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Abundance, distribution and haul-out behaviour of grey seals (*Halichoerus grypus*) in Cornwall and the Isles of Scilly, UK

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This study investigated the phenology, patterns of haul-out habitat use and distribution of the grey seal around Cornwall and the Isles of Scilly. A full census of the coast was carried out by boat over 4 days, in order to make a full count of seals hauled out and close to the coast, and to document all haul-out sites. Regular land-based surveys were made of three haul-out sites in Cornwall, to investigate the effects of spatial, temporal and environmental factors on seal haul-out behaviour. Data from 2004 to 2007 were analysed to describe long-term temporal variation in seal abundance at two haul-out sites. A total of 592 sightings were made along the coast of Cornwall and the Isles of Scilly over the four-day census period; 476 of these sightings (80.4%) were recorded at six main haul-out sites. The highest proportion of seals was observed at three haul-out areas on the Isles of Scilly. In Cornwall, seals were observed in higher numbers on the north coast, where the three largest mainland haul-out sites were documented, than on the south coast. At one key haul-out site in Cornwall, a distinct seasonal pattern was evident in data collected between 2004 and 2007, with higher numbers of seals present during the moulting and breeding seasons than over the summer months. There was considerable inter-annual variability in peak seal abundance, during the moulting season, at this site. There was no significant variation in haul-out behaviour with tidal state at this site, although haul-out counts were generally highest at mid-ebb tides. Data on seal abundance, distribution and haul-out behaviour may aid the designation of Special Areas of Conservation for the protection of grey seals in Cornwall and the Isles of Scilly.

Keywords: abundance, distribution, haul-out behaviour, grey seals, Cornwall, Isles of Scilly

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INTRODUCTION

The grey seal (*Halichoerus grypus*) population of the UK, estimated to number 182,000 (95% CI 96,200–346,000; model averaged estimate), accounts for approximately 45% of the total population of this species worldwide (SCOS, 2008). The grey seal population of Cornwall and the Isles of Scilly (IoS) is thought to constitute approximately 0.5% of the total UK population, and this species is the most abundant marine mammal in the south-west of the UK. Yet the abundance and dynamics of this population are still poorly understood, and there have been calls for further research to focus on this region (Matthiopoulos *et al.*, 2004).

Within the UK, grey seals are protected under the Conservation of Seals Act (1970), and several Sites of Special Scientific Interest (SSSIs) and Special Areas of Conservation (SACs; designated under the EU Habitats and Species Directive, Council of the European Communities 1992) have been designated primarily due to the presence of this species (Brown *et al.*, 1997; Kiely *et al.*, 2000). Potential threats to grey seals include bycatch and entanglement (Northridge, 1991; Morizur *et al.*, 1999; Hamer & Goldsworthy, 2006; Westcott, 2008), pollution (Hall *et al.*, 1996; Wolkers *et al.*, 2004), habitat loss and degradation through noise disturbance (Harwood, 2001). It has been suggested that, in areas where healthy seal populations and fisheries overlap, the seals reduce overall fish stocks, leading to calls for culling by fishermen (Parsons *et al.*, 2005). It is likely, however, that the increasing pressure of fisheries on the seas has in fact reduced available prey items for seals (Yodzis, 2001). Indeed, there is evidence that top predators actually promote biodiversity (Sergio *et al.*, 2005) and that the removal of top predators or keystone species could unbalance the entire food web, which would negatively impact upon seals, fisheries and the ecosystem (Yodzis, 2001).

The life of a grey seal comprises several distinct phases through the seasons, such as moulting and breeding, each with specific habitat requirements. At fine scales, many interacting factors have been suggested to influence haul-out behaviour of seals, such as time of day, tidal state, weather factors and disturbance (e.g. Pauli & Terhune 1987; Schneider & Payne, 1983). Previous studies have documented site fidelity in grey seals (Karlsson *et al.*, 2005; Gerondeau *et al.*, 2007). It is important to identify such sites, in designating protected areas for seals, and in considering potential impacts of development in the vicinity of such sites (Koschinski *et al.*, 2003; Thompsen *et al.*, 2006).

