Report from the Intersessional LaWE steering group

LaWE steering group[1]
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ABSTRACT
The LaWE (Large-scale Whalewatching Experiment) steering group and the LaWE advisory group were developed during SC/60 in response to SC/60/Rep6, the Bunbury report that proposed the development of an IWC research initiative to define the principles that determine how whalewatching interacts with other pressures on cetaceans to lead to impacts on their life history parameters in some instances. The steering group is to develop proposals for methodology, design, and management of this initiative, including receiving advice from the LaWE advisory group regarding candidate study sites and taxa. Following on the initial Bunbury workshop report, the steering group, including a representative of the advisory group, further developed a proposal for LaWE including the precise definition of aims and hypotheses (SC/61/Annex M/Appendix 2). Here, we provide a brief overview of this proposal and proposed options to manage this project.

Keywords: whalewatching, behaviour, modelling, management procedure, sustainability, modelling

THE LAWE PROPOSAL

The initiative aims to understand possible effects of whalewatching on the demographic parameters of cetacean populations. The first aim is to explore causal relationships between whalewatching exposure and survival- and vital rates of exposed cetacean individuals. The second aim is to understand the mechanisms involved in causal effects, if they exist, in order to define a framework for proper management. Taking heed of the precautionary principle, we chose to meet the aims concurrently; if taken sequentially, the second objective would be sufficiently time-consuming to effectively delay implementation of proper management on decadal scales.

Objectives

1. Determine whether the vital rate effects described in recent studies can be observed in other situations (IWC/58/Rep1).
2. Determine how exposure to whalewatching affects the ecology, behaviour and/or physiology of cetaceans.
3. Conduct short-term studies to inform the likelihood of long-term population impacts.
4. Assess temporal variation of individual responses to disturbance (e.g., habituation, tolerance and sensitisation).

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5. Develop a modelling framework to explore potential population consequences of changes in life history parameters given observed effects and effect sizes and use additional datasets to test model predictions.
6. Determine the effectiveness of mitigation measures employed to reduce the effects of whalewatching.
7. Develop a management framework for whalewatching that accounts for uncertainties, and includes monitoring and feedback mechanisms.

Research design

Aim 1. Demonstrate a causal relationship between whalewatching exposure and the survival and vital rates of exposed cetacean individuals.

We propose to use **a nested block study design** to account for environmental and biological variability, with multiple control and whalewatching site replicates within species, between ecological conditions, and between species with different life history strategies. A nested block design will allow accounting for inherent variability by using replicate control and exposure sites.

In principal, four categories of cetacean populations are targeted by whalewatching:

- Resident populations where breeding, nursing, and feeding occur in the same area;
- Cetaceans on their breeding grounds;
- Cetaceans on their feeding grounds; and
- Cetaceans on their migratory corridors.

Aim 2. Understand the mechanisms involved in causal effects

We will use short-term controlled exposure experiments. The interpretation of the results of these experiments will be context-specific, e.g. depending on habitat quality or physiological status. It is not feasible to measure all covariates that can influence these results. Therefore within- and between- species site replications and **nested block design** will also be essential.

Variables

Aim 1. Compare levels of exposure to whalewatching and measures of a variety of demographic parameters.

1. Vital rate and survival information, e.g. age at maturity, reproductive and survival parameters, obtained through rigorously designed mark-recapture studies using photo-identification and other non-invasive techniques.
2. Range and spatial use information using a range of non-lethal techniques such as photo-identification and passive acoustic techniques.
3. The quantity and rate of exposure of individuals to the number and type of whalewatching boats.
4. To the fullest extent possible, environmental covariates from each site (however those are not essential thanks to the study design)

Aim 2. Determine short-term responses.

1. Activity budgets, movement patterns, and habitat use by sampling the movement of individuals.
2. Data on social patterns.

3. The physiological status of individuals using metabolic indices, body condition indices, and (where possible) stress hormone levels.
4. Characteristics of whale-watching interactions including characteristics of boats and their behaviour.

Hypotheses and Work Plan

Objective 1. Determine whether the vital rate effects described in existing studies can be observed in other situations.

- *Hypothesis 1.1* There is a relationship between cumulative exposure to whale-watching interactions and the vital rates of individual cetaceans.
- *Hypothesis 1.2* For species that segregate their life history into different geographic locations, exposure in one of the locations can be sufficient to cause an effect in vital rates.

Objective 2. Determine how exposure to whalewatching affects the ecology, behaviour and/or physiology of cetaceans.

