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Report of the Workshop on Identifying Key Research Questions for the Modelling and Assessment of Whale Watching Impacts (MAWI)

New, L., Coscarella, M., Currie, J., Luck, M., Mesiti, S., Pirota, E., Rasmussen, M., Rose, N., Scarpaci, C., Senigaglia, V., Stockin, K., Waples, K.



INTERNATIONAL
WHALING COMMISSION

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1. INTRODUCTORY ITEMS

1.1. Convenor's opening remarks

The workshop was held at the Confindustria building in La Spezia, Italy, on 5-6 April 2018, immediately before the 32nd Conference of the European Cetacean Society. The agenda is given as Appendix A. New welcomed the participants (listed in Appendix B). She explained that the goals of the International Whaling Commission (IWC) Scientific Committee's Modelling and Assessment of Whale Watching Impacts (MAWI) intersessional working group are to define those research questions and hypotheses that will best benefit our understanding of whale watching impacts, identify key locations that are both suitable and amenable to addressing these research questions, and assess the available modelling tools. These goals are consistent with Action Items 1.3, 2.1 and 2.2 of the IWC's Five Year Strategic Plan for Whalewatching.

As a starting point, the workshop participants **recommended** that their discussions ultimately be placed within a Strategic Framework, supported by a Decision Tree. The latter was defined as a series of linked decisions that would enable users to prioritise research. The former would aid managers in their policy choices. The Framework's goal would be to ensure that the recommendations and concerns raised in the workshop were applicable to the wider community interested in the potential impacts of whale watching. While the detailed Framework and Decision Tree were not constructed over the course of the workshop, it was **agreed** that the report would be used to build them in the near future. The Framework and Decision Tree should be consistent with, and complement, the Five Year Strategic Plan.

In their discussions, participants used established IWC whale watching definitions and terminology (see Parsons et al. 2006) and considered the following types of whale watching (which in practise may occur simultaneously): 1) commercial vessels; 2) recreational vessels; 3) 'swim-with' encounters (in-water interactions); 4) land-based; 4) air-based, both fixed-wing aircraft and helicopters; 5) recreational drones; and 6) food provisioning.

1.2. Objectives of this workshop

The objectives of the workshop were to identify the impacts of whale watching that are of greatest concern, define the research questions that will enable assessment of these impacts, determine which data should be collected to address these questions, foster collaboration amongst stakeholders and identify where there is the current capacity to implement this research, as well as how to foster capacity building in other locations of operational concern.

1.3. Election of Chair and appointment of Rapporteur

New was elected Chair and Rose was appointed Rapporteur.

2. BACKGROUND – SUMMARY OF 2014 WORKSHOP

New gave a presentation on the progress of the MAWI initiative to date. In 2014, a workshop was held at the International Marine Conservation Congress in Glasgow to begin to address MAWI's goals (New 2015; New et al. 2015). The workshop identified the need for a unified platform that provided an integrated, coordinated approach to assessing the impacts of whale watching. Two main components of this platform were the need to identify key research questions and increase communication amongst stakeholders, which led to the organisation of this workshop.

3. IMPACTS OF WHALE WATCHING

3.1. General

In discussion, it was noted that, while the Scientific and Conservation Committees are generally concerned with population level impacts, welfare indicators (a measure of impact on individuals) not only may provide a proxy for population health, but may also inform ethical and social license implications, and should not be neglected (see, e.g., Papastavrou et al., 2017). It was generally noted that new methodologies and technologies (e.g., drones) have made it increasingly possible to measure and collect data on welfare indicators, such as stress hormone levels, and other health indices, including body condition and skin lesions. This is a promising avenue for future study of whale watching impacts. However, it was also noted that in many situations, isolating whale watching pressure as a cause of these and other impacts might be difficult. Other stressors, such as pollution or alternate sources of noise present in the environment, may also affect cetacean welfare and health.

There is a preponderance of data on whale watching impacts already available on small cetaceans, but comparatively fewer on large whales. MAWI was originally conceived with a focus on large whales for this reason. However, the participants **agreed** that it was vital to take all data currently available, which is primarily on short-term behavioural reactions (see below and item 5.1), and assess them with current and new modelling techniques, in order to move beyond short-term impacts and estimate or predict mid- and long-term (population level) impacts on cetaceans. Ideally, managers can use such modelling to establish Limits of Acceptable Change (see item 6.1) (e.g., the magnitude of a decline in foraging time due to whale watching pressure that will be tolerated before managers respond) in targeted populations. It was urged that every effort be made to leverage the existing datasets available on small cetaceans to collect similar and other data on large whales.

Participants spent some time generating a list of potential impacts from whale watching, on both cetaceans (cetacean-related) and people (sociocultural-related), including operators, local communities and tourists. The intent was to guide both natural and social science research by providing a foundation for developing research questions that appear most urgent from a conservation and management perspective. While each location at which whale watching is occurring will have unique challenges, the goal was to establish either a universal list of impacts of concern or a universal set of criteria for identifying impacts that could be evaluated relevant to a specific location. The participants **agreed** that both natural and social science research needs to proceed in tandem. Many management regimes are based on the best available science; this needs to include both social and natural science, as they are equally vital to successful management.

Participants also concurred that it was important, for each location and species, to prioritise impacts of concern. It was not considered possible to develop a universal ‘trigger’ for management decisions for all impacts everywhere, but developing universal criteria for prioritising impacts was considered possible. The lists below are of the impacts of greatest concern generally, but the prioritisation will differ between locations and species. Universal criteria for prioritisation, which could be used to generate lists of impacts of concern for each location and species, currently do not exist. The participants **recommended** that universal impact prioritisation criteria be developed as a future task of the MAWI initiative, to be incorporated into the Decision Tree (see item 1.1). Once particular impacts are identified as priorities for a location or species, researchers will know which data to collect and which modelling approaches may be most appropriate.

3.2. Impacts

3.2.1. Cetacean-related

Participants **agreed** that changes to vital rates and life history (e.g., survival, reproductive success, calving intervals) and their population-level effects (e.g., changes in abundance) were of the greatest concern, but were difficult to measure, difficult to attribute to a particular pressure and often detected long after significant impacts to a population had already occurred. Therefore, participants focused on other impacts as proxies that could be used to inform potential effects on life history parameters, recognising the role that modelling could play in predicting the long-term implications of some short-term indicators. In addition, it was noted that abundance estimates, while important, can be time-consuming and expensive to produce, requiring extensive data collection over significant time periods to detect trends; therefore, again proxies could be used (such as changes in age structure), particularly in developing regions where resources are scarce.

