

Intersessional Working Group on Southern Hemisphere humpback whales: revised tables by breeding stock (as at 1 May 2005)

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Southern Hemisphere humpback whales

Breeding Stock A

(1) BS	Population structure/stock identity			Catches	
	(2) Feeding grounds	(3) Migration routes	(4) Breeding grounds	(5) Commercial	(6) Subsistence/incidental
A	Originally thought to be IWC Management Area II (Weddell Sea) ^{1,2} but satellite tagging now shows probable feeding grounds near South Georgia and South Sandwich Is ³ .	Oceanic waters off the eastern coast of South America ^{3,4}	Eastern coast of South America from ~3° to 22°S ^{4,5,6} , particularly Abrolhos Bank ^{1,2,7} . Significant genetic structure based on mtDNA haplotype frequencies for breeding areas and migratory corridors of A <i>cf</i> B and C. Updated analysis underway ⁸ Photographic comparison between Brazil and Gabon coastal waters found no matches ⁹	1,542 (1910-1967) ^{10,11} Antarctic, 1904-1974 ^{12,13} , - allocation to be determined	0-3/year, 1983-2003 (n = 1) ¹⁴

¹ Engel, M.H., Bonatto, S.L., Rosenbaum, H.C., Fagundes, N. and Ott, P.H. In prep. Characterization and genetic variability based on mtDNA and molecular sexing of the humpback whale population, *Megaptera novaeangliae*, of the Abrolhos Bank, Bahia, Brazil.

² Engel *et al.*, 2001. Abstracts of the 14th Biennial Conference on the Biology of Marine Mammals, p.65-66.

³ Zerbini, A N, Andriolo, A, Heide-Jorgensen, M A, Pizzorno, J L, Maia, Y G, VanBlaricom, G R, DeMaster, D G, Simoes-Lopes, P, Moreira, S, and Bethlem, C, 2004. Identification of a summering ground of humpback whales from Brazil. Paper SC/56/SH1.

⁴ Siciliano, S., Pizzorno, J.L.A., Barata, P.C. 1999. Distribution and possibly migratory routes of humpback whales *Megaptera novaeangliae* in the western South Atlantic. Paper SC/50/CAWS4.

⁵ Martins, C.C.A., Morete, M.E., Engel, M.H. Freitas, A.C., Secchi, E.R. and Kinas, P.G. 2001. Aspects of habitat use patterns of humpback whales in the Abrolhos Bank, Brazil, breeding ground. *Mem. Qld. Mus.* 47(2): 563-570.

⁶ Zerbini, A.N., Andriolo, A., da Rocha, J.M., Simões-Lopes, P.C., Siciliano, S., Pizzorno, J.L.A., Waite, J.M., DeMaster, D.P. and VanBlaricom, G.R. 2004. Distribution and abundance of humpback whales, *Megaptera novaeangliae*, off Northeastern Brazil. *J. Cetacean Res. Manage.* 6(1): 101-107.

⁷ Martins, C C A, Andriolo, A, Engel, M H, Kinas, P G and Saito, C H, 2004. The use of aerial surveys to investigate the humpback whale distribution in the Brazilian breeding ground. Paper SC/56/SH6

⁸ Rosenbaum, H.C., Best, P.B., Findlay, K.P., Engel, M.H., Pomilla, C., Razafindrakoto, Y., Morete, M.E., Vely, M.E., Freitas, A.C., Baker, C.S., Jenner, C., Jenner, M-N, and Bannister, J. 2000. Mitochondrial DNA variation among humpback whales from the wintering grounds in the South Atlantic and Southwestern Indian Oceans. Paper SC/52/IA11.

⁹ Pacheco de Godoy, M M L, Collins, T, Ersts, P, Engel, M H, and Rosenbaum, H, 2004. Preliminary photographic comparisons of humpback whales (*Megaptera novaeangliae*) from two South Atlantic wintering grounds. Paper SC/56/SH8.

¹⁰ Williamson, G.R. 1975. Minke whales off Brazil. *Sci. Rep. Whales Res. Inst.* 27: 1-35.

