

Report of the Marine Mammal Observer/Passive Acoustic Monitoring Observer Data Technical Working Group

Part of the 2015–2016 Seismic Code of Conduct Review
process



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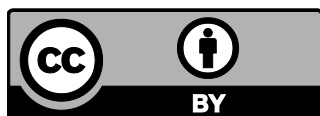
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Cite as: DOC (Ed). 2016. Report of the Marine Mammal Observer/Passive Acoustic Monitoring Observer Data Technical Working Group. Marine Species and Threats, Department of Conservation, Wellington, New Zealand. 36 p.

Publishing information:

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Published by: Marine Species and Threats
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ISBN: 978-1-98-851404-8



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Preface: background to the Technical Working Group

The review of the Code

In 2012, the Department of Conservation (DOC) developed a voluntary Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations ('the Code'), in consultation with international and domestic stakeholders representing industry, operators, observers and marine scientists. The Code (and its supporting reference document) aims to provide effective, practical measures to minimise the acoustic disturbance of marine mammals during seismic surveys. It was updated in 2013 after being incorporated by reference into the Exclusive Economic Zone and Continental Shelf (Environment Effects – Permitted Activities) Regulations 2013 ('the EEZ Regulations'; see SR2013/283).

At the time the 2012 Code was implemented, DOC committed to the Code being reviewed after three years. Accordingly, the review of the 2013 Code began in July 2015, with a request for feedback from numerous stakeholders (the Seismic Code Review Group; SCRG). In August 2015, this feedback was combined with that obtained during the three years since implementation.

Role of the Technical Working Groups

In August 2015, DOC established nine technical working groups (TWGs) to address the technical issues raised in the feedback and to provide expert advice on the most suitable methods for addressing them. It was intended that DOC would then draw on this advice when redrafting the Code. The TWGs were:

1. Marine Mammal Observer/Passive Acoustic Monitoring Requirements
2. Marine Mammal Observer/Passive Acoustic Monitoring Observer Data
3. Marine Mammal Impact Assessments/Marine Mammal Mitigation Plans
4. Consultation Requirements for Operators
5. Sound Propagation and Cumulative Exposure Models
6. Acoustic Ground-truthing
7. Non-Standard Surveys
8. Non-Commercial Surveys
9. Biologically Relevant Sound Levels

The work of these TWGs was supplemented by two workshops that were co-hosted by DOC in association with scientific conferences in 2015, to discuss the appropriate mechanisms to facilitate the integration of methodological and technological advances into the revised Code.

The nine TWGs worked until January 2016 to provide feedback on the issues assigned to them. This is the report of the second TWG: Marine Mammal Observer/Passive Acoustic Monitoring Observer Data.

Scope of work for the Marine Mammal Observer/Passive Acoustic Monitoring Observer Data TWG

Deficiencies in the current Code with regard to recording, receiving, storing and disseminating data collected by MMOs and PAM systems have been noted. Observers have reported difficulties using the current data entry forms. Accordingly, this TWG is expected to advise on improved data collection, use and dissemination protocols. These should cover:

- MMO scan procedures and PAM-to-species pairings
- Recording procedures to reduce confusion and human error
- Advice on on/off-survey reporting forms and requirements
- Suggestions on data that could be collected to increase downstream value
- Protocols for detailing encounters with non-marine mammal protected species

This TWG also advised on ways the data could be analysed to be more useful for future management decisions, including those relating to subsequent seismic survey activities. The best means of sharing results are also discussed below, including whether information should be shared via a website (internal at least, potentially public, or a mix of both) or other means.

An issue was raised on how to identify and appropriately handle poorly-performing observers. The TWG discussed reporting requirements that will help to identify sub-standard individuals or training (or PAM systems and settings) so that appropriate action can be taken. The group is also expected to suggest what might constitute appropriate actions.

Finally, this TWG makes recommendations on reporting and communication lines for compliance with Code requirements. This is because the certain situations require direct observer-DOC communication, which may be logistically difficult and conflict with contractual or other obligations. Mechanisms to ensure that observers can contact DOC directly, and a clear indication of when this is necessary, are also discussed.

The output of this TWG will be combined with that of the MMO/PAMO Requirements TWG to advise DOC and the steering group on Code elements relating to mitigation zone maintenance through animal detection, MMO/PAMO duties, and reporting requirements. Advice will be delivered in the form of a report containing two or more options (where appropriate) for addressing the specific issues raised in this subject area in the revised Code.

Specific issues raised to date have indicated the need for the following tasks:

- 1) Set out the information DOC needs to be able to assess the effectiveness of MMOs, PAM or other detection technologies.

- 2) Provide options for a more formal system for receiving, storing and disseminating data collected by observers, so the data can be more easily and usefully applied to future decisions by management.
- 3) Suggest update for the on/off survey reporting forms, including discussion of:
 - Any errors in the forms that need to be corrected
 - If space should be added for recording non-marine mammal protected species
 - If forms should be re-created using special tools, or if Microsoft Excel spreadsheets are sufficient
 - Consistent use of daylight savings time, plus a note if it is used
 - Other common errors made by observers when using these forms
 - Some facility for self-quality control (self-QC) in the field, so that obvious errors can be caught and fixed by those recording the data
- 4) Discuss any changes needed to the soft start log, such as recording steps rather than minutes, and the potential availability of such data for analysis and publication. Consider the possibility that thresholds could be exceeded during soft starts and equipment tests if redundant capacity is incorporated.
- 5) Provide options for ensuring complete and accurate collection of data (and reporting) on non-marine mammal-related items, such as PAM settings and MMO deployment locations.
- 6) Discuss the viability of, and options for, public posting of final reports.
- 7) Suggest ways the data collected by MMOs and PAM could be better used, while acknowledging all caveats.
- 8) Discuss the costs involved in various potential data collection, reporting, analysis and dissemination options, and suggest mechanisms for covering these costs.

Part 1: Introduction

1. This report offers advice for addressing known Code issues related to data collection, storage and usage

During a seismic survey, the Code requires observers (MMOs and PAMOs) to collect data using a standardised format. Data include: detections of marine mammals; mitigation events; seismic operations, environmental conditions; and instances of non-compliance. These data are submitted to the Director-General of the Department of Conservation (DOC) within specified timeframes and, commercially confidential information excepted, are held by DOC as public information. The utility of these data, as well as the methods used to record, transfer/receive, store and disseminate them is the focus for discussions of the MMO/PAM Data Technical Working Group. This discussion is part of a wider review of the 2013 Code.

The Code has five primary objectives, set out below. There are concerns (bulleted) around how well the data currently collected supports these objectives:

- 1) Minimise disturbance to marine mammals from seismic survey activities
 - The data observers are collecting at present seems ill-suited to assessing whether the Code is achieving this.
- 2) Minimise noise in the marine environment arising from seismic survey activities
 - The only point at which efforts are made to address this is in the MMIA stage of the process when proponents state they have determined what size/configuration of acoustic source is the lowest practicable for their project requirements. Observer data cannot verify this, as only the survey operator can determine their acoustic requirements. However, observers can report if approved volume, soft start length, or another noise-related limit is exceeded. How DOC tests a proponent's determination of the minimum acoustic source necessary for their project is unclear. DOC should make this process public.
- 3) Contribute to the body of scientific knowledge on the physical and behavioural impacts of seismic surveys on marine mammals through improved, standardised observation and reporting
 - Standardised observation and reporting is a worthy goal. However, observer data does not seem to contribute to the understanding of physical and behavioural impacts of seismic surveys on marine mammals. Observers cannot determine physical effects (other than through observing a dead animal, which may or may not be associated with seismic surveys). Furthermore, the behavioural data collected is quite difficult to interpret and not particularly useful for making clear scientific statements about the effects of seismic surveys. Dedicated experimental study is the best way to assess impact; but it is most likely this would require a different approach to recording data than standard observer reporting under the Code.
- 4) Provide for the conduct of seismic surveys in New Zealand continental waters in an environmentally responsible and sustainable manner

- Observer data may be useful for assessing how effective certain mitigation measures and detection techniques are – provided the data are actually analysed. If we assume the Code meets the first three objectives, then data collected by observers are useful in determining compliance with the Code. However, in the wider environmental sense, data from observers cannot inform whether the Code is providing for the conduct of seismic surveys in an environmentally responsible and sustainable manner.
- 5) Build effective working relationships between government, industry and research stakeholders
- Observer data does not support this objective, except by encouraging communication between stakeholders.