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The grey seal is a commonly-sighted marine mammal in Cornwall and the IoS (Davies, 1957; Summers, 1974; Barnett & Westcott, 1999). Although listed as a protected species by the European Union's Habitats Directive (Council of the European Communities, 1992), this species faces a number of potential threats in this region and a more detailed knowledge of the ecology of this species is required. For many years there have been conflicts between local stocks of seals and fisheries, both in this region and elsewhere in the UK (Steven, 1932; Summers, 1978). The waters of the south-west are a hotspot for fisheries (Witt & Godley, 2007; Leeney *et al.*, 2008); thus, more than ever, local stocks of seals may be at risk of interactions with fisheries. The planned construction of a wave-power generator, the 'Wave Hub', approximately 10 nautical miles from Godrevy, a key haul-out site on Cornwall's north coast, will commence in 2010, and has the potential to affect the behaviour and distribution of grey seals in the vicinity (Southwest of England Regional Development Agency, 2006). Monitoring this population, which is close to the southernmost point of the grey seal distribution (Westcott, 1997), may also be key to understanding the dynamics of grey seals across their range, especially in the face of climate change. This study documents haul-out habitat use and ecology of grey seals in Cornwall and the IoS, in combination with the most recent comprehensive census of seals along the entire coastline of this region.

MATERIALS AND METHODS

Study area

The study area is shown in Figure 1. Cornwall and the IoS are found at the south-western-most point of the UK, surrounded by the Celtic Sea and the English Channel.

Seal census

A boat-based survey was conducted over four consecutive days, 18 to 21 April 2007, which coincided with the end of the moulting season for grey seals in the south-west (Westcott, 1997). The survey covered the Cornish coast, from Boscastle to Plymouth, and the IoS. Four boats were used, surveying within the same temporal window of three hours before and after low tide. Survey vessels travelled along the coast at approximately 10 knots and distance from the coast was maintained at between 100 and 200 m, depending on the bathymetry. There was a minimum of one landward observer and one seaward observer on each vessel, with a separate data recorder when possible. When seals were sighted, the time and position were recorded, along with the number of male, female and juvenile seals and whether they were hauled out or in the water. The survey track was recorded by GPS. All surveys were carried out in sea state 2 or less. Spatial data were analysed using the GIS software ArcMap version 9.1.

Seasonal data

In order to investigate seasonal patterns of seal haul-out activity and sex-ratio, across several years, data collected by the Cornwall Seal Group (CSG) between 2004 and 2007 were used. The data were collected from Godrevy, a key haul-out area for grey seals in Cornwall; this area can be divided into two main haul-out sites, Mutton Cove and Godrevy Island. Mutton Cove is a sandy/gravel beach surrounded by rocky cliffs approximately 45 m in height. This area is frequented by walkers and wildlife watchers. Godrevy Island is rocky and uninhabited, and is about 700 m from Mutton Cove and 300 m from the closest coastline point.

A single data recorder (S.S.) collected count and sex data for seals at sea and hauled-out, at each site. When haul-out numbers were large, digital images of the haul-out site were taken and the total was verified later by counting seals in the image(s), on a computer screen. Observations lasted a minimum of two hours, and the recorded count for any date was the maximum number of seals recorded during the observation period. Observations were carried out at a range of different times of day, and usually at an intermediate tidal state (i.e. not high tide but not absolute low water, when maximum numbers of seals do not haul out on Mutton Cove beach; S.S., personal observation). From 2004 to 2006 inclusive, data were collected using Chinon 9-21×25 RB Zoom Compact Binoculars and an Opticron ES80 Angled Telescope with a HDF 24–72 times eyepiece. Still images were selected from digital video, taken with a Sony TRV330 Digital Handycam with a 25× optical zoom lens. In 2007, data were collected using a Leica APO Televid 77 Straight Body telescope with a fixed 32× eyepiece. A Leica D Lux 3 camera, attached to the scope, was used to take photographs.