- *Hypothesis 2.1* Interactions with whale-watching boats elicit behavioural responses that are analogous to responses to predation risk.
- *Hypothesis 2.2* Whale-watching boats impact cetaceans through trait-mediated indirect effects where the animals are forced to modify their behaviour because of environmental disturbance (e.g. by the boat influencing prey behaviour).
- *Hypothesis 2.3* Whale-watching boats affect cetaceans by obstructing their behaviour (e.g. the boat acting as a physical barrier or acoustic masking).
- *Hypothesis 2.4* The levels of stress hormones (e.g. corticosteroids) of individuals are related to their exposure to whalewatching interactions.

Objective 3. Conduct short-term studies to inform the likelihood of long-term population impacts.

This objective represents a work plan that follows on the hypotheses framed under Objective 2. These studies will involve a series of controlled exposure experiments within and beyond the LaWE experimental sites using the list of pre-determined variables.

Objective 4. Assess temporal variation of individual responses to disturbance (habituation and sensitisation).

- *Hypothesis 4.1* The magnitude of an individual's response is temporally dependent on exposure to a controlled stimulus.
- *Hypothesis 4.2* If 4.1 is true, the rate of habituation or sensitisation will be dependent upon the exposure history in relation to the onset of the impact assessment.

Objective 5. Develop a modelling framework to explore potential population consequences of changes in life history parameters given observed effects and effect sizes and use additional datasets to test model predictions.

Individual-based models will be used to inform the mechanistic relationships between whale-watching exposure and individual vital rates and survival probability. There will be several aims to these simulations:

- Identify possible pathways that can lead exposed individuals to have significantly altered vital rates or survival probability.

- Inform study design by highlighting the minimum set of variables required to achieve project Aim 2.
- Inform study design in two ways. First, by defining the sensitivity of demographic parameters to uncertainty in parameter estimates. Second, by estimating variance of parameters and hence informing sample size.
- These models will offer a mechanism through which we will then be able to run simulations to inform on the potential outcomes of different management actions (Objective 7).

Objective 6. Determine the effectiveness of mitigation measures employed to reduce the effects of whalewatching.

(a) Understand the precise stimulus that elicit responses from the animal

- *Hypothesis 6.1* The effect size of a response is the same regardless of the characteristics of the whalewatching interaction
- *Hypothesis 6.2* If hypothesis 6.1 is refuted, the effect size of the response is dependent upon one or more specific properties of the interaction

(b) The effectiveness of mitigation measures that reduce exposure to those areas identified in (a).

- *Hypothesis 6.3* A reduction of the exposure to significant characteristics of the whalewatching interactions will significantly reduce effect size.

Objective 7. Develop an integrated and adaptive management framework for whalewatching that accounts for uncertainties, and includes monitoring and feedback mechanisms.

- Once the models developed in Objective 5 are informed by results from the empirical studies (including those from Objective 3), we can use simulation to inform the potential outcome of different management actions in various situations.

INTERSESSIONAL TOR

During IWC61, the steering group was charged with a number of intersessional tasks:

Task 1. LaWE steering group to develop procedural mechanisms for the LaWE project
Task 2. Initiate power analyses to further develop and refine methodology
Task 3. Receive advice from the LaWE advisory group on appropriate sites and species.
Task 4. Develop an IWC-centralised data collection and QA/QC procedure for pre-existing and new data to inform Objective 3 and power analyses.

Due to both financial and time constraints the LaWE steering group did not meet intersessionally this year. However, the following progress has been made on Tasks 1-5 and further progress is anticipated prior to the completion of SC/62.

