Peter GH Evans, "Suggestions for the Establishment of an ASCOBANS Advisory Committee Working Group on Monitoring"

Submitted by: **Secretariat**

ASCOBANS

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Suggestions for the establishment of an ASCOBANS Advisory Committee Working Group on Monitoring

The first part of this document provides the suggested terms of reference for a working group, the rationale behind such a group and a suggested way of working. The second part provides a more general background and identifies some of the issues that the working group will need to address.

1. TERMS OF REFERENCE

In order to assist ASCOBANS meet its management and conservation objectives, the Working Group shall:

(1) develop practical, affordable, and cost-effective protocols for determining and monitoring the temporal and geographical distribution and abundance of cetaceans in the ASCOBANS region and adjacent waters;
(2) give initial priority to species and populations for which there is most conservation concern, for example the harbour porpoise;
(3) develop a timetabled work plan and make recommendations for action.

Throughout, it is important that any recommendations made are seen in the context of taking effective conservation action within an appropriate time frame.

2. RATIONALE

Information on spatial and temporal variation in cetacean abundance is essential to enable ASCOBANS to (1) determine whether management actions are necessary and (2) to monitor the efficacy of any management actions taken. Such information must, of course, be interpreted in the light of other scientific studies (e.g. stock identity, information on by-catches and other direct and indirect anthropogenic effects). It is required information for population modelling of the sort envisioned by the joint IWC ASCOBANS working group on harbour porpoise. Some examples of how such information is of value in helping ASCOBANS to meet its management objectives are given below:

(1) Information on *trends in abundance* is valuable for both identifying populations for which there is concern and for monitoring whether management actions taken are working.
(2) Information on *absolute abundance,* in conjunction with information on stock identity, direct and indirect removals, and productivity can identify populations for which management action is required.
(3) Information on *geographical and temporal distribution* provides information to determine if there are predictable areas and times of concentration which may be used to focus conservation measures in relation to human activity (e.g. bycatch reduction measures; disturbance by shipping, tourism etc.). It may also highlight times and areas of special significance to various stages in the life-cycle such as calving.

Such information is relevant not only to ASCOBANS as an organisation but also to individual country's obligations and interests within the EU Habitats and Species Directive, and Biodiversity Action Plans. It may also help to inform monitoring programmes within the related Agreement for the Black and Mediterranean Seas - ACCOBAMS.

3. SUGGESTED MEMBERSHIP AND MODUS OPERANDI

For such a specialist Working Group to be effective, it will need to have a membership drawn from a wider community than that which normally attends the ASCOBANS Advisory Committee. Although some progress can be made by e-mail, it will need to meet occasionally, as have other working groups established to support the Advisory Committee. This will have budgetary implications for ASCOBANS. The table below provides a suggested membership for this working group, and is not intended to be exclusive.

Per Berggren	Stockholm University, Sweden
Arne Bjørge	Norsk Institutt for Naturforskning, Norway
Steve Buckland/David Borchers/Samantha Strindberg/Sharon Hedley	University of St Andrews, UK
Mark Bravington	CEFAS, Lowestoft, UK
Kees Camphuysen	NIOZ, The Netherlands
Russell Charif/Chris Clark	Cornell University, USA
Greg Donovan	International Whaling Commission
Jan Durinck/Henrik Skøv	Ornis Consult, Denmark
Peter Evans/Barry Shepherd	Sea Watch Foundation, UK
Doug GillespieRussell Leaper	International Fund for Animal Welfare
Phil Hammond/Simon Northridge/Jonathan Gordon	Sea Mammal Research Unit, UK
Lex Hiby	Conservation Research Ltd, UK
Mardik Leopold	Alterra, The Netherlands
Nils Øien	Institute of Marine Research, Norway
Jim Reid/Mark Tasker	Joint Nature Conservation Committee, UK
Emer Rogan	University College Cork, Ireland
Rene Swift/Paul Thompson	University of Aberdeen, UK
Andy Williams/Tom Brereton	Biscay Dolphin Research Programme, UK

4. INFORMATION NEEDS To determine spatial patterns of distribution and identify areas where cetaceans are concentrated, it is necessary to have some quantitative measure of abundance. This can be expressed either in terms of density (numbers per square kilometre or at some other spatial scale) or some other index of abundance (numbers per unit effort of observation either in terms of time watched or distance travelled by the survey platform). The application of a grid at an appropriate spatial scale enables one to compare densities/or abundance indices between regions.