Factors affecting haul-out behaviour

Regular land-based surveys were carried out by a single observer (C.M.; Mills, 2007), between March and June 2007. To investigate the effect of site and tide on haul-out behaviour, surveys were carried out at Mutton Cove, Porth Joke and St Clement's Isle. Porth Joke and St Clement's Isle are both rocky islands, the former about 90 m from the mainland at high water and the latter approximately 320 m from shore. All sites were known haul-out areas for seals (S.S., personal observation), and were selected in order that surveys could be carried out at multiple sites by a single surveyor, on the same day.

At each site, the effect of tidal state was investigated. Levels of tidal state (high, ebb, low and flood) were predefined in order to achieve similar levels of sampling effort for each combination of factors. Tidal state was determined using the Falmouth Harbour Commissioners 2007 Tide Tables. Early survey work showed consistently higher numbers of seals at Mutton Cove, thus subsequent effort was concentrated at this site. Survey days were carried out three days a week. On each day, all three sites were surveyed for ninety minutes, forty-five minutes each side of a stratified randomly selected tidal state. Peak ebb and flood tide times were defined as three hours after and before high water, respectively. At fifteen-minute intervals the number of seals hauled-out and in the sea were counted and classified as males, females or juveniles. Bushnell 10×42 binoculars were used for observations. For seals at sea, the maximum seen at any one time within a two-minute period was recorded. The count of seals at sea is thus likely to be conservative. When there were large haul-outs, a Nikon D50 digital SLR camera was used to take photographs of the entire haul-out site, allowing for counting to take place later using image viewing software.

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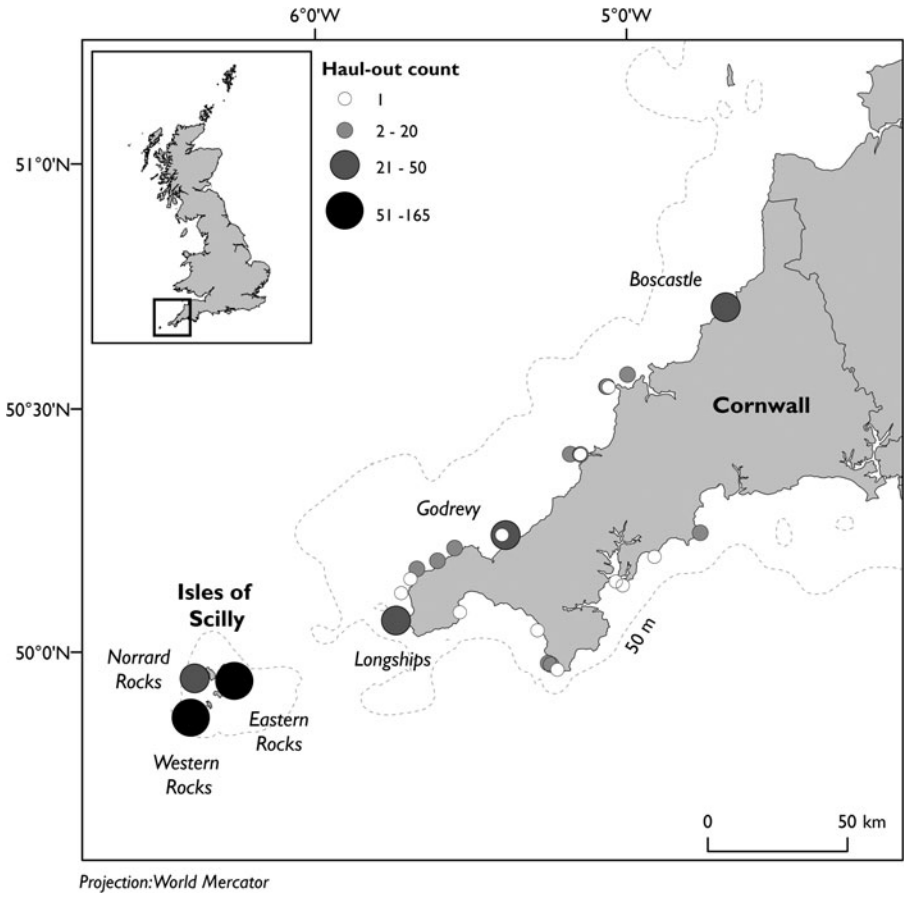

Fig. 1. Locations of grey seal numbers during the boat survey. Circles are shaded and scaled proportionally, with a range from 1 to 165 individuals recorded at each site.