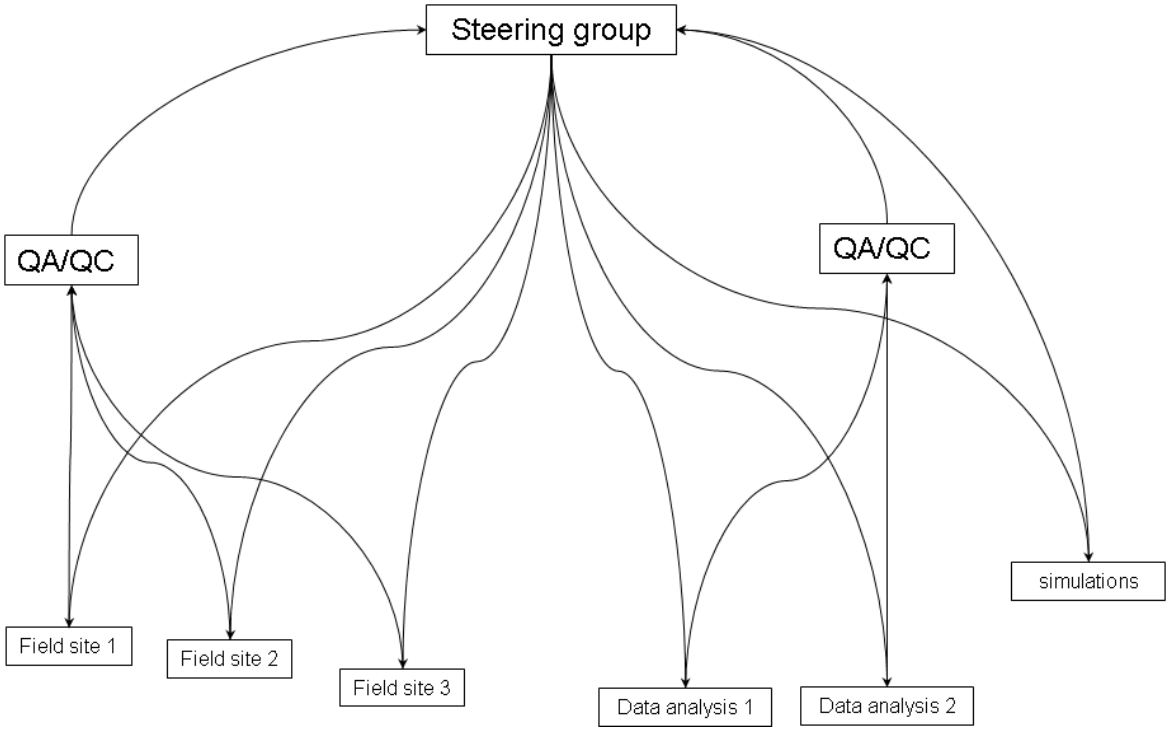
Task 1. Procedural mechanisms for the LaWE project

Procedural linkages

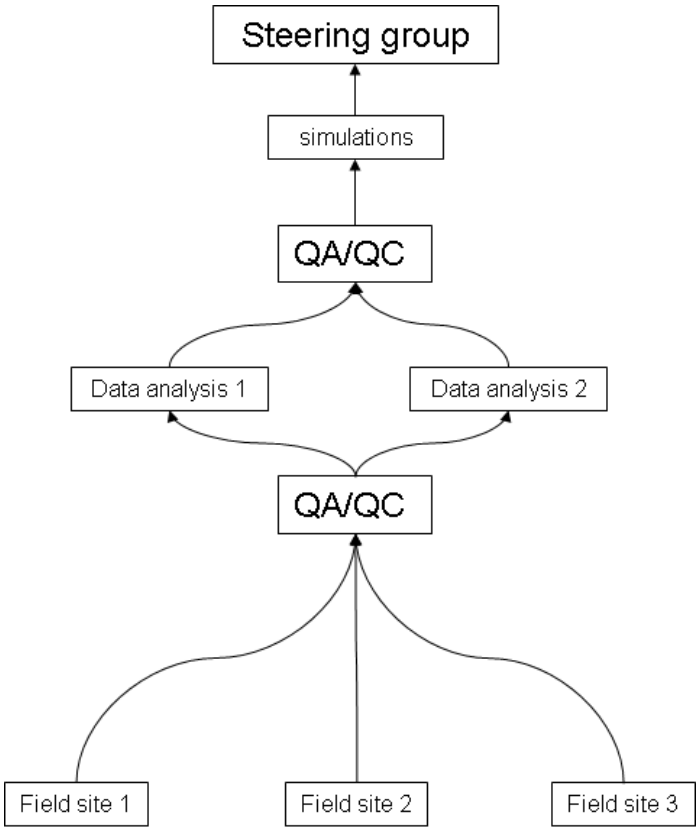
Given the number of field sites envisioned necessary for the LaWE initiative, and therefore the number of research teams needed, there are two key procedural aspects that require special planning and forethought. Firstly, we need to define mechanisms for communication and coordination of data (both collection and storage) and analytical efforts across all teams. Secondly, we need to ensure consistency between teams and within teams over the research period, in data collection and analyses. Furthermore, not all research teams will have the required skills to carry out all components of the projects and therefore, when possible, we need to ensure the provision of a homogeneous training program. For tasks for which this is not feasible (e.g., specialised analytical skills), we will need to develop separate teams.

We have identified four primary, *non-mutually exclusive*, groups of individuals who will interact during this project (1: Data management and QA/QC; 2: Field data collection; 3: Data analyses and simulations; and 4: Project management; Figure 1). These interactions could take place in a number of ways, which are presented in Figure 1. Data collection would be undertaken in a consistent manner at numerous field sites, data management would be completed by a team responsible for assuring and controlling data quality, data analyses would be conducted by dedicated specialised teams, and a group would coordinate and manage the project.

