# Progress report on the SCANS-II project

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## 1 Introduction

In 1994, the SCANS survey provided the first robust estimates of abundance for small cetaceans in the North Sea and adjacent waters (Hammond *et al*., 2002). The SCANS-II project aims to update these abundance estimates, make recommendations for future monitoring of populations, and develop a management model for determining safe bycatch limits.

Since the last ASCOBANS Advisory Committee meeting in Brest, the SCANS-II project has completed the major survey work and analyses of the data are in progress. This report updates on project activities related to these surveys and analyses, and also on the monitoring and management modelling parts of the project. Preliminary estimates of abundance are presented for the harbour porpoise and minke whale for the whole survey area. We expect these numbers to change and the associated coefficients of variation (CV) to increase slightly when the final estimates are available by July 2006. Estimates are also presented for dolphins from aerial surveys only.

## 2 SCANS-II surveys: July 2005

In July 2005, the SCANS-II surveys were carried out to generate new estimates of cetacean abundance for the whole European Atlantic continental shelf. Seven ships and three aircraft surveyed the area, which had been divided into strata (Figure 1). Double platform line transect surveys were carried out by all ships to allow analyses to account for the probability of detection on the transect line to be less than one and for responsive movement of animals to the ship. Shipboard transects covered 19 614 km in an area of 1 011 000 km$^2$ (Figure 2). The "racetrack" method used for aerial surveying also allows analyses to take account of animals missed on the transect line (Hiby 1999). Aircraft flew 15 902 km on effort in good and moderate conditions in an area of 353 000 km$^2$ (Figure 2). Over 1 900 encounters with thirteen cetacean species were recorded. The harbour porpoise was most commonly encountered and was widely distributed but there were few sightings south of 47ºN (Figure 3).

