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Article

Killer whales in Chilean Patagonia: additional sightings, behavioural observations, and individual identifications

Orcas en la Patagonia chilena: avistamientos adicionales, observaciones de comportamiento e identificaciones individuales

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Resumen.- Se conoce muy poco sobre las orcas (*Orcinus orca*) que frecuentan las aguas de la Patagonia chilena y si los individuos identificados son visitantes o residentes. Se informan 119 observaciones oportunistas recolectadas desde 2001 hasta 2012. Los tamaños de los grupos avistados varían desde un animal hasta tamaños grupales de más de 50 individuos. También se informa sobre el comportamiento observado y se presenta un primer catálogo de individuos para la Patagonia chilena, identificándose 49 individuos, de las cuales 7 han sido observados en más de una ocasión.

Palabras clave: *Orcinus orca*, región de fiordos chilenos, tamaño grupal, comportamiento de alimentación, catálogo de foto-identificación

Abstract.- Very little is known about the killer whales (*Orcinus orca*) that frequent the waters of Chilean Patagonia. Even information as to whether identified individuals are visitors or residents of the region is unknown. Here, we report on opportunistically collected observations in this region from 2001 through 2012. Killer whales were observed on 119 separate occasions in group sizes ranging from one to groups of over 50 individuals. We also describe observed behaviour and present a first catalogue of individuals in Chilean Patagonia. We identified 49 individuals, only seven of which were sighted more than once.

Key words: *Orcinus orca*, Chilean fjord region, group size, feeding behaviour, photo-identification catalogue

Introduction

The killer whale, (*Orcinus orca* Linnaeus, 1758), is a cosmopolitan species. The populations in the Eastern North Pacific are perhaps the most studied and well known in the world. These populations are divided into 3 genetically distinct ecotypes which differ substantially in diet, behaviour, and social structure: transient killer whales (or mammal-eating form), resident killer whales (or fish-eating form), and offshore killer whales who are thought to eat fish including sharks (Bigg 1982, Bigg 1987, Hoelzel & Dover 1991, Matkin *et al.* 1999, Baird 2000, Saulitis *et al.* 2000, Ford *et al.* 2011). Four ecotypes, type A to D, have recently been described from the Southern Ocean which differ in colouration, diet and size, and possibly represent different species or sub-species (Pitman & Ensor 2003, Pitman *et al.* 2011).

While data sets on northern hemisphere killer whales are comparably large and populations are often recognized on the individual level (Ford *et al.* 2000), there is very little known about Patagonian populations. In the Western South Atlantic, the only long-term studies on killer whales have been conducted off the Valdes Peninsula, northern Patagonia, Argentina. The killer whales studied here are famous worldwide for intentionally stranding to catch South American sea lions *Otaria flavescens* (Shaw, 1800) and southern elephant seals *Mirounga leonina* (Linneaus, 1758), (Lopez & Lopez 1985, Hoelzel 1991, Iñíguez 2001). Information on Chilean killer whale populations however is scarce. Only 2 congress summaries (Canto 1990[1], Marcotte *et al.* 2009[2]), one publication (Capella *et al.* 1999) and 2 reports for the

[1] Canto J, JC Cárdenas & J Yañez. 1990. Distribución y tamaño grupal de *Orcinus orca* (Linnaeus, 1758) en Chile. En: Resumen 4ª Reunión de trabajo de especialistas en mamíferos acuáticos de América del Sur. Valdivia, Chile. p. 13.
[2]Marcotte M, V Häussermann, J Biro & G Försterra. 2009. The role of the silent warden: Trophic interactions between killer whales and sea lions in Chilean Patagonia. In: Congreso de Ciencias del Mar. Talcahuano, Chile, p. 104.

International Whaling Commission (Mikhalev *et al.* 1981, Dahlheim *et al.* 1982) deal exclusively with Chilean and South Eastern Pacific killer whales. The species is also described in field guides of Chilean marine mammals (Sielfeld 1983, Cárdenas 1986). In their monograph on Chilean marine mammals, Aguayo-Lobo *et al.* (1998) briefly summarize the known information on Chilean killer whales; Capella *et al.* (1999) added new sightings which increased the number of recorded sightings for Chilean Patagonia to a total of 30. Based on the available published information, the latter authors concluded that the species is scarce in Chilean waters. After this determination of scarcity, Chilean killer whales have only been mentioned in 6 further publications (Hucke-Gaete *et al.* 2004, Hückstädt & Antezana 2004, Aguayo-Lobo *et al.* 2006, Moreno *et al.* 2008, Viddi *et al.* 2010) and one thesis (Olivares-Mancilla 2005). These publications added 29 new records for Chilean Patagonia, primarily from commercial fishing areas for Patagonian toothfish (*Dissostichus eleginoides* Smitt, 1898).

Very little information is available about the feeding behaviour of Chilean killer whales. Pinnipeds are generally an important prey item of some killer whale populations (Lopez & Lopez 1985, Hoelzel 1991, Jefferson *et al.* 1991). In Chile, killer whales regularily feed upon the South American sea lion (Capella *et al.* 1999, Hückstädt & Antezana 2004), and, to a lower extent, on the South American fur seal (*Arctocephalus australis* Zimmerman, 1783) (Capella *et al.* 1999). A variety of other prey items have also been reported (Capella *et al.* 1999). Killer whales have been observed to feed on the catches in fishing fleets for Patagonian toothfish between 53°S and 57°S (Hucke-Gaete *et al.* 2004, Olivares Mancilla 2005, Moreno *et al.* 2008), and possibly attack sperm whales in the same fishing areas (Hucke-Gaete *et al*. 2004).

