

Supporting Information for

Past, present and future of the ecosystem services provided by cetacean carcasses

This material includes:

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Appendix A. Photo credits for Figures 1, 2 and 4.

Fig. 1:

Coast: [Stranded whale carcass](#) (photo: Peter Pearsall/USFWS – Pacific Region, CC BY-NC 2.0); Campbell island teal feeding on Hooker’s sea lion (photo: Dan Brown); [Polar bear feeding on a seal, Svalbard, Norway](#) (photo: Peter Prokosch, CC BY-NC-SA 2.0); [sea crab](#) (photo: anonymous, Pixabay License).

Surface sea: Glaucous gull feeding on a grey whale (photo: Dan Brown); [white shark](#) (photo: anonymous, CC0 Public Domain).

Deep sea: [On the background chemoautotrophic whale-fall community, including bacteria mats, vesicomid clams in the sediments, galatheid crabs, polynoids, and a variety of other invertebrates. 35-ton gray whale in the Santa Cruz Basin](#) (photo: Craig Smith, Public Domain); [six gill hagfish](#) (photo: Peter Southwood, CC BY-SA 3.0); [Lithodidae crab](#) (photo: Moondigger, CC-BY-SA-2.5); [Plumarella pellucida](#) (photo: NOAA Exploring Deep Sea Coral Expedition 2010, CC BY 2.0).

Fig. 2:

a) Pierina Bermejo, b) Santiago Imberti.

Fig. 4:

(a) [Baleen](#) (photo: anonymous, GNU Free Documentation License and CC BY-SA 3.0); (b) [uncooked minke whale meat steak](#) (photo: anonymous, CC0 1.0 Universal Public Domain Dedication); (c) [whaling is still legal in Iceland](#) (photo: Thomas Quine, CC BY-SA 2.0); (d) [Qantag \(bentwood\) oil dish for seal or whale oil in shape of a merganser, wood with beads, Alaska State Museum, Juneau](#) (photo: Wmpearl, CC0 1.0 Universal Public Domain Dedication); (e) dead whale in Aith Voe, Bressay (photo: [Mike Pennington](#), CC BY-SA 2.0); (f) remains of dolphin carcass after being eaten by gulls in Isla Grosa, Spain (photo: Marcos Moleón); (g) [stranded whale at Zandvoort](#). Harvard Art Museum, Light Outerbridge Collection, Richard Norton Memorial Fund, by Hendrick Goltzius (1558-1617) (photo: anonymous, Public Domain Mark 1.0); (h) [surrounded by onlookers, university researchers conduct an autopsy on a female beaked whale, probably a Gray’s beaked whale, stranded on Sunset Beach, Port Waikato, New Zealand](#). Another stranded whale lies in front (photo: Avenue, CC BY-SA 3.0); (i) [Franks casket](#). Anglo-saxon box made of whale's bone (first half of the 8th century AD). British Museum (photo: Michel Wal, GNU Free Documentation License); (j) this fin whale skeleton is part of the “Senda de los Cetáceos” (“Route of Cetaceans”) in Fuerteventura, Canary Islands, Spain (photo: Marcos Moleón); (k) [living stranded humpback whale on Razende Bol](#) (photo: Ecomare/Salko de Wolf, CC BY-SA 4.0); (l) [St. Brendan’s ship on the back of a whale, and his men praying, in Honorius Philoponus’ Nova typis transacta navigation 1621](#) (photo: Chet Van Duzer, Public Domain); (m) [blue whale skeleton at the Central Hall of the Natural History Museum, London](#) (Jordi Ferrer, CC BY-SA 4.0).

Appendix B

Table B.1. Number of scientific articles resulting from the Web of Science search, according to the search terms used.

Search terms	Total articles	Selected articles
human AND stranded whale	14	5
human AND whale carcass	14	6
human AND strand* AND whale	308	18
human AND cetacean carcass	4	0
human AND stranded cetacean	31	1
ecosystem service AND whale	60	4
ecosystem service AND cetacean	53	4
ecosystem service AND cetacean carcass	0	0
ecosystem service AND whale carcass	0	0
ecosystem service AND stranded cetacean	0	0
ecosystem service AND stranded whale	0	0
ecosystem service AND strand* AND whale	0	0

Table B.2. List of selected scientific papers on ecosystem services associated with cetacean carcasses, divided by cetacean species, type of service provided, area and period of interest.

Search term	Ref. no.	Reference	Species	Ecosystem service	Area	Period
humans AND stranded whale*	1	Harcourt et al. 2015	Dugong and stranded whales	cultural	Australia and New Zealand	historical and modern
	2	Álvarez-Fernández et al. 2014	Southern right whale (<i>Eubalena australis</i>)	provisioning	Spain	prehistorical (Paleolithic)
	3	Harms et al. 2014	North Atlantic right whale (<i>Eubalena glacialis</i>), Common minke whale (<i>Balaenoptera acutorostrata</i>), Humpback whale (<i>Megaptera novaeangliae</i>)	supporting	North Carolina (USA)	modern
	4	Brito and Sousa 2011	Fin whale (<i>Balaenoptera physalus</i>), sperm whales (<i>Physeter macrocephalus</i>)	provisioning	Portugal	historical (medieval age and earlier)
	5	Gutierrez et al. 2001	Balaenoptera sp.	provisioning	Angola	prehistorical (lower Paleolithic)
humans AND whale carcass*	6	Erlandson et al. 2020	Fin whale (<i>Balaenoptera physalus</i>)	provisioning	Channel islands, California (USA)	prehistorical (middle Holocene)
	7	Fujiwara et al. 2019	Whale falls	supporting	Sao Paulo Ridge in the South Atlantic Ocean	modern
	8	Laidre et al. 2018	Large whales	supporting	Arctic	prehistorical (interglacial periods), historical and modern
	9	Higgs et al. 2011	Blue whale (<i>Balaenoptera musculus</i>), Fin whale (<i>Balaenoptera physalus</i>), Sei whale (<i>Balaenoptera borealis</i>), Humpback whale (<i>Megaptera novaeangliae</i>), Gray whale (<i>Eschrichtius robustus</i>), Sperm whale (<i>Physeter macrocephalus</i>) Striped dolphin (<i>Stenella coeruleoalba</i>)	supporting provisioning	North America and deep sea	prehistorical, historical and modern