Numerous behavioural (short-term) impacts of whale watching have been relatively well-studied, particularly in small cetaceans, including changes in deviation index (path of travel), dive durations, resting patterns, group cohesion and behavioural budgets. Other potential impacts have received less study, particularly in large whales, and participants focused on these concerns. They **agreed** that the following potential cetacean-related whale watching impacts were of greatest concern. These concerns were due to proven impacts (in well-studied small cetaceans), or because of potential effects of whale watching that are not well understood:

1. Acoustic impacts (from human-produced noise), e.g.,
 - a. Loss of foraging opportunities
 - b. Masking
 - c. Changes in types, sound level, or rates of vocalisations

(Acoustic impacts were considered the most likely to be universal, e.g., not location or species specific.)

2. Changes in spatial use, e.g.,
 - a. Distribution
 - b. Feeding/breeding areas
3. Temporal shifts, e.g.,
 - a. Mating season
 - b. Migration
4. Changes in population/age/social structure

5. Changes in energy expenditure
6. Effects on health indices, e.g.,
 - a. Cortisol and other stress hormone levels
 - b. Body condition, including skin lesions
 - c. Increased incidence of disease (due to immunosuppression)
 - d. Microflora
 - e. Toxicology
7. Disturbance of known individuals (via photo-identification)

Impacts to vulnerable sectors of the population, such as calves, who may have learning or nursing opportunities interrupted by whale watching, were also considered important. It was emphasised that all of these impacts are species-specific and may differ according to the type of whale watching vessels (e.g., motorised vs. non-motorised) or the type of whale watching activity (e.g., provisioning operations may require additional data to be collected, such as the prevalence of begging behaviour). Estimating the physiological impact (e.g., increased stress levels) from parameters measured in the field (e.g., respiration rate) has been or can be ground-truthed with captive studies for small cetaceans, but for large whales, only field studies are possible. Therefore, developing field methodologies and appropriate modelling approaches to link the field parameter with the physiological impact should be given priority attention for large whales.

Participants mentioned a variety of other impacts, such as harassment (including the rising popularity of close encounters to take ‘selfies’ with the animals), boat strikes, and for provisioning situations, vandalism, changes in foraging patterns and serving as an attractant to predators. However, these were considered less urgent because they were not as severe, were infrequent or were less universal in prevalence. Some concerns, such as increases in marine debris (from vessels), pollution (both in-water and in air), introduction of invasive species and increases in disease prevalence, were also considered important, but were set aside for current consideration due to the difficulty in isolating whale watching as a cause. In addition, it was noted that new technologies used for research might also contribute to impacts, either inherently (e.g., drones) or by allowing animals to be located more easily by recreational vessels. Habituation was also flagged as a concern, as overt reactions may ‘fade’ over time, while impacts (e.g., elevated stress levels) remain. Finally, it was noted that cumulative and synergistic impacts must be considered as much as possible, especially when modelling mid- and long-term impacts.

3.2.2. Sociocultural-related

Participants also generated a list of sociocultural-related impacts of whale watching. These were further divided into positive and negative impacts. It was clarified that not all listed impacts were proven to occur; for example, several studies have indicated that changes in attitudes amongst whale watchers toward the environment have been short-lived and have not led to significant conservation action on their part. The participants **agreed** that the sociocultural-related impacts of whale watching of greatest concern were:

1. Positive
 - a. Opportunity to raise issues of wider conservation concern, e.g., climate change
 - b. Changes in attitudes toward environment
 - c. Changes in conservation-related behaviour
 - d. Changes in economic indices
 - i. Direct effects
 - ii. Indirect effects
 - iii. Induced effects
 - e. Creation of human ambassadors
 - f. Opportunity to share cultural knowledge
2. Negative
 - a. Loss of cultural traditions
 - b. Conflicts with other user groups (e.g., fishermen, ferries)
 - c. Exceeding capacity of an area through an influx of people to a whale watching area (e.g., researchers, workers, tourists)
 - d. Creating unrealistic expectations of wildlife interactions

While impacts on human safety, including human injuries/fatalities due to provisioning or in-water interactions, were considered a concern, such impacts are generally a priority only for managers where provisioning or in-water interactions occur and therefore were not included in the list.

Participants **agreed** that natural science researchers should collaborate with social science experts (see also items 6.3 and 7), to ensure that these impacts are addressed satisfactorily. It was suggested that a range of experts should be consulted and included in research projects to ensure a holistic approach and improve capacity

for making informed management decisions. For example, a natural science researcher might partner with an economist, conducting two research projects in tandem, to ensure the most comprehensive and useful data relevant to management were collected.

4. DEFINE KEY RESEARCH QUESTIONS

4.1. General

Participants **agreed** that any location chosen as a study site needs to be assessed for baseline information before research on the impacts of whale watching can commence. This baseline information includes, but is not limited to: 1) the species being watched; 2) their conservation status and recovery potential including, e.g., their abundance and distribution; 3) the reason they are using the area, e.g., foraging, breeding, migrating; 4) the predictability of their presence; and 5) the identification of any data gaps. This information will need to be considered carefully depending on the length of time whale watching has been occurring in the area. ‘Baseline’ information may not be baseline, but instead more of a benchmark, if whale watching has been underway for some time, whereas it is truly baseline if whale watching has yet to be established (but is anticipated) or has only just started. Given the importance of social science research to understanding the impacts of whale watching (see item 3.1), the participants identified the need for baseline data on the socio-political aspects of whale watching as well. This baseline information includes, but is not limited to: 1) economic importance of whale watching; 2) cultural values that may be affected; and 3) knowledge of the governance of the region.

It was acknowledged that it may be difficult to secure investment (e.g., of researchers and funding) in ‘naïve’ locations, where whale watching is likely but not certain to begin. One solution suggested was to focus research attention on locations that already have baseline data from past research projects initiated for reasons other than whale watching concerns, such as Iceland. Another was to focus baseline research on locations that cetacean populations may occupy as they recover or expand (and where whale watching may commence once they do), as appears to be occurring in Argentina with the southern right whale (*Eubalaena australis*), which is now being resighted in areas from which it disappeared during the whaling era. However, it was noted that most models, including PCoD (see item 5.1), do not require pre-whale watching data to generate impact projections into the future, so this is more a management than a modelling concern.