RESULTS

Geographical distribution of haul-out sites

Haul-out habitat selection by grey seals around Cornwall and the IoS is shown in Figure 1. A total of 592 seals were observed during the survey, 411 hauled-out and 181 in the water. The highest haul-out counts were at three areas along the north Cornwall coast—Longships Island, Godrevy and Boscastle—and at the IoS (Table 1). The haul-out sites at the IoS were divided into three areas, Western Rocks, Eastern Isles and Norrard Rocks. For these six main haul-out sites, a total of 476 seal sightings were documented, of which 354 were hauled out and 122 were in the water close by. Between these larger haul-outs were several small to moderate haul-out sites. Along the south coast from Land's End there were lower counts of seals, with several small haul-out sites but no substantial aggregations. East of Chapel Point, which is half-way along the south coast, no hauling-out behaviour was observed.

Table 1. Seal sightings at key haul-out sites from the seal census.

Site	Hauled- out	At sea	Total
Boscastle	23	26	49
Godrevy	27	15	42
Longships	21	5	26
Eastern Isles (IoS)	93	19	112
Western Isles (IoS)	165	57	222
Norrard Rocks (IoS)	25	0	25
Total	354	122	476

Of the 592 seal sightings documented, 296 were categorized as males, 176 as females, 51 as juveniles and 69 as unknown. Seals observed in the water were generally in close association with haul-out sites, apart from a stretch of coast between Porth Joke and Godrevy, where seals were seen only in the water. The ratio of the number of seals in the water to the number hauled out varied greatly, with only hauled-out seals observed at the Norrard Rocks, a high ratio of 4.9 hauled out seals for every seal in the water at the Eastern Isles and 0.9 at Boscastle; for these 6 sites, the mean ratio was 2.9 hauled-out seals for every seal in the water nearby. At Boscastle, a somewhat remote site which experiences relatively little boat traffic, greater numbers of seals in the water than hauled out is perhaps due to the survey vessel having a greater disturbance effect than at other sites, and thus causing more seals to enter the water during our survey. Data from these main haul-out sites revealed that there were proportionally more males than females or juveniles (excluding Boscastle—no data on sex-ratio available).

Seasonal and yearly patterns

A total of 406 surveys were carried out between 2004 and 2007. Figure 2A shows the monthly pattern in seal abundance at Godrevy Island and Mutton Cove, between 2004 and 2007.

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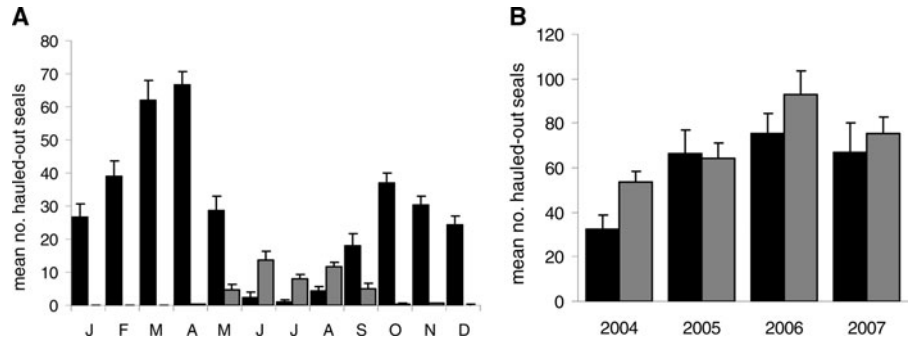

Fig. 2. (A) Mean (±SE) monthly seal haul-out counts at Mutton Cove (black bars) and Godrevy Island (grey bars), 2004–2007; (B) mean (±SE) number of hauled out seals in the two peak months for hauled-out seals at Mutton Cove, March (black) and April (grey); 2004–2007.