This report considers the various items assigned to the TWG with these objectives in mind.

Part 2: Data collection, submission and storage

2. Information required to assess the effectiveness of MMOs, PAM or other detection technologies

2.1 The need to improve the usefulness of the data collected for effectiveness assessments

Although discussed in more detail in the Marine Mammal Observer/Passive Acoustic Monitoring Requirements TWG (MMO/PAM Reqs) report, this TWG suggests assessing the effectiveness of MMOs, PAM and other detection technologies. For example, you could extend to the entire observer team (with appropriate recording of results throughout the voyage) MMOs' current practice to systematically assess their own ability (ie with the naked eye) to measure and estimate distances on the water (ie estimating distances to objects of known location, and comparing estimates with actual distances).

It was generally agreed it would be difficult to assess effectiveness of observers simply from the data, but that it would be essential to coordinate with the MMO/PAM Reqs TWG to ensure the data forms and reports were amended to incorporate any data needs identified by that group.

In short, in-field distance estimation testing within observer teams combined with the reporting of these trials in final reports should be sufficient. This TWG also recommends that data verification in the field be encouraged.

Possible methods to address performance standards:

- More formalised in-field assessments of distance estimation that should be included in reports
- Data verification in the field by team members for quality control purposes to identify and address any real-time data collection and recording issues
- Direct reporting capabilities to agency or DOC to identify severe issues in field
- Lessons learned reporting - and these should be included in the final reports
- Required refresher courses to make sure observers continue to perform to a set of minimum standards when carrying out observation and data recording tasks.

DOC could consider data recording options that minimise the need for observers to take their eyes off a sighting or (if necessary) return to the bridge to record data onto datasheets or a laptop. In our notes to the MMO/PAM Reqs TWG, members of this TWG suggested the use of digital voice recorders as an example of such data recording. However, a custom-built program was suggested, to shorten the time needed to annotate digital recordings.

2.2 Recommendations to DOC

The TWG recommends that DOC:

- Sets minimum standards of observer performance, particularly for distance estimation methods. While the TWG recognises that requiring specific gear could hinder the use of newer, possibly better, technologies in the future, the TWG recommends DOC specifies a level of accuracy and list of acceptable technologies (eg Fujinon 7 x 50 reticle binoculars). If new technologies or distance estimation methodologies become available that meet the required standard but are not on the provided list of acceptable technologies, then the TWG recommends DOC requires a calibration between the new method and an already-approved method. If the new method satisfies the required standards, then the TWG recommends DOC allows the use of the technology.
- Requires all observers to complete distance and angle-estimation calibration experiments at the start of the survey and include individual results in the final report.
- Implements regular (preferably daily) in-field data quality control and verification by other team members, and perform regular and thorough data checks to identify potential data problems in the field.

In addition, some TWG members also recommended DOC require refresher courses for MMOs every 2-3 years and require recertification for observers who have been inactive for more than 5 consecutive years. However, some TWG members argued that, with over 90 trained or qualified MMOs at present, it is highly likely that most MMOs will not get regular work. As a result, an MMO with 20 years' experience, but who has been out of MMO work in New Zealand for 5 years, would not be eligible to work, but is probably still a more effective observer than a new MMO who has just completed their first course but has never seen a marine mammal. Instead, these TWG members suggested that 'require' might be changed to 'encourage'.

Moreover, one TWG member believed that a recertification or refresher course should be required after a specified time, regardless of ongoing employment. However, noting the above-mentioned objection to the initial refresher requirement, they suggested the amount of previous experience could be considered when assessing the need for a 'refresher' or a 'recertification' course.

3. Receiving, storing, disseminating and using complete and accurate data

3.1 Data applications

The TWG discussed a more formal system for receiving storing and disseminating data collected by observers. It concluded that the type of system needed for this generally depends on the data needed, the way(s) it needs to be accessed, and other factors specific to its use. It was noted that more work to define the requirements for the data was needed, after which the systems for handling the data could be determined.

Generally, DOC should consider the use of a specific platform that allows data to be stored in an on-ship database (to allow observers to write their final reports), and directly

transferred to a database managed by DOC. These programs typically interface with a hand-held GPS to automatically record the date, time, latitude and longitude of sightings (potentially also with the entry of waypoints). The automation of these data will reduce manual data entry errors.

3.1.1 Software applications to improve data handling

There are numerous software options that allow this, including Mysticetus¹ or PSO Tracker.² VADAR Sea, an Australian reporting program, is another software platform that allows quick mitigation decisions to be made (although it would require a data platform at the observer's location) and mapping of sightings in real time for easy incorporation into reports. However, these programmes have limits that would need to be understood. TWG members generally supported systems that would allow data to be transferred and extracted easily for many uses, especially the generation of reports. Members acknowledged, however, that a custom-built program may need to be developed.

The use of such software systems would both a) remove the risk of data manipulation before it reaches the regulator, and b) make data extraction much easier, both for reporting and for future analysis by external parties. Such software would also allow data to be sent regularly to DOC, providing an efficient method of data transfer and back-up. DOC should consider alternatives to Excel spreadsheets, as Excel is extremely prone to data entry errors, data manipulation and file corruption. The TWG recommended that datasheets/software should allow for the recording of non-marine mammal species, as this would increase their value with little extra effort.³

Further discussion revealed there were several different reporting requirements across surveys beyond that required under the current Code – such as daily or weekly summaries, and health and safety reports. Many observers have had difficulty submitting data forms (which get quite large after several weeks at sea). Clarifying survey reporting requirements (ie while observers are still offshore) would help. The size of templates and forms should be kept to a minimum, and only sent when needed. Similarly, well-designed software could transmit time-sensitive compliance-related data while offshore, but hold the full dataset for later transmission from a shore-based connection.

3.1.2 Amendments to data practices to meet Code objectives

Compliance with the Code is mandatory for seismic surveys being undertaken as a permitted activity in the EEZ. An intended output of the review process is that the Code should also be mandatory within territorial waters. It is thus crucial that data collected under the Code can demonstrate compliance wherever the survey is undertaken. This will also be important for the survey proponent, as it will be up to them to show the compliance agency that their survey has achieved high regulatory performance.

The data we are collecting, while primarily useful for compliance, are insufficient to meet many of the Code's objectives – it is questionable whether collected data can robustly

¹ <http://www.mysticetus.com/>

² Developed specifically for Shell Alaska by LGL.

³ Most data collected on marine mammals also relates to other marine species, such as sea turtles.

assist in determining if the Code is meeting the first two objectives of the Code.⁴ The third objective⁵ is similarly problematic. This section provides details regarding what information is needed to meet Code objectives, and why.

An outcome of the overall Code review should be that proponents can clearly identify the steps required to meet their obligations (one of which will be ‘regulatory compliance’) – including what data should be recorded and how. Although a central aim of the data may previously have been to ‘achieve successful mitigation’, we can now add ‘demonstration of that successful mitigation’.