Several participants also emphasised that research questions should be prioritised according to management needs. Researchers should confer with managers, in order to identify those data that are most critical to the local management regime, as well as the targeted cetacean population. Academic research, and even research addressing clear impacts but which managers cannot mitigate with current management tools, may be interesting and eventually useful to conservation. However, priority should be given to questions addressing specific needs as identified by managers, especially when designing experimental approaches that seek deliberately to introduce stressors to the targeted population. One way forward to achieve this is to develop collaborative projects amongst managers, scientists and other stakeholders, which will facilitate the inclusion of results in management decisions. Finally, experimental designs that include Limits of Acceptable Change or dose/response curves are of particular importance, as they provide a useful benchmark to managers, as part of their effort to ensure sustainable practises.

4.2. Research questions

4.2.1. Cetacean-related

Participants generated a list of potential, cetacean-related research questions for each of three behavioural response timescales (see item 5.1) – short-, mid-, and long-term. It was emphasised that new technologies have made experimental designs increasingly feasible for whale watching impacts research and such approaches are encouraged. The following list of research questions was not intended to be exhaustive, but was meant as an initial effort to identify the most urgent or important issues to be addressed or variables to be assessed:

1. Short-term
 - a. What are the acoustic impacts of whale watching on cetaceans?
 - b. What features of whale watching vessel noise (e.g., intensity [sound level], quality [e.g., abrupt and frequent changes in speed; short or long intervals between watching bouts]) are most relevant to the animals?
 - c. What are the ramifications of using engine quieting technology, e.g., acoustic impacts may be reduced, but other impacts, such as boat strikes, might increase due to a decline in cetaceans’ ability to detect vessel presence.
 - d. What are the relative impacts on cetaceans from recreational, as opposed to commercial, vessels?
 - e. Do commercial vessels influence the behaviour of recreational vessels?
 - f. What are the combinations of vessel size, numbers and time spent with cetaceans that have the greatest impact?

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- g. What are the short-term responses (including welfare indicators) to whale watching that could serve as ‘triggers’ to managers or researchers that there is concern regarding potential population level effects?
 - h. Do different types of whale watching, especially those that lead to very close approaches (including in the pursuit of ‘selfies’) or include swimming with or provisioning the animals, have different impacts or different severity of impacts?
 - i. Do short-term impacts vary for different age classes (i.e., calves versus juveniles or adults)?
2. Mid-term
- a. What are the energetic costs for cetaceans targeted by whale watching?
 - b. Are cetaceans changing their spatial distribution in response to whale watching?
 - c. Are cetaceans changing how or when they use an area in response to whale watching?
 - d. Do social structure and social networks of the targeted population change in response to whale watching activities?
 - e. Is there a change in the age structure of a population due to whale watching?
3. Long-term
- a. Has there been a change in the species’ vital rates (e.g., survival, reproduction) that is leading to a decline in the population?
 - b. Could the short- and mid-term effects (e.g., changes in energetic costs) of whale watching lead to a population-level effect?
 - c. Given that welfare indicators in individuals can precede population-level impacts, what are the relevant indicators (including health indices) for a specific population?
 - d. Given the long timeframe required to identify population trends from monitoring data, how can potential trends be predicted on a timescale that is useful for management?

In addition, the participants **agreed** that a key question, regardless of the timeframe, is whether the impact of whale watching can be isolated from the other stressors the animals may face, such as pollution or environmental fluctuations (see item 3.1). An extreme example of the problems that arise from confounding factors was the possibility of conducting a whale watching study in an El Niño year. Significant impacts might be observed in such a year that would be absent in another, but could be erroneously attributed to whale watching pressure rather than El Niño. This emphasises why long-term research and monitoring commitments to whale watching locations are essential (see item 6.1), to account for large-system fluctuations of this nature.

Some participants felt that focusing research on impacts such as health indices should not be a priority because of the risk of erroneously attributing observed changes to whale watching, rather than to other causal stressors. Others felt that identifying whale watching locations where the environment is relatively pristine, with less environmental degradation, could be a strategic way of addressing this issue. Nonetheless, all participants concurred that monitoring population health was important (and see also item 7 for additional discussion of the inability of attributing impacts to whale watching when there are other stressors present).

It was generally noted that most studies have been on the impact of commercial operations. The participants **agreed** that recreational vessels in many instances may be of greater concern, as they are often more numerous, less aware of codes of conduct or regulations and more difficult to influence, due to their often transient nature in an area. For these and other reasons, it may also be more difficult to study the impact of recreational vessels, but it was **agreed** that an effort to do so nevertheless should be made, at least in situations where recreational vessels may be having a disproportionate impact on vulnerable populations. In addition, simply acknowledging the potential for recreational vessels to have equal or greater impact could help the relationship-building process between researchers and operators (see item 6.1). Finally, it was noted that while it is more difficult to manage recreational whale watching vessels individually, in some locations time-area closures and zoning (entry-prohibited areas), where targeted animals are most vulnerable and recreational vessels are excluded, can be effective mitigation.

On this last point, it was noted that there are on-going efforts internationally to establish protected areas, such as the IUCN’s Important Marine Mammal Areas (IMMAs) initiative. The participants **recommended** that any effort to establish protected areas in the whale watching context should collaborate with such initiatives, rather than begin anew. While IMMAs have no regulatory authority, they do provide locations with international recognition and can be used as leverage for research funding, local regulatory attention or simply public relations prestige. The IMMAs initiative may also be less threatening to user groups (including whale watching operators), who may be resistant to the concept of ‘protected areas’.

It was noted that at a minimum, the number of recreational vessels present on average in a whale watching area can be monitored. One suggestion was to treat areas with regulated (stable) numbers of commercial vessels, but increasing numbers of recreational vessels, as a ‘natural’ experiment. Any increases in impacts seen in such an

area that researchers attribute to whale watching could plausibly be attributed specifically to recreational vessels.

