Agenda Item 6.2.1 | Further Implementation of the Agreement

Conservation Issues

Monitoring and Mitigation of Small Cetacean Bycatch

Information Document 6.2.1.b

Development of a Rationale for Monitoring Protected Species Bycatch

Action Requested

- Take note

Submitted by: United Kingdom

NOTE:
DELEGATES ARE KINDLY REMINDED
TO BRING THEIR OWN COPIES OF DOCUMENTS TO THE MEETING

Development of a rationale for monitoring protected species bycatch

Simon Northridge, University of St Andrews. July 2016

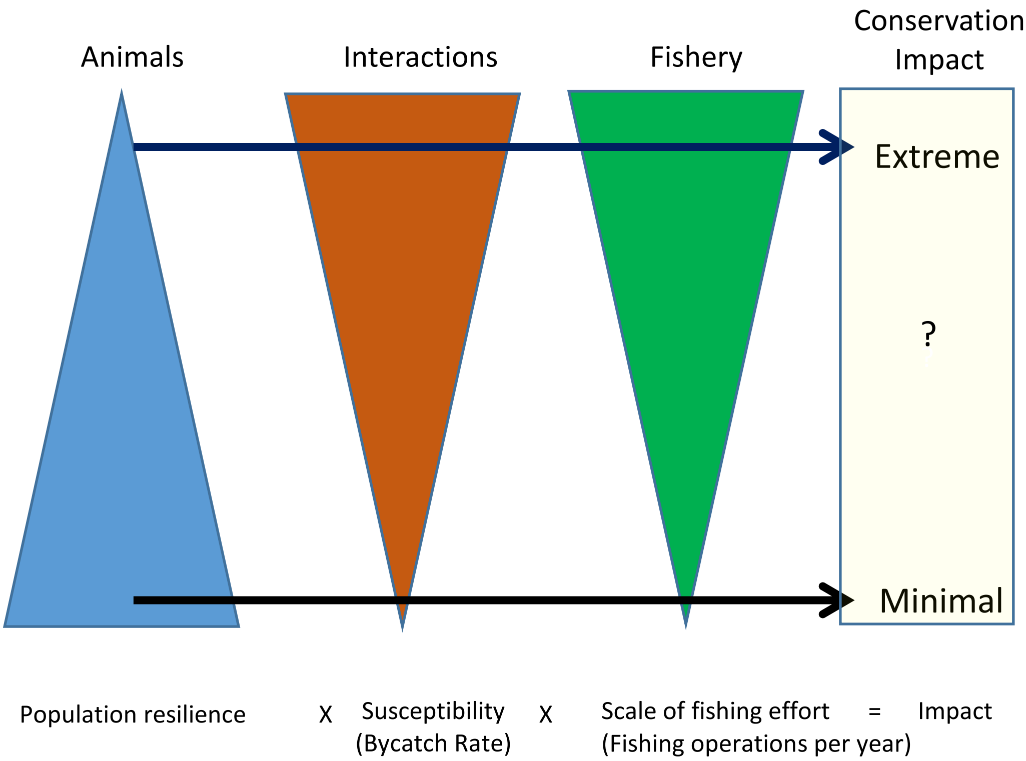
1. Context: ecological risk assessment

1.1. Attempts to move fisheries management towards 'ecosystem based fisheries management' in recent decades have led to much focus on 'risk based approaches' (Hobday et al. 2011). The specific risks being evaluated in such studies vary, and may include the perceived risk posed by specific fisheries to a particular species, or the risk that some management goal may be missed under one or more management scenarios.

1.2. In the context of protected species management, risk may be seen in terms of risk to population survival, risk to achievement of a less extreme management goal than survival, or risk that some aspect of the management framework has been misunderstood or poorly quantified with consequent impacts on conservation goals.

1.3. When fisheries bycatch of protected species is being considered, the risk assessment framework can be caricatured as consisting of three elements that can be combined in a way that is analogous to traditional risk matrix to determine the likely conservation impact. This is shown in Figure 1 below. To assess the conservation threat posed by fishery bycatch to a particular species we would need to know the resilience of the population to bycatch, the susceptibility of that population to bycatch in particular fisheries and the scale of the fisheries concerned. A species with low resilience and high susceptibility to bycatch in a large fishery is at risk of extreme conservation impact, and conversely a species with high resilience and low levels of interaction in a small fishery is not at risk.

