for both species. It is recommended that, considering refinements, the respective techniques be used in any future national census, that such surveys be ideally repeated at annual intervals and efforts are coordinated cross-border on an all-island basis.

As a result of heterogeneity in haulout behaviour across the breeding and moult periods (Thompson *et al.* 1989, Härkönen *et al.* 1999), surveys conducted in a narrow time window during these periods are likely biased towards certain age-sex classes. Population parameter estimates can be severely biased in populations with non-stable structures. We currently have no information on the population structure or sex-age related differences in haulout behaviour of harbour seals in Ireland. Studies at a range of haulout sites using marking, telemetry and photo-identification techniques will address this.

Despite recent research efforts in southwest Ireland, no other information exists on the home range of the Irish harbour seal population and its relationship with the nearby UK harbour seal population. Additionally no research on harbour seal genetics has been carried out in Ireland. Such information is essential for investigating for example, population structure, stock delineation and disease epidemiology. A large-scale initiative building on current telemetry studies in southwest Ireland and encompassing a genetic element will address this shortcoming. These research initiatives will provide critical data on the Irish harbour seal population and its relationship with those of Western Europe, information that is necessary to ensure future conservation and management strategies have a sound scientific basis.

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