4.2.2. Sociocultural-related

Research questions in this category identified as important included:

1. What are the retention rates of information and attitude changes reported by whale watching tourists?
2. What proportion of income from whale watching operations remains in the local community, particularly in locations where operators do not live locally?
3. How much of a knock-on effect does a local whale watching industry have on the related tourism economy (e.g., hotels, taxi companies)?
4. What specific information, including about communities and tourists, will help improve management?
5. What socio-political, socioeconomic or cultural factors contribute to management failures?
6. What is the impact on operator income of various management requirements?
7. When the stated intent of a whale watching operation is to 'create human ambassadors for the environment', how effective is this effort?
8. Do children make effective human ambassadors?
9. How does one study tourists who are transient, only present in an area on the order of days or at most weeks?
10. Due to the sheer density of recreational vessels, how can they be approached for surveys and other data collection?

Some research has been conducted on these questions, particularly information retention, including by participants attending this workshop, but more work needs to be done. It was noted that, as with managers, social science researchers and whale watching operators should communicate more directly with passengers, to find out what they want to learn. Framing information so that it is not perceived negatively (even if it is objectively negative, such as the impacts of climate change) is key and can be critical in improving retention rates.

Much more work also remains to be done on the socioeconomics of whale watching. Economy and business experts should be recruited to address this question specifically in whale watching communities, working in partnership with natural science researchers.

5. DATA COLLECTION

5.1. Existing data collection techniques and corresponding analytical approaches

Pirotta gave a presentation on existing data collection techniques and corresponding analytical approaches. The effects of disturbance from whale watching vessels have been mostly assessed at the individual level, measuring short-term changes in behaviour and activity state via Markov chains. A meta-analysis of visual studies on cetacean responses to whale watching has been used successfully to identify common responses across species and contexts. Acoustic data can also be used to monitor animal occurrence and activity, but appropriate modelling tools (e.g., hierarchical modelling) must be used to account for potential interference of vessel noise with the detection of cetacean vocalisations. Other important applications of acoustic methods include the estimation of communication rates, acoustic masking and ranges of various impacts.

Pirotta continued, noting that existing behavioural studies suggest that responses to whale watching are highly context-dependent. As a result, a lack of detectable responses does not imply the lack of an effect, especially as there may be physiological responses to disturbance. New data collection methods, such as dedicated tags and the collection of blow or faeces, could make it possible to measure stress hormones and thus estimate a physiological response. However, regulatory and management bodies are generally interested in population-level effects, which has motivated the development of quantitative frameworks, such as the population consequences of disturbance (PCoD), to link short-term changes in behaviour or physiology to changes in population dynamics. Different options for estimating the population-level effect of whale watching exist; individual-based models have been successfully applied to simulate individuals over time and explore long-term effects. These models can be extended to include a socioeconomic component, in order to test the effectiveness of different management scenarios. Future studies should prioritise informing such predictive approaches, using emerging technologies (e.g., drones) to non-invasively measure potential biological responses, such as the variation in individual body condition.

The participants thanked Pirotta for an excellent presentation. In discussion, it was concluded that, in order to adequately address any research questions, there were three levels of organisation to be considered: 1) identification of the nature of whale watching stressors (e.g., number of boats, acoustic footprint); 2) the cetaceans' exposure to these stressors (e.g., duration of daily/seasonal period animals are subjected to presence of whale watching vessels; multiple boats for short daily periods of watching vs. one or two boats for long daily

periods of watching); and 3) the biological responses to these stressors. Biological responses could occur at three timescales: 1) short-term (e.g., changes in behaviour); 2) mid-term (e.g., changes in spatial use); and 3) long-term (changes in vital rates and population dynamics). Data collection and modelling techniques should therefore be approached with the appropriate level of organisation in mind. While the majority of whale watching studies have focused on the short-term effects on the animals' behaviour, as noted above, in order to understand the mid- or long-term effects of whale watching it is necessary to have information on exposure. Also, data need to be collected at a sufficient level of detail to model effects.

It was noted that identifying locations for experimental approaches should be done strategically, considering where research can generate the best and most useful results for the most cost-effective investment of time, resources and funding. However, researchers should not pursue work merely because it is easy logistically, funding is readily available, or to simply replicate already common studies. An example would be the short-term effect of whale watching on bottlenose dolphins, *Tursiops* spp. It is generally accepted that vessel presence affects this species' behavioural budget. Future bottlenose research, even at new locations, should focus more on the mid- and long-term effects of whale watching. This may require the development of new research tools and approaches to analysing the data. For those species where the short-term effect of whale watching is unknown (e.g., the majority of large whales), short-term data are still necessary before research can move into understanding the potential mid- and long-term effects of whale watching.

5.2. Use of platforms of opportunity to help understand the potential effects of whale watching

Currie gave a presentation on platforms of opportunity (e.g., whale watching vessels, fishing vessels, cruise ships, ferries, seismic survey vessels, oil-rig platforms). Platforms of opportunity have been used to study a wide variety of cetacean species (e.g., humpback whales [*Megaptera novaeangliae*], sperm whales [*Physeter macrocephalus*], Bryde's whales [*Balaenoptera brydei*], fin whales [*B. physalus*], killer whales [*Orcinus orca*], common and Antarctic minke whales [*B. acutorostrata* and *B. bonaerensis*]). These platforms are low-cost alternatives to dedicated research surveys, which can facilitate long-term monitoring of populations. Inherent biases must be addressed, but if they are, then platforms of opportunity can be used to monitor changes in distribution, relative abundance and habitat use, and can potentially relate these changes to whale watching pressure. Further, platforms of opportunity can be used to assess potential impacts of whale watching on behaviour, foraging, nursing and mating, as well as to monitor compliance with codes of conduct and regulations.

The participants thanked Currie for an excellent summary of the issues surrounding platforms of opportunity. It was noted that this, or a similar summary, could be a useful addition to the IWC's guidance for researchers and managers on the benefits and limitations of platforms of opportunity for data collection.

In discussion, it was noted that citizen science is increasingly used to collect data. There are several available mobile phone apps that allow members of the public to input basic data (e.g., species sighted, estimated number of animals, location, weather), although where these data are archived or how they are utilised varies. It has been noted that without positive feedback on their data collection effort, some potential citizen scientist recruits can become disenchanted and cease to participate in these projects. Participants **recommended** that any project collecting citizen science data should clearly and consistently communicate with the public how their data are used in research.