In this paper we report 119 new killer whale sightings of generally small groups recorded between 2001 and mid 2012. Observations recorded include group size and, where possible, feeding behaviour. A first edition of a dorsal fin and saddle patch photos catalogue for individual identification and some recapture data are presented.

Materials and methods

Killer whale sightings have been recorded opportunistically since 2003 by the team of the Huinay Scientific Field Station (HSFS) in the northern Patagonian channels. Sightings were made from a variety of platforms including small vessels (6-11 m length) during year-round transport trips between Hornopirén and the research station, boat trips for non-killer whale related field work in the Comau Fjord, mainly during the austral summer months (up to 10 trips of 4-6 h per month). Photos of individuals were taken if a camera was available, and the type of displayed activity was recorded if obvious to the observer. Since 2006 boat hours and number of trips have constantly been rising with increasing scientific activity at the station.

In the southern Patagonian channels, the sightings of killer whales were recorded opportunistically by Centro Regional de Estudios del Cuaternario Fuego-Patagonia y Antártica (CEQUA) researchers from different vessels (15 and 26 m length) during the sea lion census in the Magellan region and during the humpback whale program carried out during 2001, and between 2003 and early 2012, respectively.

During several sightings, the teams took photos of the dorsal fin, saddle and eye patches for individual identification. A photo catalogue of identified killer whales was prepared for both study areas. New photographs were checked against existing photo-catalogues and also compared between both regions.

In addition, some sightings recorded by locals and some data from social media have been included in this review. Although videos from the internet are less reliable sources compared to regular sightings, we include them here to provide additional information on killer whales and their behaviour in Chilean Patagonia. Further sightings provided by DIRECTEMAR (part of the Chilean Navy) from 2005 to 2012 were also added to our dataset.

Results and Discussion

One hundred and nineteen new sightings of killer whales from Chilean Patagonia are presented here (Table 1); 29 are from Comau Fjord, Northern Patagonian Zone, 14 from the Marine Protected Area (MPA) Francisco Coloane, Southern Patagonian Zone and 15 from other areas in Chilean Patagonia (Fig. 1), (Map was created using Quantum GIS (QGIS), software SIG open source)[3]. Fifty-six sightings were reported by the DIRECTEMAR, the remaining 5 were based on videos: one made by an artisanal fisherman and 4 videos were obtained from internet social media sources (Table 1). All the observed killer whales had similar colouration to killer whales seen worldwide, with a medium-sized eye patch oriented parallel to the body axis, and no dorsal cape. No yellowish or brown staining could be distinguished, as has been recorded from some Antarctic whales (Pitman *et al*. 2003). The individuals resemble the 'type A' form in colouration (see Pitman *et al*. 2003).

[3]Quantum GIS Development Team. 2012. Quantum GIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org