Seal abundance at Mutton Cove peaks in March–April and declines sharply thereafter; abundance on Godrevy Island is low during this peak period at Mutton Cove. Seals haul out on the island in small numbers between May and September, and during the months of June, July and August, abundance on the island is greater (mean of 11.2 individuals per survey) than at the mainland site (mean of 2.9 individuals per survey). A secondary peak occurs at Mutton Cove in October–November, around the time of the breeding season. The considerable variability in haul-out count was a result of variability both within a given year (Figure 2A) and among years (Figure 2B). Between 2004 and 2006, there was a yearly increase in seal abundance at Mutton Cove, during the moulting season, but this pattern of increase did not continue into 2007. In every month of the year (2004–2007), the majority (>70% in most months) of all hauled-out seals at Mutton Cove appear to be males (Figure 3). This is consistent with the findings of the census.

Factors affecting haul-out behaviour

A total of sixty-five surveys were carried out between March and June, 2007. The maximum count of hauled-out seals varied significantly among sites ($F = 68.907$, $P < 0.001$). Of the three sites surveyed, maximum haul-out counts at Mutton Cove (mean 56.6, range 0–126) were significantly higher than Porth Joke (mean 1.5; range 0–9) and St Clements (mean 0.4, range 0–4). Low counts of seals at Porth Joke and St Clements over the time frame of this study resulted in insufficient data for a detailed investigation into influence of environmental factors on abundance at these sites. Too few replicates were collected for a comprehensive analysis of relationships between the environment and the abundance of grey seals hauled out at Mutton Cove. A GLM with negative binomial errors and log link (Table 2) was used to model the effects of tidal state and a short seasonal trend on seal haul-out counts, using function glm.nb in R version 2.7.2 (R Development Core Team, 2007). The log-linear seasonal trend made a significant contribution to the model (likelihood ratio test; χ^2 (1 df) = 12.256; $P < 0.001$) but the effect of tidal state was not significant (χ^2 (3 df) = 5.662; $P = 0.129$).

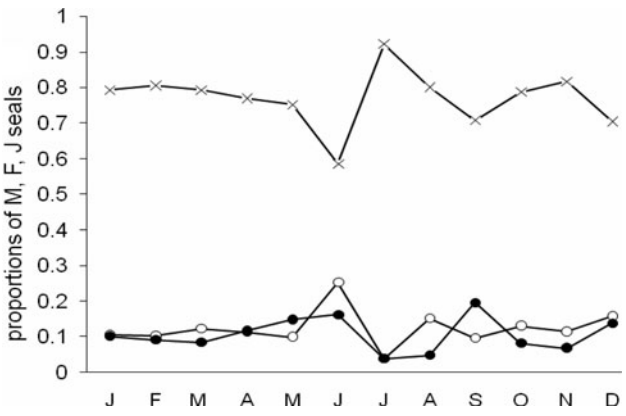

Fig. 3. Monthly mean proportion of male (crosses), female (white circles) and juvenile (black circles) seals hauled out, Mutton Cove, 2004–2007.

DISCUSSION

This study reconfirms the findings of previous assessments of grey seal abundance and distribution in Cornwall and the IoS. Our total of 592 seals counted over a 4-day period is comparable with an earlier estimate of 500–600 for the same region (south-west England, including Devon and Cornwall; Duck, 1995a, b), although it should be noted that Duck's figure was based on best available knowledge in the region, and not on census or pup production data. Counts of pups, during the first few weeks of pup production, are considered to be the only component of grey seal populations to provide reliable population estimates (Cronin *et al.*, 2007). Nonetheless, our census of all seals in the coastal strip surveyed provides an estimate of the number of seals using these waters over a four-day period, during the spring season. Whilst some individuals may have been counted more than once as a result of inter-site movement, this is likely to have been more than compensated for by the

Table 2. The negative binomial GLM with log link used to investigate effects of time (in days; continuous variable) and tidal state (categorical variable with ebb as the baseline) on seal haul-out counts. Theta = 3.73 ± 1.20.