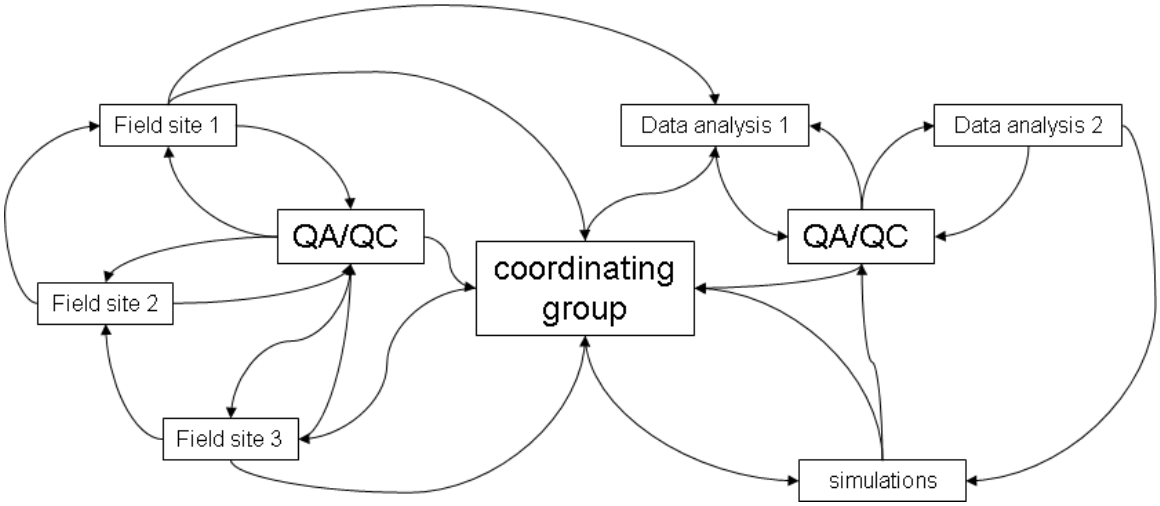
Option 1: hierarchical structure



Option 2: bottom-up approach (where team leaders might meet once a year)



Option 3: network-approach



Group 1: Data management and QA/QC
Group 2: field data collection
Group 3: Data analyses and simulations

Group 4: Project management

Figure 1. Potential procedural linkages between the different components of the project (QA: quality assurance, QC: quality control)

From the experiences drawn from other large project initiatives (e.g., the Census of Marine Life and to some extent the Revised Management Procedure), we know that neither a top-down approach (option 1), nor a bottom-up approach (option 2) will help us achieve the goal of this project. Instead, the procedures we put in place will need to ensure two primary goals:

1. Ensure that data is collected in the same manner at all field sites with the same quality standard.
2. Ensure that communication between all four groups is maximised so that if problem arise (e.g., sampling hindrances, QA/QC issues, etc.) they can be quickly dealt with, with the ability to learn from past experiences in other sections of the project, and if unanticipated difficulties arise they can be discussed and resolved in an open and timely manner.

It will be important for this procedure to:

1. Not hinder innovation emerging from field sites and allow for useful emerging procedures/ideas to be propagated at other sites if need be
2. Foster a sense of community to allow free exchange between all members
3. Foster feedback loops along the information exchange paths

Under these conditions we propose that the network approach (Figure 1, Option 3) would be most efficient for this project. Here, a coordinating group would act as a "hub" of information exchange rather than an information sink or source.

Financial considerations

Finally, it is important to recognise that to ensure the success of this project it is necessary to ensure that data collection can be maintained at all selected sites. It was recognised in the Bunbury report that external financial contributions will be necessary to sustain the project. Different countries and/or regions will have different abilities to cover, and sustain at the appropriate time scale, the cost of the workload required at their field sites. Therefore, it will be important to define a procedure to ensure that the LaWE project is not jeopardised by financial instability at selected field sites. The IWC, as an international body who has dealt with such matters in the past, has pre-existing mechanisms for nations to contribute to specific research efforts with minimal geographic restrictions, and represents a promising vehicle to achieve this important goal.

This project is essentially a Research and Development component of the global whalewatching industry. As such, it is important for the industry to realise the value of this work for its sustainability and its viability. Many countries are already funding research on whalewatching impact from levies on whalewatching passengers. Such funding scheme should be encouraged in all locations to adequately fund components of the LaWE project.

It is necessary to recognise that data collection is only one component of the project and, at times, the easiest to fund. However, financial stability is also required for the other components (QA/QC, analysis, and simulations). In time, we can envisage the procedure to be fully incorporated to the workload of the IWC in the same manner as the current whaling RMP is.