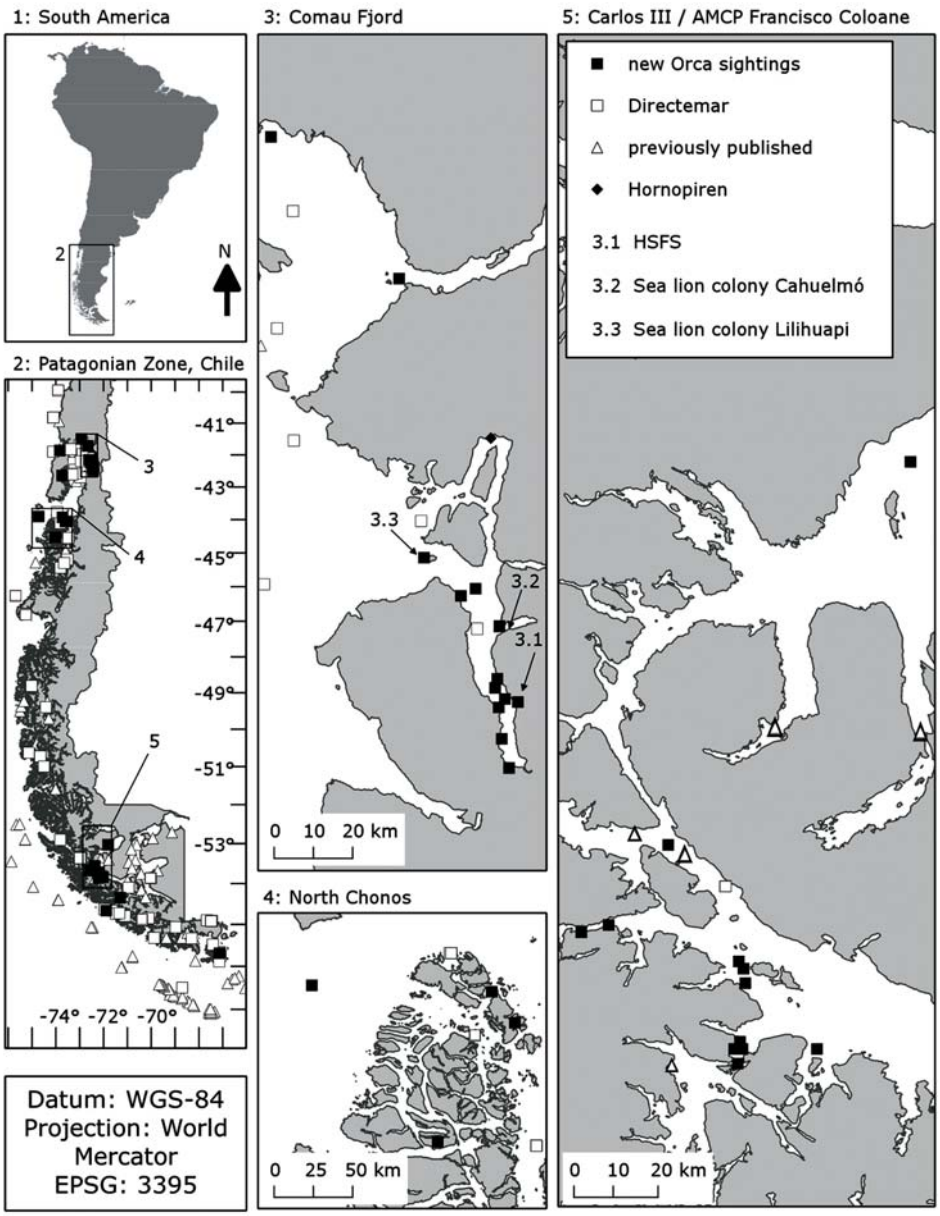

Figure 1. Map of Chilean Patagonia with the new killer whale sighting locations / Mapa de la Patagonia chilena con los nuevos avistamientos de orcas

Table 1. New killer whale sightings from the Chilean Patagonia between 2001 and 2012, m = male, f = female, y = young / Resumen de los nuevos avistamientos de orcas en aguas de la Patagonia chilena entre 2001 y 2012, m = macho, f = hembra, y = joven

Area	Sighting date	Nr. Indiv.	Sex(if known)	Site if known	Lat.	Long.	Source	Activity	Time
Comau fjord	July 20, 2006	7	2m, 4f, 1 calf	around Pta. Llonco	-42.343817	-72.458258	V. Haussermann, G. Försterra etc.	Calf training with a sea lion	morning
	August 13, 2006	approx. 5	3m, 2f	mid fjord, off HSFS to Piedra Blanca	-42.357753	-72.462703	R. Fitzek	swimming	afternoon
	May 21, 2007	3 to 4	m, 1 to 3 f or y	off HSFS	-42.379664	-72.415425	M. Melipillán	swimming	afternoon
	July 16, 2007	3	m,f,calf	off HSFS, nearly on other side	-42.387986	-72.455233	M. Marcotte etc.	hunting sea lion	late afternoon
	October, 2007	6	2m, 4 f or y	off Cahuelmo	-42.262869	-72.453592	R. Fitzek		
	November 11, 2007	7	m, 4f, 2y	inner fjord to Lilihuapi	-42.205194	-72.503408	R. Fitzek	feeding on sea lions, playing	morning
	August 1, 2008	two groups (3, ?)	m, 2f	Comau fjord	-42.374903	-72.428036	M. Marcotte etc.	feeding on sea lions, playing	
	Sept-Nov, 2008[1]			Comau fjord			R. Fitzek		
	November 19, 2008	13	2m, 11 f, or y	Marilmo	-42.216372	-72.533989	R. Fitzek, J. Sareyka	feeding on sea lions	
	July 15, 2009	5 to 6	2m, 4f?	across HSFS on other shore	-42.387986	-72.455233	L. Hernández	swimming	morning
	Aug-Nov, 2009[1]			Comau fjord			R. Fitzek		
	March 28, 2010	3	2f,1y	inner fjord, way back from Porcelana	-42.436653	-72.435639	Peruvian embassador		afternoon
	April 3, 2010	4	3m, f	off Lilihuapi island	-42.158269	-72.595267	C. Mayr etc.	swimming	
	November, 2011[2]	3 to 6		in Comau fjord (Porcelana to Caleta Soledad)	-42.436653	-72.435639	several anecdotal reports from inhabitants of the fjord		
	December 2, 2011	6	2m, 4 f or y	across HSFS on other shore	-42.387986	-72.455233	L. Hernández etc.	hunting sea lion	afternoon
	December 3, 2011	6	2m, 4 f or y	across HSFS on other shore	-42.387986	-72.455233	L. Hernández etc.	leaving the fjord	morning
	December 17, 2011	1		off Lilihuapi Island	-42.158269	-72.595267	E. Plotnek etc.	swimming	afternoon
	December 24, 2011	1	m	across HSFS on other shore	-42.387986	-72.455233	L. Hernández		
	December 2011	About 6		South of Calhuelmo	-42.280331	-72.467419	L. Hernández		
	January 6, 2012	6		Leptepu	-42.481603	-72.433708	C. Zambrano		
	February 20, 2012	3 or 4		across HSFS on other shore	-42.388206	-72.446281	L. Hernández		
	May 12, 2012	5	1m, 4 f or y	Mid fjord, Between Huinay and Boris	-42.379664	-72.415425	L. Hernández	2 smaller were hunting lobos	
	June 13, 2012	5 to 7	2 m?	Across Huinay on other shore	-42.387986	-72.455233	L. Hernández		
	June 28, 2012	5		Across Huinay on other shore	-42.387986	-72.455233	L. Hernández		
	November 21, 2012	2	1 m, 1 y	South of Cahuelmó (close to sea lion colony)	-42.280331	-72.467419	R. Winkler, J. Ingledew		Morning and noon (RW), 17:30 H (JI)
AMCP Francisco Coloane	February 11, 2004	2	--	Ingles passage, MPA Francisco Coloane			Acevedo & Aguayo-Lobo	Milling	--
	April 7, 2006	7	1 adult m, 2 mother, 2 y, 2 calves	Shag passage, MPA Francisco Coloane	-53.844444	-72.195833	Acevedo & Aguayo-Lobo	Milling. Then hunting a southern fur seal	--
	November 1, 2010	6	1 adult m, 2 subadult m, 1 f	Ballena sound, MPA Francisco Coloane	-53.676111	-72.566111	Francisco Martinez	swimming	afternoon
	February 2, 2011	3	1 adult m, 1 f, 1 y	Shag passage, MPA Francisco Coloane	-53.839167	-72.213333	Mathias Hüne	Milling	afternoon
	February 4, 2011	3	1 subadult m, 1 y	Shag passage, MPA Francisco Coloane	-53.840278	-72.194444	Mathias Hüne	--	Morning
	February 24, 2011	3	1 adult m, 1 f, 1 juv.	Shag passage, MPA Francisco Coloane	-53.843056	-72.189167	Francisco Martinez and Ricardo Matus	--	--
	March 5, 2011	3	1 f with, 1 calf, 1 y.	Shag passage, MPA Francisco Coloane	-53.833333	-72.2	Acevedo & Aguayo-Lobo	Calf training with a southern fur seal	Morning

