Surveying the seals of Carlingford Lough

A preliminary study 2008–11

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Abstract

Until recently, the seals of Carlingford Lough have not been included in regular monitoring of the seals of the Co. Down coast. A helicopter survey by SMRU in July 2006, suggesting that about one quarter of Co. Down’s harbour seal (*Phoca vitulina*) births occur in Carlingford Lough, provided the impetus for the present study. Boat surveys of all known seal haul-out sites in Carlingford Lough were carried out during the summer pupping and moultng seasons for harbour seals between 2008–11. A photo-count method was used to maximise accuracy of the pup counts and species identification. Abundance of adult/subadult seals of both harbour and grey seals was estimated from a minimum of five counts made during each harbour seal pupping (July) or moultng (August/September) period. Harbour seal abundance was estimated at 178–187 seals in July and 350–376 seals in August/September, with no significant differences between years. Maximum harbour seal pup counts were 43–54 in different years. Grey seal abundance estimates ranged from 39–55, with no significant differences between years. The distribution of seals over eight haul-out sites surveyed found that harbour pups were found at all sites, with the largest number on the southern aspect of Green Island. The largest numbers of adults/subadults of both species were also found on Green Island with harbour seals favouring the northern aspect during the moultng season. Grey seals were otherwise found mostly on the outer reefs of Blockhouse Island, whereas harbour seals also frequented sheltered sites further inside the Lough. The survey boat had to remain >200m from harbour seal groups and >170m from grey seal groups in order not to cause seals to return to the water, although harbour seals at some sites entered the water at greater distances of the boat.

This study has confirmed the approximate size of the breeding harbour seal population in Carlingford Lough and provided a baseline and methodology for future regular monitoring. The importance of the whole of Carlingford Lough for harbour seal pupping and moultng, as well as for grey seal haul-out, suggests that cross-border measures should be taken to ensure site-based protection for all seals within the Lough.
INTRODUCTION

The harbour (or common) seal, *Phoca vitulina*, occurs at many loci along the Co.Down coast with a total count over all of N. Ireland during the August moult of 1248 seals in 2006–2008 (SCOS, 2009), and a further 2,900 in the Republic of Ireland counted in August 2003 (Cronin et al. 2004). Harbour seals are more abundant in Great Britain, with a total count between 2006–08 of about 23,000, of which 86% are in Scottish waters (SCOS, 2009). The largest concentrations of harbour seals in Co. Down are in Strangford Lough, Dundrum Bay and Carlingford Lough.

There is concern for the species in Co. Down, since numbers in Strangford Lough fell dramatically in the years following the PDV epizootic of 1988, and have not recovered (Wilson and Montgomery-Watson, 2002). There is also concern for the harbour seal at a national (UK) level, with populations estimated to be falling dramatically, particularly in Orkney, Shetland and the east of Scotland (Lonergan et al., 2007). The harbour seal, which (along with the grey seal, *Halichoerus grypus*) receives strict protection under the Wildlife (NI) Order 1985, has also received priority species status in both the GB and N. Ireland biodiversity Action Plans. Because of this concern for the species, it was considered to be essential to monitor closely the most important breeding populations in N. Ireland, and make efforts to maintain a favourable conservation status for them (Thompson et al. 2001).

The Strangford population has been monitored regularly since the 1970s and harbour seal pupping has been monitored closely in Dundrum Bay since the mid-1990s (Wilson and Montgomery-Watson, 2002; Wilson et al. 2002; unpublished). The Carlingford Lough population, however, has not been monitored, and the fact that there were some tens of pups born here annually was not known until the SMRU helicopter survey in 2006. This survey suggested that Carlingford hosts about a quarter of Co. Down’s common seal births and about one third of Co. Down adults/subadults during July.