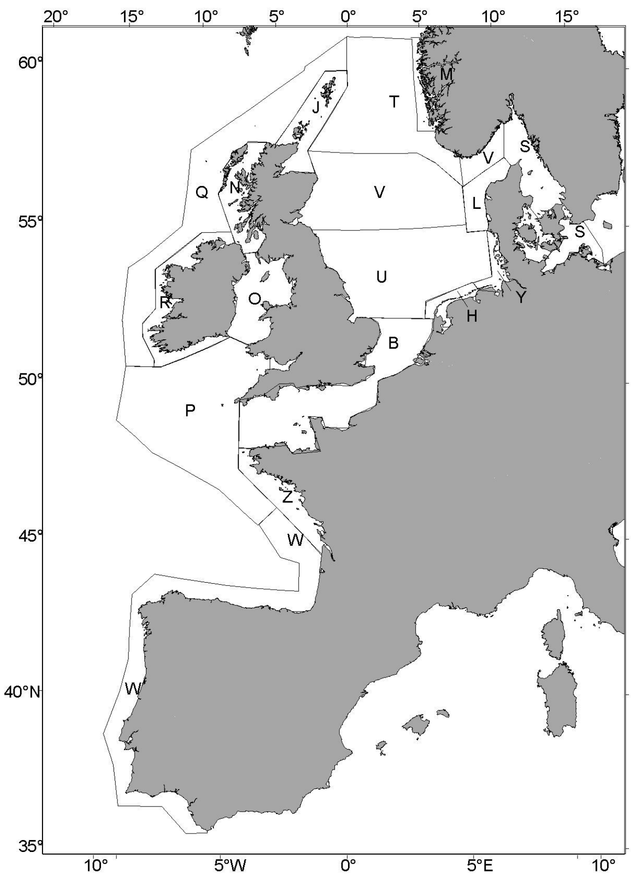


**Figure 1: SCANS-II survey strata**

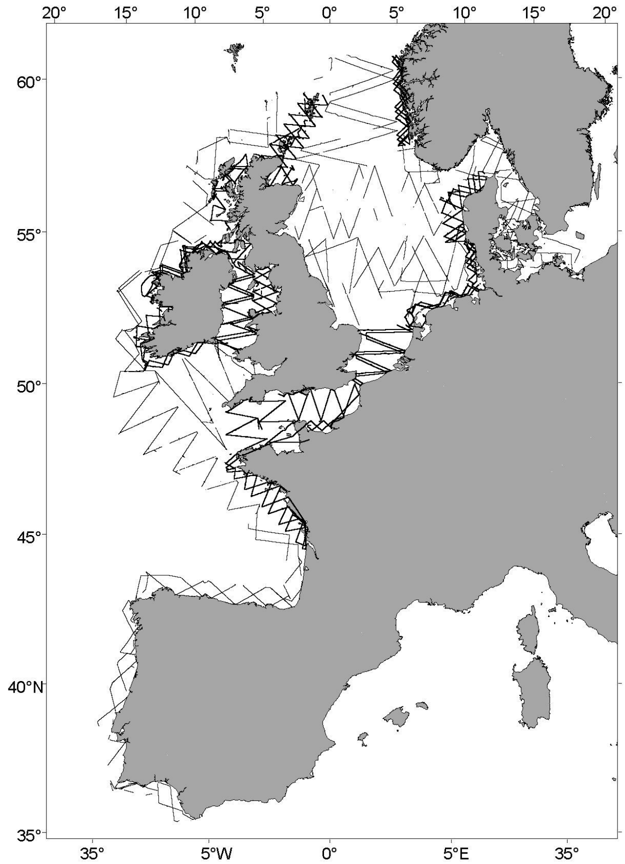


**Figure 2: Map of transects surveyed on effort during July 2005. Black = aerial, Dark grey = shipboard**

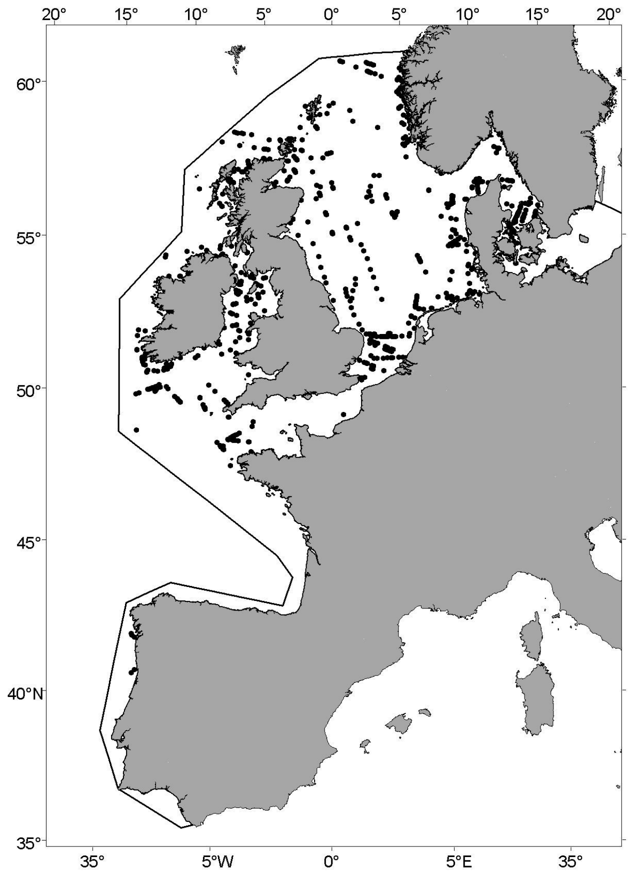


**Figure 3: Harbour porpoise sightings recorded by the shipboard and aircraft observers. The black outline delineates the edge of the survey area.**

## 3 Preliminary abundance estimates

Shipboard data for the harbour porpoise and minke whale were analysed using Mark Recapture Distance Sampling. Estimates were corrected for violations of two basic assumptions of distance sampling, that all animals are detected on the transect line and that animals are detected at their initial location before any response to the observer (Buckland *et al.*, 2001). The analysis of the harbour porpoise aerial survey data also accounts for animals missed on the transect line. Aerial survey data for all other species were analysed using conventional distance sampling methods but incorporated availability bias correction factors.