	10	Pershing et al. 2010	Baleen whales	Regulating	Open ocean	historical
	11	Hadley et al. 2010	Bowhead whale (<i>Balaena mysticetus</i>)	provisioning	Nunavut (Canada)	historical (16th century)
humans AND strandings AND whale* (listed here also 1, 2, 4, 5 and 8)	12	Brito et al. 2019	Large whales	provisioning	Portugal	historical (from the 13th century onwards)
				cultural		
	13	van den Hurk et al. 2019	Gray whale (<i>Eschrichtius robustus</i>)	provisioning	Netherlands	historical (medieval age)
	14	Roman et al. 2018	Cetacea	cultural	Massachussets	modern
	15	Collareta et al. 2017	Southern right whale (<i>Eubalaena australis</i>)	provisioning	South Africa	prehistorical (Middle Pleistocene)
	16	Borella and Borrero 2017	False killer whales (<i>Pseudorca crassidens</i>)	cultural	Strait of Magellan (Chile)	modern
	17	Mannino et al. 2015	Delphinidae, Mysticeti or large Odontoceti (<i>Balaenoptera sp. or Physeter macrocephalus</i>)	provisioning	Sicily (Italy)	prehistorical (Mesolithic-Neolithic transition)
	18	Schuhmacher et al. 2013	Sperm whales (<i>Physeter macrocephalus</i>)	provisioning	Iberian peninsula	prehistorical (from the Chalcolithic to Early Bronze Age)
	19	Weir and Pierce 2013	Cetacea	provisioning	Eastern tropical Atlantic	modern (1950s-70s)
	20	Sousa and Brito 2012	Sperm whale (<i>Physeter macrocephalus</i>), Fin whale (<i>Balaenoptera physalus</i>) and others	cultural	Portugal	modern (20th century)
	21	Bearzi et al. 2011	Sperm whale (<i>Physeter macrocephalus</i>)	provisioning	Adriatic Sea	historical and modern (1555–2009)
	22	Clarke 2001	Southern right whale (<i>Eubalaena australis</i>)	supporting	Southern south Australia	modern (19th century)
cultural						
23	De Smet 1997	Sperm whales (<i>Physeter macrocephalus</i>)	provisioning	Flemish coast	historical and modern (from 15th century)	
			cultural			
humans AND stranded cetacean*	24	Gol'din 2011	Cetecea, in particular harbour porpoise and bottlenose dolphin	provisioning	Northern Black Sea and the Sea of Azov	modern
			cultural			

ecosystem service* AND whale*/ cetacean* (listed here also 14)	25	Cook et al. 2020	Whale falls	supporting	anywhere	modern
				regulating		
	26	Hammerschlag et al. 2019	Whale falls	supporting	Deep sea	historical and modern
	27	Roman and McCarthy 2010	Baleen and sperm whales	regulating	Gulf of Maine (USA)	historical and modern

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Table B.3. Details on recorded cetacean strandings per country/region.

Country	Region	Group	Family	Years included	Length coast (km)	N/year/coast length x 10 ⁻²	Acknowledgements	Reference
Argentina	Península Valdés	Baleen whales	Balaenidae	2003/2015	600	9.448717949	Marcela Uhart and Mariano Sironi	McAloose, D., Rago, M.V., Di Martino, M., Chirife, A., Olson, S.H., Beltramino, L., Pozzi, L.M., Musmeci, L., La Sala, L., Mohamed, N. and Sala, J.E., 2016. Post-mortem findings in southern right whales <i>Eubalaena australis</i> at Península Valdés, Argentina, 2003-2012. <i>Diseases of aquatic organisms</i> , 119(1), pp.17-36.
	Patagonian waters / Océano Atlántico Sudoccidental	Toothed whales	Delphinidae	1990/2003	2500	0.154285714	Cáceres-Saez Iris	Riccaldelli, L., Torres, M.A., Goodall, R.N.P., Dellabianca, N.A., Pimper, L.E., Reyes, L.M., Fernández-Ajó, A. and Bastida, R., 2011. Records of Risso's dolphin, <i>Grampus griseus</i> , in coastal waters of southern Argen. <i>Revista de biología marina y oceanografía</i> , 46(3), pp.463-469.
	Argentina	Toothed whales	Physeteridae	1988/2011	4989	0.007843342	Laboratorio de Ecología, Comportamiento y Mamíferos Marinos División Mastozoología, Área Zoología de Vertebrados Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" - CONICET Buenos Aires, ARGENTINA	Degrati, M., García, N.A., Grandi, M.F., Leonardi, M.S., Loizaga de Castro, R., Vales, D.G., Dans, S.L., Pedraza, S.N. and Crespo, E.A., 2011. New record of a stranded sperm whale (<i>Physeter macrocephalus</i>) and a review of strandings along the continental Argentine coast. <i>Mastozoología neotropical</i> , 18(2), pp.307-313. inside publication: Fraga, 1994; Albareda and Albornoz, 1992; Bastida and Rodríguez, 2003
Australia		Baleen whales	Balaenidae; Balaenopteridae		2137	0.437373265		Haering, R. and Ross, G.A., 2009. Summary of New South Wales Marine Fauna Events in 2009:

