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

Summary:

The Expert Working Group on Animal Culture and Social Complexity, in collaboration with Red de Cachalotes del Pacífico, has submitted the attached report on the implementation of the Concerted Action for Sperm Whales *(Physeter macrocephalus)* of the Eastern Tropical Pacific, UNEP/CMS/Concerted Action 12.2 (Rev.COP13).

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

UNEP/CMS/ CONCERTED ACTION 12.2 (Rev.COP13)

1. CONCERTED ACTION

Title: Concerted Action for Sperm Whales (*Physeter macrocephalus*) of the Eastern Tropical Pacific

Document number: UNEP/CMS/Concerted Action 12.2 (Rev.COP13)

2. REPORTING ORGANIZATION

CMS Scientific Council Expert Working Group on Animal Culture and Social Complexity

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3. TARGET SPECIES/POPULATION

Class:	Mammalia
Family:	Physeteridae
Order:	Artiodactyla
Species:	*Physeter macrocephalus*
Population:	Eastern Tropical Pacific sperm whale clans

4. PROGRESS IN ACTIVITIES

1. Creation of a collaboration network across Range States

We held the “Cachalotes del Pacifico” workshop in November 2022. The workshop featured talks from sperm whale researchers on photo-identification protocols, social network analysis, acoustic monitoring, clan identification, sample collection and processing, and stranding management and data collection. During the workshop, we established the **Cachalotes del Pacífico Network** among 17 participants from across the Range States. The objective of the

network is to promote collaborative research and conservation of sperm whales throughout the etP and the southeastern Pacific through a transversal cultural lens.

2. Update on the status of sperm whale clans of the etP

Since the drafting of the Concerted Action Plan in 2017, analyses have revealed aspects of the status of sperm whale clans in the etP. Analysis of sperm whale recordings from across the Pacific Ocean (1978 – 2014) revealed the presence of seven clans in the etP[1]. This analysis confirmed the presence of the previously documented *Regular, Plus-One, Short*, and *Four-Plus* clans mentioned in the 2017 Action Plan[2,3], and discovered three additional clans (*Palindrome*, *Rapid Increasing*, and *Slow Increasing*) (Figure 1)[1].

