2nd Working Group Meeting on the Multi-study OCean acoustics Human effects Analysis (MOCHA)
University of St Andrews, St Andrews
19-21 September 2012

1. Summary

This document briefly reports on the second meeting of the US Office of Naval Research sponsored MOCHA working group, held on 19-21 September 2012 in St Andrews. The overall aim of the group is to develop and implement innovative statistical methodologies for the analysis of behavioral response study (BRS) data. In this second meeting we focused on deep-divers, namely beaked whales and sperm whales, and the related analyses that the MOCHA team and BRS project teams have been working on thus far.

2. Background and objectives of working group

The background to the work and the objectives of the working group are described in full in the report of the 1st Working Group Meeting and in the project proposal. Both of these documents are available for download from http://www.creem.st-and.ac.uk/mocha/

The specific objective of the 2nd Working Group Meeting was to review the work carried out thus far by the MOCHA team and other BRS project teams on deep-divers (beaked whales and sperm whales) and to plan ahead for the 3rd workshop.

3. Summary of second working group meeting

The working group meeting started with a presentation of the data that have been collated by the MOCHA team on beaked whales and sperm whales. Both baseline data and exposure data were presented and discussed.

Following the first working group meeting a number of technical groups was set up to discuss different aspects of the MOCHA project. The remainder of this meeting was split into discussions relating to each technical group.

Firstly we reviewed the work relating to the "Check Exposure and Response Measurements Technical Group ". At the first working group meeting it was agreed that it would be important to capture a range of contextual variables associated with each exposure event and a table of fields was generated (see Appendix 2 of 1st working group meeting report). Since then the MOCHA team has developed a database to capture the relevant variables for each exposure event across species and projects. The database was presented to the working group and feedback was received. Once the database has been updated and finalised, a field definition document will be produced.

The second technical group to be reviewed was "Expert Scoring". Expert scoring is a method that has been used primarily by the 3S team and they have submitted a manuscript for publication on their application of expert scoring to their exposure data (now published, Miller et al. 2012). During the previous field effort the SOCAL team attempted to carry out expert scoring on the data they had collected during that leg. The SOCAL team reported that there had been much debate about how to best apply the method with regards to using experts that were present in the field or not, and providing experts with information about the exposure. The 3S team clarified that the aims of the 3S approach were to try to describe behavioural changes during the exposure time that weren't normally seen in baseline behaviour. It is important to note that this doesn't necessarily indicate change as a result of sonar, but it does provide a first cut of the data and allows conclusions to be drawn about whether behavioural changes did or did not occur during exposure events.   3S did not score behavioural changes during an exposure event if the change was regularly seen during baseline periods, the advantage being that false positives are reduced and a list of putative responses are produced rather than a full list of all changes observed. There was discussion about the different types of bias that may result from the different approaches. Discussion swayed towards having experts that were present in the field and have full knowledge of the event. It was agreed that the SOCAL team would repeat the exercise at the end of their next field effort. Although the effort involved in conducting expert scoring is large it was agreed by all to be a worthwhile exercise.

We then reviewed the "Change-Point Analysis Technical Group". There were a couple of presentations given which made use of state-space modelling techniques and it was agreed that since these methods are now being applied in the BRS context it would be good to initiate a separate technical group specifically focussing on state-space modelling. The MOCHA team then presented change-point methods that they have been applying to the deep-diver data at different resolutions. Firstly they presented change-point analysis conducted on beaked whale behavioural time series data and then they presented dive-by-dive analysis of beaked whale and sperm whale data. There was interest in taking all of the methods described forward to at least allow assessment of which method may provide the most flexibility across species and contexts.

Finally we reviewed the "Dose Response Modelling Technical Group". Firstly there were presentations of analyses methods trialled – namely an analyses looking at the relationship between dose and response intensity, and further development of the Bayesian dose-response analysis first presented with respect to killer whales at the 1st working group meeting. It was noted that, thus far, the dose-response relationship for each species is different and this to led to a discussion about the importance of trying to combine species into one analysis to determine if parameters can be shared across species. Currently, in the regulatory setting, thresholds are applied to groups of species as determined by expert judgement and so any advances we can make in this area will be valuable. It was agreed that modelling of both presence/absence of a response and intensity of a response should be pursued further. The dose metric was discussed in detail in terms of the significance for animals and the problems with correlation between the different dose metrics such as received levels, ramp-up energies and range. A range of different dose metrics will be examined further.

Multivariate mixed models and multinomial Generalised Estimating Equations (GEEs) were presented as statistical methods that might be applicable to the types of data we have within MOCHA. For example the multinomial approaches may provide a method for analysing the severity scores that result from expert scoring. It was noted that this is important because regulators want to understand the possible severity of responses as well as whether responding is likely or not.

Overall it was agreed that the format of the MOCHA project is working well, i.e. biannual working group meetings with interim technical group meetings. In the period between the 2nd working group meeting and 3rd working group meeting there is an expectation that there will at least be some developmental work on the next focal species but not necessarily complete, and that work should continue on beaked whales and sperm whales over the next few months.

The final session of the working group meeting focussed on plans for the 3rd working group meeting which will be on pilot whales (although see note below) and was provisionally scheduled for the week commencing 18th March 2013. Each BRS team presented information on the data they hold for pilot whales including baseline and exposure data. There is a relatively large amount of data available to the MOCHA team for pilot whales but it was noted that the large variability in baseline behaviour may be problematic for this species. In particular there are large quantities of acoustic data for pilot whales but MOCHA has to be careful to not only focus on acoustic analysis because it could be extremely time consuming and may not be applicable to other species groups. There are opportunities to integrate acoustic data with good visual data and movement data for these species.

An interim progress meeting will be held in January 2013 to present more complete analyses on the deep-divers and to further plan the efforts of the MOCHA team in relation to pilot whales to ensure reasonable developmental progress has been made by the 3rd working group meeting.

4. Post-workshop amendment

Following the workshop it was realised that there were logistical constraints associated with having the 3rd workshop focus on pilot whales. The steering group therefore made the decision to change the focus of the 3rd workshop to "other odontocetes", which includes killer whales, Risso's dolphins, false-killer whales and melon-headed whales. The 4th workshop, scheduled for September 2013, will now focus on pilot whales.

5. References

Miller, P.J.O., Kvadsheim, P.H., Lam, F-P.A., Wensveen, P.J., Antunes, R., Alves, A.C., Visser, F., Kleivane, L., Tyack, P.L., Doksaeter Sivle, L. (2012). The severity of behavioral changes observed during experimental exposures of killer (*Orcinus orca*), long-finned pilot (*Globicephala melas*), and sperm (*Physeter macrocephalus*) whales to naval sonar. Aquatic Mammals 38(4): 362-401 http://dx.doi.org/10.1578/AM.38.4.2012.362

6. Acknowledgements

Appendix 1 – 2nd working group meeting attendees

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