SC/69A/E/02

Sub-committees/working group name:

Persistent organic pollutants in living southern right whale (Eubalaena australis) mothers and calves at Península Valdés, Argentina

Carina F. Marón, Andrea C. Hued, Franco Cecchetto, Nicolas D. Vazquez, Marcela M. Uhart, Mariano Sironi, Lidwina Bertrand, María Valeria Amé, Karina Miglioranza

INTERNATIONAL
WHALING COMMISSION

Persistent organic pollutants in living southern right whale (*Eubalaena australis*) mothers and calves at Península Valdés, Argentina

Carina F. Marón[1,2], Andrea C. Hued[1,3], Franco Cecchetto[4], Nicolas D. Vazquez[4], Marcela M. Uhart[5,6], Mariano Sironi[1,2,5], Lidwina Bertrand[7], María Valeria Amé[7], Karina Miglioranza[4]

Contact e-mail: carimaron@gmail.com

[1]Facultad de Ciencias Exactas, Físicas y Naturales (FCEFyN), Universidad Nacional de Córdoba, Córdoba, Argentina

[2]Instituto de Conservación de Ballenas (ICB), Ciudad Autónoma de Buenos Aires, Argentina

[3]Instituto de Diversidad y Ecología Animal (IDEA), CONICET (Consejo Nacional de Investigaciones Científicas y Técnicas), Córdoba, Argentina.

[4]Instituto de Investigaciones Marinas y Costeras (IIMyC), CONICET-UNMDP Mar de Plata-Conicet

[5]Southern Right Whale Health Monitoring Program, Puerto Madryn, Argentina

[6]Karen C. Drayer Wildlife Health Center, School of Veterinary Medicine, University of California – Davis, California

[7]Centro de Investigaciones en Bioquímica Clínica e Inmunología (CIBICI- CONICET) and Facultad de Ciencias Químicas, Universidad Nacional de Córdoba, Córdoba, Argentina.

ABSTRACT

Southern right whales off Península Valdés, Argentina, have experienced high newborn calf mortality in some years since the 2000´s. Between 2003-2013, calf mortality averaged 55 deaths per breeding season, almost seven times more than the numbers recorded in the previous decade (1993-2002). In this context, assessment of persistent organic pollutants in mother-calf pairs at Península Valdés has been proposed as one of the priorities for research, since transfer of pollutants from reproductive females could be compromising calf health. We analyzed persistent organic pollutants in the blubber of 35 mothers and calves, and in 14 juveniles and non-calving adults. A total of 16 organochlorine pesticides were found. In calves, the mean pesticide concentration was on average two to 13 times higher than in mothers, and in adults and juveniles the concentration were two to ten times higher than in reproductive females. This finding suggests that mothers eliminate some of these chemicals through gestation and lactation. All pesticides reported here in whales are already banned for agricultural use, and are thus environmental residuals and/or indicate current use of these chemicals. These findings are relevant since persistent pesticides could affect calf physiology and health and potentially reduce survival, thus affecting the population dynamics.

KEYWORDS: PESTICIDES, CONTAMINANTS, BIOACCUMULATION, BALEEN WHALES, MATERNAL TRANFER

INTRODUCTION

Persistent organic pollutants (POPs) comprise a large group of legacy contaminants that are used for agricultural or industrial purposes, among others. POPs are globally distributed via the atmosphere

and transferred to higher latitudes that act as sinks for these contaminants [1]-[2]. Bioaccumulation and biomagnification of POPs have been detected in Antarctic fauna reflecting not only global pollution but also specific use of these pollutants in the Southern Hemisphere. The effects of POPs on the health of individuals have been associated with failures in reproduction, changes in the normal functioning of the endocrine system, increased risk of infection and immune suppression [3]-[5]. In marine mammals, there is increasing evidence of these contaminants contributing to high mortality events in several species, because of the strong effects of POPs on nutritional condition and health [5]-[7].