On the basis of the SMRU survey, the present survey was initiated by Tara Seal Research and the Loughs Agency to investigate the Carlingford seal population in more detail. The aim of the survey is to focus on the annual pup production, distribution and conservation status. However, attention was also drawn to a perception among local salmon fishermen of seals having an adverse effect on the salmon and trout rod fishery in Carlingford Lough. The White Water river is stocked with salmon and trout, and the rod fishery is focused on the area of Mill Bay (the ‘Black Hole’) between the river and Greencastle. Observations by local people of large numbers of seals hauled out on Green Island have resulted in the perception that these seals are targeting salmon and threatening the rod fishery. A related study to investigate the diet and behaviour of seals at Green Island, with a view to assessing evidence for a significant seal-salmonid fishery interaction, is also underway, and will be reported separately.
METHODS

Counting from survey vessel

The TSR/LA survey was carried out by boat between about 2 hrs before low water to 1 hr after low water. Surveys were begun only in slight sea state and when the forecast wind force was <5. Either the Lough Agency's launch or the dinghy 'Pioneer' were used in 2008–10 and the RIB 'Lutra' was used in 2010. From July 2009, seals at one site not readily accessible by boat (Carrigaroan) were counted from the shore at Ballyedmond before starting the boat survey.

The boat survey was begun from Carlingford, Warrenpoint or Greencastle with a team of three people including the pilot. The boat’s track was recorded on a hand-held GPS unit and a waypoint was marked at each location where seals were seen. A visual count of adult/subadults and pups of each species was made by one member of the team using binoculars and notepad. A second team member marked waypoints and took photographs of all seal groups and individual seals using a Canon digital SLR camera with a 300x zoom lens. Accurate seal counts of each species and age class were later made from these photographs.

The seal haul-groups were approached slowly and obliquely. An attempt was made to maintain the boat at an observation position beyond the seals’ flight distance by attending to increased scanning by seals or incipient movement. During some surveys in 2011 the visual count team member recorded the closest approach distance of the boat (using a Nikon 1200 laser rangefinder), and the number of seals entering the water.

Estimating seal abundance

The average proportion of seals hauled out $P_{av}$ is calculated from the Olesiuk equation (Olesiuk et al. 1990):

$$P_{av} = C_x / [C_{max} + (C_{max} - C_{max-1})]$$

where $C_x$, $C_{max}$ and $C_{max-1}$ are the mean, maximum and 2nd highest counts respectively. Abundance is then calculated from $C_x / P_{av}$. A minimum of five counts over the study period is required for a valid estimate. There were sufficient data (i.e. five surveys in each period) to carry out abundance estimates for common and grey seals in August 2008 and 2011, and July 2009 and 2011.
Fig. 1. Carlingford Lough seal haul-out sites
(The markers indicate the position of the survey boat, ~200m from the actual site)
Table 1. Name, number and approximate GPS coordinates* of seal haul-out sites surveyed

<table>
<thead>
<tr>
<th>Site name</th>
<th>°N</th>
<th>°W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballyedmond (Carrigaroan)</td>
<td>I 54 03.619</td>
<td>6 08.978</td>
</tr>
<tr>
<td>Carlingford Island (‘Seal Rock’)</td>
<td>II 54 02.427</td>
<td>6 08.963</td>
</tr>
<tr>
<td>Carriganean</td>
<td>III 54 03.142</td>
<td>6 08.036</td>
</tr>
<tr>
<td>Mill Bay</td>
<td>IV 54 02.396</td>
<td>6 06.806</td>
</tr>
<tr>
<td>Green Island (Greencastle side)</td>
<td>Vn 54 01.948</td>
<td>6 06.207</td>
</tr>
<tr>
<td>Green Island (Carlingford side)</td>
<td>Vs 54 01.888</td>
<td>6 06.207</td>
</tr>
<tr>
<td>Blockhouse Isl.</td>
<td>VI 54 01.376</td>
<td>6 05.088</td>
</tr>
<tr>
<td>Blockhouse Isl reefs</td>
<td>VII 54 00.864</td>
<td>6 05.243</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54 01.103</td>
</tr>
<tr>
<td>Greenore</td>
<td>VIII 54 00.791</td>
<td>6 05.622</td>
</tr>
</tbody>
</table>

*Coordinates are position of survey boat

RESULTS

Seal counts and abundance estimates

All counts for all harbour and grey seals 2008–2011 are presented in Appendix 1. Harbour seals recorded were mainly adults and pups. Juveniles (between yearling and subadult) were infrequently distinguished. Harbour seals will therefore be referred to as either ‘adults’ or ‘pups’, although the ‘adult’ counts include some juvenile animals >1 year old. Grey seals recorded were mostly adults of both sexes, although a small number of juveniles were recorded. The grey seal counts are a total of all sex and age classes.