[1] 3 sightings, dates not properly recorded

Area	Sighting date	Nr. Indiv.	Sex(if known)	Site if known	Lat.	Long.	Source	Activity	Time
	April 14, 2011	4	1 adult m, 1 f	Charles Islands, MPA Francisco Coloane	-53.741333	-72.186	Acevedo & Aguayo-Lobo	swimming slowly and milling	afternoon
	April 14, 2011	15	4 f with 4 calves, and y or/and adult f.	Shag passage, MPA Francisco Coloane	-53.861944	-72.205278	Acevedo & Aguayo-Lobo	Milling. Then swimming slowly thogether the boat	afternoon
	May 12, 2011	2	2 Adult m	MPA Francisco Coloane	-53.728747	-72.181833	Acevedo & Aguayo-Lobo	swimming	Morning
	October 10, 2011	4	≥ 1 adult m, 1 subadult m	Carlos III Island, MPA Francisco Coloane	-53.564444	-72.365556	C. Gonzalez	--	--
	November 10, 2011	4	≥ 1 adult m	Ballena sound, MPA Francisco Coloane	-53.671667	-72.503056	Francisco Martinez	swimming	afternoon
	December 14, 2011	5	≥ 1 adult m, 2 calves	MPA Francisco Coloane			Francisco Martinez	swimming	afternoon
	December 20, 2011	2	≥ 1 adult m	Charles Islands, MPA Francisco Coloane	-53.719	-72.205028	Aguayo-Lobo & Haro	swimming	afternoon
Other areas	February 1, 2001	1	skull	Cockburn channel	-54.35	-71.3	Acevedo & Aguayo-Lobo	--	--
	March 3, 2002	2	--	Bárbara channel	-54.666	-71.883	Acevedo & Aguayo-Lobo	--	--
	2003 or 2004[2]	60		off Puerto Montt	-41.500364	-72.929244	R. Fitzek	swimming	
	January 19, 2008[3]	2	1 m, 1f	Golfo Corcavado	-41.604854	-73.005617	Gerard Prins	swimming	
	received June 2010[4]	at least 3 to 4		Chonos Archipielago	-44.531872	-74.020031	video taken by a fishermen, received by Ana Guzman	attacking a sei whale	
	January 13, 2007	1	1m	Melinka	-43.930639	-73.719111	F. Viddi	swimming	
	February 20, 2007	7	1m	off Melinka	-43.904917	-74.719694	F. Viddi		
	March 8, 2007	5	≥ 1 adult m	Cape Horn	-55.692778	-67.138056	Guía de turismo COMAPA	swimming around boat	afternoon
	March 2, 2008	8	1 year old, 1 y	Guaitecas Archipelago	-44.05525	-73.590972	F. Viddi		
	December 14, 2009	2	1 large and 1 small	Between Arena and Puelche	-41.716333	-72.657228	Carlos Zambrano	swimming in the ferry track	morning
	February 8, 2011	3		Island between La Arena and Puelche, Ancud Gulf	-41.722431	-72.65	C. Jantzen	swimming	
	April 15, 2011	5	1 adult m, 2 f with 2 calves	Otway sound	-53.0255	-71.7975	Acevedo & Aguayo-Lobo	swimming slowly and milling	afternoon
	January 31, 2012	1	m	Isla Bertrand	-55.14121	-68.212967	Gerard Prins	swimming	
	February 9, 2012	1	1m	Yal channel	-73.73166	-42.64555	C. Cifuentes	swimming	
	November 17, 2012	2	1 m, 1 small	Pillán, Renihué Fjord	-42,556	-72,553	R. Winkler	swimming	19:00 H
Directemar sightings	March 25, 2005	4	≥ 1 m, 1 f	Canal Balleneros	-54.796667	-71.098889	Marcela Zamorano, Directemar	swimming to NE	08:00 H
	May 12, 2005	7		Paso Mackinlay, canal Beagle	-54.884167	-70.381389	Marcela Zamorano, Directemar	Hunting sea lions, swimming to W	10:45 H
	May 25, 2005	10		Canal Yal	-42.65	-73.667	Marcela Zamorano, Directemar	swimming to S	13:00 H
	June 28, 2005	3	--		-55.325	-69.875833	Marcela Zamorano, Directemar	swimming to SE	13:35 H
	July 30, 2005	7	--		-51	-74.5	Marcela Zamorano, Directemar	swimming to SW	15:15 H
	December 29, 2005	2	--		-55.666667	-67.118889	Marcela Zamorano, Directemar	swimming to W	17:40 H