3.1.2.1 Supporting Code objectives

Acknowledging the limitations of using seismic surveys as a platform to collect systematic data suitable for hypothesis-driven research, some in the TWG suggested that these three objectives could be reframed to be more achievable from a data collection perspective, while still providing benefits beyond the management of marine seismic surveys in New Zealand waters. Below, is set out the TWG’s suggested alternative wording around the first three objectives of the Code, which in turn are (in some members’ view) linked to the three main objectives of data collection.

Members noted these objectives have been formed based on feedback from the Department of Conservation (DOC) and the Environmental Protection Authority (EPA); however, members also noted that further consideration of these by the Steering Group is needed. (Note that the final two objectives of the Code are less related to data issues and are, members believe, still valid objectives.) However, other TWG members felt that the current situation should not lead to changes to the objectives of the Code, but that we should instead a) come up with smarter ways of collecting data or b) spend some money on an experiment. Some TWG members strongly opposed any suggestion that we should change the Code objectives just because our collected data are poor and cannot meet them.

3.1.2.2 Improving data collection practices

Data collection should be as quick and easy as possible for the observers, and needs to reflect limitations imposed by training and other duties. The use of a dictaphone or similar recording device can improve continuous data collection during sightings to make later data entry more complete.

The data report produced by Blue Planet Marine (BPM: Childerhouse et al., 2016) was a good example of the output we can get from collated data, but highlighted some concerns. These are listed in detail in the **Appendix**. In addition to the analyses in the BPM report, the following analyses would be useful:

- A comparison between species of concern and other marine mammals.

⁴ Referring to minimising disturbance to marine mammals, and minimising noise in the marine environment more generally.

⁵ Seeking to increase the body of scientific knowledge on the physical and behavioural impacts of seismic surveys on marine mammals.

- A review of contributing factors to a lack of animal identification to species level. For example, is this a function of distance and/or sighting conditions? Equipment specifications should also be considered (eg magnification and aperture of binoculars), as should the experience of the MMOs in sighting and identifying marine mammals. Some TWG members favoured recording these types of data in observer reports; yet others felt this was an unnecessary level of detail, and there are many other reasons for a marine mammal going undetected.
- A breakdown of mitigation actions per survey, or per unit distance of acquisition and/or observer effort.
- A further break-down of marine mammal numbers by petroleum basin
- Details of how often a higher number of species were observed than expected in a certain area or if a species was observed in an area that was not expected. However, while the MMMP indicates animals likely to be seen and a rough idea of numbers, it may not be possible for an MMO to determine this in the field, despite the existing requirement for them to inform the DG immediately of such things. There is also no guidance on how much the expected numbers need to be exceeded by before contact is required. DOC should advise on this requirement, without placing undue requirements on observers.

Many of the items above could be achieved using the current datasheets. Some items, however, might need further information to be recorded at the time of the sighting to resolve, but this should not be difficult.

3.1.2.3 Recording date and time

Finally, there was general agreement that all times should be standardised for consistency. Use of Coordinated Universal Time (UTC) was suggested for standardising with other data reported aboard ships. However, if the MMO is independently recording airgun activity, the data does not usually need to be synchronised with ship logs, and use of UTC may create some issues in later reporting.⁶

The recording of data in local time is important if sightings are to be assessed in relation to time (eg day, month, time of day). This is particularly important for species that may display diel-related behaviours (eg a tendency to be more actively foraging at certain times), which may provide context for their avoidance (or lack thereof) of a seismic array. Thus, New Zealand standard time is another alternative that would better reflect environmental conditions.

However, it was noted that the MMOs might not be able to record all details independently. They may not see or hear the very beginning of a soft start, and would not be able to tell when full power is reached. Thus, some data will need to be taken by reference – to seismic crew logs (that use UTC), or information conveyed by them at the time. Similarly, MMOs can watch screens for start and end of line times – but these vary, and subtly change continually. Gun test and soft starts are not displayed also. However,

⁶ Although it should be possible to account for UTC v. local time issues through appropriately designed systems.

this issue could be resolved by incorporating a conversion to UTC on the worksheets. This issue was not resolved among the TWG.

3.2 Recommendations for DOC

3.2.1 Objectives of the Code

Protection of marine mammals is the chief purpose of the Code. Data collection is therefore primarily for compliance/enforcement – science is a secondary benefit. Mitigation objectives of the Code should be set first, with appropriate data collected to suit the Code, not the other way around. The data collection related to mitigation actions, additional effort and sightings data should also not be too complicated.

A different set of data is needed to inform whether the Code is meeting its objectives. Also, there's nothing wrong with having aspirational objectives, so long as we are realistic about how to meet them.

Rather than rewriting the objectives, a wider discussion is needed about what research is necessary to meet the original objectives, and how best this can be done. However, the TWG made no suggestions on what data currently collected by observers assist with meeting the Code's original objectives, and/or what data are missing.

3.2.2 Purpose of data

Members agreed that the purpose of data collection by MMOs and PAMOs during marine seismic surveys should be prioritised as follows:

- Inform real-time mitigation decision-making and actions to minimise exposure of marine mammals to noise from seismic survey activities
- Document decisions and actions taken to minimise noise exposure to marine mammals, for compliance purposes
- Contribute to a publicly-available database on marine mammals in the proximity of seismic surveys, in New Zealand waters.

With these in mind, the TWG recommends that GPS track-lines (latitude and longitude at a minimum resolution of five-minute intervals in time) of vessels accompany datasheet submissions on completion of surveys.⁷ The data collected for these track-lines should be specified, eg vessel position every minute (or another interval), speed over ground, true course, etc.

⁷ One member noted that this is more of a compliance issue, as it is already required under the Code but infrequently implemented.

3.2.3 Functionality of existing datasheets

Although many of the other recommendations made by the TWG address datasheet functionality, the TWG specifically recommends that this functionality can be greatly improved by adding VBA code to DOC datasheets to allow export to .csv files of:

- Detection summary
- On-Survey Effort
- Individual sighting sheets as required

3.2.4 Data format – date/time

We recommend that date/time is collected and stored primarily in local format, with an automatic conversion to UTC format in the spreadsheets. Alternatively, both local time and the UTC offset can be logged. Local time is functionally easier to work with and more biologically relevant, although it is important to also record what the offset is. This is essential for interpreting the data later, especially when dates for daylight saving can shift.

3.2.5 Detection sheet fields for possible removal or amendment

The TWG recommended edits or removal of the following existing datasheet fields:

- *Water depth*: In general, this information isn't required for immediate decision-making but can be used as part of a mitigation requirement for some surveys that state in their MMIA that a different source power or mitigation option may be applied depending on the water depth (eg Māui dolphin habitat). Therefore, this information should be collected as part of sighting information. However, any future analyses could presumably utilise a detailed bathymetric dataset to extract depth information.
- *Behaviour fields*: TWG members generally agreed that these data are unlikely to be completely reliable and therefore could be removed. However, while the behavioural categories are broad and subjective, they may be useful for a broad interpretation of other data, and are also collected as part of standard marine mammal research internationally. Some in the TWG thus felt they should be retained. A recommended alternative to, or expansion for, behavioural data is a system of 'cues' – such as 'blow', 'aerial behaviour', 'porpoising', 'logging', 'slow surfacing', etc that are discrete definable sighting observations. An extra column noting an observable change in behaviour was recommended.
- *Mammal course*: (main form only) a course is only going to be relevant if multiple sightings of a pod can be made, so this field could stay in the table at the bottom.
- *Position of pod versus vessel*: having both a click-and-drag plot and the true plot is an unnecessary double-up. Members suggest removing the click-and-drag plot.