### 3.1 Harbour porpoise abundance

The total abundance of harbour porpoises in the SCANS-II area was estimated to be 344,400 (CV = 0.14). The density estimates by stratum (Table 2) from the shipboard and aerial surveys show that porpoise density was highest in the southern North Sea and coastal waters of northwest Denmark. The preliminary results suggest regional differences in density within the SCANS area between 1994 and 2005 (Figure 4). Density was generally lower in the northern strata and higher in the southern strata in 2005.

**Table 1: Estimated abundance and density (animals per square kilometre) of harbour porpoises by survey stratum. All estimates and coefficients of variation (CV) are preliminary.**

| Stratum | Location | Abundance | Density | CV |
|---|---|---|---|---|
| **Shipboard Estimates** | | | | |
| U | Southern North Sea | 80,000 | 0.51 | 0.34 |
| S | Skagerrak/Kattegat | 21,400 | 0.31 | 0.42 |
| P | Celtic shelf | 58,400 | 0.30 | 0.43 |
| V | Central North Sea | 38,900 | 0.24 | 0.30 |
| T | Northern North Sea | 25,300 | 0.18 | 0.46 |
| Q | Western UK & Irish shelf | 7,800 | 0.05 | 1.12 |
| W | Iberian shelf | 2,900 | 0.02 | 0.65 |
| **Aerial Estimates** | | | | |
| B | Channel | 40,900 | 0.33 | 0.38 |
| H | Netherlands coast | 3,900 | 0.35 | 0.45 |
| J | Scottish Northern Isles | 10,300 | 0.27 | 0.36 |
| L | NW Denmark | 11,600 | 0.56 | 0.43 |
| M | Coastal Norway | 3,900 | 0.31 | 0.38 |
| N | West Coastal Scotland | 12,100 | 0.39 | 0.43 |
| O | Irish Sea | 15,200 | 0.34 | 0.35 |
| R | Coastal Ireland | 10,700 | 0.28 | 0.37 |
| Y | North Sea coast Germany/Denmark | 1,500 | 0.13 | 0.47 |
| Z | Coastal NW France | 0 | 0.00 | 0.00 |

In 1994, harbour porpoise abundance in the SCANS area was 341,000 (CV = 0.14) whilst in 2005 the abundance in a comparable area was 296,000 (CV = 0.15). The difference between these two estimates was not statistically significant ($z = 1.69$; critical z at $p=0.05$ is 1.96).