Trend analyses can also use measures of either relative abundance or absolute abundance, but different management objectives will have different information requirements. If birth and/or death rates are affected by a particular human activity, and this effect can be measured directly, then it becomes possible to determine whether the affected population can sustain the net removal of a particular number of individuals. For some human activities like pollution, sound disturbance, and habitat destruction, direct measures of effects on survival and fecundity are rarely possible, and trends in relative abundance linked to a specific activity may be sufficient measures. With those activities that involve direct removal of animals, e.g. hunting and fisheries by-catch, direct measures can often be made, so that estimates of absolute abundance become specially valuable.

5. APPROACHES CURRENTLY USED Four approaches are generally adopted towards the collection of information on cetacean distribution and status. These are detailed below in ascending order from lowest costs but yielding least information to highest costs but yielding most information. In addition, a fifth approach, that of photo-ID, has been used in certain situations to estimate population size and to measure various life history parameters (such as birth and death rates) that give an indication of population status. Various types of platform can be used within each approach: they can be fixed observation points like headlands, islands or oil rigs; or mobile, including aircraft and a wide variety of types of vessels. Surveys can be very basic or of increasing sophistication capable of yielding indices of abundance or absolute abundance measures. Two main detection methods will be considered: visual and acoustic.

5.1 Incidental Sightings for Preliminary Information on Status & Distribution

For regions about which little is known, the collection of incidental sightings information tends to be the first step to developing a species list and some rough measure of status and seasonal variation in abundance. It provides no quantitative measure for assessing population change and is often difficult to interpret without information on effort and sightability, but it yields basic data at low cost, and can be useful in drawing attention to geographical areas or seasons for cost-effective targeting using more refined survey methodology. It may also reveal gross distributional changes over time. For rare species it may be the primary source of information.

Several European countries have either regional or national schemes for reporting sightings. Data come from a wide variety of platforms which may be coastal land-based observation points like headlands, vessels of many different types, or light aircraft/helicopters. There tends to be greater heterogeneity of observers since the general public are also targeted as well as specialists. This means that for data to be of any value, special emphasis has to be placed on ensuring that they are of high quality and species ID is correct. Once started, and operating satisfactorily, it is important that these schemes continue in the long-term otherwise the data collected has limited value.

5.2 Surveys using Platforms of Opportunity to Estimate Relative Abundance

Many groups in Europe conducting surveys of cetaceans use platforms of opportunity – ferries, oceanographic or fisheries research vessels, oil exploration guard vessels, whale-watching boats, etc. They do so primarily to minimise costs. Some specialist vessels that may also carry additional specialised equipment for oceanographic/hydrographic monitoring can be particularly valuable platforms for surveys to understand factors affecting distribution and abundance. Indices of abundance are obtained either in terms of time spent in observation or distance travelled, and in some cases, analyses are conducted which also take into account viewing conditions such as sea state. They are a cost-effective means of providing wide coverage over protracted periods, but limitations are that there is rarely any control over the routes taken, the speed of the vessel (or variation in speed), and for that reason it is generally more difficult to establish a statistically robust sampling procedure. Aircraft may also be considered as survey platforms although as platforms of opportunity, their scope may be limited given that many will be travelling too high or too fast.

Although surveys and monitoring have traditionally employed only visual observations, there are many advantages to using acoustic devices to detect vocalising animals: for most species they are usually more efficient at detecting cetaceans; they are relatively independent of viewing conditions and they are generally less affected by weather conditions; and surveys can continue throughout 24 hours; if automated detection is employed (or recrodigns made and analysed by several operators), the data collected are more homogeneous being less susceptible to variability in skills/experience between operators. There are some disadvantages, however: first, they rely upon animals vocalising, and if those are silent during particular activities or at certain seasons, they will not be detected. Thus, for example, in the North Atlantic, large baleen whales are detected vocally mainly during mating & calving seasons (September – March). Second, the relationship between vocalisation rates and absolute abundance remains unclear in most cases, although work is underway to try to achieve at least some form of semi-quantitative assessment. Finally, the vocalisations of some dolphin species can be difficult to distinguish from one another, although better discrimination techniques are being trialled by various groups. Other disadvantages in some situations include the costs of equipment and its deployment, equipment maintenance requirements, and the need to minimise and/or distinguish other sounds present in the marine environment (not least being engine noise from the survey vessel).