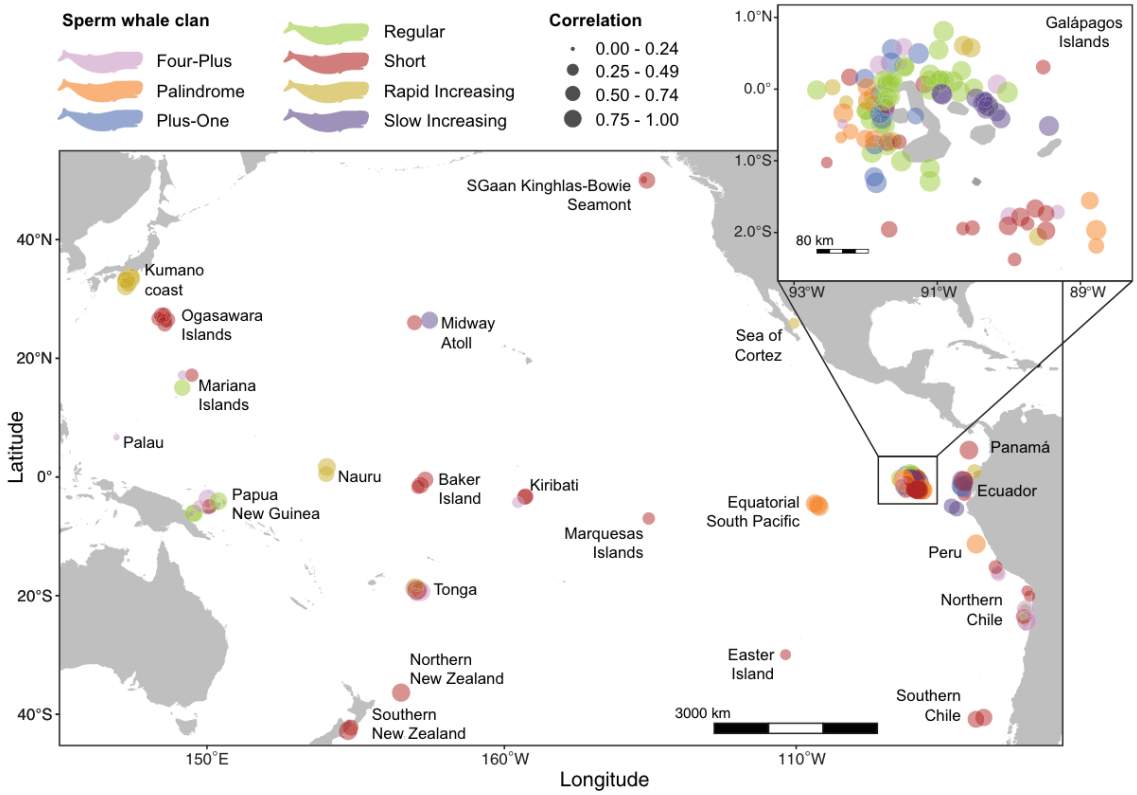

Figure 1. *Location of sperm whale clans identified across the Pacific Ocean using the identity call method[4]. Points represent a single repertoire of codas, colored by clan. Point size indicates statistical confidence in the repertoire-to-clan designation. (Figure adapted from Hersh et al. [1]).*

All clans found throughout the Pacific Ocean were also found in the etP, making it the most culturally diverse sperm whale region currently known in the Pacific Ocean. When looking at clan presence in the etP by year, the region typically hosts at least three different clans per year (Table 1).

Table 1. Clan presence per year in the ETP based on the Hersh et al. dataset[1]. Location abbreviations are C = Northern Chile, E = Ecuador, G = Galápagos Islands, and P = Peru.

Clan/year	1978	1985	1987	1989	1991	1993	1995	1999	2000	2013	2014
Four-Plus		E		G	G	C, P			C	G	G
Palindrome						P				G	G
Plus-One	G	G	G	G		E					
Regular		G	G	G	G		G		C		
Rapid Increasing		G	G		E		G			G	
Short		G	G		E	E, P			G	C, G	G
Slow Increasing			G		E	P		G			

The newly identified clans stem from the addition of recordings outside the regions used to describe the four original clans as well as from using a new method for assigning clan identity developed by Hersh et al.[4].

There are no clan-level estimates of the sperm whale population size in the etP. However, an estimate for the total population using the etP in 1986-1990 is 37,777 (c.v. = 0.37)[5]. The overall population in the etP was estimated to have decreased by 4% (s.e. = 4.3) annually between 1986 (soon after the end of commercial whaling in the region) and 2000[5]. This trend likely arises from the nearly complete removal of mature males from the etP in the 1980s, which impaired the fecundity of remaining females, as well as the social disruption of surviving individuals who may have lost crucial information for their survival [5,6]. These lingering effects of whaling on population growth likely reduce with time (c.a. 15 years[5]), so the population may now be stable or recovering slowly.

Local patterns in the two areas where long-term dedicated research has taken place indicate a dynamic distribution of sperm whales across the etP. Off the Galápagos Islands, sighting rates have more than halved over the last few decades[5–7]. This pattern most likely results from clans that have moved from the Galápagos region towards other areas of the etP[7]. In the Great Islands of the Gulf of California, a decrease in sightings has been documented since 2012, resulting in no sightings at all since 2015[8]. The clan identity of these whales remains unknown.

3. Development of an environmental niche model for sperm whales

An environmental niche model based on a species distribution model (SDM) was developed for sperm whales. Such model was built based on the quantified ecological niche of sperm whales and can be used to predict changes in distribution in response to environmental and temporal variables[9,10]. Figure 2 shows the predicted distribution of the sperm whale worldwide. This modeling tool predicts the environmental conditions under which sperm whales are likely to occur and then extrapolates on this data to map the species' potential distribution across the ocean. This will be useful for management decisions, especially in the context of global and/or regional climate change, where the species are moving or dispersing due to changing oceans (e.g., Alava et al.[11]).