3.2.6 Detection sheet fields for possible addition

- *Sighting cue*: (as a replacement for behaviour). Consider the following in the drop-down options: birds, splash, blow, body, footprint (although in some instances it is

conceivable that more than one cue is noted at once (ie logging and blow). An extra column noting observable change in cue is also recommended.

- Add check box to indicate whether photos or screen shots of a detection were obtained by the observer. The detection sheet should also record file names for the relevant images to allow ease of cross-checking.
- Add fields to display non-standard mitigation zones (when relevant).
- *Additional mitigation information:* currently this is added manually, which makes extraction/summaries/analyses of this information much harder. For example:
 - Add cells for when shut-down is requested and occurs. This could make use of the “=now()” function in Excel, with cells formatted to, for example, hh:mm:ss. However, it was noted that this function will update (unless options are specifically set not to calculate automatically and not to recalculate when saving) so there is the potential for it to get overwritten. A better alternative to inserting a static time is to use [CTRL+SHIFT+;]. However, it was also noted that either option will only prove useful if observers are entering data into Excel in real-time.
 - Add a cell for when operations recommenced (as above), plus another cell with the description of that change (eg pre-start commenced; soft-start commenced; guns restarted etc).

3.2.7 General recommendations

- *Re-draft species codes using some, but not all, IWC codes:*
 - Add automatic filter of species listed (dependent on family)
 - Provide ability for typing family/species name and cell autofill
- *Replace the terms ‘on effort’ and ‘off effort’ with ‘inside operational area’ and ‘outside operational area’ (respectively).* Furthermore, consider merging inside and outside operational area recording into a single sheet, with a new field recording inside or outside. This would require adjustment of auto-calculation of summary data to account for the changes to support this merging.
- *Include pod position in the ‘detection summary’ worksheet* of the reporting forms to enable easier access to these data and reduce the possibility of transcription error. Note that many pod positions may be recorded for each sighting (or none at all) and so a decision needs to be made about which position(s) are included in the ‘detection summary’ worksheet.
- *As much as possible use Darwin Core data standards (<http://rs.tdwg.org/dwc/>)* when designing a new or revamping the old data collection system. This set of standards will facilitate data sharing across institutions by maximising reusability.

3.2.8 Appendix 2 of the Code – observer reporting

The content of the summary report (as outlined in Appendix 2 of the Code) should be reviewed, to determine how/if any of the changes suggested above alter the required

content of summary reports. For example, the removal of a field would require this detail to be removed from summary reporting requirements as well.

4. Reporting during surveys

4.1 The need for data/reports onshore while observers are offshore

During the 2014/15 seismic survey season, the EPA requested voluntarily weekly report submissions from operators, covering their seismic survey operations and results from MMO and PAMO teams. In making this request, the EPA was aware that at least some of the MMO/PAMO service providers were already providing their reports to clients. From the EPA's perspective, weekly reports were (and are) preferable to daily logs as a quick and easily digestible summary of the week's activities. Notwithstanding the concerns surrounding working hours of MMOs and PAMOs, and EPA firmly believes that regular (ie weekly) reports from the survey vessels are crucial to monitoring regulatory performance.

Although some MMO providers may be producing daily reports for their clients for quality control, the TWG does not recommend requiring daily reports. Weekly reports are far more efficient for compliance purposes, which is a consideration as their review would become a cost-recoverable activity for the EPA. Specifically, weekly reports were initiated due to lack of regular reporting during surveys under the current Code. By obtaining regular updates from operators, the EPA was hoping to facilitate early detection of potential compliance issues, so that a positive compliance outcome could then be achieved for the remainder of the survey.

Because the request was voluntary, the EPA did not prescribe report content, but did provide informal guidance on the areas of interest. In particular, the EPA was interested in obtaining basic data summaries (ie seismic activity); visual and acoustic detections of marine mammals (including array status at time of detection, etc); any mitigation action; and any issues encountered (particularly related to compliance). It was left up to the operators and service providers to determine the exact content and format of the reports.

The outcome of the EPA's request was:

- All operators who were asked to provide weekly reports did so
- All reports provided sufficient data summaries
- Reports provided a mechanism for important regulatory oversight while the activity was underway
- The ability to provide educational guidance to the operator when compliance issues were detected (in at least one instance)
- Positive responses from some operators at the end of the surveys confirmed that the benefits of weekly reporting extended beyond the EPA

The EPA intends on requesting weekly reports during the 2015/16 season. Given the success of these reports in the 2014/15 season, consideration should be given to making these reports mandatory. The agencies could then prescribe the content of the reports, focussing on demonstration of compliance for the reporting period in question.

Weekly reports do not need to be long or onerous to produce. The content of weekly reports should be aligned with the content of the re-designed workbook (or any other data capture tool proposed). Further mandatory reporting should mirror or modify existing reporting requirements rather than creating new ones, given observers' already-high workload.

The reports should come straight from the MMO/PAMO team leader and be posted online or emailed to a distribution list. This list would include relevant regulatory authorities, and anyone else the operator considers an interested person or group. The file size of these reports (most commonly in .pdf format) should be small, to prevent bandwidth issues from seismic survey vessels occurring.

Also relevant to this action point are the datasheet submissions that are currently due following each swing. These have been problematic, in part due to the very large file size of the DOC datasheets. Consideration needs to be given to minimising the ship-to-shore transfer of data. Notwithstanding the other action points that will touch on this, an 'export to .csv' function in the worksheets would facilitate these submissions. The export would likely be one or two worksheets from the large Excel file, focussing on detections and survey effort. This would result in a much smaller file that could easily be emailed from vessels. However, while the summaries might initially be sufficient, any specific questions or queries could need following-up. It would be possible to use VBA (or other) code to export all (or individual) worksheets, potentially just as needed.

Together with the weekly reports, regulatory agencies would then have all the data they would likely require during the survey. From the agencies' point of view, full workbooks could therefore be submitted on completion of the survey, and when vessel bandwidth issues no longer hinder emailing large files. Investigations of potential non-compliance may occasionally trigger extra data requirements, but these are best dealt with on a case-by-case basis. Service providers may still require their personnel to submit full workbooks, but this would no longer be a regulatory requirement.

4.2 Recommendations for DOC

- Weekly reports should be a mandatory requirement under the Code. The relevant agencies should prescribe the content, and potentially provide a template form, taking into account the Code's current requirement that observer working hours not exceed 12 hours in any 24-hour period (including reporting duties). Weekly reports will focus on information required to demonstrate compliance.
- Periodic submission of data should continue as part of reporting requirements, but should utilise a data export (as discussed above).

5. Should datasheet reporting be by swing, deployment or survey?

5.1 Datasheets need to support final reports

Datasheet reporting is different to the final report. Data should be reported back to DOC at regular intervals to ensure it is backed up and added to a survey's database. This will

depend on the resources (ie staff) available at DOC to deal with incoming data on a regular basis.

Currently the Code requires submission of raw datasheets up to 14 days after completion of each 'deployment'. This is most often interpreted to mean swing (which normally coincides with MMO rotations, but not necessarily also PAM deployment). However, team members can occasionally swap-out mid-swing. After submission of datasheets at the end of the swing in one such case, DOC expressed that they would prefer to have received them after the end of the team leader's rotation. This makes sense, since the team leader is responsible for the data collected under their watch. Regardless of the ultimate decision on the frequency of submissions, the use of data entry, receipt and processing software could ease this process, as discussed above.