As with visual monitoring, acoustic recording may take place over an area using towed hydrophones, or be deployed at a single location. The latter may be preferential if information on usage of a particular area is required on a continuous basis, and autonomous units can be deployed to record both vocal activity and related environmental parameters like sea temperature and salinity. The recent use of PODs and PopUps in this context has shown strong potential.

5.3 Surveys using Dedicated Platforms to Estimate Relative Abundance

If a platform can be dedicated to surveying for cetaceans, it becomes possible to select a sampling procedure which can ensure that sampling is both representative and unbiased, although there may still be other constraints, both economic and logistic. The same measures can be used as in 5.2 to derive relative abundance indices – i.e. numbers per unit effort expressed either in terms of hours of observation or distance travelled. Actual density estimates may also be derived if the distance and angle to the sighting is measured so that perpendicular distance to the track-line can be calculated. Difficulties may exist in obtaining accurate angle and distance measurements, and in the more social odontocetes, it is often difficult to accurately estimate school size. Density estimates can also be obtained from surveys with platforms of opportunity, but the inability to have any control over the survey vessel may impose limitations. Detectability curves will vary with sea state and other viewing conditions, and the extent to which these can be derived and appropriate corrections made, will depend largely upon the sample size of the dataset upon which one is working. It may therefore not be possible to apply to rare species.

The method has obvious advantages over use of platforms of opportunity, but it requires much larger resources, and this in turn may pose limitations on the spatial and temporal extent of the surveys that is possible. Vessels and aircraft can be used as dedicated platforms. In some situations, the latter may be more cost effective although they will be unable to collect associated oceanographic data. Both visual and acoustic methods of detection can be used, and these can be either mobile or at fixed locations.

5.4 Line Transect Surveys to Estimate Absolute Abundance

Line transect methods using distanced methodology are widely used when one is trying to determine absolute abundance of a population within a prescribed area (other methods like cue counting, and point sampling have been used but tend to be limited to particular species and situations). The usual procedure is to use the survey platform (which may be a vessel or an aircraft) to search along predetermined transect lines, placed so that the whole area under study is representatively sampled. Density estimates are derived from detectability curves which allow the effective width of the strip searched to be calculated, as described in 5.3. If an area has been sampled in an unbiased and representative manner, it is then possible to extrapolate from the sample to the total area to arrive at an estimate of the population. It is important to note that the estimate applies to the number of animals in a given area during the study period. It is not possible to extrapolate to other areas or to other times of year. This is specially relevant to cetaceans which are mobile species with often wide geographical ranges.

The design of representative and efficient surveys is one of the practical difficulties encountered with meeting the various assumptions of line transect sampling. This applies particularly to nearshore areas with dissected coastlines or around island archipelagoes, although this can be catered for if surveying by aircraft is undertaken.

Most importantly, however, the line transect method assumes that all individuals along the trackline will be detected. This assumption is likely to be violated for various reasons: animals spend a high proportion of their lives out of sight underwater and they may also respond to the survey platform before being detected. In order to obtain an unbiased estimate of abundance, it is necessary to estimate the probability of detection on the transect line and include this in the abundance estimation. The best way to do this is to use duplicate sightings collected from independent platforms on the same survey vessel, and to employ methods that take into account the possibility of animals responding to that vessel before detection, either by being attracted or repelled (cf. Buckland-Turnock method; and see Palka & Hammond, in press). In order to provide facilities for independent viewing platforms (and for some other logistic reasons), relatively large vessels are usually used. This inevitably imposes a substantive cost, and a properly organised abundance survey using several vessels can cost in excess of a million pounds sterling (viz. The SCANS survey of the North Sea and Baltic).