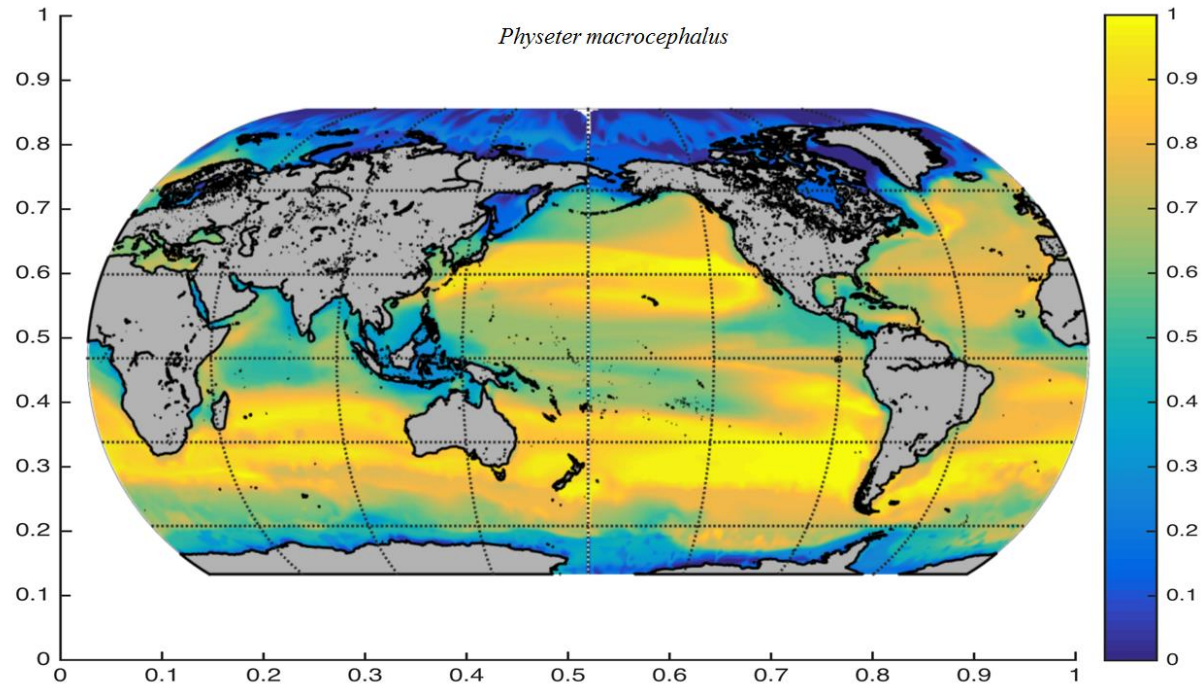

***Figure 2**. Global map of the environmental-ecological niche using the species distribution model (SDM) of the sperm whale based on Reygondeau[10]. (Courtesy of Dr. G Reygondeau and Dr. JJ Alava).*

4. Review of anthropogenic and environmental threats

Sperm whales are classified as Vulnerable due to a >30% decline in their population in the last 200 years resulting from whaling between the 18th – 21st centuries[5]. The etP sperm whales were targeted intensely throughout these times[6,12-13]. While sperm whales are no longer hunted, they continue to face threats that hamper their recovery. Potential threats in the etP include entanglements with fishing gear, vessel collisions, marine pollution, oceanographic changes, and direct catches (Figure 3)[14–18]. While there is rotund evidence for the impact of each of these threats on individuals, the degree to which they affect populations remains unknown. Moreover, **given the current lack of knowledge on the present distribution and foraging ecology of sperm whale clans, we do not know the degree to which each clan may be vulnerable and more sensitive to distinct anthropogenic threats**.

***Figure 3**. Distribution of documented threats potentially faced by sperm whales resulting from the intersection between threats documented between 1991 – 2016 and the range of the species. Adapted from Avila et al. 2018[14].*

5. CHANGES TO THE CONCERTED ACTION (IF ANY)

Primarily, our gaps in knowledge stem from the logistical and financial constraints of studying a highly oceanic, deep-sea dwelling species at a spatial and temporal scale that is comparable to that of their life histories and movements. Thus, besides the long-term projects off the Galápagos Islands and in the Sea of Cortez, no other monitoring projects exist in the region (Table 2). Colleagues have been able to opportunistically collect data on sperm whales through collaborations with whale-watching operations (Table 2). However, surveys carried out on these platforms are limited in time and space by the needs of tour operators.

Table 2. Summary of data collected on sperm whales across the etP. Detections may refer to visual or acoustic encounters. Data marked in green has been analyzed and/or published, while data in orange has not.

