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CONCERTED ACTION FOR SPERM WHALES (*Physeter macrocephalus*) OF THE EASTERN TROPICAL PACIFIC

Adopted by the Conference of the Parties at its 12th Meeting (Manila, October 2017)

A. Target species/population(s), and their status in CMS Appendices

Sperm Whales (*Physeter macrocephalus*) are a highly migratory marine species, listed on Appendix I and II of CMS (CMS, 2015), which have been included on the CMS concerted action species list since 2002. They are listed globally as vulnerable on the IUCN Red-List¹, with the Mediterranean sub-population categorized as endangered².

This proposal for concerted action is focused specifically on four clans of Sperm Whales which have been identified in the eastern tropical Pacific (etP) (Rendell and Whitehead, 2003; Cantor *et al.* 2016). Decades of research has revealed a complex social structure within the etP Sperm Whales, where clans can be identified by their unique acoustic click patterns or codas, but also differ in their movement patterns, feeding success and other attributes (e.g. Whitehead & Rendell, 2004). The clans in this region are known as the Regular, Plus-one, Short and Four-plus clans.

These large clan structures are often sympatric, with two or three clans using a given area. The geographic distributions of the clans are also dynamic so that the clans using a sea area can change over years or decades (Cantor *et al.* 2016), representing large-scale population shifts that are not readily detectable from basic sighting surveys which record only the presence of whales without respect to clan membership. However, these clans show little or no differences in their nuclear DNA and the primary differences between them are socially learned and therefore, cultural (Whitehead, 2003).

Since social learning is understood to be the major driver for the clan structure within this species and there is important interplay between social structure and the transmission of social learning within these social systems (Whitehead and Lusseau, 2012), the clan structure presents unique conservation challenges. For example, there is compelling evidence for differential responses between clans to environmental variability (either natural or anthropogenic), which may have important management implications for sperm whale cultural units in this region (see section D).

¹ <http://www.iucnredlist.org/details/41755/0> (last assessed 2008)

² <http://www.iucnredlist.org/details/16370739/0> (last assessed 2012)

CMS Range States³ in which individuals from different etP Sperm Whale clans have been identified

<i>Clan</i>	Panama	Ecuador	Peru	Chile
<i>Regular</i>		X	X	X
<i>Plus-one</i>	X	X		
<i>Short</i>	X	X, Y	X	X
<i>Four-plus</i>		Y	X	X

Data from: X Rendell, L. & Whitehead, H. (2003). Y Cantor, M. *et al.* (2016)

Movements of photo-identified individuals between CMS Range States

	Panama	Ecuador	Peru	Chile
Panama				
Ecuador	8			
Peru		2		
Chile		8	1	

[Assuming maritime boundary between Ecuador and Peru at 3.39°S, between Chile and Peru at 18.35°S]

Data from: (reanalysis based upon maritime boundaries given above): Whitehead, H., A. Coakes, N. Jaquet and S. Lusseau. (2008).

Movements of individuals of known clan between CMS Range States

	Panama	Ecuador	Peru	Chile
Panama				
Ecuador	8 <i>Plus-one</i>			
Peru		2 <i>Short</i>		
Chile		1 <i>Regular</i> , 5 <i>Short</i>	1 <i>Regular</i>	

Data from: H. Whitehead (unpublished)

³ The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CMS Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.

B. Activities and expected outcomes

Institutional Activities:

It is proposed that as a specific action for the eastern tropical Pacific region, under the existing concerted action for Sperm Whales, a concerted action is undertaken for etP Sperm Whales, based on their culture, with the objective of creating a collaboration across Range States for data gathering within their jurisdictional waters (and where possible, beyond). The key elements of this collaboration would be to enable photo identification, acoustic monitoring and where possible, the collection of behavioural data and faecal samples to further elucidate social structure and differences in foraging success between clans. Passive acoustic monitoring will be particularly useful as the presence, and clan membership, of Sperm Whales can now be detected autonomously over large spatial and temporal scales (Rendell & Whitehead 2004; Zimmer 2011). Additional ecological data including environmental monitoring and prey distribution would also be highly valuable. The scientific leader of this collaboration (Dr Luke Rendell) would then report back to the next CMS Conference of the Parties in 2020.