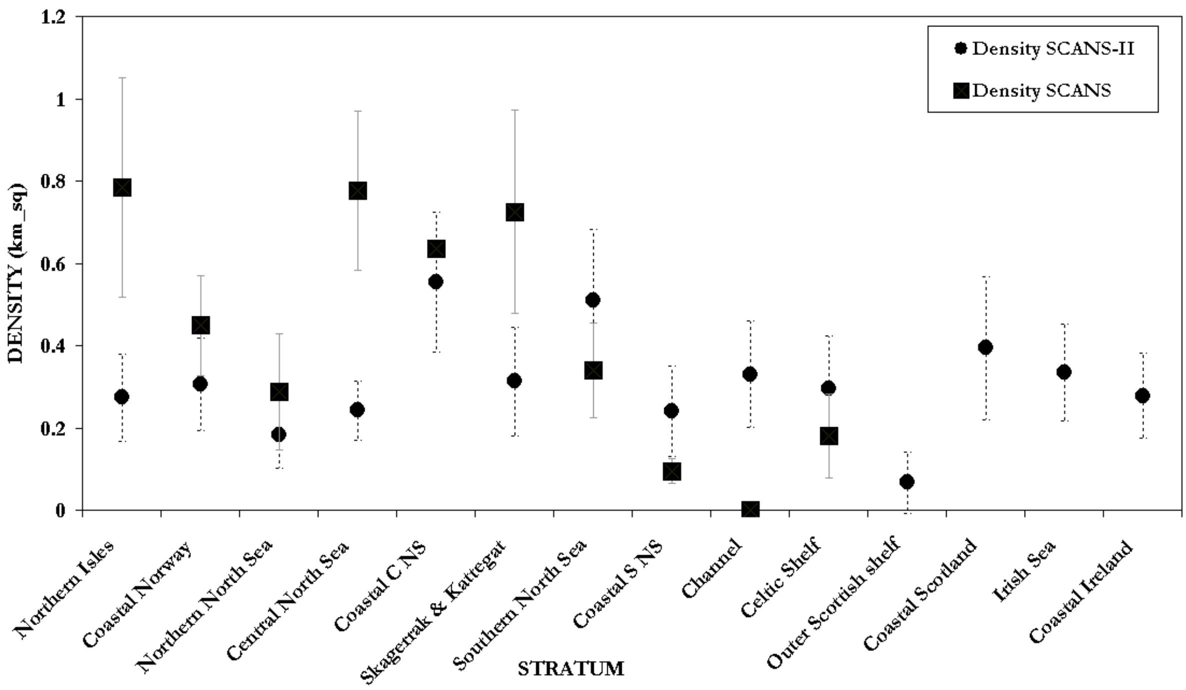


**Figure 4: Density estimates by stratum from SCANS (1994) and SCANS-II (2005) surveys. Error bars are ± 1 SE.**

### 3.2 Minke whale abundance

Minke whale abundance in the entire survey region was estimated to be 16 600 (CV = 0.43). Minke whales were not encountered in all survey strata (Table 3). The highest densities occurred in the coastal waters of Ireland.

**Table 2: Estimated abundance and density (animals per square kilometre) of minke whales by survey stratum. All estimates and coefficients of variation (CV) are preliminary.**

| Stratum | Location | Abundance | Density | CV |
|---|---|---|---|---|
| **Shipboard Estimates** | | | | |
| V | Central North Sea | 4,400 | 0.028 | 0.7 |
| Q | Western UK & Ireland | 1,900 | 0.009 | 0.7 |
| U | Southern North Sea | 3,500 | 0.026 | 1.9 |
| T | Northern North Sea | 1,700 | 0.012 | 0.45 |
| P | Celtic shelf | 1,700 | 0.012 | 0.33 |
| **Aerial Estimates** | | | | |
| B | Channel | 1,200 | 0.010 | 0.96 |
| J | Scottish Northern Isles | 800 | 0.022 | 1.02 |
| O | Irish Sea | 1,100 | 0.024 | 0.89 |
| R | Coastal Ireland | 2,200 | 0.058 | 0.84 |

### 3.3 Estimates of abundance of other species from aerial surveys

Estimates of abundance of other species (common dolphin, bottlenose dolphin, striped dolphin and white-beaked dolphin) from the aerial surveys are given in Table 4. The shipboard estimates for these species are not yet available.

**Table 3. Abundance estimates for dolphins in the whole aerial survey area. Patterned dolphins are either common, striped, white-beaked or white-sided dolphins.**

| Species | Abundance | CV | 95% CI |
|---|---|---|---|
| Bottlenose dolphin | 1,970 | 0.45 | 712 – 5,460 |
| Common dolphin | 32,800 | 0.82 | 8,060 – 133,000 |
| Striped dolphin | 157 | 1.30 | 22 – 1,100 |
| White-beaked dolphin | 10,800 | 0.83 | 2,590 – 44,600 |
| Common or striped dolphin | 313 | 0.67 | 95 – 1,030 |
| Patterned dolphin | 1,860 | 0.62 | 611 – 5,660 |

## 4 Monitoring

The project aims to make recommendations for "best practice" for monitoring small cetacean populations in the future. A sensitivity or power analysis will be used to compare how well the data generated by different monitoring methods tell us about changes in populations over time. The model being developed for determining safe bycatch limits (see below) is structured to allow this analysis to be carried out. It will be used for harbour porpoise data in the first instance.

Data are available from other sources or have been collected during the project using a variety of potential monitoring methods. These include data from towed passive acoustic arrays, visual observers onboard seabirds at sea cruises and platforms of opportunity of various kinds (e.g. ferries and fisheries research surveys), static acoustic devices (PODs) and aerial surveys. The analysis will estimate the variation in encounter rate within an area and between years from data from each monitoring method, and how informative these data are with respect to inferring changes in populations.