Term	Coefficient	SE	Z	P
Intercept	5.356	0.274	19.549	<0.0001
Flood	−0.058	0.317	−0.183	0.8546
High	−0.207	0.340	−0.609	0.5428
Low	−0.727	0.304	−2.387	0.0170
Time	−0.019	0.004	−4.435	<0.0001

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likelihood that many other individuals were foraging offshore during the survey, and thus were not counted. On average, harbour seals and grey seals spend 70–80% of their time in the water (estimate by S. Tougaard and P. Reijnders in 1992, cited in Leopold *et al.*, 1997; Adelung *et al.*, 2006; Austin *et al.*, 2006), although this proportion will vary with habitat, as well as season, as they go through different stages of their yearly cycle. Sjöberg & Ball (2000) documented an average haul out period of 4.8 hours with a corresponding 35 hours spent away from the haul-out site, for grey seals in the Baltic; however, these data applied to the autumn and winter months, when seals spend longer periods at sea to forage. McConnell *et al.* (1999) found that, outside of moulting and breeding periods, grey seals spent over 40% of their time on or in the vicinity of a haul-out site. We might, then, expect that during the period in which our study was carried out, seals spend greater proportions of their time hauled out, increasing the likelihood that they were counted during the census. Sites on the north coast of Cornwall and the uninhabited islands of the IoS, regions both previously documented as important during the breeding season (Summers, 1974; Prime, 1985), are clearly important haul-out areas for this population.

Haul-out habitat selection may be affected by the suitability of nearby foraging areas. McConnell *et al.* (1999) found that in 88% of trips to sea, grey seals exhibited haul-out site fidelity and travelled a mean of 39.8 km from the haul-out site. These findings suggest a large proportion of foraging activity takes place in close proximity to haul-out sites. Grey seals eat a wide variety of prey, with different fish species dominating in different areas in seasons (Prime & Hammond, 1990; Hammond *et al.*, 1994; Ridoux *et al.*, 2007). This implies that they are quite generalist feeders and so prey type would not necessarily limit their distribution. Bathymetry has been found to be important in the foraging success of grey seals. Thompson *et al.* (1991) showed that grey seals off the British coast dive to the bottom on most dives and are mainly benthic feeders. Sjöberg & Ball (2000), in a study of satellite-tagged grey seals in the Baltic Sea, noted that depths between 11 and 40 m were most commonly visited, and depths greater than 51 m were used less frequently than expected, a pattern which they suggested was likely related to prey availability or foraging success. Depending on the preferred prey of grey seals in our study area, the gentler slopes on the north coast may provide larger areas of potential foraging habitat, compared to the steeper contours found on the south coast.

Seasonal variation in haul-out counts was evident from the long-term dataset collected at Godrevy, one of the key haul-out sites. At Mutton Cove, seal abundance increased from the start of the year into early spring, peaking in March and April, which corresponds to the moulting season (Westcott, 1997). Whilst abundance increased over the summer months at Godrevy Island, a corresponding decrease in numbers was observed at Mutton Cove until late summer, when a second, albeit smaller peak occurred around the breeding season in October. After this point, abundance declined again through the end of the year. This general pattern was observed in each year from 2004 to 2007.