The average proportion (Pav) of adult/subadult seals hauled out in July was generally higher for harbour seals (72–83%) than for grey seals (44–58%), although in August-September the average proportion hauled out was similar in both species (67–76%) (Tables 2, A1, A3, A4). The average proportion of harbour seals hauled out was similar in both the July pupping and August moulting seasons.

The abundance estimates (Pav/Cx) for adult harbour seals were 178–187 in July and 350–376 in August (Tables 2, A1, A3). There was no significant difference between the years in either July (2-tailed P=0.614; T-test) or August (P=0.463). The maximum number of pups recorded each year was 54 (2009), 43 (2010) and 43 (2011), recorded on July 13, 23 and 14 respectively (Tables 2, A2).

The abundance estimates for grey seals ranged from 39–55 (Table 2, A4). There was no significant difference between the years in counts in either July (2-tailed P=0.199; T-test) or August (P=0.197).
Table 2. Abundance estimates 2008–2011

<table>
<thead>
<tr>
<th></th>
<th>P. vitulina</th>
<th>H. grypus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P&lt;sub&gt;av&lt;/sub&gt;</td>
<td>Abundance</td>
</tr>
<tr>
<td>N July</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>5</td>
<td>0.83</td>
</tr>
<tr>
<td>2010</td>
<td>2 /</td>
<td>/</td>
</tr>
<tr>
<td>2011</td>
<td>5</td>
<td>0.72</td>
</tr>
<tr>
<td>August</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>5</td>
<td>0.76</td>
</tr>
<tr>
<td>2010</td>
<td>1 /</td>
<td>/</td>
</tr>
<tr>
<td>2011</td>
<td>5</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Distribution of seals at different haul-out sites

The distribution of seals over all eight haul-out sites is shown by the cumulative numbers of seals at each site over all surveys (Fig. 2). Green Island (V) was used by the largest numbers of adult/subadult seals of both species in both June–July and August–September. The shingle beach at Blockhouse Island (VI) was the next most common site for common seals in both seasons (Fig. 2), followed by Carlingford Island (II), Carriganean (III) and Mill Bay (IV). Harbour seals used Ballyedmond (Carrigaroan) for pupping in July, but were absent from the site during the moulting season (August–September). Grey seals, by contrast, usually congregated on the reefs to the seaward side of Blockhouse Island (VII) and only occasional individuals (usually adult females) were seen at Carlingford Island (II) and Mill Bay (IV), and no grey seals were noted at Ballyedmond or Carriganean.

Fig. 2. Distribution of seals at different haul-out sites (totals for all surveys).
Hg: grey seals, Pv: harbour seals; ads: adults/juveniles
Harbour seal mothers and pups occurred at all sites. There was a tendency for mother-pup pairs to group together, particularly at Green Island, but pups also occurred within the haul-out group including other adults.

In all July surveys in the three years, the largest overall number of pups was found on Green Island (V), usually on the Carlingford (southern) aspect (Vb). The next most important and consistently used sites for pups were Carlingford Island (II) and Blockhouse Island (VI), with usually fewer pups at Ballyedmond (I), Carriganean (III), Mill Bay (IV), reefs off Blockhouse Island (VII) and Greenore (VIII) (Table 3). Apart from the fairly consistent use of Green Island for pups in all July surveys, the numerical distribution of pups between the sites showed no significant consistency between the three years (Kendall’s coefficient of concordance, W = 0.12).

**Disturbance by the survey vessel**

During the surveys, despite effort not to cause disturbance, seals at some sites entered the water at various distances as the boat approached. In 2011 an attempt was made to measure the approach distances using laser rangefinder, and record distances at which seals did and did not enter the water. These data are given in Appendix Table A5 and summarized in Table 3.

