

3rd Working Group Meeting on the Multi-study OCEAN acoustics Human effects Analysis (MOCHA)

TNO, The Hague
18-20 March 2013

1. Summary

This document briefly reports on the third meeting of the US Office of Naval Research sponsored MOCHA working group, held on 18-20 March in The Hague. 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 third meeting we focused on odontocete species (other than pilot whales), namely killer whales, Risso's dolphins, false killer whales and melon-headed 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 3rd Working Group Meeting was to briefly review the work carried out by the MOCHA team on deep-divers (beaked whales and sperm whales) since the 2nd working group meeting; to focus mainly on analysis carried out by the MOCHA team and other BRS project teams on the odontocete species (killer whales, Risso's dolphins, false killer whales and melon-headed whales); and to plan ahead for the 4th workshop (on pilot whales). The focus on these odontocete species provides an opportunity to look at a species with shorter behavioural time-scales, more sociality and associated acoustic data, and more extensive focal follow data during trials (all compared with the deep divers).

3. Summary of third working group meeting

The meeting began with an overview of the most recent developments in relation to deep divers (the focus of the 2nd working group meeting). Specifically, the MOCHA team presented a comparison of four different change-point methods (all based on Mahalanobis distance), an expert classification scheme for sperm whale dive types for use in change-point analysis and a state-transition model with acoustic exposure as a covariate, and an update on the Bayesian dose-response analysis which has been further developed to allow fitting to data from multiple species in one analysis. Detailed technical discussions followed each presentation.

We then moved on to the main focus of the meeting, the odontocete species (with the exception of pilot whales) for which we have data from one or more BRS project. The AUTECH, 3S and SoCal project teams all presented an overview of the data they have for this

species group and the analysis that they have conducted so far and plan for the near future. The AUTEK project has data on a melon-headed whale and false killer whales, the 3S project has data on killer whales and the SoCal project has data on bottlenose dolphins, common dolphins, killer whales and Risso's dolphins (although Risso's dolphins will be the main focus for MOCHA because this is the species which has tag data associated with all of the controlled exposure events (CEEs)).

The MOCHA team are particularly interested in developing state-based methods for this species group and also in planning ahead for the pilot whales (focus of 4th working group meeting). We therefore spent a discussion session developing priorities and guidelines for application of state-based models to BRS data. As part of this session we presented the latest developments on a Hidden Markov Model (HMM) that is being developed for application to BRS type data to allow us to look at behavioural states from tag or focal follow data and look at transition probabilities between states in the presence of covariates (e.g. acoustic exposure). Other developments being investigated by the MOCHA team include a non-hidden state-space model being applied to sperm whale dive data and a further model looking at horizontal avoidance in the focal follow data from killer whales and Risso's dolphins. We discussed the merits of both hidden and non-hidden models and the interpretability of the results – the hidden states identified by HMMs are not always identifiable as biologically meaningful by experts. However, the advantage of the HMMs is that we're not pre-defining the states nor are we dictating the type of change we're looking for; we are allowing the results to be driven by the data and not expert judgement. It will be of interest to try both model types and compare results.

One feature of this species grouping which presents an opportunity and challenge is the large amount of acoustic data collected on the tags. We therefore dedicated a discussion session to discuss how to incorporate acoustic data into behavioural models. As part of this the SoCal team presented analysis of the acoustic data from Risso's dolphins. It is hoped that this sound-production-rate data may be available for looking at changes in acoustic behaviour using state-based models. We discussed the added value of acoustic data in relation to the large amount of effort required to process such data. It was agreed that we should be willing to try analysis with rough acoustic call production data (e.g. foraging versus social calls) if detailed call-type, call function, or focal/non-focal classifications are not available; waiting for the detailed data could cause huge delays.

Similarly, for this species group, there are good records of focal follow data collected during trials. We had a general discussion session about the incorporation of these and other non-tag data, into behavioural models. As well as discussing the use of the focal follow data, we discussed a range of environmental data types, some collected in the field and some available from remotely-sensed datasets. We discussed how best to incorporate environmental data into the models as covariates to help explain how animals respond in different contexts.

The final session focussed on plans for the 4th working group meeting on pilot whales which will be held at the Duke Marine Lab in Beaufort, North Carolina in September 2013. The Cape Hatteras, AUTEK and 3S project teams presented the data they hold on pilot whales and the analysis they have conducted and plan for the near future. 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.

Following the technical discussions, the MOCHA team outlined a number of opportunities for presenting our research at international conferences and laid out plans for a number of manuscripts. The next working group meeting will be 4-6th September 2013, but before then we will be having a small workshop with the BRAHSS project team in St Andrews during May 2013, and we will hold an interim progress meeting in June 2013. Finally it was agreed that Cascadia Research Collective will host the 5th working group meeting on behalf of the SoCal project team, and this meeting was scheduled for mid-March 2014 in Olympia, Washington.

4. Acknowledgements

We would like to acknowledge that, although the MOCHA project itself is funded by the US Office of Naval Research, we rely on the participation of the working group members whose time and efforts are kindly supported by a wide range of institutes and funders.

Appendix 1 – 3rd working group meeting attendees

Patricia **Arranz**, SMRU (attended remotely)
Matt **Bowers**, DUML
John **Calambokidis**, CRC
Rene **Dekeling**, NLDMO
Stacy **DeRuiter**, CREEM
Catriona **Harris**, CREEM
Ruth **King**, CREEM (attended remotely)
Petter **Kvadsheim**, FFI
Frans-Peter **Lam**, TNO
Monique **MacKenzie**, CREEM (attended remotely)
Patrick **Miller**, SMRU
Silvana **Neves**, SMRU
Len **Thomas**, CREEM
Peter **Tyack**, SMRU
Dina **Sadykova**, CREEM
Filipa **Samarra**, SMRU
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