Standardisation of data was also discussed. There are now multiple apps available that allow the public to collect data while watching whales and the designers have rarely if ever coordinated to ensure the most relevant information is collected. The IWC Five Year Strategic Plan on Whalewatching prioritises data standardisation under Action 2.1. The Scientific Committee has previously offered guidance on standardising the types of data collected, but to date, this guidance has had limited influence on app design. Wider promotion of this guidance is needed; the IWC could also provide guidance on the apps themselves, at least at the level of informing the public of the various apps that are available and their specifications.

It was noted that one substantive drawback of apps is that they encourage recreational vessels using them to approach closer than regulations allow or codes of conduct recommend. Educating the public on why the use of apps should not be used as an excuse for close approaches by recreational boaters should be a priority for managers, researchers and NGOs, in areas where this has been observed.

The value of monitoring compliance when researchers are on board a whale watching vessel was discussed. The presence of a researcher might influence an operator to comply with regulations or a code of conduct, biasing any monitoring results. Compliance might fall when researchers are not on board, although it was also noted that some studies indicate that compliance is independent of the presence of researchers on board. In addition, it was noted that many compliance studies on small cetaceans indicate a low level of compliance irrespective of the presence of a researcher on board. This led to the suggestion that passengers could be recruited to monitor

compliance. Should a distance finder capability for mobile phones be developed, this could greatly enhance the ability of passengers to monitor compliance.

It was noted that one issue commonly considered a weakness of platforms of opportunity – the fact that multiple whale watching vessels approach groups of cetaceans, making it difficult to establish the start of a first approach for surveying purposes – was not a weakness if the research question related to cumulative approach impacts. Research questions, identifying data to be collected and study design should always carefully take available data collection methods, including from platforms of opportunity, into account.

Given the concerns expressed about the potentially greater impact of recreational vessels, the participants **recommended** that managers give serious consideration to recruiting commercial whale watching vessel operators and passengers as monitors of recreational vessel activity and behaviour. In some jurisdictions, this is already happening or is being considered. In addition, consideration should be given, in jurisdictions where recreational vessels are a significant management issue and regulations governing recreational vessels exist but are difficult to enforce, to placing a dedicated observer on board commercial whale watching vessels, whose sole responsibility would be monitor compliance of recreational vessels.

5.3. Identify whether the types of data currently being collected are sufficient for addressing key research questions

In discussion, it was noted that it would be a useful exercise to attempt to identify archives of whale watching-related data (including on paper data sheets), at universities, government agencies and elsewhere, that may be lying neglected. At least some of these data may be suitable, with review and preparation, to inform modelling approaches that did not exist when the data were collected. In addition, rather than continue to replicate behavioural response studies in different locations, it should be a priority to take available short-term behavioural data and model it to assess mid- and long-term impacts (see items 3.1 and 5.1). In fact, new research should avoid replicating short-term behavioural impact study designs. The exception is when studies are focused on species (including several large whales) where there is reason to conclude that there exist sufficient differences in ecology and behaviour from well-studied species to justify adding these results to the literature. Finally, there is a considerable body of research on impacts from other stressors, such as noise, and this work should be reviewed to help determine best experimental and modelling approaches for whale watching impacts.

One participant noted that some government agencies are collecting track data from registered commercial whale watching vessels using GPS technology, as well as sightings data. These are routine data collections, not tied to any particular research question or project, but allow the agencies to monitor commercial effort and cetacean distribution data. The participants encouraged the sharing of such data with researchers wherever possible.

It was suggested that a proxy for direct impacts, such as boat strikes by recreational vessels, might be certain types of injuries and scars. Recreational vessel strikes would be rarely observed and almost never reported, while passengers are highly likely to report strikes from commercial whale watching vessels. Injuries inflicted by various sizes of commercial vessels could be categorised and then attributed to recreational vessels when similar injuries are observed.

It was noted that in many locations, passive acoustic recorders could be deployed and are a cost-efficient, minimal-effort method for collecting important data on ambient soundscapes, sound levels of engine noise and cetacean occurrence and vocal behaviour. Such data collection was considered especially relevant for large whales, where masking of important communication signals may be a significant impact of whale watching.

There was discussion of the feasibility of using drones to collect relevant whale watching impact data. Drones may prove particularly valuable for collecting body condition data and age structure information (e.g., the number of calves present in a group). They may also capture finer details of behaviour, particularly for large whales where the aerial perspective enlarges the observational field of researchers beyond the water level, but also for small cetaceans, as high-resolution stills can now be captured from drone video footage of these smaller, faster moving species. Some limitations of drones were noted, including the need for high visibility in air and water and the possibility of the drone itself causing disturbance (see item 3.2).

It was noted that a key gap in many areas is adequate metrics for determining whether management measures are actually proving effective at mitigating whale watching impacts. This lack was identified as an urgent need for managers and it was suggested that adequately monitoring and measuring management effectiveness should be built into the Strategic Framework (see Action 5.4 of the Five Year Strategic Plan).

There was discussion of the need to aid developing locations and those with limited resources to monitor impacts. This will require identification of those aspects of short-term effects that may serve as management

‘triggers’ (see item 4.2), as well as specific strategies to help such areas build the capacity to collect the data required (see next item).

6. CAPACITY BUILDING

6.1. Impacts of whale watching on social and biological components of an area

Coscarella gave a presentation on a holistic approach to studying whale watching as part of a ‘sociobiological’ system (i.e., the interaction between the human socio-political system and the biological system facing whale watching pressure). He offered a case study for how researchers’ direct involvement in management increased the influence of whale watching studies on the subsequent behaviour of managers and operators (see also Chalcofsky et al. 2017). Whale watching targeting southern right whales began in Península Valdés, Argentina, in 1973. Building a long-term collaboration with stakeholders, including managers, has allowed the sustainable development of whale watching in this location. This holistic approach focused on setting Limits of Acceptable Change by assessing indicators in four dimensions: Social, Political, Economic and Biological. Social indicators include the percentage of acceptance of whale watching by local inhabitants; attitude changes in people on conservation issues affecting whales; and the importance of the whales in daily life. Political indicators include regulations and governance. Economic indicators include inclusion in the provincial budget of whale watching ‘credits’ and incentives to whale watching operators. Biological indicators include whale respiration rates (observed from land via theodolite) in the presence and absence of whale watching vessels and an evaluation of the proportion of whales being affected by the activity. Respiration rate data indicate that the presence of whale watching vessels is the only variable influencing changes; collecting these data is a first step toward building bioenergetic models to assess the mid- to long-term impacts of whale watching. All of these indicators will be incorporated into a Bayesian Decision framework.

