

## CSD 3.2 Report

### Harbour seal diet composition and diversity

#### Executive summary

Previous studies of harbour seal diet around Scotland and elsewhere in Britain and Ireland have described diet composition at small spatial scales. However, these studies have been patchy in time and space, and the most recent results are from the early 2000s. In addition, declines in harbour seal numbers have been observed since 2000 in Shetland, Orkney and eastern Scotland. Reduced availability of prey is one potential contributory cause of these declines. Comparison of diet among regions that exhibit different population trajectories may shed some light on why harbour seals are declining in some parts of Scotland but not others.

The objective of this study was to provide seasonal and regional estimates of harbour seal diet composition and regional estimates of prey consumption, and to investigate how harbour seal diet (composition and/or diversity) relates to the different population trajectories observed around Scotland.

Harbour seal scats were collected seasonally throughout Scotland and along the east coast of England over a 12 month period in 2010/11. Methods used to estimate diet followed those used in previous SMRU studies of seal diet. Hard remains of prey (fish otoliths and cephalopod beaks) were recovered, identified and measured, and corrections made to account for partial and complete digestion. Diet composition was estimated as the percentage, by weight, of each species in the diet for each region and season. Sampling variability was estimated using non-parametric and parametric bootstrap resampling methods. Diet diversity was estimated for each region within a season using estimates of prey species richness and the relative abundance of prey species (species evenness). Standard molecular methods were used to ascertain the sex of the seal corresponding to each scat. A total of 1,976 harbour seal scats containing hard prey remains were processed, yielding 65,534 otoliths and beaks.

In the Outer Hebrides, harbour seal diet was approximately evenly split between *Trisopterus* species, pelagic fish, large gadids, scorpion fish, and sandeel. In the Inner Hebrides, large gadids were the main prey; other important species were *Trisopterus* species and pelagic fish. Sandeel contributed little to the diet along the west coast of Scotland. In Orkney, sandeel dominated the diet in summer and spring. Large gadids were important prey in all seasons. Pelagic prey were important in autumn. In Shetland, the diet comprised primarily pelagic prey, large gadids and sandeel.

In south east Scotland the diet comprised primarily flatfish (mainly plaice) and also sandeel and large gadids. In the Moray Firth, sandeel strongly dominated the diet in all seasons. In the southern North Sea, there was considerable seasonal variation in diet composition. The diet was dominated in summer by sandy benthic species, flatfish and sandeel; in autumn by flatfish, large gadids and dragonet; in winter by whiting, scorpion fish and sandy benthic prey; and in spring by flatfish and sandy benthic prey.

The large majority of fish consumed by harbour seals were <30 cm in estimated length and the mean size of each species was mostly below the minimum landing size for cod, haddock, whiting and plaice. The effect of harbour seal predation on fish stocks can only be assessed robustly by incorporating seal predation in fish stock assessments. However, mortality rates of the main fish species in the diet of harbour seals are mostly high so predation on the much larger younger age classes of fish is likely to have less of an effect than would predation on much smaller older age classes. If so, this suggests that the interaction between harbour seals and commercial fisheries around Scotland may not be important for most fish species.

In all regions, except the Moray Firth, there were some differences in male and female diet across all seasons. In The Wash and Scottish west coast regions, females ate fewer large gadids than males and made up the difference in percentage contribution with sandy benthic and pelagic fish in The Wash, pelagic fish in the west coast - central region and *Trisopterus* species in the west coast - south region. The diet of male and female harbour seals matched most closely during the summer. This similarity in prey composition of the diet may reflect male seals mirroring the distribution of female seals at this time of year. Overall, across all seasons, species richness and evenness did not vary greatly between the diet of male and female harbour seals; however,

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a small degree of seasonal variation was observed across the diet of both sexes in The Wash in winter and spring.

Overall, harbour seals were estimated to have consumed 23,710 t (95% confidence interval: 21,900-26,170 t) of prey in the North Sea (ICES Subarea IV) and 29,950 t (95% confidence interval: 26,820-32,980 t) of prey west of Scotland (ICES Division VIa) in the 12 months from April 2010 to March 2011, and a grand total of 53,660 t (95% confidence interval: 50,18057,400 t).

Overall, no clear consistent pattern emerged to link estimated diet composition of harbour seals with observed population trends. Instead, variation in diet appeared to correspond largely to regional and seasonal differences in prey distribution and abundance. However, there was a pattern between diet diversity and population trend. Prey species richness and evenness were generally lower in Orkney and Shetland, where harbour seals have declined, and higher in the west coast of Scotland and The Wash, southern North Sea, where harbour seals have not declined. This relationship did not hold in the Moray Firth, where the diet was dominated by a single prey type (sandeel).

Sandeel was an important component in harbour seal diet in Shetland, Orkney and the Moray Firth and quite important in southeast Scotland - all regions where populations have shown declines. Sandeel was not an important component of the diet west of Scotland, where populations have remained stable, nor in the southern North Sea, where the population is increasing.

Direct comparison of results with other studies was affected by methodological differences but it was possible to take this into account qualitatively and draw some inferences about changes in harbour seal diet over time. Combining this with information on estimated sandeel biomass from stock assessments revealed a general pattern regarding the relationship between diet and trends in population size of harbour seals. Where harbour seals have declined (northern and eastern Scotland) sandeel stocks have also declined and, although their contribution to the diet has declined, they remain an important component of the diet. In regions where harbour seals have not declined (west coast of Scotland, southern North Sea), sandeel were and remain unimportant in the diet and, in the southern North Sea, sandeel stocks have increased.

Overall, with the caution that information is incomplete, the diet of harbour seals is less diverse and at least partially reliant on declining sandeel stocks in regions where population declines have been observed, and is more diverse and not reliant on sandeels in regions where population declines have not been observed. A tentative conclusion is that declines in harbour seal abundance in northern regions may be linked to a decline in the abundance of sandeels.