To date, we have been investigating the use of acoustic data from the SCANS-II survey and visual survey data from the European Seabirds at Sea database. The latter have been collected on shipboard surveys in European waters over the past 25 years. While the primary focus and study design of these surveys were related to seabirds, observers also recorded sightings of marine mammals. We have been exploring whether the sighting rates of small cetaceans on these surveys might provide useful indices of relative abundance over time.

Further work on the development of acoustic methods for monitoring has also been undertaken. Analysis of data from preliminary bow mount trials on the RV Calanus (2005), using an array with an element spacing of 86cm, showed quite high levels of noise and problems discriminating rapid click train bearings. In the light of this, the bow mount array has been redesigned to reduce spacing between elements to 25cm (improving tracking of rapid click trains) and to reduce noise by providing better vibration isolation and acoustic shielding from engine and propeller noise from astern. The new array design was trialled from the RV Calanus in mid March 2006, in the Inner Hebrides and some of the hoped for improvements were evident. Data from the bow mount array are now being compared with data collected concurrently from towed hydrophone arrays of differing lengths to understand the 'availability' of porpoises for detection at arrays mounted on the bow and towed from the stern of platforms of opportunity.

## 5 Management modelling

The first step in the development of a management model (usually called a management procedure) is the definition of specific, quantitative management objectives, particularly conservation objectives. This is a policy decision that must be made before the appropriateness of bycatch limits can be assessed. For the development of the SCANS-II management procedure for harbour porpoise bycatch, the objective has been taken as that defined by ASCOBANS: to maintain or recover populations to 80% or more of their carrying capacity. The time frame within which the management objectives should be achieved is also an important decision. Before the procedure could be used in practice, there would need to be agreement on the specific management objective(s).

Two candidate management procedures are being explored. The first is the Potential Biological Removals (PBR) approach used by the United States government (Wade, 1998) that calculates appropriate limits to removals from a population (e.g., bycatch) given a current estimate of population size. The second procedure is a Bycatch Limit Algorithm (BLA), which is adapted from the Catch Limit Algorithm of the International Whaling Commission's (IWC) Revised Management Procedure (Cooke, 1999). The BLA procedure calculates appropriate limits to bycatch given time-series of estimates of population size, relative population size and bycatch.

The management procedures are 'tuned' to ensure that the specific management objectives would be achieved in practice. This tuning is done through computer performance simulation testing. At the heart of these simulations is an 'operating model' of a small cetacean population. The operating model is used to simulate a 'known' population over time. Survey data are generated (simulated) from this population with some frequency (e.g. 10 years). These simulated survey data then feed into the management procedure producing a bycatch limit. This bycatch limit is then removed from the known population on an annual basis until the next simulated survey. By running these simulations many, many times we can assess the proportion of runs in which the management objectives are achieved if the bycatch limit is removed each year. The management procedure can then be tuned so that objectives are achieved with some desired probability. These simulations can also be used to assess the relative performance of the two candidate management procedures.

One of the advantages of performance simulation testing is the ability to examine the performance of our management procedure under multiple scenarios regarding uncertainty in our knowledge of small cetacean population dynamics, estimation of bycatch, environmental variability, etc. As per the recommendation of a joint IWC/ASCOBANS working group, our operating model incorporates age structure, density dependence and subpopulation structure, which allows flexibility in the scenarios that can be explored. Data will be used to guide the scenarios that are explored. For example, data have been analysed on the age structure and reproductive rates of stranded and bycaught harbour porpoise collected by collaborators in several European countries. These data provide information about potential growth rates of harbour porpoise populations. With respect to scenarios of subpopulation structure, available information on genetic differentiation and movement of harbour porpoises in the study area is being considered.

Data that will ultimately feed into the management procedure in practice include estimates of absolute abundance, relative abundance and bycatch. Estimates of the absolute abundance of small cetaceans are available from the SCANS and SCANS-II surveys (July 1994 and 2005). Estimates of relative abundance over time could potentially come from several sources including acoustic and visual surveys (see above under Monitoring). Estimates of bycatch for several countries are being derived using information on bycatch rates from observer programmes in combination with data on fishing effort.

The final management procedure will enable us to determine limits to bycatch of small cetaceans that will achieve the stated management objectives, given information on population abundance and bycatch.

## 6 Literature Cited

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