Reporting on a project should be in the form of a final report that encompasses all swings/rotations of observers over the project's course. The content of such reports is outlined in Appendix 2 of the Code; they should include, as a minimum:

- Information on the sightings/detections
- Effort, including any relevant equipment specifications (eg binocular specs, distance estimation methods, etc)
- Air-gun activity collected over the duration of the project
- Compliance
- Any issues with implementation of the Code, with suggested improvements

However, Appendix 2 needs to be reviewed. DOC/EPA should determine the specific details necessary for them to meet their responsibilities and needs. Are the final reports useful in their current form? It would be useful to detail who the final reports are produced for, and (specifically) why they produced.

The MMO team leader/s (as a survey would include multiple swings and multiple team leaders) would be best placed to write this report with (ideally) the assistance of the observer provider; therefore data collected over the course of an entire project must also be stored aboard the project vessel. With sufficient report templates and analysis/data summary templates, it should be easier for the lead observers to start, add to, and finalise reports over rotations. Accordingly, templates for all reports required of the Code should be developed by DOC/EPA to meet their needs. If the weekly and final reports were cleverly designed, then this could work. For example, if DOC/EPA developed an updated template of what they require in a final report, the weekly report would just be a subset of that information. In this way, team leaders would be producing (likely mandatory) weekly reports for the EPA that would also be relevant on a whole-survey basis. This would be an efficient use of a team leader's time during a survey.

5.2 Is function best served by multiple or single datasheet submissions?

Some members recommended that datasheets continue to be submitted up to 14 days post-swing (regardless if the swing is 1-2 day CSS or a 5-6 week MSS), unless the TL (or whomever is responsible for data collection up to that point) leaves the swing early, in

which case datasheet submission is tied to their deployment and datasheets be submitted up to 14 days after they leave the vessel. They suggested that waiting until the end of a survey (depending on its length) would be too long. There is a risk that errors/non-compliances in the datasheets over an entire survey would not be picked up until the end. However, to simplify matters, others strongly recommended that datasheets be submitted at the end of an entire survey. The original rationale for submission at the end of each swing was to prevent MMOs from leaving poor/incomplete work for any MMO taking over from them on a multi-swing job. However, those who have worked under the Code on a multi-swing survey have still seen MMOs do a poor job of recording on a previous swing, with the lead MMO then required to beg them to fix records/work for final reporting. While some providers check the datasheets daily, not all sheets are currently being checked and the MMOs are not always being chased up when necessary. This is justification for improving MMO standards (somehow) through the MMO/PAM operator requirements TWG.

Also, depending on how observer teams were instructed, sending in raw datasheets partway through a survey can mean that detection records restart part-way through a survey, meaning duplicate detection numbers for final reporting.⁸ One option would be to design software to make submission of daily or weekly data summaries, as well as their analysis, easier for both observers and DOC. A well-designed sheet (in Excel or otherwise) could simplify submission by observers in the field to a click of a button.

Regardless of any decision on submission frequencies, MMOs should be recording data completely and correctly from the start: The TWG recommends creating checklists that MMOs are obliged to use to ensure they're completing any reporting requirements. Some MMO-providers are taking a lot of responsibility for managing their MMOs during the deployment to ensure that work is being done, and that records are complete and accurate. However, this is not universally practised (most of them are very hands-off).

If DOC sticks with submission of the raw datasheets at the end of each swing, there should be an extra requirement for either:

- The MMO-provider to take responsibility for error-checking raw datasheets prior to submission to DOC
- DOC to error-check these documents as soon as they are received, and chase up any errors with the MMO-provider.

Either (or both) of these would address the risk of errors not being picked up until the end of a survey. However, it was noted that not all MMO providers can do this, as some lack the specialist knowledge needed to understand and check datasheets. Others countered that the providers should have the capability to make such checks if they are accepting contracts to provide MMOs.

5.2.1 Datasheet use: swing-by-swing or cumulative

Related to the BPM report mentioned above, and to the preceding discussion about submission frequency for raw datasheets, is whether a separate DOC reporting form

⁸ The datasheet charts for a single swing of a multi-swing survey are also meaningless in the context of a final report submitted at the end of a survey.

should be used for each swing of a multi-swing survey, or whether one reporting form can be used cumulatively for an entire survey. A related issue is that the coversheet of DOC reporting forms suggests the datasheets are to be used on a swing-by-swing basis. This can cause problems; for example, if observation point information is changed on the coversheet, then the marine mammal distance-to-source field in any relevant detection from the previous swing will change. There are several conflicting difficulties:

- Final reporting is unnecessarily difficult if the same datasheet is used on a swing-by-swing basis.
- DOC reporting forms currently include functionality that can cause problems if the forms are used cumulatively.⁹
- Fields in the coversheet of the DOC reporting form suggest that a new reporting form should be started for each swing. However, doing this for each swing of a multi-swing survey causes problems with data (eg multiple marine mammal sightings with the same sighting number), requires manual extraction of data for analysis and summary, and is incredibly inefficient. There is also a risk of transcription error when extracting data.

Enabling the use of DOC reporting forms so that the same file can be used for multiple swings of the same survey would be sensible. This should be included as part of the wider revamp of the DOC reporting forms.

5.3 Recommendations for DOC

1. A summary (final) report template document should be developed for all surveys. This will enable consistent data reporting and comparisons across surveys and observers. This will require:
 - DOC and the EPA to determine the content of the final report, for these agencies to fulfil their roles under the Code
 - Consistency with the data collected in the DOC Excel reporting forms (so that the data required for final reporting are being collected)
 - Consistency with data required in weekly reports (ideally weekly reports should simply be a subset of the final report content, so the whole reporting process is efficient)
 - A review of Appendix 2 of the Code, to update the required content
2. Raw datasheets should continue to be submitted to DOC as per the 14-day period currently specified in the Code. However, a checklist should be developed so that observers check the entered data daily and systematically. This checklist should be based upon:
 - Common errors detected in previous spreadsheets
 - Areas of data records relevant to DOC and the EPA for compliance purposes

⁹ For example, changing the names of the observers, or making any change to observation points in the coversheet, has undesirable flow-on effects for subsequent data.

The checklist should be maintained by DOC/EPA (informed by information from observer providers and/or observers) and be updated as required.

3. The DOC reporting forms should be amended so that they can be used on multi-swing surveys.

Part 3: Specific form changes

6. Contents and fields of the on/off-survey reporting forms

6.1 Recommendations about inclusion of non-marine mammal species

Observers should be focussed on marine mammals as per the intent of the Code. However, some MMIA's will require particular note of some species (eg sharks). For example, while sea turtles should be considered (at least in terms of mitigation), the merits of extensive data collection are unclear. However, datasheets would probably be needed for recording species, location and number, at a minimum, to support this.

Accordingly, it might be worth considering adding such species to the worksheets, although careful consideration needs to be given to what is usefully recorded and how this information would be analysed.

6.2 Recommended changes to address errors and omissions

6.2.1 Cover sheet

1. Some fields are not flexible enough to allow relevant data to be entered. They should be changed to allow a range to be entered:
 - Frequency range: (Hz)
 - Hydrophone bandwidth: (Hz - kHz)
 - Sound card sampling frequency: (Hz - kHz)
2. Using the DOC reporting forms cumulatively for multiple swings raises the following issues:
 - The names of observers will need to be changed for each swing. This can be done on the coversheet and doesn't change the data entered into the 'first detected by:' field of a marine mammal sighting - which is good. However, if the file is used cumulatively, only the names of the previous swing of observers will be recorded on the coversheet.
 - If for any reason the observation points listed on the coversheet are changed between swings, the 'marine mammal distance to source' field (in an individual marine mammal sighting worksheet) will automatically update. This may cause issues regarding mitigation decisions since the marine mammal distance to source will change.