Line transect surveys can be conducted either by vessels or by aircraft. Where detection rates are influenced particularly by weather conditions, an aircraft that potentially has a much wider survey coverage, may be more cost effective at making use of windows of opportunity with optimum weather, although in those cases there may be other logistical constraints such as access to an airstrip and plane availability at short notice. By using an aircraft, one can overcome the problem of responsive movement experienced when surveying by vessel, although missing animals on the track-line becomes harder to account for.

At present, visual observations are used as the primary method of detection since it has not yet proved possible to calibrate acoustic detections in terms of absolute abundance values.

5.5 Mark-Recapture and Photo-Identification

For some cetacean species where individuals can be recognised by unique markings, or nicks on their dorsal fins or tail flukes, the population size can be estimated using mark-recapture techniques (in this case by comparison of photographs, but DNA analyses of skin samples from individuals have also been used). Mark-recapture has been applied successfully, for example, to northern right whales and humpbacks in the western North Atlantic. As with line transect methods, there are many assumptions that may be difficult not to violate. For example, each animal must have the same probability of being captured on film within any one sampling occasion, but some animals may never be available to be sampled whilst others may be disproportionately so. To minimise this problem, one must design a sampling procedure that gives every animal a chance of being captured, and then to capture as many animals as possible. This is more easily achieved if the distribution of the whole population is concentrated in a limited area for a limited period of time during the year. Unfortunately, rarely is that the case. Although closed population models can be used in analysing mark-recapture data from cetaceans, it is important to remember that the abundance estimate applies to a particular study area and should not be extrapolated over a wider area. Understanding the ranges of individuals within the study population may therefore be specially pertinent.

In Europe, mark-recapture analyses using photo-ID data have been used to derive estimates of coastal populations of bottlenose dolphins, and trends in abundance (e.g. in the Moray Firth population, NE Scotland) have been detected using appropriate models, such as Bayesian trend analysis.

6. Conclusions & Topics for Further Discussion

It would be both impractical and unwise to suggest that one methodological approach be used over all others. Each has its advantages and disadvantages, and the approaches may frequently complement one another in providing a more complete picture of the status and distribution of a particular cetacean species. The function of this working group should probably be to conduct a cost-benefit analysis on the various methods available within each approach, determine precisely what information can be gained and what limitations exist, and then prioritise where resources should be concentrated both between and within the various approaches listed above. The type of platform, level of sophistication of survey, and detection method should be examined in each case, and the most appropriate ones identified. As part of the cost-benefit analysis, it is very important to consider whether the benefits of the research method deemed most appropriate outweigh the costs in terms of improving the conservation status of that species. There may be occasions when it is better to channel a limited budget primarily into mitigation measures (e.g. Baltic harbour porpoises – see Annex).

6.1 Line Transect Surveys Large-scale SCANS-type line transect surveys are designed to estimate absolute abundance over a wide area and are therefore too expensive to be conducted more frequently than, say, every 5-10 years. At this frequency they are not able to give information on short-term changes in population size, and neither do they provide information on fine scale distribution. Other data sets are needed for this (see below). It is most appropriate to conduct a SCANS-type survey in summer when the weather is better but a survey in the month of January (or perhaps even June or August) may show a very different species distribution to that in July. This might not be important if the entire range of the population was being surveyed, but that will rarely be feasible. An example of the conservation management implications can be illustrated with the common dolphin. If this species undergoes seasonal movements onto the European continental shelf, then a July population estimate for that region may be very different from one at another time of year. If the species experiences a significant fisheries by-catch during a different season to that from which the population estimate was derived, it may be difficult to determine what proportion of the population is being removed by fisheries activities.

Line transect surveys could probably be conducted much more cheaply using smaller vessels, but then one must consider whether the larger amounts of data that might then be available would be more than compromised by any logistical restrictions on data collection. In some cases, the use of aircraft may be more cost effective. Those situations need to be considered on a species by species basis as well as both regionally and seasonally.

Given that fisheries by-catch is one of the most important management issues facing at least some cetacean species (e.g. harbour porpoise) in the ASCOBANS region, a large-scale SCANS-type line transect survey of the region is clearly a priority. However, for proper interpretation, it would be beneficial to have other population information first: the structure and geographical limits of the population, seasonal changes in distribution, and if possible some understanding of fine scale distribution.