	New South Wales	Toothed whales	Kogiidae; Physeteridae; Ziphiidae	2006/2013, 2016		0.156878802	New South Wales National Parks & Wildlife Service (2016)	Whales, dugongs, seals and marine reptiles. New South Wales National Parks and Wildlife Service. Report pp 15. Haering, R., 2011. Summary of New South Wales Marine Fauna Events: 2010 to 2011: Cetaceans, dugongs, seals and marine turtles. Report pp. 74. Lloyd, H.B. and Ross, G.A., 2014. New South Wales Marine Fauna Events: Whales, dolphins, seals, turtles & sea snakes. Biennial Report: 2012-2013. pp52.
		N.i. cetacean	N.i. cetacean			0.079459783		
		Toothed whales	Delphinidae			0.653759164		
Australia	Northern Territory	Baleen whales	Balaenopteridae	1990/2016	10953	0.003043306	Department of Environment and Natural Resources © Northern Territory of Australia	
		Toothed whales	Delphinidae			0.058837254		
		N.i. cetacean	N.i. cetacean			0.002367016		
		Toothed whales	Physeteridae; Ziphiidae			0.001352581		
Australia	Western Australia	Baleen whales	Balaenidae; Balaenopteridae; Neobalaenidae	1990/2016	20781	0.039744282	Science and Conservation Division of the Department of Parks and Wildlife, The Department of Biodiversity, Conservation and Attractions, Western Australia.	
		Toothed whales	Delphinidae			0.20977139		
Belgium		Baleen whales	Balaenopteridae	1998/2016	66.5	0.237435694	The Royal Belgian Institute of Natural Sciences (RBINS)	
		Toothed whales	Delphinidae; Phocoenidae			97.34863474		
		Toothed whales	Monodontidae; Physeteridae			0.237435694		

		Baleen whales	Balaenopteridae			0.237435694		
Canada	Newfoundland and Labrador	Baleen whales	Balaenidae; Balaenopteridae	2000/2009 - 2014/2016	17542	0.021486893	Wayne Ledwell, Whale Release & Strandings	"Ledwell, W., Huntington J., and Lien J. 2000.; Ledwell, W., Huntington J., and Lien J. 2001.; Ledwell, W., Huntington J., and Lien J. 2002.; Ledwell, W. and Huntington, J. 2003.; Ledwell, W. and Huntington, J. 2004.; Ledwell, W. and Huntington, J. 2006; Ledwell, W. and Huntington, J. 2007; Ledwell, W. and Huntington, J. 2009; Ledwell, W., and Huntington J., 2010; Ledwell, W. Huntington, J. and Sacrey E. 2014; Ledwell, W. Huntington, J. and Sacrey E. 2015; Ledwell, W. and Huntington, J. 2017.
		Toothed whales	Delphinidae; Phocoenidae			0.035080642		
		N.i. cetacean	N.i. cetacean			0.007454636		
		Beaked whales	Kogiidae; Monodontidae; Physeteridae; Ziphiidae			0.016663305		
Canary Islands (Spain)		Baleen whales	Balaenopteridae	2000/2018	1583	0.112211989	Gobierno de Canarias	Cetáceos varados 2000-2018. Base de datos del Gobierno de Canarias.
		Toothed whales	Delphinidae; Phocoenidae			1.593410247		
		Toothed whales	Kogiidae; Physeteridae; Ziphiidae			0.618412741		
		N.i. cetacean	N.i. cetacean			0.241879177		
Chile		Baleen whales	Balaenidae; Balaenopteridae	2009/2016	6435	0.837218337	Mauricio Ulloa-Encina Unidad Nacional de Rescate, Rehabilitación y Conservación de Fauna Marina de Sernapesca); Vreni Häussermann (Director of the Huinay Scientific Field Station)	
		Toothed whales	Delphinidae; Phocoenidae			0.522533023		
		N.i. cetacean	N.i. cetacean			0.013597514		
		Toothed whales	Kogiidae; Physeteridae; Ziphiidae			0.048562549		
China	Hainan island	Baleen whales	Balaenopteridae	1993/1996,	1529	0.04474889	Zhang P, Li S and Lin M (Institute of Deep-sea	Zhang P, Li S, Lin M et al. Database of Cetacean Stranding Records around Hainan Island (1993

		Toothed whales	Delphinidae; Phocoenidae	1998/2016		0.161784448	Science and Engineering, University of Chinese Academy of Science)	– 2015). China Scientific Data 2 (2016). DOI: 10.11922/csdata.170.2015.0085 http://www.cetacean.csdb.cn/portal/page/stranded/p/1.html
		Toothed whales	Kogiidae; Physeteridae			0.013768889		
Croatia	na	Baleen whales	Balaenopteridae	1990/2016	5835	0.001269479	Tomislav Gomercic (Faculty of Veterinary Medicine VEF University of Zagreb)	
		Toothed whales	Delphinidae			0.253895712		
		Toothed whales	Ziphiidae			0.002538957		
Denmark	na	Baleen whales	Balaenopteridae	1992/2014	8750	0.018881988	Danish Stranding Network	
		Toothed whales	Delphinidae; Phocoenidae			1.649924812		
		N.i. cetacean	N.i. cetacean			0.002981366		
		Toothed whales	Physeteridae; Ziphiidae			0.020372671		
Falkland / Malvinas Islands	na	Baleen whales	Balaenidae; Balaenopteridae	1990/2017	1300	0.056980057	Nicholas Rendell (Environmental Officer, Environmental Planning Department, Falkland Islands Government) and Dr iLaria Marengo (South Atlantic Environmental Research Institute) “We gratefully acknowledge the contribution to this publication made by the Falkland Islands data centre for providing the data”	
		Toothed whales	Delphinidae; Phocoenidae			9.817663818		
		N.i. cetacean	N.i. cetacean			0.005698006		
		Toothed whales	Physeteridae; Ziphiidae			0.068376068		
France	all	Baleen whales	Balaenidae; Balaenopteridae	1990/2015	4668	0.229055435	Observatoire Pelagis - Reseau National	Dabin, W. 2016. Observatoire Pelagis - Reseau National Echouage (French stranding network)