It may be possible to 'lock' a marine mammal sighting worksheet after the data are entered, so that they do not automatically update, but can be manually edited if necessary.

- If source levels (such as lower levels in the shallower parts of the operational area) and/or mitigation zones change, the change needs to be accurately reflected in the cover sheet (currently it cannot).
- The observation points only allow the eye height of one observer to be entered; there are two MMOs working per shift.

6.2.2 Specific formula errors

Formula errors in the current datasheet need to be fixed, as detailed in **Table 1**.

Table 1: Formula errors in the datasheet

Worksheet	Cell #	Formula error	Correct formula
On/Off survey summary	P2002	=SUMIF(M2:M881,"NA",H2:H881)	=SUMIF(M2:M1989,"NA",H2:H1989)
As above	P2006	=SUMIF(I2:I881,"dr",H2:H881)	=SUMIF(I2:I1989,"dr",H2:H1989)
As above	P2012	=SUMIF(J2:J881,"fo",H2:H881)	=SUMIF(J2:J1989,"fo",H2:H1989)
As above	R2017	=SUMIF(N2:N1989,"PAM only",H2:H881)	=SUMIF(N2:N1989,"PAM only",H2:H1989)
As above	P2024	=SUMIF(K2:K881,"4",H2:H881)	=SUMIF(K2:K1989,"4",H2:H1989)
On/Off survey summary	N2019	=(N2018*100)/#REF!	=(N2018*100)/T2018
As above	Q2019	=(Q2018*100)/U2018	=(Q2018*100)/T2018

6.2.3 'Comments' fields

6.2.3.1 Review of current use

The existing forms include the facility to calculate the distance of the animals from the source by calculating the position of the array, the position of the animals, and then the distance between the two. However, the position of the array is determined by assuming it is aligned with the vessel's true course; in fact, it will be more closely aligned with the vessel's heading – which in areas of strong currents could differ significantly from the true course. The resulting error in the array position will lead to an error in the calculated distance between the animals and the array, on which mitigation decisions may be based.

While acknowledging the need for observers to keep their eyes on an animal rather than be entering data into a spreadsheet, if the calculation is to be included on the forms it needs to be correct. This could be resolved by replacing the vessel's true course on the marine mammal detection form with the vessel's heading (as was the case in the original draft of these forms), which would then be used in the ensuing calculations. However, true course may remain a better reflection of the path of the array. Either way, this is not necessarily a straightforward fix, as during line turns the source is unlikely to be behind

the vessel as described by either the heading or course. This is only an issue for turns when the source is active.

There are also several instances where data critical to the observer's job (eg for purposes of determining compliance, such as airgun status) are not stored anywhere in the sightings datasheets, so observers are forced to use comments fields to record this information.

Notes typically found in the comments column of the *sightings* sheet include:

- Start of line time
- End of line time
- Time of entry/exit into 'Survey area + the associated lat/long:' (which is not recorded elsewhere to our knowledge) – this is often recorded by observers, even though the time is already recorded in column C of the 'On or off-effort' tabs in workbooks.
- Time vessel left port
- Deployment time of seismic streamers, etc began and when it was finished (despite the availability of DR in *Effort* spreadsheet). Same for retrieval of gear. Details of the deployment/retrieval of PAMO gear are also common, but there is no other place to record this.
- End of visual observations (although this can be determined from column K of the 'On or off-effort' tabs).
- Time the 'all-clear' is given to start with soft start
- Timing of bubble tests, line turns etc
- Names of observers/operators on watch
- Time at which PAM observations begin and when they give OK for seismic source deployment
- Time at which pre-start watch begins (this would be a useful addition to the array status column options at present most observers use NG)

6.2.3.2 Importance of this information

Many of these things can be gleaned from looking at entries in other columns, but this is the typical information observers add to the worksheets, which is useful in confirming the timing of events. In particular, the final two items here (PAM and MMO watch onset and 'all-clear') represent information that would be particularly useful to assess compliance and effectiveness. Some of the missing data could be automatically brought in from other sheets by better structuring the Excel sheet. Others would require manual entry by the observers. As this is extra effort, DOC should decide how useful it is to recording the additional information as standard. For example, MMOs will often not be on watch when the ship departs, so this field may not be used, making it useless for analysis. Similarly, with airgun status recorded, the start and end of a line is unlikely to be very useful.

6.2.3.3 Dedicated collection of operational information

Adding a tab on the data form for entry of operational details (eg observers on duty) should be considered to reduce the out-of-context use of comments fields, and to help auto-populate the detection data to reduce data entry times. These details are just as important as effort and sighting-related data, as any future analysis of the data must include the operational details of the project for the sighting data to have real meaning. It was also noted that sighting conditions should be recorded whenever conditions change, or more regularly when observers are on watch as environmental conditions can often change very subtly without an observer noticing. This is due to their direct impact on detection rates. However, glare was highlighted as likely to be directional and thus may only be affecting detection in certain parts of the mitigation zone.

While the TWG did not recommend use of the Australian datasheet format, it was used to highlight the type of information that can be captured by the 'Operations' that is present there, which in turn is really just an altered JNCC Operations page. This tab collects information on operation times being start of pre-search, end of pre-search/start of Soft Start, Full Power, Start of Line and End of Line/source stopped (power-down is an Australian feature and therefore not relevant). There is a yes/no column if any mitigation action is required, and a column for notes (eg MMO can write in this column what the mitigation action was and what sighting number refers, for example). Sometimes there can be a 1-2 min difference between end-of-line and the time the guns stopped due to noise recordings made at the end of any line, which is based on a stipulated number of shot points. Other items (eg start of deployment, inside/outside operational area) could also be recorded in this tab, rather than in the comments section. The utility of this tab has not gone unnoticed, and some MMOs in New Zealand have also just created their own additional spreadsheet for recording operations, pre-searches, etc.

Some felt that having a separate tab with all information pertaining to one survey line in one record would make analysis of compliance much easier than having times listed over many records in a column. However, others felt that adding another tab would be confusing. An alternative suggestion was simply to add extra column(s) to the 'on-survey effort' worksheet with the relevant information auto-populated into sightings, as mentioned above. The 'operational' column could include the following options in a drop-down menu:

- Left Port (LP)
- Arrived Port (AP)
- Start of Line (SOL)
- End of Line (EOL)
- Entered Operational Area (EOA)
- Exited Operational Area (ExOA)
- Start of Seismic Gear Deployment (SGD)
- Seismic Gear Deployment Finished (SGF)
- Start PAMO Gear Deployment (PGD)
- PAMO Gear Deployment Finished (PGF)

- Start of Visual Obs (SVO)
- End of Visual Obs (EVO)
- Start PAMO Obs (SPO)
- End PAMO Obs (EPO)
- Line turn (LT)
- Bubble Test (BT)
- PAMO OK for Seismic to Deploy (POK)
- Pre-Start Watch begins (PSW)
- All clear for Soft Start (ACSS)

These would correlate with the time typed into column C (Time start). Alternatively, some of these could be included with the current Array Status options. Another column could be added for the names of the observers on watch. Initials of the individuals need only be entered.