Figure 1 - A conceptual schema for assessing bycatch risk to conservation aims



1.4. Figure 1 conceals a number of complexities. Population resilience is usually taken to be a function of animal population abundance and the ability of the population to grow or recover – or to sustain certain levels of removal. Management practice usually involves determining a bycatch limit for a given population and then determining whether bycatch currently exceeds that limit, and if so taking appropriate management action. Bycatch limits for protected species have been discussed in great detail (Wade 1998; Curtis et al. 2015), and usually assess the risk that management objectives may not be met by explicitly accounting for uncertainty in parameter estimates (such as abundance).

1.5. Uncertainty in the other elements of the bycatch risk schema has been less well addressed. Determining whether or not bycatch totals exceed a bycatch limit requires knowledge of susceptibility to bycatch, most usefully expressed in terms of a bycatch rate, and the size or intensity of the fishery concerned. The size of a fishery is usually taken to be known, because this can often be inferred from fishery data collected for fish stock management and financial accounting purposes. It is usually assumed (rightly or wrongly) that fishing effort can be assessed with precision and accuracy, without uncertainty.

1.6. Susceptibility is often the least available and most difficult to determine element of the risk assessment. Sometimes it is guessed or assumed by 'expert solicitation' and categorised as "low" to "high" (e.g. Brown et al. 2015). Often a lack of information is assumed, and then taken to justify either a broad scale categorical approach to risk assessment, or to avoid any risk assessment.

2. Addressing susceptibility

2.1. In reality there is much more information on susceptibility than is often assumed. On-board fishery observations have been conducted for many years throughout the EU, and further afield. Where observers have been instructed to record protected species bycatch, bycatch rates can be estimated and used in broader risk assessments such as depicted in Figure 1. *A crucial aspect of such on-board observations needs to be borne in mind. Zero counts do not imply zero information. As long as it is known for sure that a certain number of fishing operations have been observed and that no bycatch of a particular species occurred, then a likely maximum bycatch rate can be calculated under some general assumptions* (Northridge & Thomas 2003). *It follows from this that the greater the number of observations available, regardless of whether or not bycatch of a particular species was observed, the less the uncertainty or the greater the precision of the ensuing bycatch rate estimate.*

2.2. Reducing uncertainty in the susceptibility component is therefore a key task in any bycatch risk assessment. This means that existing information needs to be collated in order to produce best estimates of bycatch rates but also, given that bycatch of any marine species might occur in any type of fishing gear, that targeting on-board observations to particular fisheries is an effective way to optimise scarce financial resources to minimise uncertainty in the overall bycatch estimate.

3. Using monitoring programmes to optimise bycatch estimation

3.1. Systematic and regular on board sampling of fishing vessels has been conducted in Scotland since the 1970s and in Northern Ireland, and England and Wales since the mid-1990s. Largely, such programmes have been devoted to investigating commercial fish discard rates and biological parameters of fish. Since at least 2005, all such schemes have also agreed to record bycatch of any protected species (birds, mammals and turtles). Additionally a UK-wide observer programme was established in 1996 to estimate bycatch rates of cetaceans, but since 2005 this scheme has addressed all protected species. In combination, these four monitoring programmes have made observations of tens of thousands of fishing operations covering most of the important metiers or fishery types prosecuted by UK fishing vessels, but by no means in proportion to the size of each fishery type, or taking account of bycatch likelihood in any of them.

3.2. *The existence of this large (but as yet disparate) dataset provides us with the opportunity to generate best estimates of the likely maximum (and minimum) bycatch rates for any given species and for all types of fishing that have been monitored, provided we assume that there is a high likelihood that any relevant animal that was caught would also have been seen and recorded in all four schemes.*

3.3. *More importantly, such an analysis also enables us to identify fisheries for which uncertainty regarding bycatch impacts remains greatest, and hence to allocate sampling parsimoniously among and between fishing sectors to minimise uncertainty in any estimates of total annual bycatch.*

3.4. This task is currently being undertaken. Primarily it involves collating and standardising four data sets, in order to generate estimates of the likely maximum bycatch rates of protected species and, using fleet effort data, to estimate likely maximum annual takes for particular species.

3.5. If, as is intended, such an analysis is to be used to optimise on board sampling with respect to protected species bycatch in the future, then it is important also to be able to compare likely maximum rates (based on current data) with some meaningful bycatch reference levels. Put simply, if there is great uncertainty about the bycatch rates of species X in several fisheries, but the current estimates suggest that the likely maximum annual bycatch is well below that which would give concern, there is no need to devote more sampling to improving the precision of that estimate. Conversely, if there is a large amount of uncertainty which implies that species X could indeed be subject to bycatch levels that exceed a reference level of concern, then more monitoring should be warranted. In the latter case, it is important that such monitoring is focused on fisheries where the greatest uncertainty lies in order to improve the precision of the estimate most efficiently.