6.2 Other Methods for Survey & Monitoring For many conservation management applications, it may not be necessary to have absolute abundance estimates. After all, for most other animal taxa, relative abundance indices are mainly used to measure population trends. Using generalised additive models, some promising results have been obtained recently by CEFAS (Mark Bravington) and University of St Andrews (Sharon Hedley) using data collected by JNCC and IWC respectively. Those have been post-hoc analyses conducted on fairly heterogeneous data, and in the former case primarily using platforms of opportunity. With refined monitoring protocols in place, the potential for using such data for trend analysis may be further increased. They may serve not only to detect population trends but also to compare distributions on a probabilistic basis. Finally, there may also be scope to calibrate relative abundance estimates with absolute abundance estimates.

6.3 Specific Topics to Address In reaching recommendations on the type(s) of approach for survey & monitoring, it may be helpful to consider this on a species by species basis, and in some cases, even a population by population basis. As a starting point for discussion, some brief thoughts are presented as an Annex (they are applied to all cetacean species, although it is understood that for the purposes of ASCOBANS, emphasis will be upon toothed whales, dolphins & porpoises).

6.4 Development of New Techniques for Detection and Analysis In a number of situations, acoustic detection may be the more cost-effective means for monitoring population trends in abundance and distribution. This needs to be considered more closely on a species by species basis bearing in mind the feasibility of regular detection, and species discrimination, as well as the costs of different types of equipment and their deployment. In some cases, direct calibration with sightings data may also be possible. Acoustic monitoring needs to be considered in greater depth for ways in which it might be developed alongside the more traditional survey methods.

Spatial analytical models (such as GAMS) also need further consideration with respect to detecting population trends and spatio-temporal distribution patterns. In the latter context, it would be helpful if we could be more predictive of the biotic and hydrographic factors primarily influencing cetacean distribution. This could inform our survey design protocols, and might allow more refined extrapolation from sample surveys.

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ANNEX

1. Harbour porpoises on the NW European Shelf This species is widely distributed throughout the NW European Continental Shelf, though rare in the Channel and southernmost North Sea. It also occurs to a small extent in the pelagic zone. The SCANS survey omitted most of the Irish Sea, west of Scotland, and Irish waters where porpoises are common. Fisheries bycatch is recognised as a major conservation problem for which estimates of absolute abundance are necessary, and therefore line transect surveys by vessel and/or aircraft would seem most appropriate. However, consideration should be given to the extent of the coverage, and whether detectable trends can be obtained in a cost effective manner. Information on spatio-temporal variation in relative abundance would additionally be valuable for regional management issues.

2. Harbour porpoises in the Baltic The overall harbour porpoise population in the Baltic proper is small and improperly known. An accurate absolute abundance estimate may be unrealistic to aim at, and instead it may be more cost effective to use alternative methods to identify hot spots and subsequently target them with the appropriate mitigation measures.

3. Bottlenose dolphins in coastal NW European waters Bottlenose dolphins inhabit for varying lengths of time a number of large bays, estuaries and coastlines in various parts of NW Europe. Traditionally, population estimates of bottlenose dolphins in the nearshore zone, that show some degree of residency, have been obtained using mark-recapture and photo-ID techniques. However, for detecting trends, it would be useful to determine on a population by population basis, whether this is the most appropriate or cost-effective method. It may also be worth considering alternative methods, including some stratified sampling using line transect techniques, and surveys using relative abundance measures.

4. White-beaked, White-sided, Common and Striped dolphins on the NW European Shelf Other dolphin species are more widely dispersed over the NW European continental shelf. The white-beaked dolphin is distributed primarily over the Northern European shelf and confined to the North Atlantic; the other three species (white-sided, common and striped dolphins) have more pelagic distributions but do come onto the shelf, in some cases on a seasonal basis. Absolute abundance may be estimated by line transects, but for monitoring trends and other spatio-temporal analyses, relative abundance measures may be sufficient.