**Table 3. Mean distances of boat at which seals remained on shore or re-entered water (2011)**

<table>
<thead>
<tr>
<th>Site</th>
<th>Harbour seals</th>
<th>Grey seals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None &gt; water</td>
<td>≥1 seal &gt; w</td>
</tr>
<tr>
<td>II</td>
<td>mean 213m</td>
<td>3362m</td>
</tr>
<tr>
<td>III</td>
<td>451m</td>
<td>3237m</td>
</tr>
<tr>
<td>IV</td>
<td>311m</td>
<td>5362m</td>
</tr>
<tr>
<td>Vn inlet</td>
<td>319m</td>
<td>50247m</td>
</tr>
<tr>
<td>Vs</td>
<td>205m</td>
<td>7190m</td>
</tr>
<tr>
<td>VI</td>
<td>209m</td>
<td>5238m</td>
</tr>
<tr>
<td>VII</td>
<td></td>
<td>1170m</td>
</tr>
<tr>
<td>VIII</td>
<td>242m</td>
<td>5190m</td>
</tr>
</tbody>
</table>

The ‘safe’ distance at which haul-out groups could be approached without any seals entering the water averaged >200m for groups consisting mainly of harbour seals and >170m for grey seals. However, in most of the cases in which seals did enter the water, the average distance was no less than this. Exceptions were one harbour seal disturbed from site Vs into the water at 155m (Table A5) and two instances where grey seal groups at site VII went into the water when the boat was 100-158m distant. The harbour seal site where seals predictably showed the least tolerance of the boat was III (Carriganean).
Difference between visual and photo counts

In order to assess the potential accuracy of visual counts alone from the boat, the visual counts of harbour seal pups and grey seals were compared with the photo counts (Table A5). The number of pups counted visually, even with the same observer, varied between 0–60% of those identified in the photo count (Table A6a). Similarly, the number of grey seals identified varied between 0–38% of the total grey seals in the photo count (Table A5a). Table A6(b) presents a number of examples from the 2011 counts which indicate how much more accurate the photo count is than the visual count, especially with larger seal groups.

DISCUSSION

Type and timing of survey

The purpose of this survey is (i) to estimate harbour seal pup production in Carlingford Lough, and determine the most important nursery sites for pups in the Lough (ii) to estimate the abundance and distribution of both harbour and grey seals in Carlingford Lough throughout the summer months, which covers the harbour seal pupping and moulting periods. The survey was not extended to cover the grey seal pupping season in the Autumn, since grey seals are not known to breed in Carlingford.

Obtaining a reliable estimate for the numbers of harbour seals occurring in a particular area is notoriously difficult, due to high seasonal and daily variability in the number of seals visible at haul-out sites during survey series (e.g. Boulva, 1971). There have been a number of studies investigating the factors affecting this variability. Over a given season, the most significant factors have been found to be the tidal cycle and a diel cycle (e.g. Schneider & Payne, 1983; Stewart, 1994; Pauli & Terhune, 1987a; Roen & Bjørge, 1995; Frost et al. 1999; Jemison & Pendleton, 2006). Tidal cycles are most pronounced where seals haul out on tidal rocky ledges or shorelines where there is a large tidal amplitude resulting in sites being flooded at high tide, as in Carlingford Lough. Since, in such areas, the largest number of seals are visible around the low tide period, conducting surveys within about 2 h either side of low tide has therefore become standard practice for boat and aerial surveys (Gilbert et al., 2005), and this is the practice we followed in Carlingford.

Diel cycles may prevail over tidal cycle where there is adequate haul-out area available even at high tide. A midday peak has been recorded at colonies in Norway, California and the Canadian Pacific coast, where haul-out sites are available throughout the tidal cycle (Roen & Bjørge, 1995; Stewart, 1984; Watts, 1996). However, at a colony on the Canadian east coast, the highest numbers were observed when low tide occurred in the afternoon, leading to a recommendation that harbour seal censuses should be carried out at that time (Pauli & Terhune, 1987a), while Thompson & Harwood (1990) found a peak around 16:00 h at a site in Orkney). Our surveys were carried out, as far as logistically possible, between late
morning and mid/late afternoon. However, although an early morning (07:35) survey on 13/09/09 yielded a near-average number (167) of adult common seals for July, an early morning start (07:00 h) on 01/09/11 yielded only half the average number of common seals for August-September. This was also an exceptionally low spring tide, which we felt might have been part of the explanation.

Meteorological influences on haul-out numbers also have an effect, with greater numbers of seals during the moulting season in fine, warm weather with less precipitation and cloud cover (Pauli & Terhune, 1987b). Wave height was found to have no significant effect on haul-out numbers in one study (Schneider & Payne, 1983), while in another study high waves offshore were found actually to increase the numbers hauling out, which was suggested possibly to be due to a requirement for rest in such conditions (Pauli & Terhune, 1987b). Our Carlingford survey was limited to days when there was no small craft advisory (i.e. wf < 5) from the Coastguard, and we also avoided days of heavy rain – for practical reasons in an open boat, as well as an expectation of lower numbers of seals in the rain. However, one very low count (62 adult common seals) was obtained during an early morning (08:30) count on 21/07/11 which started in calm drizzle conditions, but turned to torrential rain and wf ~5–6 during the survey.