The strategic objectives of this collaboration would be to obtain more detailed information about the social structure, foraging behaviour and acoustic segregation of Sperm Whales in the eastern tropical Pacific to determine whether and how these clans should be conserved separately according to their differing responses to environmental pressures. For example, continuing research in the region on foraging success during differing environmental conditions could be used to project the expected relative population growth rates of clans that differ in feeding strategies.

The main role of CMS Parties would be to facilitate, where possible and appropriate, collaboration between institutes and researchers.

Outcomes:

Encourage capacity-building and collaboration between academic institutions and Range States, using integrated research methods. This is particularly important research because it will provide insights into how we manage these (and other) long-lived, highly social animals. For example, providing insights on whether acoustic clans of Sperm Whales should be managed separately (as socially significant units). This approach contrasts with geographic definitions of stock structure, which can fail to capture the dynamics of the sympatric clans.

Determine whether more targeted concerted actions are necessary for these cultural units of whales, in order to provide more focused attention on the necessary conservation measures. This will ensure that conservation policy is consistent with the most up-to-date scientific knowledge on how populations of these difficult to study species are organized and may respond to anthropogenic threats and conservation actions.

C. Timeframe

Milestones

- Agreement at the 2017 COP that the etP Sperm Whale clans should go into the concerted action process on the basis of socially learnt behaviour, which segregates them and may require them to be managed as distinct population segments
- Project leader to discuss preliminary collaboration between relevant institutes (by 20 December 2017)
- Funding requirements determined and resources secured (by 30 October 2018)
- Project leader to facilitate data collection as per standardized data collection protocol (by June 2019)
- Preliminary result analyzed and reported back to the Scientific Council and the CMS COP in 2020 by the project leader
- Next steps in relation to conservation of etP Sperm Whale conservation agreed (2020)

D. The case for action

(i) Conservation priority

In 2014 the CMS and WDC jointly hosted a workshop on the conservation implications of cetacean culture at the Linnaean Society in London (CMS, 2014). The workshop culminated in the adoption of Resolution 11.23 on Conservation Implications of Cetacean Culture adopted at COP11 (UNEP/CMS/COP11/Resolution 11.23). The Resolution requested the Scientific Council to establish an intersessional expert working group to address the conservation implications of culture and social complexity, with a focus on, but not limited to cetaceans. The deliberations of this expert group are described in the report 'CMS Expert Working Group on Culture Intersessional Report' to which this case study is appended.

The expert group discussed several instances where social knowledge may result in vulnerability or resilience to anthropogenic change. In order to distil some practical management advice on this burgeoning area of conservation science, it was agreed that case studies could provide the best insights, since each instance of social learning and interaction with the environment may be unique.

To that end etP Sperm Whales were considered to be a suitable case study, as there is good evidence for social learning relevant to their conservation across several behavioural domains.

Socially learnt behavioural (cultural) differences between Sperm Whale clans in the eastern tropical Pacific

Trait	Strength of evidence	Reference
Coda dialect	Excellent	Rendell & Whitehead 2003
Geographical extent	Excellent	Rendell & Whitehead 2003
Small-scale distributions (10's km)	Good	Whitehead & Rendell 2004
Large-scale movements (days-years)	Good	Whitehead et al. 2008
Small-scale movements (hours)	Good	Whitehead & Rendell 2004
Feeding success	Good	Whitehead & Rendell 2004
Changes in feeding success with El Nino	OK	Whitehead & Rendell 2004
Diet	Indication	Marcoux et al. 2007b
Reproductive rates	OK	Marcoux et al. 2007a
Diving synchrony (babysitting)	OK	Cantor & Whitehead 2015
Homogeneity of social relationships within social units	OK	Cantor & Whitehead 2015
Duration of social relationships	Indication	Cantor & Whitehead 2015