Task 2. Initiate power analyses to further develop and refine methodology
Preliminary work on this task (as reported in SC/60/Rep 6) showed that a meta-analysis cannot be completed using currently published information, largely due to a disparity in information reported. This task will therefore require Task 4 to be completed before analyses can proceed. Development of a budget for such efforts, as well as potential funding sources, will also be required.

Task 3. Receive advice from the LaWE advisory group on appropriate sites and species.
We have not engaged with the LaWE advisory group intersessionally because we have not yet reached the point where specific field sites and dialogues on other issues would have been helpful. We look forward to initiating and streamlining this process starting at SC/62.

Task 4. Develop an IWC-centralised data collection and QA/QC procedure for pre-existing and new data to inform Objective 3 and power analyses.
A. We plan to engage in discussion with the IWC Secretariat to assess the feasibility, and associated costs, for housing data with the Secretariat to both ensure transparency and take advantage of data sharing mechanisms already in place at the Secretariat.

B. We have drafted the following email to be distributed through the marmam listserv subsequent to discussions at IWC/SC/62.

Text of e-mail for consideration by the WW sub-committee:

International Whaling Commission – Large-scale Whalewatching Experiment: participation scoping call

For the past 25 years, a large number of studies have investigated the effects of whalewatching on cetaceans and their potential impacts. From this body of work we now have a consensus emerging that “the fitness of individual odontocetes repeatedly exposed to whalewatching vessel traffic can be compromised and that this can lead to population level effects” (IWC 2006). There is currently no consensus on mysticetes. The IWC Scientific Committee recommended that studies looking at effects on individual fitness of cetaceans be carried out where ever possible. However, in the absence of these data it should be assumed that such effects are possible until indicated otherwise, as supported by the precautionary principle. The Committee strongly encouraged the development of similar studies on large whales, in particular research to determine sustainable levels of whalewatching.
To this end we are developing a large-scale research programme (Large-scale Whalewatching Experiment – LaWE) with the goal of providing scientific advice to determine sustainable levels of whalewatching. This IWC initiative has been developed to assess how whalewatching exposure can interact with the life history strategies of the targeted individuals and the ecological conditions of their habitat to lead to population-level consequences. We have developed a research programme proposal (available at

http://www.iwcoffice.org/conservation/whalewatching.htm) that we are hoping to be able to initiate in the year to come.

To this end, we are opening a call to researchers who have conducted behavioural studies on cetaceans in the past or are currently doing so. We have carried out previous attempts to meta-analyse data from pre-existing whalewatching impact assessment studies but came to an impasse due to disparities in methodology and the statistics reported. Such meta-analyses will help focus sampling strategies and work towards several of the objectives of LaWE. We are therefore interested in collating raw data to carry out such meta-analyses (as well as power analyses) for the one of the aims of the LaWE ("Understand the mechanism involved in the causal relationship between whalewatching exposure and the survival and vital rates of exposed individuals"). We have identified interest in the following variables:

"Activity budgets, movement patterns, and habitat use by sampling the movement of individuals."

If you possess such data, with information on quality control and quality assurance during sampling (e.g., formalised sampling protocols, consistent and regular calibration of sampling procedures), and are interested in participating to this collaborative effort, please contact us by emailing David Lusseau (d.lusseau@abdn.ac.uk). We will then discuss the possible mechanisms to develop this collaboration, ensuring the respect of data ownership, which will be coordinated from within the IWC.

OTHER MATTERS

The Conservation Committee has now focussed its work on whalewatching through the creation the Standing Working Group on Whalewatching (IWC\61\Rep5). This working group is developing a strategic plan to foster the development of whalewatching in a sustainable manner. We feel it is primordial that a close working relationship exists between LaWE and the Standing Working Group on Whalewatching to ensure that any development advice is based on robust scientific advice and to ensure that LaWE receives advice from the Standing Working Group on whalewatching for Objective 7.

The IWC SC sub-committee has recognized the relevance of the Population Consequence of Acoustic Distrubance (PCAD) model and framework to whalewatch effect studies on the scale of the LaWE (IWC/58/Rep1). LaWE steering group members have become aware of other current endeavours to implement the PCAD framework. This effort is providing a formalisation of PCAD and testing it on a wide variety of marine mammal case studies (see SC/62/WW#). This effort has made considerable progress in developing a modelling approach to PCAD which will be extremely valuable for LaWE. Indeed, this approach echoes LaWE's Objectives 2-4 and provides a statistical modelling framework to use data collected under the proposed study design to achieve Aim 2. It would be profitable for LaWE to engage more closely with this initiative.