		Toothed whales	Delphinidae; Phocoenidae			13.65846022	Echouage (French stranding network), University La Rochelle	strandings 1934-2015. Data downloaded from OBIS-SEAMAP (http://seamap.env.duke.edu/dataset/1406) on 2018-01-04.
		N.i. cetacean	N.i. cetacean			0.065091293		
		Toothed whales	Ziphiidae; Odontoceti; Physeteridae			1.087601345		
Guatemala	na	Baleen whales	Balaenopteridae	2007/2012	400	0.125	Andrea Cabrera Arreola (Marine Evolution and Conservation (MarE Con), Groningen Institute for Evolutionary Life Sciences, University of Groningen, Netherlands)	CONAP Costa Sur; Dávila, 2011
		Toothed whales	Delphinidae			0.416666667		
Hong Kong	na	Baleen whales	Balaenopteridae; Mysticeti	1995/2016	733	0.037206995	HK Government (Agriculture, Fisheries and Conservation Department)	
		Toothed whales	Delphinidae; Phocoenidae			3.652486667		
		N.i. cetacean	N.i. cetacean			0.142626814		
		Toothed whales	Physeteridae			0.024804663		
India	all	Baleen whales	Balaenopteridae; Mysticeti	2000/2016	7517	0.045729679	Marine Mammal Conservation Network of India	http://marinemammals.in/index.php/database/sightings-strandings
		Toothed whales	Delphinidae; Phocoenidae			0.093953705		
		N.i. cetacean	N.i. cetacean			0.008514035		
		Toothed whales	Kogiidae; Ziphiidae; Physeteridae			0.015797526		
Ireland	na	Baleen whales	Balaenopteridae	1990/2016	3171	0.01985587	Irish Whale and Dolphin Group: IWDG	

		Toothed whales	Delphinidae; Physeteridae			2.569583144		
		N.i. cetacean	Unidentified cetacean			0.107455295		
		Toothed whales	Kogiidae; Physeteridae; Ziphiidae			0.140159081		
Japan	all	Baleen whales	Balaenidae; Balaenopteridae; Eschrichtiidae; Mysticeti	1996/2015	29751	0.043359887	Institute of Cetacean Research	http://www.icrwhale.org/zasho2.html
		Toothed Whales	Delphinidae; Phocoenidae			0.411414742		
		N.i. cetacean	N.i. cetacean			0.004201539		
		Toothed Whales	Odontoceti; Physeteridae; Ziphiidae			0.092433868		
Korea	na	Baleen whales	Balaenopteridae	1997/2004	2413	0.222751761		Song, K.J., 2016. Cetacean Strandings in Korean Waters. Pacific science, 70(1), pp.35-44.
		Toothed whales	Ziphiidae			0.093244923		
		Toothed whales	Delphinidae; Phocoenidae			0.476585164		
		N.i. cetacean	N.i. cetacean			0.005180274		
Madeira archipelago (Portugal)	na	Baleen Whales	Balaenopteridae; Mysticeti	1990/2016	156	0.261158594	Contribution from the Museu da Baleia da Madeira (MBM) and Madeira archipelago Cetacean Stranding Network (RACAM)	
		Toothed whales	Delphinidae			1.923076923		
		N.i. cetacean	N.i. cetacean			0.118708452		

		Toothed whales	Kogiidae; Physeteridae; Ziphiidae			0.56980057		
Netherlands	na	Baleen whales	Balaenopteridae	1990/ 2016	451	0.27100271	Naturalis Biodiversity Center	walvisstrandingen.nl
		Toothed whales	Delphinidae; Phocoenidae			63.97306397		
		N.i. cetacean	N.i. cetacean			0.082122033		
		Toothed whales	Physeteridae; Ziphiidae			0.254578303		
New Zealand	all	Baleen whales	Balaenidae; Balaenopteridae; Mysticeti; Neobalaenidae	1990/ 2016	1513 4	0.045029832	Department of Conservation - Te Papa Atawhai, New Zealand.	
		Toothed Whales	Delphinidae; Phocoenidae			1.118159259		
		N.i. cetacean	N.i. cetacean			0.00734182		
		Beaked whales	Kogiidae; Odontoceti; Physeteridae; Ziphiidae			0.262837173		
Russia	Chokotka	Baleen whales	Balaenidae; Eschrichtiidae	1985/ 86 - 1988	3143			Laidre et al 2018 - Historical and potential future importance of large whales as food for polar bears
Slovenia	na	Baleen whales	Balaenopteridae	1996/ 2016	46.6	0.195083886	Morigenos	Morigenos data base; Gombač. M., et al., 2013. Post-mortem findings in bottlenose dolphins (<i>Tursiops truncatus</i>) in the Slovenian Sea. <i>SlovVetRes</i> , Volume 50(2), pages 75-82. ; Kryštufek B., Lipej L., 1993. Kiti (Cetacea) v severnem Jadarnu. <i>Annales, Anali Koprškega primorja in bližnjih pokrajin</i> . Volume 3, pages 9-20. ; Kryštufek B., Lipej L., 1993. Kiti (Cetacea) v
		Toothed whales	Delphinidae			4.096761607		
		N.i. cetacean	N.i. cetacean			0.195083886		

								severnem Jadarnu. Annales, Anali Koprskega primorja in bližnjih pokrajin. Volume 3, pages 9-20.
Spain	Galicia, C Valenciana, Cataluña, País Vasco, Baleares, Ceuta	Baleen whales	Balaenidae; Balaenopteridae; Mysticeti	1990/2016	4453	0.094817476	MEDACES	
		Toothed whales	Delphinidae; Phocoenidae			4.210228643		
		N.i. cetacean	N.i. cetacean			0.549775016		
		Toothed whales	Kogiidae; Physeteridae; Ziphiidae			0.120601176		
Sweden	na	Toothed whales	Phocoenidae	1995/2016	3218	3.432397311	Swedish Museum of Natural History's (NRM)	
Turkey	Aegean and eastern Mediterranean ; Marmara Sea TSS ; Turkish Western Black Sea	Baleen whales	Balaenopteridae	1990/2016	5559	0.00591646		Katağan, T., Tokaç, A., Beşiktepe, Ş., Öztürk, B. (Eds.) (2015). The Aegean Sea Marine Biodiversity, Fisheries, Conservation and Governance. Turkish Marine Research Foundation (TUDAV), Publication No: 41, Istanbul, Turkey; Aytemiz et al J. Black Sea/Mediterranean Environment Vol. 20, No. 3: 2; Tonay and Dede J. Black Sea/Mediterranean Environment Vol. 19, No. 1: 132-137 (2013) ; Öztürk et al J. Black Sea/Mediterranean Environment Vol. 21, No. 2: 232-237 (2015) ; Turan, C., Salihoğlu, B., Özgür Özbek, E., Öztürk, B. (Eds.) (2016). The Turkish Part of the Mediterranean Sea; Marine Biodiversity, Fisheries, Conservation and Governance. Turkish Marine Research Foundation (TUDAV), Publication No: 43, Istanbul, Turkey. ; Özsoy, E., Çağatay, M.N., Balkıs, N., Balkıs, N., Öztürk, B. (Eds.) (2016). The Sea of Marmara; Marine
		Toothed whales	Delphinidae; Phocoenidae			28.03375251		
		Toothed whales	Physeteridae ; Ziphiidae			0.009297294		
		N.i. cetacean	N.i. cetacean			2.144341501		