The main prey of Sperm Whales in the etP is mesopelagic squid. Nevertheless, differential feeding success under different oceanographic conditions have been observed in this region. Research on Sperm Whales off the Galápagos Islands has shown that in the 1980s and 1990s there were two clans principally found in this area. Results from studies on defecation rates indicated that in normal years, the regular clan had higher defecation rates, but during a warm El Niño year, when all of the animals showed greatly reduced defecation rates, the plus-one

clan consistently had a higher rate than the regular clan (Whitehead, 2010; Marcoux, Rendell, & Whitehead, 2007a). Since the clans were feeding in the same area and in the absence of any signs of aggression, this difference in defecation rate is inferred to be due to different feeding strategies having different benefits during these oceanographic cycles. These two clans also show evidence for differences in reproductive success (Marcoux, Rendell, & Whitehead, 2007b). Subsequent field research has since revealed what scientists are calling a ‘cultural turnover’ in which two other clans appear to have usurped regular and plus-one clans in this area (Cantor *et al.*, 2016). The evidence for differential effects arising from changes in environmental conditions coupled with the complex dynamics of the sperm whale clan structure in this region provide a compelling case that these whales should be managed in a modular fashion. Further, it is predicted that as a result of global warming, El Niño frequency and duration is expected to change, so the differential reactions of these clans to the El Niño cycle may be particularly important.

(ii) Relevance

Whitehead (2003) noted that the offshore distribution and habitat use by Sperm Whales is generally not well understood. However, in the last decade an emerging understanding of the complex clan structure of etP Sperm Whales, including cultural turnover between clans in this region (Cantor *et al.*, 2016), has emerged. This is a highly migratory marine species, listed on CMS Appendix I and II and listed globally as vulnerable by the IUCN. It is the view of the culture expert group that the Sperm Whale clans in this oceanographic region provide an excellent example of the challenges associated with managing highly migratory species that learn socially and have complex social structures, which may therefore require multilateral collaboration for monitoring and conservation.

Resolution 11.23 on Conservation Implications of Cetacean Culture adopted at COP11 (UNEP/CMS/COP11/Resolution 11.23) noted the findings of the 2014 workshop that “management decisions should be precautionary and assume that populations may contain discrete social elements which have conservation significance warranting further investigation”. Further the resolution noted *inter alia* that:

- a number of socially complex mammalian species, such as several species of cetaceans, great apes and elephants, show evidence of having non-human culture;
- highly social species face unique conservation challenges;
- that the social transmission of knowledge between individuals may increase population viability and provide opportunities for the rapid spread of innovations and thus adaptation to environmental change;
- whereas this transmission of knowledge may also increase the impact of anthropogenic threats or can operate synergistically with anthropogenic threats to compound their impact on a specific social group or more widely;
- recognized that the impact of removal of individuals from populations of socially complex species may have consequences beyond simply a reduction in absolute numbers;
- and that populations of some species are better delineated by cultural behaviour than genetic diversity or geographic isolation;

The Resolution then:

- encouraged Parties to consider culturally transmitted behaviours when determining conservation measures;
- encouraged Parties and other stakeholders to assess anthropogenic threats to socially complex mammalian species on the basis of evidence of interactions of those threats with social structure and culture; and
- urged Parties to apply a precautionary approach to the management of populations for which there is evidence that influence of culture and social complexity may be a conservation issue.

Finally, of most relevance to this case study, the resolution also encouraged Parties and other stakeholders **to gather and publish pertinent data for advancing the conservation management of these populations and discrete social groups**. This concerted action is targeted specifically at achieving that objective.

(iii) Absence of better remedies

CMS is uniquely positioned as the only multi-lateral environmental agreement currently engaging with the policy implications of this emerging field of science. Moving beyond the traditional approach of conserving only genotypic diversity towards a more advanced approach, which incorporates specific aspects of phenotypic diversity, is likely to provide opportunities for more efficient and effective methods for conserving some species that learn socially.

(iv) Readiness and feasibility

This proposal requires, wherever possible and appropriate, Range States to support and facilitate collaboration between the necessary experts, specifically to increase data collection, initially through passive acoustic monitoring and to investigate other opportunities for collaboration on data gathering for this species. Dr. Luke Rendell of St Andrews University in Scotland, who has extensive experience researching Sperm Whales in this region and has relevant academic contacts in the region, has offered to provide leadership for this project. Professor Hal Whitehead of Dalhousie University, Canada has also offered to provide his expertise and guidance to assist this project.

This is a novel area of conservation science, with the potential to attract funds from external sources.

(v) Likelihood of success

Implementation of this collaboration will facilitate a better understanding of distribution of the clans across the Range States, providing higher resolution data on distribution, clan mixing and potentially on feeding behaviour. This will provide insights into how changes in the environment, both natural and anthropogenic, may differentially affect these discrete clans and thus how they may need to be managed accordingly. There is a high probability of success through this collaboration because there are already researchers with experience and expertise in this field within the region and both Dr. Rendell and Professor Whitehead have good contacts with many of these researchers.