This seasonal pattern in abundance is invariably a result of the life stages grey seals go through every year. During the moulting season, seals utilize haul-out sites (McConnell *et. al.*, 1999) in order to satisfy thermal requirements, due to increased blood flow to the skin (Boily, 1995). Therefore, individuals spend more time hauled-out and move less between haul-out sites, resulting in high site fidelity (Gerondeau *et al.*, 2007) and higher haul-out counts. In the summer months, seals may be freer to travel further distances, and during the 3–4 months prior to the breeding season, adult seals exhibit increased diving frequency and energy storage in preparation for the high-energy costs of breeding (Beck *et al.*, 2003). They may also need to replenish low supplies due to reduced foraging during the moulting season. During the breeding season, seals are to be found closer to shore, as females must give birth on land (Matthiopoulos *et al.*, 2004). This likely explains the higher counts of adult seals at Mutton Cove during October and November. Overall haul-out numbers decline again during the winter months, as adult seals return to sea more frequently to feed. Seasonal peaks of grey seal abundance have been reported in Wales (Baines, 1994) and west Ireland (Cronin *et al.*, 2007) during the breeding season and in the east and south-east of Ireland (Lidgard *et al.*, 2005) during the moulting period.

The seasonal pattern at Godrevy Island was distinctly different from that at nearby Mutton Cove. Haul-out numbers at Godrevy Island are considerably lower, overall, than at Mutton Cove, and the island appears to be used almost exclusively during the summer months. Since the seaward side of the island is not visible from shore, it is possible that the abundance figures for this site are conservative; however, the seaward side is very steep and unlikely to be suitable haul-out habitat (S.S., personal observation). This exposed aspect of Godrevy Island may also make it a less suitable haul-out site in winter, when it is not used by grey seals. Conversely, during the summer months, seal numbers increase on Godrevy Island, perhaps due to lower levels of anthropogenic disturbance from walkers at this offshore site, compared with Mutton Cove, although boat activity around this area is also a frequent cause of seal disturbance during the summer. The seasonal variation in habitat-use between these two sites suggests that different sites are used preferentially, due to seasonal variation in environmental factors. Vincent *et al.* (2001) found evidence of different habitat preferences by grey seals in the Molène Archipelago, Brittany, France, during different stages in life history. During moulting and nursing, seals selected permanently emerged islands with associated less tidal disturbance, whereas tidal pools were used as resting habitat during the rest of the year.

In addition to a seasonal pattern in abundance, tidal state appeared to influence haul-out behaviour at Mutton Cove, although this effect was not found to be significant. Counts of hauled-out seals were highest during an ebbing tide, and were lowest at peak high and low water. A number of temporal factors, including season, tidal state and time of day have been found to effect haul-out counts of many species of seal (e.g. Schneider & Payne, 1983; Pauli & Terhune, 1987; Thompson *et al.*, 1997; Reder *et al.*, 2003). The timing of this study during the moulting season for grey seals, and the inherent biological constraints on seals during this period may have influenced the results. Given the significant effect of season on overall abundance of seals at Mutton Cove, and likely other haul-out sites also, more detailed studies over longer time periods will be required in order to determine the role that factors such as tidal state play in determining seal haul-out behaviour in the study region.

Longer-term data show great inter-annual variability in overall seal abundance or site utilization, at Mutton Cove. The 2008 SCOS report documents an overall increase in

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pup production of 0.5% between 2002 and 2007 at the main UK colonies (the Scottish sites for this species represent the vast proportion of these numbers). The growth of the breeding colonies of grey seals in the Western Isles of Scotland is documented to be slowing (SCOS BP 06/4; cited in SCOS, 2008), and pup production in Scotland decreased by 2.8% in 2007, compared to 2006. However, it is suggested that the British grey seal population as a whole will likely continue to increase for some years, due to the time lag in pup production translating into population size (SCOS, 2008). At a smaller spatial scale, McMath & Stringell (2006) likewise suggest that pup production, and thus the population as a whole, in Wales (considered the largest in southern Britain) to be stable over the period of their study, although this only included data for years between 1992 and 2006. Certainly, longer-term monitoring of the Godrevy site, incorporating Mutton Cove and Godrevy Island, in the future, combined with monitoring of other key haul-out sites in Cornwall and the IoS, will be required in order to determine whether there is any long-term trend in haul-out site utilization, or in region-wide grey seal abundance in Cornwall and the IoS. Even an apparent increase, such as that seen between 2004 and 2006 at Mutton Cove, may simply represent a shift in the distribution of seals or their selection of haul-out site, or may be part of a cyclical pattern in population abundance.