The southern right whale (SRW, *Eubalaena australis*) population that calves off Península Valdés (PV), Argentina, has been studied continuously since 1971. Annual deaths appeared to mirror the population's growth until the 2000s. However, mortality has spiked in the past years. Over 2003-2013, calf mortality averaged 55 deaths per breeding season, greatly surpassing the previous decade's (1993-2002) average of 8.2 yearly. Furthermore, in 2012, 113 first-season calves died (33% of calves born). This represents the highest number of natural deaths ever to be recorded for the species in a single year [8]-[10].

Such high numbers of calf deaths are unheard of in baleen whales, and several hypotheses have been proposed to explain this high mortality [11]-[13]. Assessment of POPs presence and concentration in mother-calf pairs at PV has been proposed as one of the priorities for research [12], since in cetaceans, reproductive females accumulate POPs in their tissues (especially blubber) and transfer them to their calves through gestation and lactation [14]-[16], potentially compromising the offspring´s health. The presence of persistent chemical pollutants (organochlorine pesticides, OCPs, and polychlorinated biphenyls, PCBs) has been previously recorded in the blubber of 35 SRW dead calves [17]. This finding indicates that SRW calves likely incorporate toxic chemicals during gestation (through the placenta) and lactation (through milk). However, no study has yet analyzed the presence and concentration of these pollutants in living SRW, especially in reproductive females and their newborn calves. Therefore, the aim of this study is to characterize POPs concentrations in reproductive females and their calves, and compare them to other groups of the SRW population (adult males and juveniles).

PRELIMINARY RESULTS AND DISCUSSION

The presence of POPs in the blubber of 49 living SRW off the PV calving ground in Argentina was analyzed from biopsies collected in 2017. We analyzed 35 mothers and calves and 14 juveniles and non-calving adults. A total of 16 OCPs were found in the blubber of the whales, including: α-HCH, β-HCH, γ-HCH, Heptachlor, Heptachlor epoxide, α-Chlordane, γ-Chlordane, α-Endosulfan, β-Endosulfan, Endosulfan sulfate, Dieldrin, Endrin, p,p'-DDT, p,p'-DDE, p,p'-DDD and Methoxychlor. Among all pesticides, the concentrations of α-chlordane, p,p'-DDE and β-HCH accounted for the highest values (ng/g wet weight) in most of the samples. Notably, p,p'-DDT in its parental form was also found in some individuals. The alfa:beta endosulfan relationship found in most samples indicates current use of these chemicals.

Mother-calf pairs

Except for some OCPs, most contaminants were found in both mothers and calves. This finding could be related to the direct relationship between mothers and calves through gestation and lactation. In calves, the mean concentration of POPs was on average two to 13 times higher than the concentration found in mothers (Table 1). This fact suggests that mothers eliminate some of these chemicals through gestation and lactation, as reported for other marine mammals [14]-[15]. Right whale mothers fast during most of their time at Valdés, which means that blubber is their (and their calves) main source of nutrients and energy. Since lipophilic pesticides such as all OCPs tend to accumulate in blubber, they are likely mobilized into milk during lactation and are thus transferred

from mothers to calves.

The OCPs reported here for living calves showed a similar behaviour to those observed previously in the tissues of dead calves at PV [17]. Given that the Torres et al. 2015 study on dead calves was conducted using the same protocol and techniques than the ones used during the current study, results from both studies are directly comparable.

Juveniles and adults

OCPs concentrations found in non-calving adults (n=2) were added to the group of juveniles (n=12) to increase the sample size for non-calving individuals. When comparing this group with mothers and calves, most pesticides were shared among juveniles, adults and mothers; however, γ-HCH, endrin and β-endosulfan were only found in juveniles and adults. Furthermore, OCPs in adults and juveniles were on average two to ten times higher than the concentrations found in the blubber of lactating females. This finding provides additional evidence that mothers lose contaminants from their bodies through gestation and lactation. Similar concentrations of pesticides were found in juveniles and adults compared to calves, but the mean concentrations for α-, β-, and γ-HCH, heptachlor, dieldrin, *p,p'*-DDE, endrin and β-endosulfan, were two to six times higher in juveniles and adults than in calves.

Table 1. Average percentage of organochlorine pesticides in the blubber of living southern right whale mothers (n=17), calves (n=18) and non-lactating adults and juveniles (n=13).