								Biodiversity, Fisheries, Conservation and Governance. Turkish Marine Research Marmara; Marine Biodiversity, Fisheries, Conservation and Governance. Turkish Marine Research; Dede et al J. Black Sea/Mediterranean Environment Vol. 19, No. 1: 121-126 (2013) ; Öztürk et al 2012 abstract - high mortality of harbour porpoise neonates in the southwestern Black Sea in 2010 and 2011 ; Öztürk B, Öztürk AA, Dede A. 1999. Cetaceans by-catch in the western coasts of the Black Sea in 1993-1997. Page 134 in: The Abstracts of the 13th Annual Conf. of European Cetacean Society. ; Tonay et al 2016 Cetacean strandings monitoring studies on the Turkish Western Black Sea coast during 2003-2016 I. ULUSAL DENİZLERDE İZLEME VE DEĞERLENDİRME SEMPOZYUMU, 21-23 Aralık 2016
United Kingdom	all	Baleen whales	Balaenopteridae	1990/2016	31368	0.053014632	UK Cetacean Strandings Investigation Programme	Deaville, R. (compiler) (2019) UK Cetacean Strandings Investigation Programme Final Contract Report, 2011-2017 http://sciencesearch.defra.gov.uk/Document.aspx?Document=14514_FINALCSIPContractReport2011-2017.pdf
		Toothed whales	Delphinidae; Phocoenidae			1.326074225		
		Toothed whales	Kogiidae; Physeteridae; Ziphiidae			0.041679655		
		N.i. cetacean	N.i. cetacean			0.205564529		
USA	all	Baleen whales	Balaenidae; Balaenopteridae; Eschrichtiidae; Mysticeti	2006/2016	19924	0.186161961	National Oceanic and Atmospheric Administration (NOAA)	National Oceanic and Atmospheric Administration (NOAA)
		Toothed whales	Delphinidae; Phocoenidae			4.111532916		

		N.i. cetacean	N.i. cetacean			0.021445128		
		Toothed whales	Kogiidae; Monodontidae; Odontoceti; Physeteridae; Ziphiidae			0.249128507		

Table B.4. Regulations on cetacean strandings per country/region, with details related to stakeholders involved, dependence on stranding location for distinct disposal or procedure methods and available carcass disposal methods.

Country/region	Regulations	Stakeholders involved	Methods of disposal (*most frequently used method)	Stranding location dependent method
AUSTRALIA - NEW SOUTH WALES	<p>Policy and Procedures for Marine Wildlife Management; Office of Environment and Heritage NSW (2013).</p> <p>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), for the protection of all cetaceans, pinnipeds and marine reptiles. National Parks and Wildlife Act 1974 (NPW Act) for the protection of all native fauna in NSW.</p> <p>The Veterinary Surgeons Act 1986 (VS Act) and The Australian Veterinarian Association’s policy on cetaceans’ care and treatment as well as veterinary responsibilities at strandings.</p>	<p>Landholder; local government on NSW beaches (specialist burial sites in parks, if not local landfill site); if scientifically valuable, National Parks and Wildlife Service (NPWS) may assist in its dismemberment and burial at the request of the Australian Museum</p>	<ul style="list-style-type: none"> • natural decomposition • local landfill site • burial 	<p>YES</p> <p>If in remote location, natural decomposition option is preferred; if in urban or peri-urban location, carcass is removed</p>
AUSTRALIA - NORTHERN TERRITORY	<p>No specific regulations managing stranded carcasses.</p> <p>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), for the protection of all cetaceans, pinnipeds and marine reptiles.</p>	<p>Marine WildWatch, Aboriginal ranger groups, local organisations and the public. Department of Primary Industry and Fisheries Berrimah Veterinary Laboratory (BVL) for autopsies.</p>	NA	NA

AUSTRALIA - WESTERN AUSTRALIA	No specific regulations managing stranded carcasses, but 'Whale Carcass Management' guidelines by the Department of Parks and Wildlife.	Parks and Wildlife Service within the State Government's Department of Biodiversity, Conservation and Attractions (Government of Western Australia); the Department of Primary Industries and Regional Development; land manager.	<ul style="list-style-type: none"> • natural decomposition • local landfill • burial* 	YES, if in a populated area the responsibility for the disposal of the carcass rests with the relevant land manager. If the beach is part of a marine park or is directly adjacent to a national park, the responsibility for removal rests with DBCA's Parks and Wildlife Service. In all other instances the responsibility rests with the relevant local government or other land manager. Carcasses are removed from hot spots for surfers
ARGENTINA	Each province has specific regulations.	In Peninsula Valdes municipality and Instituto de Conservación de Ballenas and University of California, Davis.	<ul style="list-style-type: none"> • local landfill • composting • beach burial • towing • chopping up • burial for skeletal recoveries by museums 	NO, but local Government attempted to develop a zonification map showing where in Peninsula Valdes it was possible performing necropsy or not based on proximity to urban settings
BELGIUM	Royal Decree of 21 December 2001 is the national legislation specifically protecting all Belgian marine mammal species and their remains.	Royal Belgian Institute of Natural Sciences, Department of Morphology and Pathology of the Faculty of Veterinary Science of the University of Liège for necropsies.	Remains are processed in a destruction plant (also used for dead cattle etc). No remains become part of the food chain (always incinerated).	NO
CHILE	No specific regulations managing stranded carcasses.	Municipalities are responsible for carcass management.	<ul style="list-style-type: none"> • burial • landfill 	NA
CANADA - NEWFOUNDLAND AND LABRADOR	No specific regulations managing stranded carcasses.	Provincial government.	<ul style="list-style-type: none"> • left in situ - natural decomposition* • burial • landfill 	NO, only if strong opinion of the community living nearby, or the stranding is on a popular beach