Several authors have found a significant effect of disturbance on haul-out numbers (Allen et al. 1984; Roen & Bjørge 1995; Stewart, 1984; Terhune & Almon, 1983). The effect of disturbance in Carlingford is not known at present. During 18 surveys of this study, actual disturbance caused by a boat landing at a haul-out site was only recorded on three occasions (twice at Blockhouse Island and once at Green Island). However, the seals’ lack of tolerance of the survey boat approach suggests that disturbance by boats may occur at a significant level.

Harbour seal surveys in Scotland and Ireland in recent years have been carried out, using a helicopter with thermal imaging, on a single day during the harbour seal moulting period in August, with an attempt to cover each area once every few years (Cronin et al., 2004; 2007; Lonergan et al., 2007). It has long been realised, however, that even during the moult, when maximum numbers of seals are expected to remain ashore for long periods, a proportion of animals will be in the sea and will not be counted during surveys. An attempt to add a correction to haul-out counts from aerial and boat survys in order to estimate abundance during the pupping season was initiated in 1990 (Thompson & Harwood, 1990; Thompson et al., 1989). This correction was based on telemetry data from VHF-tagged seals, which provided information on the proportion of time that individual seals spent ashore (estimated at 0.71). Some adult males hauled out daily during the puppng season and made ony short foraging trips to sea, while others were absent for several days at a time. At the start of the moult, all males hauled out every day. Adult females spent about 59% of the time hauled out during both pupping and moulting seasons. These data were used to apply a correction factor to haul-out countstotalling 6616, resulting in a total opulation estimate.
of 9331 (Thompson & Harwood, 1990). VHF-tagging has since been supplanted by satellite and SMS tagging (Cronin & McConnell, 2008). The telemetry approach is extremely valuable in providing approximate population estimates based on moulting season counts over wide areas (such as Orkney, or the entire Irish coastline). However, for detailed study of specific areas, such as Carlingford Lough, it has five main drawbacks:

(i) Telemetry data on haul-out behaviour and foraging patterns is to some extent site specific, depending to some extent on local availability of prey and social structure of colonies (whether predominantly breeding or non-breeding adult males and females, or juveniles).

(ii) Telemetry data are not available for seals in all areas, and are not currently available for Carlingford seals.

(iii) The success of applying a telemetry-based correction factor is still dependent on the reliability of the original survey data to which it is applied. Even an accurate count from a helicopter, if made only on an occasional basis once a year or every few years, is vulnerable to daily fluctuations in visible seal numbers, and may not be a representative count.

(iv) These moulting counts give no information on pup production and pupping sites or breeding success. Such information is fundamental to informing effective conservation practice for the harbour seal, which is declining in the UK and is a priority species.

(v) A particular area, such as Carlingford, needs to be monitored more closely than the overall UK monitoring cycle of 5 years or the longer Irish cycle.

Owing to the predictable daily variability of seal numbers due to season, tide, time of day and weather, we opted for a series of surveys over both the harbour seal pupping and moulting seasons, with the aim of using the maximum and mean counts in order to take the variability into account in estimating abundance (Olesiuk et al. 1990; Olesiuk, 1993). Since even the number of pups visible at the haul-out sites varies daily, in order to obtain a maximum pup count for each year, we attempted to cluster the July pupping season surveys around the time when most or all pups would have been born, but not yet weaned and dispersed. Unfortunately this peak period, around mid-July, coincides with the Irish holiday period, placing constraints on days when personnel are available for surveys. A combination of this, weather and logistical reasons resulted in only two surveys being possible in July 2010.