Capacity-building across the scientific community and collaboration between institutes undertaking research on this species within the region will provide a legacy mechanism, through which ongoing data can be collected to better understand the patterns of change between these cultural units.

(vi) Magnitude of likely impact

This has the potential to be a flagship collaboration for integrating the science on social learning and social structure into practical conservation for migratory species. Therefore, this concerted action has excellent potential as a catalyst for further collaborations, across a wide range of taxa, which can assist the CMS Parties in conserving migratory species that learn socially.

(vii) Cost-effectiveness

Because this concerted action has the potential to become a flagship project and because the research is ongoing and the demands on Parties is not onerous, seeking only that the Range States facilitate and support this initiative wherever possible and appropriate, it likely to be highly cost-effective for CMS, in terms of developing competency as a multi-lateral agreement leading understanding in this aspect of modern conservation efforts.

E. Associated benefits

Public outreach in an emerging field of conservation science, the policy implications of which CMS is spearheading. It is also anticipated that information garnered and lessons learnt through this collaboration may also benefit similar initiatives on other CMS-listed species in the future.

F. Relationship to other CMS actions

CMS Resolution 10.15 Global Programme of Work for Cetaceans (2012-2024) instructed the CMS Scientific Council's Aquatic Mammals Working Group to provide advice on the impact of the emergent science of cetacean social complexity and culture as it related to regional populations.

This instruction resulted in the hosting of the 2014 workshop (CMS, 2014) and the adoption of Resolution 11.23 on Conservation Implications of Cetacean Culture adopted at COP11 (UNEP/CMS/COP11/Resolution 11.23). The ongoing objectives of this Resolution (outlined in section D(ii) above) can only be achieved for highly migratory marine species such as sperm whales, by undertaking the type of collaboration between range states suggested in this concerted action.

References

- Cantor, M. and H. Whitehead. (2015) How does social behavior differ among sperm whale clans? *Marine Mammal Science* 31: 1275-1290.
- Cantor, M, H. Whitehead, S. Gero and L. Rendell (2016) Cultural turnover among Galápagos sperm whales. *Royal Society Open Science* 3: 160615.
- CMS (2014) Report of the CMS Scientific Council Workshop on the Conservation Implications of Cetacean Culture (available at http://www.cms.int/sites/default/files/document/Inf_10_14_ScC_WG_Rpt_on_Cetacean_Culture_Eonly.pdf).
- CMS (2015) Appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) http://www.cms.int/sites/default/files/document/Appendices_COP11_E_version5June2015.pdf
- Marcoux, M., L. Rendell, and H. Whitehead. (2007a) Indications of fitness differences among vocal clans of sperm whales. *Behavioural Ecology and Sociobiology* 61: 1093-1098.
- Marcoux, M., H. Whitehead, and L. Rendell. (2007b) Sperm whale feeding variation by location, year, social group and clan: Evidence from stable isotopes. *Marine Ecology Progress Series* 333: 309-314.
- Rendell, L. & Whitehead, H. (2003) Vocal clans in sperm whales (*Physeter macrocephalus*). *Proceedings of the Royal Society: Biological Sciences* 270:225-231.
- Whitehead, H. (2003) *Sperm whales: Social evolution in the ocean*. Chicago: Chicago University Press
- Whitehead, H (2010) Conserving and managing animals that learn socially and share cultures. *Learning and Behavior* 38: 329–36.
- Whitehead, H., A. Coakes, N. Jaquet and S. Lusseau. (2008) Movements of sperm whales in the tropical Pacific. *Marine Ecology Progress Series* 361: 291-300.
- Whitehead, H. and D. Lusseau (2012) Animal social networks as substrate for cultural behavioural diversity. *Journal of Theoretical Biology* 294: 19–28.
- Whitehead, H., and L. Rendell. (2004) Movements, habitat use and feeding success of cultural clans of South Pacific sperm whales. *Journal of Animal Ecology* 73: 190-196.
- Zimmer, W.M. (2011) *Passive acoustic monitoring of cetaceans*. Cambridge: Cambridge University Press.