CHINA - HAINAN ISLAND	No specific regulations managing stranded carcasses.	Marine Mammal and Marine Bioacoustics Laboratory, Institute of Deep-sea Science and Engineering, Chinese Academy of Sciences in Hainan	<ul style="list-style-type: none"> • burial • scientific collection 	NO
CROATIA	Nature Protection Act and Veterinary Act (1997), Nature Protection Law (2003) for strictly protected species including all marine mammals.	Nature Protection Agency receives report from the public about any finding of marine mammal carcass; Faculty of Veterinary Medicine is then contact as they monitor marine mammal mortality through necropsy; local municipality is responsible for carcass management.	<ul style="list-style-type: none"> • incinerator after necropsy • natural decomposition if in remote location 	NO, but no necropsy if carcass is difficult to reach
DENMARK	National policy on strandings - Emergency plan for marine mammals Stranding preparedness 2012 Ministry of the Environment, Nature Agency J.nr. NST-369-00002.	Natural History Museum of Denmark	<ul style="list-style-type: none"> • natural decomposition/left in situ for harbour porpoises; • toothed and baleen whales collected for the museum; • any specimens (except harbour porpoise) that is too rotten, will be collected and destructed 	NO
FALKLAND / MALVINAS ISLANDS	No specific regulations managing stranded carcasses.	FIG Environmental Planning DPT	<ul style="list-style-type: none"> • natural decomposition 	NO
FRANCE	Ministerial Order of July 1, 2011 for protection of marine mammals; Article R411-7 of the Environmental Code for derogation to Réseau National D'échouage (RNE) for intervention; Rural Code (L226-1) 2009 supervises the execution of the carcass rendering public service	Réseau National D'échouage (RNE) for interventions; municipality for evacuation of the carcass, reporting to RNE and elimination by the public rendering service	<ul style="list-style-type: none"> • elimination at the rendering service 	NO

HONG KONG	Wild Animals Protection Ordinance 1997 (Cap. 170) for protection of wild cetaceans both alive and dead.	Collaboration between Agriculture, Fisheries and Conservation Department and local NGOs; Environmental Protection Department for disposal	NA (but landfill, incineration for animal carcasses)	NO
INDIA	Schedule I and II of the Wildlife Protection Act of India 1972 for protection of all the Indian marine mammals. Handling carcasses from strandings requires official permission.	Marine Mammal Conservation Network of India for sample collection, Environmental Department for permits, District or City Municipal or Development Authority in urbanised coast	<ul style="list-style-type: none"> • natural decomposition * • burial * • chopping up before burial • incineration when in urbanised areas 	YES
IRELAND	NO specific regulations managing stranded carcasses. The Department of the Environment, Community and Local Government through the National Parks and Wildlife Service has responsibility for the conservation of wildlife, but not clear which government department has responsibility for cetacean welfare	no formal cetacean strandings response network, the Irish Whale and Dolphin Group (IWDG) for reporting, local authorities for removal and disposal	NA	YES
JAPAN	'Coping manual for whale stranding' under the Regulation of "Ministerial Ordinance Concerning Permission and Control of Designated Fishery" of Ministry of Agriculture, Forestry and Fisheries.	Ministry of Agriculture, Forestry and Fisheries; Municipality	<ul style="list-style-type: none"> • burial at seashore • incineration • disposal at sea 	NO
PORTUGAL - MADEIRA	National legislation by the Ministry of the Environment (Instituto de Conservação da Natureza e da Biodiversidade - ICNB)	Madeira Whale Museum, cetaceans' stranding network (RACAM)	NA	NA

NETHERLANDS	European level in Regulation (EC) No 1069/2009 and Regulation (EU) No 142/2011 for the disposal and processing of carcasses (animal by-products regulations)	municipality for the removal and disposal	<ul style="list-style-type: none"> processed if taken by municipality and destroyed by officially certified destruction company* natural decomposition/left in situ in remote areas 	YES
NEW ZEALAND	The Marine Mammal Protection Act (1978) (section 4 and 18) protects marine mammals, Conservation Act and Treaty of Waitangi Act for involvement of Maori, Service Level Agreement for assistance by Project Jonah (an NGO), Resource Management Act 1991 for carcass disposal.	Iwi (Maori) will often undertake a karakia (prayer) for dead cetaceans, Department of Conservation for permit to manage carcass, consultation between person authorised by Minister and landowner for carcass disposal	<ul style="list-style-type: none"> burial natural decomposition/left in situ disposal at sea chopped in pieces 	YES
SPAIN	Regulation (EC) 1069/09 for incineration, Royal Decree 1632/2011 and Directive 2009/147/EC for consumption by wildlife.	Stranding network of the Autonomous Communities, trained people either of the cleaning services, or Civil Protection, SEPRONA, Local Police and Salvage maritime if arriving first, City council, Authorised Centre for both necropsy and disposal	<ul style="list-style-type: none"> natural decomposition incineration landfill burial in situ consumption by wildlife recovery of skeletons 	YES
UNITED KINGDOM - England and Wales	Royal Prerogative is not formalised in modern law, but legislation for protection of cetaceans (dead and alive) at EU level and national level : The Conservation of Habitats and Species Regulations 2012, The Wildlife and Countryside Act 1981, marine licence from DEFRA to overcome The Marine and Coastal Access Act 2009 (for removal of stranded cetacean below the mean high water mark) and Waste	Marine Mammal Observer (MMO), Receiver of Wreck (Maritime and Coastguard Agency) for reports, DEFRA, city council	<ul style="list-style-type: none"> landfill * incineration natural decomposition (when not euthanised) rendering 	YES (when inaccessible or in remote area)