The average proportion of harbour seals hauled out in Carlingford during this study ranged between 0.68 and 0.83 in the different years and parts of the summer season. This is not dissimilar to the figure of 0.71 from the Orkney study (Thompson & Harwood, 1990), and suggests that the results from using a series of boat surveys and the Olesiuk method of
estimating abundance may be as effective as using a telemetry based method. The Carlingford average proportions were also similar to those for a small population of Harbour seals in the Tees Estuary, NE England, which were also monitored in 1989–97 by a series of bimonthly counts using the Olesiuk method, with the average proportion ranging in different years from 0.58–0.79 in June/July and 0.73–0.84 in August/September (Wilson, 2001).

Terhune (1983) suggested that a high variability in harbour seal numbers in a particular area may indicate that the population is mobile, ranging over a wider area of coastline. The Carlingford harbour seal counts in July ranged from 113–176 (with the exception of the early morning count on 21/07/11, which encountered bad weather; Table A1) and the August/September counts ranged from 227–320, with the exception of two very low counts, one of which was the early morning/low spring tide of 01/09/11. This predictable presence of seals suggests that the Carlingford seals may have some integrity as a local entity, structurally distinct from neighbouring populations along the coast such as in Dundrum Bay and Strangford Lough.

The Tees estuary, similar to Carlingford, hosted relatively small numbers of grey seals which did not breed at that site. The average proportion of grey seals hauled out in Carlingford in June/July (0.44–0.58) was similar to those in the Tees in June/July, the summer months ranged from 0.36–0.56. However, the proportion of grey seals hauled out in Carlingford in the summer rose to 0.67–0.75, while the proportion remained similar to the early summer in the Tees (Wilson, 2001).

**Boat survey method**

The Orkney study (Thompson & Harwood, 1990) found that aerial survey techniques were more accurate than boat counts, although they did not give details of their boat survey technique. The present survey used digital photography with the aim of improving accuracy of boat counts. Indeed, the comparison of the visual and photo counts indicated the potential enormous loss of accuracy with visual counts alone. In particular, the number of harbour seals pups and grey seals would have been hugely underestimated. This poor accuracy of visual counts in Carlingford was due mainly to the difficulty in doing more than a very approximate head count while the boat is moving up and down in the choppy sea while trying not to cause disturbance by keeping a 200m distance. Additionally, pups were often difficult to spot, even by an experienced observer, from the moving boat owing to their dark, camouflage colouration, and pups would sometimes be half-hidden behind rocks or adult seals (Fig. A1). With more experience, visual observers should be able to distinguish grey seals in groups from common seals, but small numbers of grey seals with a group of predominantly harbour seal would always be hard to spot visually. We conclude that quality assurance of surveys in Carlingford necessitates the use of digital photography. As well as
allowing a more accurate count of the total seal numbers, each species and harbour seal pups, it provides a permanent record which may be accessed for later confirmation or further study if required. While we agree that aerial surveys are probably more accurate even than photo counts from a boat, aerial surveys are too expensive for regular monitoring in a local area, such as Carlingford, and boat surveys are the more practical option.

The number of seals in Carlingford Lough, summer 2008–2011

The results of this survey have confirmed that the Lough is one of the most important locations for harbour seals in Co. Down at the present time. The abundance of adults/subadults in July of 2009 and 2011 was estimated at about 180 seals in both years, with a maximum count of 54, 43 and 43 pups in 2009, 2010 and 2011 respectively. Common seal abundance in the Lough doubled during the moult, with an estimated 350 and 375 seals in 2008 and 2011 respectively. Over the past three years, therefore, the population seems to be stable. Pup survival seems to be good, with only one ‘orphan’ known to have been stranded in Carlingford over these three years (this pup was taken to the rehabilitation centre in Portaferry).

Grey seals are much less abundant in the Lough, with about 50 animals estimated to use the Lough during the summer months, although the low average proportion hauled out suggests that some of these grey seals may be transient animals rather than being permanently based in Carlingford. This is actually likely to be the case, since grey seals are not known to breed in Carlingford, and breeding animals may therefore migrate to breeding areas elsewhere along the coast. Quite a number of grey seals photographed during the survey were juveniles, and so it is possible that Carlingford attracts primarily juvenile and non-breeding animals, although a very pregnant female was recorded on Blockhouse Island on 01/09/11.