5. **Bottlenose, White-sided, White-beaked, Common and Striped dolphins in the pelagic zone of the eastern North Atlantic** All five of the commoner species of dolphin in Europe occur in the pelagic zone. White-sided, common and striped dolphins have predominantly deep-water distributions although different species may favour different depths (or slopes vs troughs). White-beaked dolphins enter the pelagic zone on a more casual basis, but bottlenose dolphins may show a distinct offshore ecotype that may mix rather little with coastal animals. The problem with this zone is that for practical survey purposes, it has no distinct boundary, and line transect surveys become prohibitively expensive if extended to the limits. Furthermore, the often large group sizes and inclination to respond to vessels

sometimes beyond visual/acoustic detection make absolute abundance estimates of these species difficult to obtain. Since in these areas, one of the major conservation threats is fisheries bycatch, it may be more cost effective to target specific localities where a problem is known to exist, and conduct surveys of this nature at the appropriate seasons. However, temporary and annual fluctuations in abundance at particular localities may mitigate against the derivation of useful estimates. As with other species and situations, relative abundance measures may be sufficient for monitoring trends and other spatio-temporal variations.

6. Common large odontocetes (e.g. Long-finned pilot whales) in the pelagic zone of the eastern North Atlantic Large odontocetes which are both common and widely dispersed in the pelagic zone present similar problems to the pelagic dolphins reviewed in section 5. A good example is the long-finned pilot whale, which is abundant in the eastern North Atlantic (and also not infrequently comes onto the continental shelf), often very clumped in its distribution and exhibiting large group sizes. Absolute abundance estimates were attempted during the North Atlantic Sightings Surveys organised by the International Whaling Commission, but some of the same difficulties indicated above were encountered. Photo-ID, although used on local resident populations of pilot whales, is unlikely to be practical here, and other methods may need to be considered for monitoring trends, etc.

7. Uncommon large odontocetes (e.g. Sperm whale, Killer whale) in the pelagic zone of the eastern North Atlantic Photo-ID has been widely used on sperm whales and killer whales since both can exhibit unique individual markings (nicks in tail flukes in sperm whales for example, and fins and pigmentation patterns in the case of killer whales). However, in offshore waters of northern Europe, sea conditions can be a limiting factor. Acoustic detection methods have also proved successful with these species, although only rarely have they been used to derive absolute abundance estimates. Survey methods using indices of relative abundance may be best for measuring trends and other spatio-temporal variation.

8. Rare large odontocetes (e.g. Northern bottlenose whale, *Mesoplodon* beaked whales) in the pelagic zone of the eastern North Atlantic Some large odontocetes are only rarely seen or detected acoustically. Amongst these are the beaked whales: northern bottlenose whale, Cuvier;'s beaked whale, and various members of the genus *Mesoplodon* (note that the Sowerby's beaked whale may be of particular interest since it is confined to the North Atlantic, and specially the eastern sector). Line transect surveys are therefore unlikely to be either cost-effective or appropriate unless local concentrations can be found.

Some progress has been made in recent years with photo-ID, mainly with the northern bottlenose whale (leading to preliminary local population estimates by mark-recapture for animals inhabiting the Gully, east of Newfoundland, Canada). However, it is likely to prove very difficult for most beaked whales given the indistinct differences between individuals and low frequency of sightings of these often deep-diving species.

9. Mysticetes (e.g. Fin, Sei, Blue, Humpback & Right whales) in the pelagic zone of the eastern North Atlantic For the commoner baleen whales like fin and sei whale, absolute abundance estimates have usually been derived from line transect surveys (or using cue counting of blows) either by vessel or aircraft. However, coastal populations of some species (e.g. blue, humpback and right whales) have been counted using photo-ID of fin markings or fluke patterns and mark-recapture techniques. Trend analysis has rarely been possible except in certain local situations.

10. Mysticetes (e.g. Minke whale) on the NW European Shelf Minke whales in NW Europe inhabit specially the continental shelf although animals also range into deeper waters. Line transect techniques by vessel or aircraft have been used to estimate absolute abundance, whilst photo-ID and mark-recapture analysis have been used for some localised coastal populations although population estimates have rarely if ever actually been derived from these. As with several other species, relative abundance measures may be the most appropriate way to monitor trends and other spatio-temporal variations.