	Directives (Animal By-product legislation) 2011.			
UNITED KINGDOM - Scotland	Royal Fish' in Scotland was devolved to the Scottish Government – Royal fish regulations in Scotland 2007.	Scottish Government Marine Directorate or Fisheries Research Services (FRS), the local authority and the Scottish Strandings Co-ordinator at the Scottish Agricultural College (SAC) and Scottish Environment Protection Agency (SEPA) (when larger than 25ft) Environment Health Department, local authority and SAC (when smaller than 25ft) National Museums of Scotland for rarer species	<ul style="list-style-type: none"> • landfill • beach disposal 	YES
USA	Marine Mammal Protection Act (MMPA) 1972, Marine Mammal Stranding Agreement 2009 between Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) and Stranding Network Participant to take marine	NOAA, Marine Mammal Stranding Network for operations, landowner, and municipality	<ul style="list-style-type: none"> • natural decomposition/left in situ • burial • towed/pushed below the high tide line • composting • refuse disposal provider for other disposal options (landfill or other suitable location) 	YES

	mammals, local disposal policies and rules.		<ul style="list-style-type: none">• scientific and educational specimens	
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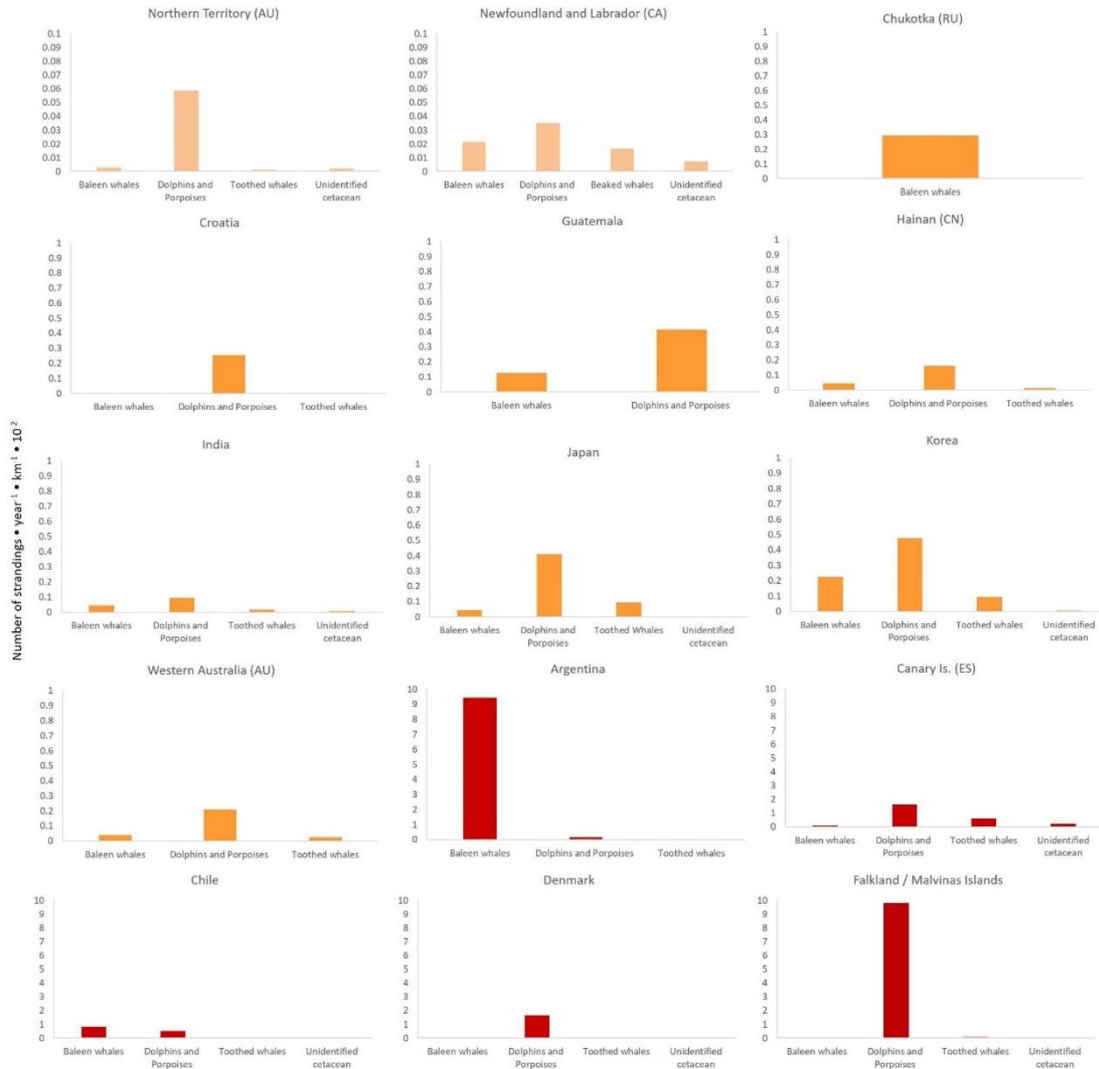
1 **Table B.5.** AIC-based model selection to explain the density of stranded cetaceans. Df, degrees
 2 of freedom; DEV, deviance; AIC, Akaike Information Criteria; Δ AIC, AIC difference from the best
 3 model; CST, constant/no effect; Density, coastal population density and Law, presence of
 4 management policy; "+", additive effect; "*", interaction effect. Best competing models in bold.
 5 See Figure B.2 for estimates.