Seal distribution within Carlingford Lough

The counts at each site indicated that harbour seals and pups were widely distributed at all eight sites recorded in the Lough. Pups were not evenly distributed, however, with the largest numbers usually on Green Island (V) and Blockhouse Island (VI). The explanation for this is most probably that these sites are exposed for more of the tidal cycle than the other sites. Sites II, III, IV, VII and VIII were mostly exposed only about 2 h either side of low tide, and VIII was not exposed at all in some neap tides. Conversely, there was no water at Site I during extreme spring low tides. Harbour seal pups can swim and follow their mother within an hour of birth. Maternal care typically involves mothers guiding their pups in the water from one site to another neighbouring site as the tide fluctuates. Pups interact with their mothers while in the shallow water and usually suckle just after re-hauling out. In the sheltered waters of Carlingford Lough, therefore, mothers and pups may be expected to
move from site to site, and vary the chosen site according to tide height on any particular day.

The biggest difference in harbour seal distribution between the pupping and moulting seasons appeared to be

(i) The preference for the Carlingford aspect of Green island (site V) during the July and the Greencastle aspect during the August/September moulting period. We have no explanation for this at present. Moulting seals used much of the elevated island area, not flooded at low tide (Fig. A5).

(ii) The presence of mothers and pups at Ballyedmond (site I) in July, but the apparent abandonment of this site in August.

Potential interaction between seals and salmonid fishing

Because a considerable proportion of the Carlingford Lough seals haul out during Augustad September on the Greencastle aspect of Green Island and on the nearby sandbanks in Mill Bay, this has given rise to a perception by rod fishermen that the seals are hauling out there because of the proximity to the White Water, and are targeting the salmon and trout going to and from that river. However, the preliminary diet analysis, based on scats on Green Island from 19 seals in early September 2009, indicated that these seals were feeding opportunistically on a wide variety of commonly occurring small inshore fish, shrimp and octopus, and only occasionally including salmonid fish as part of a mixed diet. Since the proportion of seals hauled out during the moulting period was estimated at only about 0.68–0.76, this means that about one quarter of the seals were foraging at sea. If they were targeting salmonids from the White Water, they would haul out very low tide.

There was therefore no evidence thus far from these samples to suggest that the harbour seals on Green are targeting salmonids in Carlingford or pose any threat to the rod fishery. However, there are many more samples collected in 2009 which have yet to be analysed. The explanation for the assembly of harbour seals on Green Island in August/September is that much of the island remains exposed at high tide, allowing the seals to remain haul-out during the moult for much of the tidal cycle. Thermal imaging studies of moulting seals has shown that their surface body temperature heats up to as much as 30°C. This temperature rise allows the seals to complete their moult as quickly as possible so that they can return to sea. This is why seals choose haul-out locations such as Green island which are not flooded at high water.

Conclusions and Recommendations

This study has confirmed the importance of Carlingford Lough for the harbour seal, and demonstrated that the survey method employed has been successful in achieving the aims of the study, i.e. to estimate harbour seal pup production and abundance and distribution of both harbour and grey seals in Carlingford Lough. At present the Carlingford population
seems to be the largest single breeding assembly for the harbour seal along the Co. Down coast. Since the harbour seal is a priority species in the UK as a whole, and in Northern Ireland, we would recommend that serious consideration should be given to continuing this monitoring in order to acquire an annual series of surveys which will enable trends in the numbers and distribution of seals in the Lough. Thompson et al. (2001) stress the importance of studying the abundance and age structure of seals, in local areas in order to inform management decisions. Juvenile harbour seals have not been specifically distinguished in the results presented here, but the permanent photo record is available for later scrutiny if required at a later stage. We recommend that the photo count method be used in all future surveys, and that Loughs Agency personnel develop experience in identifying pups and distinguishing the species from the photos.

Although the boat surveys with photo counts appear to be an effective survey tool in Carlingford, we nevertheless recommend consideration also be given to SMS tracking of Carlingford seals. Extensive tracking of Strangford seals has been carried out by SMRU in recent years, and the foraging areas and duration of foraging trips for these seals is now well documented (SMRU, unpublished data). It would be very interesting to compare these with foraging areas and duration of trips by Carlingford seals. This could be done in collaboration with SMRU and the University of Cork.

A present there is no site protection for seals in Carlingford Lough. Both species are protected against killing and injuring by legislation in both NI and ROI, but seals are protected from deliberate disturbance only in NI. In view of the vulnerability of these seals to disturbance we recommend that consideration be given to cross-border site protection against disturbance.
REFERENCES