The participants thanked Coscarella for an excellent presentation. In discussion, it was noted that only in the past 15 years has the research started having a positive and measurable influence on management and operator decisions to protect southern right whales from whale watching pressures. Operators can feel threatened by researchers and the prospect of management, so it is essential to address these concerns. It was noted that it can take some time before sufficient trust is built to allow productive and effective communication amongst stakeholders, including researchers. Participants **recommended** that whale watching research be planned for the long-term (on the order of 5-10 years or more) and research sites chosen strategically to ensure that long-term investment is possible and indeed likely.

It was noted that research can produce detailed, comprehensive and compelling science, yet lead to ineffective or even no management action. In response to this, participants emphasised that, in the case of whale watching and managing its impacts on cetaceans, natural science researchers must take on a greater role in the management process. It was suggested that researchers can, and should, actively engage with managers, both in discussing research questions prior to undertaking research and in providing support for the decisions made by managers, which they already do in several locations. Without effective communication, constructive relationships and direct involvement by the researchers in the local socio-political and socioeconomic systems, science will be insufficient in effecting necessary management change. Yet without good science, necessary management decisions will also be impossible to effect. Both are essential to cetacean conservation and effective whale watching management. It was suggested that a potential way to increase communication was the identification of knowledge brokers who could facilitate researchers’ connections within management agencies, or the use of knowledge transfer partnerships to directly link researchers with managers to co-produce information.

It was emphasised that, in order for research to effectively influence policy, management and operator decisions, researchers must become members of the community, to build trust. Researchers cannot behave as outsiders who come into a whale watching community, collect data, offer information and then leave (also known as ‘parachute science’). For successful conservation and management, they must build relationships and learn to communicate effectively with all stakeholders, including local, regional and/or national managers and policy-makers, whale watching operators, local residents and tourists. The participants **strongly recommended** that researchers studying whale watching impacts learn effective communication skills in order to facilitate this process.

It was noted that the principle difference between whale watching operators and many other user groups is that, as an industry, they are often more willing to adapt their behaviour to protect the ‘resource’. This is, in part, because whale watching customers often perceive the operators as a ‘green’ industry and the operators may perceive themselves in the same context. Therefore, interacting positively with operators to influence their behaviour through bottom-up management, such as voluntary codes of conduct, may be more effective in certain situations than top-down management through regulations. Researchers working within a bottom-up management regime may go so far as to, at times, consider refraining from publishing research results that

would be perceived negatively, such as on poor compliance, until they have discussed these results with operators, in order to build trust.

It was noted that relationship-building can be an on-going process, as government officials, at all levels, turn over with time, changing the receptiveness to recommendations. Researchers would also benefit from understanding local socio-political and socioeconomic issues, as these may explain the resistance at times of managers and operators to recommendations based on the best available science. Managers' and tour operators' receptiveness to advice from researchers can vary widely due to political, social or economic issues that can hinder communication and re-order management priorities. It was noted that, when research results fail to influence management, the research could still have value from a political standpoint. That is, sometimes it is important for researchers to be present and continue their work, despite a lack of current management response, to maintain and build relationships into the future, when the socio-political climate may change and eventually allow action.

It was noted that in some areas, the whale watching public may be resistant to certain research; for example, passengers on whale watching vessels may not be receptive to biopsy sampling. The suggested solution was an extension of researcher-manager relationship-building. Researchers must also build relationships with the public; whale watching is a business and researchers must market their work to ensure its acceptance by whale watching customers. Researchers should consult and collaborate with business experts who are proficient in conservation marketing.

A final point was made about the political climate in a whale watching location. Issues such as government corruption or tourist/researcher safety should be considered when determining appropriate research locations. This should be part of the Strategic Framework – areas where corruption or safety are concerns should be assessed and approached carefully before decisions to initiate research projects are made.

Despite the various difficulties or complexities inherent in building capacity where it does not currently exist, participants **agreed** it was important to make the effort to expand capacity, as otherwise there can be no expansion of, or diversification in, the research community, locations or questions.

6.2. Current capacity to address the defined research questions

In discussion, the participants noted that social science is just as important, and often more so, as natural science when addressing whale watching impacts (see item 3.1). This is because it enables understanding of the motivations, attitudes and challenges of all stakeholders who play a role in whale watching and without whose cooperation management and compliance are hindered. Indeed, whale watching management is about managing people rather than cetaceans. Unfortunately, the importance of social science is often ignored and even challenged by policy-makers, managers and natural science researchers. Capacity for such research is therefore often limited. Many locations of operational concern could benefit from investment in well-designed social science research.

Participants recognised that in many locations of operational concern, particularly in developing countries, small whale watching operators may have neither the capacity nor the willingness to cooperate with researchers. Building that capacity, but particularly improving the willingness to work with researchers, should therefore be a priority. Long-term researcher presence and relationship-building are essential to accomplish those goals. Wherever such capacity and willingness are already present, data sharing amongst operators and with researchers should be encouraged. Sharing can be facilitated with the establishment of centralised websites or other mechanisms to ensure data are suitably archived and accessible to all stakeholders.

It was also suggested that wherever capacity and willingness amongst operators to have dedicated naturalists or researchers on board are present, this should be actively encouraged. While in some cases, operators themselves can collect data, in many cases the focus and priority for the captain of a vessel are the passengers and safe operation of the vessel. However, having a dedicated, trained data collector on board, who could also serve as the naturalist, addresses this concern.

It was noted that, in developing countries in particular, new and emerging technologies for research may not be utilisable. In some, it is a simple case of lacking capacity; in others, it might be a governance issue. However these problems are addressed, a strategic approach should be made to ensure any investment in overcoming the obstacles will have maximum benefits and minimum costs.

As an example of the former problem, researchers might collect blow or faecal samples to assess for stress hormones, but must export the samples, as no laboratories in-country can handle the analysis. However, one participant cautioned against assuming establishing such a laboratory (or adding to the capacity of existing labs) will solve this problem. Some assurance should be secured in advance that the added capacity will be useful into

the future. It cannot be assumed that a new lab, for example, will always be used frequently enough to justify its existence and it could eventually become dormant and even derelict from lack of use.