6.2.3.4 Recommendations for DOC

- Consider replacing the vessel's true course on the marine mammal detection form with the vessel's heading instead. DOC should check with crew familiar with seismic survey navigations to get their thoughts on where the source is likely to be.¹⁰
- Add the following options to column C (Array status): Left Port (LP), Arrived Port (AP), Start of Line (SOL), End of Line (EOL), Entered Operational Area (EOA), Exited Operational Area (ExOA), Start of Seismic Gear Deployment (SGD), Seismic Gear Deployment Finished (SGF), Start PAMO Gear Deployment (PGD), PAMO Gear Deployment Finished (PGF), Start of Visual Obs (SVO), End of Visual Obs (EVO), Start PAMO Obs (SPO), End PAMO Obs (EPO), Line turn (LT), Bubble Test (BT).
- Add column with observers' names
- Add column with sighting conditions, eg (1) Excellent, (2) Good, (3) Fair, (4) Poor, (5) Terrible.
- Add details to descriptions of glare: No glare (N), Weak glare forward (WF), Strong glare forward (SF), Variable glare forward (VF), Weak glare behind (WB), Strong glare behind (SB), Variable glare behind (VB). Alternatively, two fields can be added: (1) Vertical sun (12 to 3 with 12 being overhead); and (2) Horizontal sun (1-12, like hours on a clock, relative to the ship with 12 dead ahead on the bow.
- Add column with Mitigation action: yes/no.

¹⁰ It was also noted that the GPS track data could be obtained from the ship. It should be possible to design a system that would record these data; all that would then need to be entered is the angle of the sighting relative to the ship's bow.

7. Avoiding common errors in data collection

7.1 Common errors

Certain data errors are common. Observers and observer providers must identify and correct these errors when performing quality assurance on the data. It was suggested that providing general advice on this process, which could be shared across industry to reduce errors overall, would be worthwhile.

During their review of seismic data, Childerhouse et al. (2016) identified several common data errors. These are listed below, with members' suggested solutions:

- Misinterpretation of NG (no source/gear out) – some people think this means no source/gear in the water, but it actually means the gear is in the water but the source is not active. Members suggested changing NG to SI (source inactive) – or similar.

On a related note, it might be useful to also include another field for 'new location for the first time'. This is a tricky one for compliance and so perhaps it would be useful to have a field that shows when this particular pre-start watch began (and where) so that we can more easily identify and account for the 2 hours, 20 nm requirements etc.

It would also be useful to be able to identify when Line Turns occur and what the array status is during this time.

- Confusion over use of NA v. Poor in column L of the 'On-Survey Effort' or 'Off-Survey Effort' worksheets. This is a matter of training.
- Not clicking on the 'Retrieve Survey Effort Conditions' button after starting a marine mammal detection form for sighting a New Zealand fur seal. Correct information is not always being pulled through to the summary worksheet. Suggest there be a prompt for this.
- Distance to source is sometimes not entered for a sighting. There are valid reasons for this, but perhaps observers could be prompted to state why there is no distance.
- Empty cells – this is sometimes a problem. Perhaps DOC can determine the mandatory cells and require entries into those cells before observers go further. Members were not sure how this would work in reality.¹¹
- Some teams use the same on- and off-survey spreadsheets for an entire survey (multiple swings), whereas others use a different on/off-survey spreadsheets for each swing. This impedes reporting as spreadsheets must be unlocked, data need to be combined, there are multiple sightings with the same ID number, etc.

Members suggested one 'on effort' and one 'off effort' spreadsheet be used for multiple swings on the same survey, and the coversheet be amended so that information can be added for each swing as needed.

- Missing data on covering sheet. The TWG noted this issue, but identified it as one that needed to be addressed by observers and their QA/QC processes.

¹¹ The TWG agreed that some cells should be mandatory, but did not advise which these should be.

7.2 Recommendations for DOC

7.2.1 Incorporate quality control

Data verification, or quality control assessment of data, is a vital (yet likely a rarely-performed) step to data entry and submission. An observer team can verify data while on rotation. Data entered by one observer should be verified independently by another observer on the team. Any missing data or glaring issues can then be dealt with efficiently – observers may need a checklist of data combinations to perform the verification. However, it should be recognised that DOC would still need to check data following submission.

Datasheets/databases or data entry software can often be set up with checks in place to ensure proper data entry, although not all potential errors can be avoided this way.

For example, the JNCC provides observers with guidance to complete their forms (available from <http://jncc.defra.gov.uk/page-1534>). This guidance notes in particular that observers should not:

- Change the validation settings
- Leave blank lines between records
- Add extra columns
- Change columns
- Delete columns
- Change the order of columns
- Use formulae
- Use 'N/A' where data are not available – just leave the cell blank
- Submit as a pdf

It also provides date formats, etc. There is also guidance on how to record detections made by both MMOs and PAM to avoid duplication.

7.2.2 Changes needed to the soft start log

TWG members generally agreed that the current reporting forms do not allow for accurate reporting of soft starts. They should be amended to allow recording of actual increases of the source volume or sound levels, rather than trying to record by time. It was noted that the timing of these steps would still need to be recorded to assess compliance with the Code (ie that the whole process takes between 20 and 40 minutes).

The sheets should record volume of array, number of shots and approximate step duration. The rows 6 to 11 would remain, showing whether the soft start duration was compliant.

7.2.3 Public posting of final reports

Final reports are ‘official information’ (subject to the provisions of the Official Information Act 1982) once submitted to DOC, and therefore must be made available to anyone who submits a request. Rather than waiting until such requests are received, the TWG recommends DOC simply posts the reports online once received, as is done with MMIAAs.

The TWG noted this is a policy decision that bears consideration, and one that is not directly tied to this review process. There are privacy issues related to naming of individuals that require careful consideration (if final reports are posted with names included). Further discussion should thus be held on this topic, independently of the Code review process.

8. Other issues

8.1 Cost recovery options for potential data collection, reporting, analysis and dissemination

Although discussed, the TWG felt it did not have the expertise to address this issue. However, it is important to note that the expense in collecting these data does not appear to be balanced with the amount of funding allocated to data review, quality assurance and quality control (QA/QC), storage and reporting. Between 2013 and 2015 there were 26 seismic surveys under the Code, with over 770 days of survey effort. Given that almost all surveys had two MMOs, two PAMOs and a PAM system undertaking mitigation, it is likely that over NZ\$3.5 million has been spent on the collection of these data. This dataset represents the best available source of information on New Zealand offshore marine mammals – it is important that suitable funds are allocated to the maintenance, storage and reporting of it.

8.2 Off-survey forms and non-seismic sources

The ‘Off-survey’ forms (used during multibeam sonar operations) have been generally easy to use, although the tracking sightings section is not so straightforward. The TWG agreed that DOC forms are easier to use than the Australian or JNCC forms. However, they are not tailored to operations outside of seismic surveys; various fields could be added to the reporting forms (including the cover sheet) to capture these instances (to refine the data collection). While the forms may be used for other purposes such as multibeam surveys, it is unlikely that major changes would be made to facilitate this use. However, minor changes have been discussed above.

8.3 Sub-array shut-downs

Another issue pertains to sub-array shut-downs. When there are gun issues on an array while on line, one sub-array is often shut down and retrieved while the other continues firing every second shot until the first array is returned and working. Every second shot is therefore recorded, allowing at least some data to be captured. Normally the missing data is reacquired later with both sub-arrays working.

There is an argument that unless both sub-arrays are working, the data will have to be re-acquired – and so shutdown of the source should occur and restart with a soft start, rather than continuing to fire. If a survey is cut short, however, these data gaps may never be reacquired. What is going on remains unknown to regulators; therefore, whenever a single sub-array is not working for more than 10 shots the mitigation team should be notified, and this should be recorded. Once the sub-array is working again, this should also be recorded. Later, reacquisition of the line portion should be recorded as infill. It is possible that shooting during gun repairs is creating noise of little or no value as data are acquired later as infill. Without data on the subject it is impossible to evaluate this properly, and therefore this practice must be recorded to be assessed.