Pesticide	**Age class**		
	Calves	Juveniles and adults	Mothers
α-HCH,	21.33	42.65	10.82
β-HCH,	24.53	43.88	9.71
γ-HCH,	0.86	2.85	0.00
Heptachlor	2.43	8.18	0.90
Heptachlor epoxide	4.39	3.50	0.69
α-Chlordane	35.17	51.40	11.20
γ-Chlordane	5.81	5.66	1.37
α-Endosulfan	36.26	23.28	9.84
β-Endosulfan	0.16	0.86	0.00
Endosulfan sulfate	21.18	4.90	1.61
Dieldrin	0.92	3.13	1.13
Endrin	0.63	1.28	0.00
p,p'-DDT	0.82	0.98	4.56
p,p'-DDE	16.52	8.98	7.01
p,p'-DDD	16.67	32.19	5.46
Methoxychlor	0.00	0.32	0.53

PRELIMINARY CONCLUSION

We detected different levels of OCPs in the blubber of southern right whale calves, juveniles and adults at Península Valdés. In calves, the OCPs likely have a maternal origin since calves exclusively nurse during their stay at PV (~3 months), the period when the samples were collected. All pesticides reported here are already banned from agricultural use. Given recent high calf mortalities at PV, this finding is especially relevant since POPs could affect their physiology and overall health. Additional analyses of other POPs, such as PBDEs and PCBs in available samples are ongoing and will be reported when analyses are completed.

ACKNOWLEDGMENTS

We thank Marcos Ricciardi, Agustina Donini, Adrian Rodriguez, Maria Constanza Marchesi, Diego Taboada, Roxana Schteinbarg, members and volunteers of the Instituto de Conservación de Ballenas (ICB) and collaborators of the Southern Right Whale Health Monitoring Program for providing invaluable support of various kinds. This work was conducted under research permits issued by the Dirección de Fauna y Flora Silvestre and by the Subsecretaría de Turismo y Áreas Protegidas of Chubut Province, Argentina. IACUC approval for collecting biopsy samples from living whales was obtained from the Wildlife Conservation Society's Institutional Animal Care and Use Committee (protocol #16:02). This work was supported by the Society for Marine Mammalogy grants in aid of research to C.F.M., and PURA to ICB.

REFERENCES

[1] Bidleman et al., Mar. Pollut. Bull., 26:258–262, 1993.
[2] Wania and Mackay, Environ. Sci. Technol., 30:390–396, 1996.
[3] Aguilar A, et al. Mar Environ Res 53:425–452, 2002.
[4] UNEP (United Nations Environment Programme and the World Health Organization). En: Bergman A, et al. (Eds.), (ISBN: 978-92-807-3274-0 (UNEP) y 978 92 4 150503 1 (WHO), 2012.
[5] Roos AM, et al. Environ Pol, 170:268–275, 2012.
[6] Van Bressem MF, et al. Dis Aquat Org, 86:143–157, 2009.
[7] Mazzariol S, et al. PLoS One, 6(5), e19417, 2011.
[8] Uhart, et al., SC/60/BRG15, 2008.
[9] Uhart, et al., SC/61/BRG18. 2009.
[10] Rowntree, et al., Mar. Ecol. Prog. Ser., 493:275–289, 2013.
[11] Sironi, et al. SC-65b-BRG06, 2014.
[12] International Whaling Commission, J. Cetacean Res. Manag., vol. 12, no. SUPPL., pp. 367–398, 2011.
[13] Thomas, et al., SC/60/BRG15, 2013.
[14] Addison RF & Brodie PF. Can J Fish Aquat Sci 44:782–786. 1987.
[15] Tanabe S, et al. Sci Total Environ. 154, 163–177, 1994.
[16] Marsili L & Focardi S. Environ Pollut, 91:1–9, 1995.
[17] Torres et al., Sci. Total Environ., 518–519:605–615, 2015.
[18] Brown, et al. Rep. Int. Whal. Comm., vol. 13, Spec Issue, pp. 81–90, 1991.
[19] Metcalfe and Metcalfe, Sci. Total Environ., 201:245–272, 1997.
[20] Miglioranza et al., Environ. Toxicol. Chem., 22: 712–717, 2003.