# Towards a scientific framework for assessing lethal vs non-lethal take of cetaceans

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**ABSTRACT**
Assessing the utility of lethal vs non-lethal techniques for collecting information on cetaceans is a complex exercise, as a full assessment of this issue requires evaluation of a host of normative factors (e.g., value judgements; tolerances of various types of risks; ethical considerations). On the other hand, some aspects of the assessment are largely scientific and can (in theory at least) be conducted in an objective manner. We briefly outline one possible framework (based on cost-effectiveness analysis) for conducting scientific assessments of the relative merits of lethal vs non-lethal sampling of cetaceans. We do not claim that the proposed framework is definitive, nor that it necessarily includes all important technical considerations. Rather, we suggest that it might be useful as a starting point for discussions about how to move forward with technical evaluation of this key feature of scientific whaling.

## INTRODUCTION

In 1982, amidst scientific uncertainties and concerns for the conservation status of cetaceans, the International Whaling Commission imposed a worldwide ban on all commercial whaling, effective in 1985-86. Subsequently, the governments of Japan, Norway, and Iceland initiated programs for 'scientific' whaling, which is justified on the basis of the scientific information produced by lethal take of cetaceans. These programs have been controversial (Clapham et al. 2003; Morishita 2006) and, in an unprecedented move, in 2008 the IWC commissioned an independent science panel to review scientific whaling conducted by Japan in the northwestern Pacific Ocean. It is clear that many had high expectations that the report of the Panel would convincingly settle the controversy around scientific whaling, in particular the justification for lethal take (Normile 2008; Corkeron 2009). The actual charge to the Panel was more limited, however. According to the Panel Report (IWC 2009), the primary task of the Workshop was to 'review the scientific work undertaken thus far against the stated objectives of the programme and to review future plans in the light of the likelihood of meeting objectives, the techniques used (lethal and non-lethal), appropriate sample sizes and the effects of any catches on the relevant stocks.' Thus, although the workshop considered scientific issues related to lethal take, the Panel did not attempt a comprehensive assessment of whether lethal take is 'justified'.

Three major factors constrained the ability of the Panel to fully analyze this issue. First, as detailed in the Panel Report, the information available at the Workshop was not sufficient to rigorously address many key issues regarding lethal sampling. Second, no framework has been developed that would allow a systematic and objective comparison of the relative merits of lethal and non-lethal sampling methods for cetaceans. Finally, a full assessment of this issue cannot be achieved solely through scientific investigation; it is also necessary to consider a host of normative factors (e.g., value judgements; tolerances of various types of risks; ethical considerations).

The Panel Report identifies a number of steps that could be taken to address the first factor; responsibility for the third factor lies in the policy realm, although effective communication between scientists and policy makers will be essential to making progress in this arena. This paper is an initial attempt at addressing the second factor. We briefly outline one possible framework for conducting scientific assessments of the relative merits of lethal vs non-lethal sampling of cetaceans, using the JARPN II program as an example. We do not claim that the proposed framework is definitive, nor that it necessarily includes all important technical considerations. Rather, we suggest that it might be useful as a starting point for discussions about how to move forward with scientific evaluation of lethal vs non-lethal sampling of cetaceans.

## COST-EFFECTIVENESS ANALYSIS

Assessing the relative merits of alternative actions is often conducted by comparing their benefits and costs. A formal benefit-cost analysis (BCA) can be used to assess the 'best' action among a set of possible alternatives, where 'best' is determined by finding that action which maximizes net benefits (Zerbe and Dively 1994). Because BCA assesses the value of an activity by literally subtracting the costs from the benefits, it requires that

both be gauged with a common metric (most commonly dollars). In many cases, a full assessment of benefits is possible but not in a dollar metric, which makes the use of benefit-cost analysis problematic.