As an example of the latter, drones might not be legal for researchers to fly in some countries. Before investing in such new technologies or designing a study that requires them, it is important to assess the governance structure of a country or region to ensure that all planned methods are both legal and properly permitted.

An issue of growing concern within the research community at large was identified as potential gaps in modelling capacity. It is imperative to ensure a new generation of experts in modelling is available to meet the needs of various natural science research projects seeking to determine long-term impacts of various environmental threats and human activities. It was noted that, rather than trying to train biologists in advanced statistics or modelling, natural scientists building partnerships and research collaborations with expert mathematicians who are interested in marine conservation could be a more fruitful way forward. It was also suggested that making certain resources easily available online, including statistical software or packages for open-source languages such as R, would be useful.

A major gap identified in capacity world-wide is sources of funding for whale watching research and associated management initiatives. While some locations, such as the Arabian Sea where a critically endangered population of humpback whales is targeted by an emerging whale watching industry, are receiving much-needed attention, others constantly struggle to attract needed investment of funds and other resources, particularly in long-term whale watching research and management. It was noted that this may be because potential funding sources look at whale watching as a business with its own revenue, without recognising that this money is not necessarily available to researchers. One participant suggested that affluent whale watching companies with a strong commitment to conservation could potentially subsidise research in other locations where whale watching is conducted by indigenous or local operators with limited income. Tourists from affluent or developed regions might also be willing to participate in a scheme where a small ticket surcharge goes to subsidising research in less affluent or developing regions of operational concern. Appropriate, context-specific marketing would be a critical element in making such a surcharge scheme acceptable and/or successful.

Participants **agreed** that identifying and securing – and even creating – reliable sources of funding for whale watching research should be a major focus of any initiative such as MAWI and the IWC's Five Year Strategic Plan. It was suggested that international bodies such as the IWC could create a whale watching research fund, to which Contracting Parties contribute (similar to the existing Small Cetacean Research Fund) and to which researchers competitively apply for grants. In addition, a future task for the IWC might be to identify locations where funding is a critical need, allowing foundations and granting agencies to more strategically evaluate research proposals. It was noted that a reliable source of funding in developing areas would strongly support capacity building.

6.3. Global areas of particular operational concern and approaches to building capacity

In discussion, it was determined that it would not be possible at this workshop to develop a comprehensive list of locations where impacts research as envisioned by the MAWI initiative can be undertaken in the near future. This is, however, the ultimate goal – to identify specific locations of operational concern where research addressing key questions, relevant to local management, can be undertaken with sufficient investment to leverage existing capacity and build additional capacity where needed. Action 1.2 of the Five Year Strategic Plan is related to this goal. Participants did make a preliminary, very general list of possible locations, where whale watching impacts are clearly occurring but long-term investment in research is currently lacking, including Panama (Bocas del Toro), Sri Lanka, southeast Asia, the southwest Pacific Islands (e.g., Samoa, French Polynesia), Africa and the Philippines. It was noted that there may be locations of operational concern where such research is not yet possible due to logistical, socio-political, economic or other reasons. Such areas should either be prioritised for capacity building or set aside at present to focus on locations where investment will be most effective.

Participants **agreed** that the goal of any research project undertaken under the MAWI initiative should be to produce data useful to management, conducive to modelling, acknowledged and accepted by operators and of course beneficial to the animals. 'Parachute science' should be actively discouraged, as it not only hinders trust-building but can actually breed distrust of researchers in the local community. Long-term investment of resources, effort and funding, should be built into any research project. This should include capacity to train researchers to communicate effectively with managers and other stakeholders (see item 6.1), to partner with social science and business experts and to effectively market research projects to the public. It was emphasised that, rather than limiting recommendations to students interested in marine mammals or marine conservation to a career in biology, it would be equally and even more effective to encourage such students to study, *inter alia*, social sciences, policy, communication, economics or statistics, as these disciplines are essential to managing the impacts of environmental threats and human activities on cetaceans.

One suggested approach to building capacity was for outside and local researchers, NGOs and managers to partner and collaborate with local and regional universities. Identifying and recruiting local and regional graduate students in an effort to create and support a research community in the whale watching area can help ensure the continuation of a research project, which may need to persist for years in order to collect sufficient data, particularly for modelling purposes. Even temporary programmes such as ‘junior year abroad’ or exchange programmes can help identify students who might return to an area and continue research into the future. It was suggested that graduate research programmes sending international students to a whale watching region might include a requirement to train local students to continue collecting data. It was also suggested that formal exchange programmes be developed in which graduate students from each university would spend time in both institutions, thus further building capacity in students who would be likely to return to, or remain in, an area of operational concern. It was noted that such partnerships with universities already exist in several locations, while in others this approach has been infrequent or non-existent. Participants **recommended** that international bodies addressing whale watching impacts, such as the IWC, emphasise the value of academic collaborations, as international recognition and promotion of academic partnerships with whale watching research projects could be useful in encouraging local universities to see the value in such efforts.

Another approach discussed was conducting local and regional workshops, with local operators, managers and other stakeholders, under the aegis of international bodies such as the IWC. Workshop organisers should seek to bring operators from developed regions with successful management approaches to offer input to fellow operators in developing regions of operational concern. This approach has been used in various locations, sometimes successfully, sometimes not. In the latter case, while attendance at some workshops has been high, ultimately the information on codes of conduct, research results and the like has been ignored or under-utilised, for various social or political reasons. It could also be because the input offered by the workshop organisers was not prepared or packaged in a way that appealed or made cultural sense to the attendees, or because local operators did not react well to outsiders ‘telling them what to do’. When workshops do not improve a situation of significant operational concern, it should be a priority to determine why and to identify and implement other approaches that may be more effective, which may include simply reframing information so it can be assimilated and appreciated within the local culture.

In general, it was noted that research should be considered and planned under the assumption that conditions in the identified location will be ideal, but then modified as necessary to accommodate local capacity and circumstances. For example, alternative data and data collection techniques should be considered and/or incorporated into research programmes when capacity for ideal techniques is lacking. Building capacity under those circumstances should be factored into the research programme and funding requests as necessary and possible.