[2] Dates not properly recorded
[3] <http://gallery.gerardprins.com/main.php?g2_view=tags.VirtualAlbum&g2_tagName=Orcinus+orca&g2_itemId=3852>
[4] <http://www.youtube.com/watch?v=dHVr8x4rBkM&feature=youtu.be>

Table 1. Continued / Continuación

Area	Sighting date	Nr. Indiv.	Sex(if known)	Site if known	Lat.	Long.	Source	Activity	Time
	June 14, 2006	4	--		-54.743333	-71.475	Marcela Zamorano, Directemar	swimming to E	09:12 H
	July 03, 2006	2	--	Canal Brecknock	-54.731111	-71.331667	Marcela Zamorano, Directemar	swimming to N	12:58 H
	July 31, 2006	6		Estrecho Magallanes, cuadra faro monte Radford	-53.367	-72.95	Marcela Zamorano, Directemar	swimming to E	14:40 H
	August 02, 2006	5	--	Paso Mackinlay	-54.917222	-67.451111	Marcela Zamorano, Directemar	swimming to W	09:40 H
	August 08, 2006	1	Adult male	Paso Largo, estrecho Magallanes	-53.365556	-72.985278	Marcela Zamorano, Directemar	swimming to W	14:30 H
	September 01, 2006	6	≥ 2 adults m		-44.533583	-73.466708	Marcela Zamorano, Directemar	swimming to S	17:49 H
	September 10, 2006	10	--		-46.266694	-75.683417	Marcela Zamorano, Directemar	Approaches boat	11:45 H
	October 19, 2006	2	--	Paso Mackinlay	-58.014833	-67.416667	Marcela Zamorano, Directemar	swimming to W	16:15 H
	November 02, 2006	6	--		-48.800222	-75.01675	Marcela Zamorano, Directemar	swimming to S	16:36 H
	December 02, 2006	5	--		-42.466667	-73.2	Marcela Zamorano, Directemar	swimming to S	11:00 H
	January 08, 2007	1	--		-42.583333	-73.133333	Marcela Zamorano, Directemar	swimming to N	21:00 H
	March 07, 2007	6 (1 calf)			-55.066697	-68.966725	Marcela Zamorano, Directemar	swimming to W	15:30 H
	April 18, 2007	8	--		-54.916667	-67.483333	Marcela Zamorano, Directemar	swimming to E	08:20 H
	June 19, 2007	5	--	Bahia Tekenika	-55.335278	-68.301389	Marcela Zamorano, Directemar	swimming to SW	10:30 H
	July 08, 2007	3	--		-54.100056	-70.95	Marcela Zamorano, Directemar	swimming to S	14:22 H
	August 30, 2007	10	--		-42.6125	-73.3125	Marcela Zamorano, Directemar	swimming to E	11:20 H
	November 06, 2007	8	--	Golfo Ancud	-41.966806	-72.866917	Marcela Zamorano, Directemar	swimming to N	08:50 H
	November 26, 2007	3	--		-43.766806	-72.933528	Marcela Zamorano, Directemar	swimming to SW	17:15 H
	December 08, 2007	1	--		-42.198333	-72.943333	Marcela Zamorano, Directemar	swimming to W	11:43 H
	January 14, 2008	4		Isla Quellin	-41.866667	-72.966667	Alex Rich, Directemar	swimming NE	15:45 H
	February 18, 2008	1		Puerto Williams	-54.666667	-71.65	Alex Rich, Directemar	swimming W	20:15 H
	February 19, 2008	2		Puerto Montt	-41.7	-73	Alex Rich, Directemar	swimming N	10:00 H
	March 14, 2008	5		Puerto Williams	-54.9	-67.666667	Alex Rich, Directemar	swimming W	12:00 H
	June 2, 2008	3		Puerto Williams	-54.85	-70.116667	Alex Rich, Directemar	swimming W	16:00 H
	June 4, 2008	5		Puerto Natales	-50.733333	-74.65	Alex Rich, Directemar	swimming W	11:15 H
	July 23, 2008	3		Puerto Montt	-42.25	-73.25	Alex Rich, Directemar	swimming W	09:05 H
	July 25, 2008	2		Isla Diego Ramirez	-56.5	-68.7	Alex Rich, Directemar	swimming W	10:30 H
	January 23, 2009	2		Chaiten	-42.701667	-72.971667	Alex Rich, Directemar	swimming E	10:15 H
	July 28, 2009	14		Puerto Aysen	-45.2	-73.516667	Alex Rich, Directemar	swimming S	10:30 H
	August 15, 2009	4		Punta Arenas	-53.616667	-72.233333	Alex Rich, Directemar	swimming NW	16:07 H
	August 23, 2009	4		Puerto Aysen	-45.439167	-73.805	Alex Rich, Directemar	swimming E/W	14:15 H