In certain circumstances, an alternate framework—cost-effectiveness analysis (CEA)—can be used to compare two or more alternatives and reveal which one is 'best.' Ideally, CEA quantifies both the benefits and costs of each alternative but uses different metrics for each. CEA can provide an unambiguous signal of the 'best' action if all alternatives being considered have the same outcome (measured in terms of the 'effectiveness' metric). The 'best' action is then the action that achieves the outcome at least cost (Mishan and Quah 2007; Zerbe and Dively 1994). Alternatively, if all actions under consideration have the same levels of costs, the one that is the most effective in terms of producing a greater output level is then the 'best' action. A common application of this method is to health care strategies, where the benefits of a strategy are quantified in terms of lives saved, additional years of survival, or some other quantitative, health-related measure (Gold et al. 1996). More recently, CEA has seen increasing application in the analysis of habitat preservation for species conservation (Arponen et al. 2005; Wätzold and Schwerdtner 2005; Wilson et al. 2006; Murdoch et al. 2007).

The general approach we propose uses a cost-effectiveness framework, but one that (almost certainly) falls short of the ideal circumstances described above. The basic idea is to assess the cost and effects of lethal and non-lethal sampling regimes and compare them in a transparent, objective framework. In this framework, the costs are the resources required to conduct the sampling; the effects are outcomes or products of various types, including a) the quantity and 'quality' of the diverse types of information gathered through sampling, b) the biological consequences for the stocks of the two types of sampling, and c) ancillary outcomes (*e.g.*, the supply of valuable whale meat) of a sampling program.

The first step in using a cost-effectiveness framework is creating a 'typical' lethal and non-lethal sampling program with equal costs. Focusing on the resources used to conduct sampling (vessels, fuel, labor, and so forth), the cost of a typical lethal sampling program could be estimated in dollars using data from the actual effort levels taken under JARPN II. This cost level could then be used to create an 'efficient' non-lethal sampling program – that is, one that uses that same amount of resources most effectively. Because encountering whales is an inherently uncertain undertaking, cost could be expressed as an expected amount required to deliver a particular amount of information.

Given these typical sampling programs, the next step is to assess and quantify the effects of each program. These effects would include things like:

- Primary information gathered with the sampling program, including feeding ecology and ecosystems studies (Government of Japan 2002).
- Secondary information gathered, including monitoring environmental pollutants and studies of stock structure.
- Population-level effects of the sampling program, quantified (for example) in terms of population growth rate or probability of persistence, but also additional considerations such as harassment, behaviour modification, and so forth.
- Ancillary effects, including sale and consumption of whale meat obtained through the research program, and the possibility that legally-sanctioned 'scientific' catches might provide a cover for sale of illegal whale products obtained through illegal harvests.

In each case, the two programs (lethal and non-lethal sampling) would be compared in terms of a common set of effects, with the possibility that one program produces a 'zero' level of any particular effect. For example, sighting survey output might be greater under non-lethal sampling because taking biopsies would require less diversion time than securing the animal and thus possibly introduce less bias into abundance estimates associated with deviation from the trackline. On the other hand, analysis of stomach contents is essentially impossible without lethal take, and considerable additional effort might be required to generate comparable information using less direct, non-lethal methods. It might be possible to quantify the benefits derived from sale and consumption of whale meat in such a way that this effect could be used to reduce the net cost associated with a lethal sampling program. Whether doing so would be 'ethical' or 'acceptable' is a topic for policy consideration.

Identifying and quantifying all possible effects for each sampling program leaves open the possibility that one program will be unambiguously 'better' than the other, in the sense that one program produces a 'better' amount than the other program for every effect, given the same fixed effort or cost. In that case, even though the various effects are measured with different metrics, one program dominates the other and an unambiguous preference emerges from the analysis. A more likely outcome is that comparing the two sets of effects will reveal tradeoffs: One program has 'better' levels for some effects, while the opposite is true for other effects. For example, for

some types of analyses it is easy to imagine that lethal sampling might provide more information per unit effort but also have more negative biological consequences for the population. In that case, the choice between the two programs rests on assigning weights to the various effects, which inherently involves applying a set of values to this problem. The cost-effectiveness framework can therefore illuminate the tradeoffs that are present in choosing between the two programs, but it cannot indicate (or is unlikely to indicate) which is preferable from a social perspective.

Thus, it is not possible by scientific methods alone to answer questions such as, Is lethal sampling of whales 'acceptable' or 'justified'?, because doing so requires consideration of societal (and personal) values. Some components of the comparison of lethal vs. non-lethal sampling are quantifiable in an objective way, however, and to the extent that this can be accomplished it should led to more productive discussions of these normative issues.

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