7. CONCLUSIONS AND RECOMMENDATIONS

The workshop achieved a majority of its goals and objectives, but was unable to go into depth on some important points, such as the type of data that need to be collected to address the research questions generated. The participants **recommended** the organisation of a third workshop whose principle focus would be to identify and develop specific research locations, research questions, data to be collected and study designs.

Participants **strongly recommended** that potential study sites be identified by this future workshop where a holistic approach using social and natural sciences, taking into account socio-political and socioeconomic factors, is both possible and welcomed. It is essential for researchers to build a network of international and local experts, managers, NGOs and others with needed expertise, to ensure appropriate input and assistance is readily available as research projects progress.

It was emphasised that each whale watching location needs to be assessed individually, but global tools can and should be developed and made available, to assist in assessing and addressing a local industry. Chief amongst these was the **recommendation** to develop a Strategic Framework supported by a Decision Tree, to assist users to prioritise research and assess policy choices (see item 1.1). It was noted that the Framework must include the viewpoints of all of its potential users – tour operators, local business owners, managers, the public (customers) and researchers – and identify the communication links amongst them. Using the Decision Tree, researchers should assess the research and management tools available in each location, including research technologies, modelling methods and monitoring and enforcement capacity, so their research is relevant (e.g., to managers addressing established or emerging industries, whose management needs will differ); there is no immediate use for answers to questions managers are not asking.

Participants **strongly recommended** the development of toolkits and resources so global stakeholders can ideally be directed to a single location (a ‘repository’) where these resources can be accessed. The IWC is developing several resources, such as its Whale Watching Handbook, and these can be expanded to include,

inter alia, modelling toolkits and statistical packages that can be downloaded. Such software is dynamic and constantly being upgraded – any repository would need to keep pace with these updates. Ideally, managers would also find resources of value in this repository; for example, the IWC’s compendium of whale watching regulations and codes of conduct. A tagging toolkit, available at <http://www.animaltags.org/doku.php>, was offered as an example of the freely available type of resource whale watching researchers need to develop.

The participants **strongly recommended** that data collection be standardised to the extent possible, on a global scale (see item 5.2). They urged collaboration and coordination with other bodies, such as the Secretariat of the Convention on Migratory Species, which are also undertaking work streams to expand understanding of the impacts of whale watching on cetacean populations, to avoid unnecessary duplication of effort and to optimise standardisation of data collection, methodologies and general approaches to various areas of operational concern. This will also aid in the comparability of studies, greatly furthering the understanding of the potential impacts of whale watching.

It was noted that, from a management perspective, the difficulty in isolating whale watching as a cause of observed impacts when multiple stressors are known to be present in the environment can be addressed by focusing attention on populations whose conservation status is sub-optimal (see also item 4.2.1). In such situations, while it may not be possible to assign responsibility to whale watching operations for a decline in population or poor health status, it can reasonably be assumed that whale watching pressure is having a cumulative/synergistic impact, thereby justifying a precautionary approach to whale watching management. For example, a migrating whale may pass through areas facing a series of stressors, then arrive on a feeding or breeding ground where whale watching occurs. If whales’ foraging or breeding behaviours are affected by this whale watching, then there is the potential that the role of whale watching as part of the cumulative effects of stressors could have an impact at the population level. Prohibiting or restricting whale watching under such circumstances might need to be considered by managers, as it is a stressor they have the ability to mitigate.

It was also noted that regulations can be rigid and unresponsive to changing circumstances; building in adaptive management principles to regulations and codes of conduct is important from the outset. However, in practice, adaptive management has rarely been effectively implemented, in part because of the extended time horizon and lack of continuity in managers and other stakeholders over that period. Improving implementation of adaptive management principles should be a focus of whale watching management.

As a final point, participants wished to highlight for the IWC that whale watching development and management can be extremely complex, from a socio-political and socioeconomic viewpoint. The impact of whale watching on indigenous cultures, small community structures (which can be strained and changed by the influx of whale watching infrastructure and tourism) and so on, can be considerable, but engagement with local communities by managers and natural science researchers is often insufficient or initiated well after social impacts are already occurring. Additional complexities, such as whale watching developing in countries that conduct whaling, also need to be considered. Participants **strongly recommended** that the IWC approach its increasing focus on whale watching holistically, integrating the work of the Scientific Committee’s Sub-Committee on Whale Watching and the Conservation Committee’s Standing Working Group on Whale Watching as much as possible.

8. ADOPTION OF THE REPORT

The report was adopted by email correspondence on 22 April 2018 at 17:30hrs. The workshop participants thanked New for her constructive and helpful guidance during the discussions and Rose for her efficient rapporteuring.

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APPENDIX A

Agenda

Identifying Key Research Questions for the Modelling and Assessment of Whalewatching Impacts 6-7 April 2018

1. Introductory items

- 1.1. Convenor's opening remarks
- 1.2. Objectives of this workshop
- 1.3. Election of Chair and appointment of Rapporteur

2. Background

Background on the IWC intersessional committee on the Modelling and Assessment of Whale watching Impacts (MAWI) and summary of the related workshop held at the Marine Conservation Congress in Glasgow 2014.

3. Impacts of whale watching

Identification of the potential impacts of whale watching that are of greatest concern. These concerns may be due to proven impacts, or because of potential effects of whale watching that are not well understood.

- 3.1. General
- 3.2. Impacts
 - 3.2.1. Cetacean-related
 - 3.2.2. Sociocultural-related

4. Define key research questions

- 4.1. General
- 4.2. Research questions
 - 4.2.1. Cetacean-related
 - 4.2.2. Sociocultural-related

5. Data collection

- 5.1. Existing data collection techniques and corresponding analytical approaches
- 5.2. Use of platforms of opportunity to help understand the potential effects of whale watching
- 5.3. Identify whether the types of data currently being collected are sufficient for addressing key research questions

6. Current capacity

- 6.1. Impacts of whale watching on social and biological components of an area
- 6.2. Current capacity to address the defined research questions
- 6.3. Global areas of particular operational concern and approaches to building capacity

7. Conclusions and recommendations

8. Adoption of the report

APPENDIX B

List of Participants

Lars Bejder
A. Mel Cosentino
Mariano Coscarella
Jens Currie
Michael Lück
Sara Mesiti
Leslie New
Enrico Pirotta
Marianne Rasmussen
Naomi Rose
Carol Scarpaci
Valeria Senigaglia
Karen Stockin
Kelly Waples