Area	Sighting date	Nr. Indiv.	Sex(if known)	Site if known	Lat.	Long.	Source	Activity	Time
	September 7, 2009	12		Puerto Montt	-42.266667	-72.5	Alex Rich, Directemar	swimming NW	10:20 H
	September 8, 2009	1		Puerto Aysen	-44.106667	-73.813333	Alex Rich, Directemar	swimming S	16:00 H
	October 22, 2009	30		S of Cape Horn	-57.951	-66.884167	Alex Rich, Directemar	swimming SW	15:30 H
	December 28, 2009	6		Puerto Williams	-55.75	-67.091667	Alex Rich, Directemar	swimming NW	15:01 H
	January 29, 2010	2		Puerto Williams	-54.633333	-71.96	Alex Rich, Directemar	swimming SW	06:21 H
	February 6, 2010	3		Puerto Montt	-41.816667	-73.366667	Alex Rich, Directemar	swimming W	08:30 H
	March 24, 2010	5		Puerto Montt	-42.1	-72.616667	Alex Rich, Directemar	swimming N	16:40 H
	December 6, 2010	2		Puerto Montt	-41.616667	-72.883333	Alex Rich, Directemar	swimming SW	13:22 H
	March 4, 2011	1		Madre de Dios Archipielago	-50.6333	-75.1333	Alex Rich, Directemar	swimming SW	
	March 10, 2011	2		Straights of Magellan	-53.8667	-70.0167	Alex Rich, Directemar	swimming N	
	May 30, 2011	2		PeninsulaTaitao	-46.8	-75.266667	Alex Rich, Directemar	swimming NE	09:39 H
	July 1, 2011	3		Chiloe Island	-41.9	-74.1167	Alex Rich, Directemar	swimming NW	
	September 09, 2011	2		Punta Arenas	-55.883333	-67.15	Alex Rich, Directemar	swimming S	08:25 H
	October 24, 2011	2		Straights of Magellan	-52.9	-73.816667	Alex Rich, Directemar	swimming NE	21:30 H
	November 29, 2011	8		Isla Wellington	-49.4	-74.416667	Alex Rich, Directemar	swimming N	13:10 H
	March 26, 2012	1		Puerto Aysen	-45.3	-73.65	Alex Rich, Directemar	swimming N	11:15 H
	March 26, 2012	1		Puerto Montt	-41.8	-72.916667	Alex Rich, Directemar	swimming S	11:35 H
	August 15, 2012	12		Puerto Williams	-55°00'	-68°18'	Alex Rich, Directemar	swimming N	19:10 H
	September 6, 2012	5		Puerto Aysén	-44°32'	-73°30'	Alex Rich, Directemar	swimming S	08:30 H
From social media	uploaded May 13, 2008[5]	1	m	south Chileen channels, next to a salmon farm			Youtube video by Gabriel Cornejo	swimming	
	September, 2009[6]	>4		Canal Lemuy, Chiloe Island	-47.57	-73.6822	uploadad by Daniel Fajardo	possibly feeding (birds also seem to be feeding)	
	September 09, 2009[7]	1	m	Ancud	-41.866667	-73.833333	uploaded by "kalektor"		
	uploaded April 8, 20108	1		south Chile			uploaded by "sebastian 24666"	swimming fastly next to fisherboat, following some sea lions	
	uploaded May 5, 20109	at least 3	1m, 2 f	south Chile			uploaded by "sebastian 24666"	swimming fastly next to fisherboat, following some sea lions, on of which is trying to climb up the back of the boat	
	uploaded January 201110	2 or 3		Canal Baeza/Melinka Guaitecas Archipielago	-44.4692	-73.8397	Youtube video	swimming around boat, eating imperial shag	
	uploaded September 23, 201111	at least 5		south Chile			uplodaded by "somethig Kathos"	swimming	

5 <http://www.youtube.com/watch?v=Kn05xJWV82k>
6 <http://www.youtube.com/watch?v=AjpbPuEPLHw&feature=related>
7 <http://www.youtube.com/watch?v=4if9w3D3dWc&feature=related>
8 <http://www.youtube.com/watch?v=CreD57rSL-I&feature=related>
9 <http://www.youtube.com/watch?v=Ss6PW2buj_c&feature=related>
10 <http://www.youtube.com/watch?v=T4AKJunYNsI>
11 <http://www.youtube.com/watch?v=ZL2C8Z1OF_E&feature=related>

The great number of new incidental sightings recorded, primarily from 2 restricted areas of Chilean Patagonia (Comau Fjord, MPA Francisco Coloane) and from the few places where the Chilean navy operates regularly, indicates that killer whales may be more common in Chilean waters than previously assumed (another 27 sightings from the Chilean coast north of Puerto Montt and Antarctica are not mentioned here). The probable reason for few reported sightings is likely due to the remoteness of most areas of Chilean Patagonia, the absence of dedicated local marine mammal research, and the lack of a public sighting database.