						Type of Data Collected			
Region	**Time period**	**Type of research**	**Funding sources**	**Predominant age/sex classes**	**Clans Identified**	**Detections**	**Photo-Identification***	**Coda Recordings***	**Other**
Galapagos Islands	1985 – 2022	Dedicated surveys	Public research funds Foreign NGO's	Females/ Juveniles Mature males	X	X	X	X	X Defecation rate Fecal samples Skin samples Surface behavior
Mainland Ecuador	1985 – 1996	Dedicated surveys	Public research funds (Canada) Foreign NGO's	Females/ Juveniles Mature males	X	X	X	X	X Skin samples Defecation rates
Chile (Northern)	2000	Dedicated surveys	Public research funds (Canada) Foreign NGO's	Females/ Juveniles Mature males	X	X	X	X	X Defecation Rate
Chile (Central)	2006 – 2022	Opportunistic (Whale-watching platforms)	Whale-watching operations Self-funded	Unknown		X	X		
Perú (North & South)	1995 - 2002	Opportunistic	Public funds (IMARPE)	Unknown		X			
Costa Rica (Pacific)	2009-2022	Opportunistic (Whale-watching platforms)	Whale-watching operations	Unknown		X			
Mexico	1998 - 1999	Dedicated Surveys	Unknown	Females/ Juveniles		X	X		

(Gulf of California)				Mature males					
Mexico (Great Islands in the Gulf of California)	2010 - 2018	Dedicated Surveys	Unknown	Unknown		X	X		

*Datasets that can be used to determine clan identity.

Questions that arise from our current knowledge pertaining to the 2017 Action Plan include:

1. **What is the current population status and distribution of sperm whales from the *Regular*, *Plus-One, Four-Plus*, *Palindrome, Short, Rapid Increasing*, and *Slow Increasing* clans?** Although the *Short* clan has been sighted across the region and in recent years, we have no reports of any of the other clans. Particularly, the *Regular* and *Plus-One* clans, which were frequently sighted in the 1980s and 1990s, have not been documented since. Likewise, there is no information about the newly described clans.

2. **What is the foraging ecology (including diet, foraging strategies, and feeding success) of each of the sperm whale clans in the etP?**
   While we have recent data on the foraging success of *Short* clan sperm whales, there is no information on the foraging ecology of any of the other clans since the 1990s.

3. **What are the primary anthropogenic threats faced by each of the clans in the etP?** The impact each of the previously identified threats has on individual sperm whales is unknown. Particular attention needs to be given to the increased fishing of the main prey of sperm whales in the etP, *D. gigas.*

4. **How vulnerable/resilient are each of the ETP clans to anthropogenic threats and environmental change?**

Future research should be directed toward answering the questions above to adequately determine **whether and how these clans should be conserved separately according to their differing responses to environmental pressures.**

Formalizing the “Cachalotes del Pacífico” network is a key step toward answering these questions. However, we identified a lack of financial support among Range States to sustain the logistically demanding fieldwork that is required for studying sperm whales at a clan level. In the cases in which long-term dedicated monitoring has taken place, funding has been provided by research funds and NGOs based in high-income countries (e.g., Canada, the United Kingdom, United States). This highlights the need to build ties among Range States and institutions from high-income countries.

A tool that would propel data acquisition on the distribution and behavior of sperm whale clans to new levels in the region is autonomous recording. Autonomous hydrophone recorders can be moored at the bottom of the ocean floor, drift at the ocean’s surface, or glide along the water column. By constantly recording the acoustic landscape in a site, they can be used to assess sperm whale distribution, population size, behavior, and clan identity. An array of autonomous recorders along the etP waters can gather data in any condition (e.g., overnight, in rough seas, and distant waters) throughout the year at a significantly lower cost than active surveys. Such arrays have been instrumental in greatly increasing knowledge of cetacean distributions off North America and in informing place-based conservation policies.

Our current knowledge of the behavior and distribution of sperm whale clans in the etP provides strong support for sperm whale clans having distinct behaviors, ecologies, and distributions. It is highly likely that they then experience different levels of human impacts. However, the specific status of each of the clans with respect to anthropogenic threats remains unknown. In the face of the threats identified in the region, we strongly recommend continued research and support toward answering these questions. Additional research and conservation fronts to be fostered are recommended as follows:

- **Assessment and prediction of cumulative multiple-anthropogenic stressors (e.g., climate change, illegal, unregulated, and unreported (IUU) fishing, and ocean pollution) affecting and influencing the population health, behaviour, and survival of sperm whales in the ETP.**
- **Knowledge mobilization of science and community-based conservation outreach with remote, coastal communities, and peoples of the ETP to foster capacity-building and awareness to champion sperm whale conservation.**
- **We, thus, recommend the renewal of the Concerted Action Plan, emphasizing the need for collaboration mechanisms that funnel funds toward research in low-income Range States and highlighting the potential of autonomous recording technologies to propel data acquisition.**

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7. ACTION

The Concerted Action is proposed for renewal.