The census data and data from the land-based studies suggest that overall, there is an adult sex-ratio skew towards males in this region. Proportionately more male seals than females were recorded at both Godrevy and on the IoS. Barnett & Westcott (1999) reported that significantly greater numbers of male seal pups presented for rehabilitation to Gweek National Seal Sanctuary in Cornwall. However, considerable differences may exist in behaviour between sexes and age-classes of pinnipeds such as harbour seals (Härkönen *et al.*, 1999), suggesting that the hauled-out ratios do not represent the total population and so leading to biased estimates in ecological parameters. Females may exhibit different haul-out behaviour, which is not observed with the methods used in this survey, such as preferring caves. Interestingly, Gerondeau *et al.* (2007) showed that female grey seals preferentially use the Molène Archipelago, Brittany, France during the summer and leave just before the breeding season. Since satellite tagging studies have shown that seals sighted in Cornwall also travel as far as this site in France, as well as to Wales and Ireland (Vincent *et al.*, 2005), it may be that some kind of sexual segregation occurs within the metapopulation. Breed *et al.* (2006) reported a large scale spatial segregation of male and female grey seal habitat use on the Scotian Shelf in Canada. This related, however, to foraging grounds, with females and males using distinctly different areas and selecting different prey species. A spatial segregation of grey seals, based on sex, has been observed by Harvey *et al.* (2008) in the Gulf of St Lawrence, with females being more concentrated in the shallowest parts of their home range than males. The biased sex-ratio recorded in our study may be in part due also to a bias in data collection, since mature male seals are easier to positively identify, due to their much larger size and conspicuous facial profile.

This study documented the importance of several haul-out sites for a large proportion of the local grey seal population. The fact that seals preferentially haul out at specific sites such as Mutton Cove means that disturbance near to a key haul-out site could be damaging on both an immediate and a longer time scale. Thus, impacts such as construction on the seabed or extensive boat traffic may prevent seals from accessing one of their optimal haul-out sites. A study by Madsen *et al.* (2006) noted that pile-driving and other activities that generate intense impulses during construction are likely to disrupt the behaviour of marine mammals at ranges of many kilometres. However, Edrén *et al.* (2004) observed no long-term change in the proportion of grey and harbour seals hauling-out at Rødsand, a key haul-out site in the Baltic Sea, from the baseline phase to construction phases of an offshore wind farm. They concluded that there was no effect of the construction activities on the local seal population. Whilst there may be no lasting effect of a construction phase on seal haul-out habitat selection, a short term displacement of animals from a key site may have consequences for fitness. This needs to be taken into account when assessing the environmental impact of offshore construction.

The grey seals of Cornwall and the IoS are not geographically isolated; indeed, a number of studies have identified seals, seen in Cornwall and the IoS, in other key grey seal habitats in France, Wales and Ireland (Vincent *et al.*, 2005), and Gerondeau *et al.* (2007) suggest that the seals seen in the Molène Archipelago may in fact be born and breed in the south-west UK. Thus, the seals of Cornwall and IoS are an integral part of a metapopulation which spans the Celtic Fringe. Expansion of this research to include data from studies in Ireland, Wales and France will provide a better understanding of year-round habitat preferences and the dynamics of this population, both on a local and international scale. Previous studies in Cornwall and the IoS have focused on pup production and breeding or pupping sites (SCOS, 2008), as this is the method used to assess population size and because SAC designation requires sites which fulfil these roles. Whilst it is crucial to protect these sites, other haul-out sites are very important for resting and moulting, and should arguably also be considered critical habitat for grey seals, especially given how few they are. In focusing outside the breeding season, our study has provided novel information on grey seal distribution and habitat use through the rest of the year, which will be invaluable in the management and conservation of this local population.

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