Feeding behaviour and group sizes

During 14 of the 119 sightings, the killer whales were observed displaying active predatory behaviour: 10 times they were hunting and/or feeding on South American sea lions, twice on southern fur seals, once they were filmed attacking a sei whale *Balaenoptera borealis* Lesson, 1828) and once a killer whale was filmed swallowing an imperial shag *Phalacrocorax atriceps* King, 1828 (see Table 1). Once a killer whale was observed tail-slapping in Comau Fjord. Fishermen have also observed small groups of killer whales feeding on gull species and Magellan penguins *Spheniscus magellanicus* (Forster, 1781) during the summer seasons, and removing fish from the lines of artisanal fishermen outside the AMCP Coloane. These sightings are not included in Table 1 because the sighting locations are not provided with certainty. In 3 instances, adult killer whales were observed encircling South American sea lions or fur seals without attacking, while the young calves appeared to be practicing attacks.

The observed attack of a killer whale on a sei whale is the third instance recorded (both times in Tierra del Fuego, see Ford & Reeves 2008 and Goddall *et al*. 2007). The filmed whale is seen moving heavily and slapping its tail, which may be interpreted to be an attempt to deter the attacking killer whales[4]. However, baleen whales have been classified as flight species (in contrast to fight species) when being attacked by killer whales (Ford & Reeves 2008): no whale of the genus *Balaenoptera* has been documented defending itself from a killer whale attack. The only recorded observation that could be interpreted as an attempt to defend itself was a Bryde's whale *Balaenoptera edeni* Anderson, 1878 which 'forcefully wave[d] its tail laterally' once during an hour and a half attack (Silber *et al.* 1990). Thus we believe the behaviour of this sei whale most probably represents a panicking response by the animal trying to swim away.

In Comau Fjord, killer whales were observed preying on South American sea lions but never on other marine mammals, birds or fish. The MPA Francisco Coloane shelters moderate numbers of pinnipeds, penguins and humpback whales during the summer and fall seasons, however predation behaviours were observed on few occasions. Although humpback whales are also a common marine mammal species in MPA Francisco Coloane, they were not observed being attacked by killer whales.

The group sizes varied between one and 60 individuals, with a mean group size of five. The large group sizes of 30 and 60 individuals were outliers in the data, being the only large aggregations reported. Excluding these outliers, the mean group size was 4.2 individuals, ranging between one and 15 individuals.

The report of a large group of approximately 60 killer whales close to Puerto Montt and the DIRECTEMAR report of another group of 30 killer whales south of Cape Horn are only the second and third records for a group of killer whales larger than 15 animals in Southern Chile. The first record reported 25 killer whales feeding on fish close to Puerto Natales (Capella *et al.* 1999). It is possible that 2 ecotypes (fish-eaters and mammal-eaters) are present in Chilean waters or that Chilean killer whales are feeding on mammals as well as on fish. Following consumption records and metabolic calculations of Northern Hemisphere transient killer whales (Williams *et al.* 2004), Chilean Patagonia killer whales may have an important impact on the local sea lion populations and may represent an important regulatory factor. An increase in sample size of observed kills is needed to better understand their feeding behaviour. Analytical techniques (such as identification of fatty acids, stable isotopes) coupled with field observations may prove useful to obtain a more complete picture of the feeding habits of killer whales.

Seasonality of killer whale sightings

Between 2006 and 2012, 29 groups of killer whales were observed in Comau Fjord. The groups were present briefly (generally one or 2 days) as it is known for mammal-eating killer whales from the North Pacific who remain in one area for a relatively short period of time before moving on to avoid sensitization of prey (Saulitis *et al.* 2000).

Although observer effort (boat hours) in Comau Fjord is consistently higher during the austral summer, and is

[4]<http://www.youtube.com/watch?v=dHVr8x4rBkM&feature=youtu.be>

increasing every year, reported sightings within summer months (December to March) have been rare until summer 2011/2012. Over all the years, sightings have been quite equally distributed over the seasons (see Table 1). However, it is notable that there were no winter sightings in 2010 and 2011 (Table 1). This apparent absence of killer whales in the winters 2010 and 2011 coincides with the disappearance of the South American sea lions from Lilihuapi Island, the larger of 2 principal non-breeding colonies in Comau Fjord (Lilihuapi Island, before 2010 typically between 400 and 1500+ sea lions year round and Cahuelmó, before 2010 between 100 and 300 sea lions). The sea lion colony at Lilihuapi Island was greatly reduced in early 2009, and practically disappeared in 2010, presumably due to feral dog presence: at least 9 recently born pups were first spotted on the island in December 2008 (Häussermann & Försterra, unpublished data). Since 2012, the colony in Cahuelmó has been increasing significantly to up to 2000 animals. In the neighbouring Reñihué fjord, in which killer whales were spotted nearly every year in winter, there were no winter sightings in 2011 and 2012. In Reñihué the sea lion colony (approx. 200 animals) was greatly reduced in early 2011, and never recovered to its original size. The resulting low densities of sea lions in the Comau and Reñihué Fjord area may have been insufficient to satisfy the high metabolic requirements of killer whales.