6

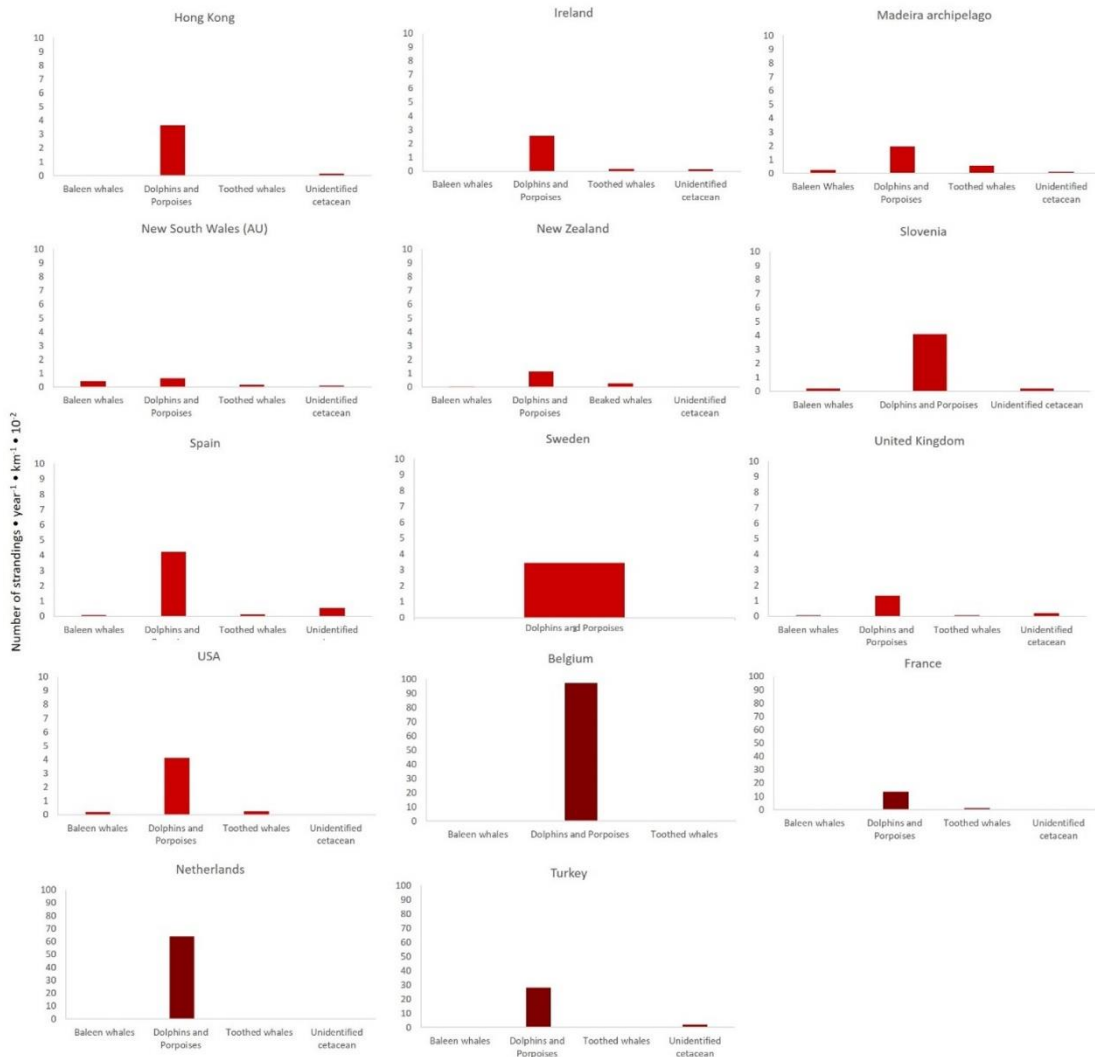
Model	Effects	df	DEV	AIC	Δ AIC
0	CST	26	26.00	79.60	0.290
1	Density	25	23.88	79.31	0.000
2	Law	24	22.84	80.10	0.788
3	Density+Law	23	22.43	81.61	2.297
4	Density*Law	21	21.43	84.38	5.066

7

8 **Figure B.1.** Relative abundance of strandings belonging to different cetacean groups (Baleen
 9 whales or Mysticeti; Toothed whales or Odontoceti, excluding small toothed whales like
 10 dolphins and porpoises; Dolphins and Porpoises and Unidentified cetaceans) per
 11 country/region.
 12

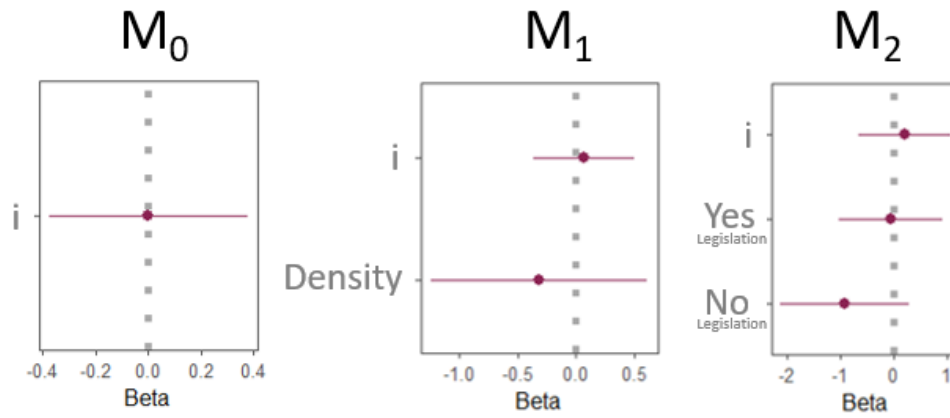


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18 **Figure B.2.** Covariate Beta estimates for set of best competing models (M_0 , M_1 and M_2)
19 explaining the density of stranded cetaceans. “i”: intercept; “Density”: coastal population
20 density; “Yes”: population legislation in place; “No”: population legislation not in place.
21



22
23