References

Childerhouse, S.; Douglas, L.; Kennedy, J.; Burns, D. 2016: Analysis of Marine Observer data from New Zealand seismic surveys, in DOC (Ed.): Preliminary Analysis of Marine Observer data from New Zealand seismic surveys. Pp 1-44. Available at: <http://www.doc.govt.nz/Documents/conservation/native-animals/marine-mammals/seismic-code-of-conduct/mmo-prelim-data-analysis-report.pdf>

Appendix: Necessary improvements to data collection practices

The analyses undertaken by Blue Planet Marine (BPM: Childerhouse et al. 2016) highlighted some concerns with the data collection process – related to the ways that it limits what can be achieved, or creates difficulties in extracting the relevant information. The TWG noted the following issues:

- Extracting some data was cumbersome, and required manual entry – particularly when summarising data over multiple surveys (as with the BPM report), as every interrogation of the DOC reporting forms required manual extraction of data into another Excel spreadsheet.

This could be avoided if all data were in a relational database, or the Excel spreadsheet was more properly structured. At present (and depending on the question to be answered), relevant data may be on different worksheets or even in different files. In these cases the relevant data will need to be manually extracted. Macros may enable automated extraction of data, but this is inefficient and problematic, and is likely a temporary fix.

- The GIS plots used vessel positions when, in fact, pod positions appeared to be calculated in most cases (based on vessel GPS position, as well as distance and bearing to the pod). If pod positions are available, then these should be used in the first instance. It was noted that budgeted time prevented this being done for the BPM data analysis.

At present pod positions are recorded for each observation within its each sighting record. To facilitate analysis, the field ‘pod position’ should be added to the detection summary worksheet. This would speed-up analysis and remove the possibility of transcription errors. Care needs to be taken, however, in determining which pod position is included in the detection summary worksheet (many may be recorded for a single sighting – or none at all).

A clear decision on the question(s) to be answered should help determine this. For example, do we want to record pod position at first sighting, pod position that resulted in mitigation action, and/or pod position at closest point to source?

- There is a lot of redundancy in species codes. Currently, there are family names, common species names, and many generic categories. Family names as well as repetitive categories (eg ‘dolphins and toothed whales’ v. ‘toothed whale’) should be removed. In addition, the following would help speed-up data entry:
 - The species list should update automatically when a family is selected, so that a reduced list of (only the relevant) species is shown, from which observers can select.
 - The cell should autofill when observers type in a family/species name, rather than having to click on a cell, scroll down to the species they want and then select it. Currently observers can type in the family/species name but the cell doesn’t autofill – so they need to get the name exactly correct, or they receive an error message.

- ‘On’ and ‘off effort’ are terms generally used internationally to indicate when observers are on or off duty. As mentioned in the TWG and in the BPM report (Childerhouse et al. 2016), different categories should be used to indicate inside or outside the operational area, with data being added into the same data file.
- Fur seals are currently reported on a separate worksheet. Although having all sightings reported on the same worksheet would help simplify and streamline the data collection, most members did not recommend changes to this, as:
 - Fur seal and cetacean data do not line up exactly
 - The TWG understands that part of the rationale behind separating these sightings in the first instance was the expected high number of sightings of fur seals in at least some areas

However, some TWG members believed that fur seal data should be consistently recorded in the same way as other marine mammal (eg cetacean) data. A single datasheet should be able to handle details of both pinnipeds and cetaceans. Pinnipeds enjoy the same legal protections as cetaceans, meaning we have a legal obligation to protect and report them. This seemingly undermines the rationale for reduced data reporting; the TWG was unable to resolve these differing opinions.

- The BPM report states that “It is not possible to determine the length of achieved [MMO] survey effort in km as that is not reported to DOC in any of the ERFs” (p 13, Childerhouse et al. 2016). Having access to the ship’s track-line (perhaps as recorded by MMO hand-held or PAM-incorporated GPS units) would be invaluable in terms of analysis. Sighting data need to be corrected for effort when used in analyses.
- Data entry needs to be made as quick and easy as possible – this would be facilitated by being able to tab between input cells.
- The datasheets currently being used are very large, and cause difficulties when trying to email from a vessel. It would be possible to set up some VBA code within the Excel file to allow export of a specified worksheet (eg detection summary) to a .csv file with a dynamic file name. The data export functions should also facilitate additions to the master database, so it will be important to ensure that detection sheets and resulting detection summary capture information that can be imported directly to the database without any manual data entry.
- Datasheets are often sent with images (eg photos, PAMGuard screenshots) embedded. If not done very carefully, this will cause the file size to expand even more. It is however useful that all sighting-related data is collated in one place (as photos and screenshots stored separately can easily be lost); this should be kept in mind if designing a new custom-built data recording program.
- The datasheets get unwieldy with new tabs added for each sighting. As long as the data capture tool remains in Excel this feature is likely to be unavoidable, as eliminating the individual tabs would make data QA harder.
- There is a lot of overlap between the ‘on-survey effort’ and the ‘on-survey summary’ tabs. The ‘effort’ tab contains a column for notes; and ‘line number’ on the effort tab is called ‘general area’ on the summary tab. Otherwise, both sheets contain the same information. Given the discussions around data collection, the TWG does not

recommended changing this. As an alternative to trimming the overall file size of the datasheets and eliminating anything not considered critical to decision-making and reporting during the survey, we instead recommend creating an 'export to csv' function to satisfy end-of-deployment reporting requirements.

- The datasheet is set up to generate several charts automatically. Only some of these are needed for compliance or weekly reporting, eg array status, monitoring effort and sighting conditions. The remainder are potentially only needed for a final report. While these could be eliminated from the field datasheet to trim the file size, as per the above comments we instead recommend a system for end-of-deployment data submission that does not rely on emailing the entire datasheet.
- While Excel is a useful tool, it is clumsy and cumbersome when used for survey data collection. A data collection program needs to be designed with the ability to record directly into a database (such as Microsoft Access), multiple tables that can be linked, and where data can be easily queried and extracted post-survey. This type of program should be able to interface with a hand-held GPS to records survey effort (GPS track) as well. Examples of such programs are: 1) Mysticetus, 2) Pro Tracker, 3) VADAR Sea, and 4) WinCruz.
- The TWG noted that the existing DOC datasheets do provide a good, broad overview of relevant data. However, a much more comprehensive collection of data would require an entirely separate research effort to avoid detracting from mitigation efforts. Depth could be taken from charts, but it is much more convenient (and accurate) to record it at the same time. Mammal course/heading can be difficult to accurately assess, but could prove useful in determining approach or retreat from a vessel.
- The only data that might be dropped from recording is behaviour, which is subjective and often hard to distinguish (eg behaviour at first sighting, which might be at over 1 km from the vessel). However, even this might be useful when assessing very broad and generalised responses to the vessel. Objective cues are likely to be more useful (and consistent). Even though cues are theoretically more limited in potential 'information content' than behaviours, the validity of the behavioural information collected is debatable. However, it was noted that a simple yes/no box asking if there was an observable reaction to the vessel/seismic activity (with a comment box for further explanation) would suffice. Some TWG members believed that 'cue' should be reserved for sighting cue only (eg birds, splash, blow, etc).
- It was suggested that an annual review of new survey data would be useful. It was estimated that approximately a week of QA/QC would be needed, depending on the number of surveys that year. Report writing and data analysis is expected to take another week, depending on the use of a certain amount of automated analysis (eg by using standard codes and sheet functions). This would usefully summarise annual survey activity in New Zealand and provide a high-level summary of marine mammal detections from seismic surveys.