3.6. A purely fictitious example is given below to illustrate this principle. It is assumed that for a species of concern (Species X), there is a maximum bycatch reference limit of 1000 individuals. This reference limit is divided notionally among four fisheries, pro-rated with respect to the number of days at sea (fishing effort) expended by each fishery (column labelled "Allocated bycatch reference limit"). One fishery (Type B) has been intensively sampled as bycatch is perceived to be high there.

Table 1 - Species X has a bycatch reference limit of 1000 and may be caught in 4 fisheries, which vary in size greatly, and each of which has been subject to varying amount of observation.

Fishery metier	Days at Sea	Days observed	No of animals observed	Upper Confidence Limit on bycatch estimate	Allocated bycatch reference limit	Difference between allocated limit and current estimate
Type A	3800	50	1	103	95	-8
Type B	31000	3000	15	248	775	527
Type C	200	30	0	23	5	-18
Type D	5000	10	0	1540	125	-1415
Summed	*40000*	*3090*	*16*	*1914*	*1000*	*-914*

3.7. From Table 1 it can be seen that current sampling levels suggest total bycatch of Species X may exceed the reference limit overall by 914 animals. But most of this uncertainty comes from Fishery Type D, where only ten observation days have been carried out with no observed bycatch. On the basis of these observations, bycatch in Fishery Type D lies between 0 and 1540 animals per year, assuming bycatch events are binomially distributed. Increased sampling of this one fishery could greatly increase the precision of the likely maximum estimate. If another 20 days observations were made in this one fishery and assuming no bycatches were observed, the upper confidence limit on the bycatch estimate for species X in this scenario would fall to below 580 in Fishery Type D and to less than 1000 overall. A further 30 days in fishery B would do little to change the existing figures.

3.8. This approach will allow us to determine which fisheries require most monitoring in order to minimise the uncertainty about the bycatch estimates for any particular species. A more complex problem will be to optimise sampling when 2 or more species are of concern, and where there are different bycatch reference limits for each species and varying susceptibilities among the fisheries. Such a scenario will help focus attention on species and fisheries of greatest uncertainty in relation to risk.

3.9. The importance of setting reference limits as yardsticks against which to compare current best estimates of the likely maximum bycatch should be clear. Such reference levels could be aligned with conservation targets (such as the 1.7% limit on small cetacean bycatch adopted by ASCOBANS), but they need not be. It would be equally possible to use reference limits unrelated to estimates of sustainability, though this would alter the results. The way in which the overall reference limit is divided or allocated between the fishery types or strata is also important. For expedience in the example above the limit has been allocated in relation to the amount of fishing effort. Other metrics such as landed catch or value of landings could be used to apportion the reference limit.

4. Discussion

4.1. In times of restricted budgets it is important that attempts to implement ecosystem based fisheries management are directed in a rational way to meet different overlapping objectives. Already, within the UK, sampling schemes that were established to monitor discards are being used to address bycatch of protected species, while the sampling scheme established to monitor cetacean bycatch has been adapted to monitor all protected species. Within such schemes, resources need to be allocated in a way that best addresses management needs and uncertainties. The approach outlined here, once developed further, aims to provide a rationale for parsimonious sampling that will address the key uncertainty in bycatch risk assessment, that of susceptibility by fishery.

5. References cited

Brown, S. L., D. Reid, and E. Rogan. 2015. Spatial and temporal assessment of potential risk to cetaceans from static fishing gears. Marine Policy **51**:267–280. Curtis, K. A., J. E. Moore, C. Boyd, P. W. Dillingham, R. L. Lewison, B. L. Taylor, and K. C. James. 2015. Managing catch of marine megafauna: Guidelines for setting limit reference points. Marine Policy **61**:249–263.

Hobday, A. J. et al. 2011. Ecological risk assessment for the effects of fishing. Fisheries Research **108**:372–384. Elsevier B.V..

Northridge, S., and L. Thomas. 2003. Monitoring levels required in European fisheries to assess cetacean bycatch, with particular reference to UK fisheries. Final report to DEFRA (EWD). 37pp. 2003.:37.

Wade, P. R. 1998. Calculating limits to the allowable cetaceans and pinnipeds human-caused mortality of cetaceans and pinnipeds. Marine Mammal Science **14**:1–37.