In the southern Patagonian channels, 51 new killer whales sightings were made. Of these, 15 groups were observed inside AMCP Francisco Coloane in different years, but particularly in the 2011 summer season, where groups of killer whales were observed each month between January and May. Although survey effort in this area is highest during summer and autumn, groups of killer whales have also been observed year round in the Magellan region. Most of the encounters were in summer (34%), followed by autumn (25%), winter (21%) and spring (20%). When comparing the monthly distribution, at least 2 peaks are denoted, the first in February-March (28%), and the second in June-July (21%). The increase in sightings during summer is likely linked to the breeding cycles of pinnipeds and Magellan penguins.

Very little is known about the movements of killer whales from Antarctic waters, however many animals have been recorded to migrate to lower latitudes during the austral winter for feeding (Mikhalev *et al.* 1981, Kasamatsu & Joyce 1995). In particular, type A killer whales head north during the winter following the departure of their primary prey, the minke whale (*Balaenoptera acutorostrata* Lacépède, 1804 and/or *B. bonaerensis* Burmeister, 1867) in autumn (Budylenko 1981, Mikhalev *et al.* 1981, Berzin & Vladimirov 1983, Kasamatsu & Joyce 1995). Further research is required to fill in data gaps regarding the seasonality of killer whale occurrence in southern South American and Antarctica.

Killer whale photo database

In this paper, a first version of a Chilean killer whale catalogue is presented. Photographs of sufficient quality of dorsal areas from 12 of the observed killer whales in Comau fjord during 6 sightings events (2006, 2007, 2008 and 2010) and from 37 killer whales in southern Patagonian channels, including AMCP Coloane during eleven sightings events between 2006 and 2011 were collected. The identification guide presents 49 distinct individuals from Chile (Fig. 2). A large male killer whale (HUINAY005) was positively identified from 2 separate sightings in August and November, 2008, and another large male (HUINAY007) from 2 separate sightings in November, 2008, and March, 2010 (see Table 1). The individual HUINAY001 of unknown sex, photographed in July 2006 was likely re-sighted in November 2008 (HUINAY009). Roberto Winkler (Pumalín Foundation) saw a large male with a smaller individual in Renihué Fjord on November 17, 2012, and again on November 21, 2012 close to Cahuelmó in Comau Fjord.

Two more individuals seen in Chile were added to the database: one killer whale was photo-identified during the commercial Patagonia toothfish activities in 2002-2003 (see Hucke-Gaete *et al.* 2004); and one additional photo from a large male was received from Francisco Viddi (WWF Chile).

Of the 37 identified killer whales in the Magellan region, 6 individuals have been positively re-sighted after their first identification (Fig. 2). The individuals CEQUA#016, CEQUA#017 and CEQUA#018 were first photographed in AMCP Francisco Coloane in early February 2011 and re-sighted in the same area during the same month: CEQUA#016 was re-sighted twice, and CEQUA#017 and CEQUA#018 once (in late February). CEQUA#019 was first photographed in March 2011 in Francisco Coloane and then re-sighted in April and October 2011 in the same area. CEQUA#021 was first sighted in a group of 3 individuals in March 2011 in Francisco Coloane and then re-sighted in a group of 15 individuals in the same area in April 2011. CEQUA#011, a young male killer whale, was first photographed at Cape Horn in March 2007 and then re-sighted in Francisco Coloane in April 2011. The individuals accompanying him in the second sighting were not the same photographed at Cape Horn suggesting a change in group composition during these 4 years.

Huinay001
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Huinay010
Huinay011
Huinay012
Huinay012
CEQUA#001
CEQUA#002
CEQUA#003
CEQUA#004
CEQUA#005
CEQUA#005
CEQUA#006
CEQUA#007
CEQUA#007
CEQUA#008
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CEQUA#034
CEQUA#035

Figure 2. Photo catalogue of dorsal fins from Huinay and CEQUA/ Catálogo de foto-identificación de aletas dorsales de orcas desde Huinay y CEQUA

One killer whale (photographed on November 19, 2008) appears to have a healed cookie-cutter shark wound[5]. Cookie-cutter sharks are common outside the shelf break in warm-temperate waters, indicating killer whales may have travelled quite far equator-ward and off the Chilean coast (Dwyer & Visser 2011).

With the help of the photo-ID guide, re-sighting data over the next years will help to clarify the behavioural and migratory patterns of these killer whales.

Conservation of killer whales in Chile

Artisanal fishermen in southern Chile have been reported to shoot at killer whales with fire arms because they believe the whales present a danger to them (Sielfeld 1983). The general perception that killer whales are 'man-eaters' is still prevalent in Chile. Increased public education will help to show that killer whales are not a threat to humans. It may help to highlight that killer whales principally eat sea lions, a species fishermen traditionally see as an enemy due to the damage they cause through direct and indirect interference with their fishing activities (Goetz *et al.* 2008).

We encourage tourism operators and the public to participate in collecting data on killer whales in Chile and submitting it to scientists.

Accordingly, it can be concluded: 1) Killer whales along the Chilean Patagonian coast are considerably more common than previously thought, 2) The absence of re-sightings between CEQUA and HUINAY specimens indicate either a significantly larger population and/or separate subpopulations which occupy different parts of the Chilean fjord region and 3) Observations indicate that the food spectrum of killer whales in Patagonia includes a variety of marine mammals and birds, and fish.

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