¹¹ Pinedo, M.C. 1998. Review of colonial whaling in Brazil (16th to 19th Centuries) and from 1910-74. Paper SC/50/CAWS30.

¹² Findlay, K.P. 2001. A review of humpback whale catches by modern whaling operations in the Southern Hemisphere. *Mem. Qld. Mus.* 47(2):587-598.

¹³ Findlay, K.P., Cunningham, C.L. and Butterworth, D.S. 2000. A first step towards a preliminary assessment of Southern Hemisphere humpback whales. Paper SC/52/IA2.

¹⁴ Marcondes, M.C.C., Más-Rosa, S., Engel, M.H., and Martins, C.C.A. In prep. Strandings and mortality of humpback whales (*Megaptera novaeangliae*) on the Brazilian coast, 1964-2002.

Southern Hemisphere humpback whales: summary of information available for Breeding Stocks (BS) A and B.

(7) Pop. abundance	(8) Pop. trend	Biological parameters			(12) Environ. concerns	(13) Assess. models
		(9) Age at sex. mat.	(10) Juv. survival	(11) Adult survival		
<i>Mark recapture</i> : Abrolhos Bank ¹⁵ (273-1,519)	?	?	?	?	Oil and gas exploration, boat traffic, whale-watching	Bayesian assessment ⁷ Age-aggregated production model ²² .
<i>Empirical Bayes</i> ¹⁶ : (1995) 1,634 (90% probability interval = 1,379-1,887)						
<i>Chapman corrected Petersen</i> ¹⁷ : (1996-2000) 1,389 -3,977 CV=27%						
<i>Max. Likelihood</i> ³ : 1996-2000 2,393 (95% CI = 1,924-3,060)						
<i>Max. likelihood + growth rate</i> : (2000) ³ : 3,871 (95% CI = 2,795-5,542)						
<i>Line transect</i> : Ship survey (5 to 12°S) (2000) 580 (95% CI = 315-1,069) ¹⁸						
<i>Aerial survey</i> (12-20°S) (2001) 2,291 (95% CI = 970-5,460) ¹⁹ ; (2002) 2,396 (95% CI = 1,691-3,100) ²⁰ (2004) ca 24% of K (95% CI: 13.3%, 42.2%) where K ~ 20000 ²¹						

¹⁵ Bethlem, C.B.P. 1998. Estimativas de abundância da baleia jubarte (*Megaptera novaeangliae*) em sua concentração reprodutiva no Banco dos Abrolhos, Bahia Brasil. Masters Thesis, Fundação Universidade do Rio Grande.

¹⁶ Kinas, P.G. and Bethlem, C.B.P. 1998. Empirical Bayes abundance estimation of a close population using mark-recapture data, with application to humpback whales, *Megaptera novaeangliae*, in Abrolhos, Brazil. *Rep. int. Whal. Commn* 48: 447-450.

¹⁷ Freitas, A.C., Kinas, P.G., Martins, C.C.A and Engel, M.C. 2002. Population estimate for humpback whales from Abrolhos Bank, Brazil wintering ground in the southwestern Atlantic Ocean. Paper SC/54/H11.

¹⁸ Zerbini, A.N., Andriolo, A., da Rocha, J.M., Simões-Lopes, P.C., Siciliano, S., Pizzorno, J.L.A., Waite, J.M., DeMaster, D.P. and VanBlaricom, G.R. 2004. Distribution and abundance of humpback whales, *Megaptera novaeangliae*, off Northeastern Brazil. *J. Cetacean Res. Manage* 6(1): 101-107.

¹⁹ Andriolo, A., Martins, C.C.A., Engel, M.H., Pizzorno, J.L., Más-Rosa, S., Freitas, A.C., Morete, M.E., Petta, C.B. and Kinas, P.G. 2002. Aerial surveys of humpback whale (*Megaptera novaeangliae*) to estimate abundance in the breeding ground, Brazil: preliminary results. Paper SC/54/H5.

²⁰ Andriolo, A., Martins, C.C.A, Engel, M.H, Pizzorno, J.L., Más-Rosa, S., Morete, M.E. and Kinas, P.G. 2003. Second year of aerial survey of humpback whale (*Megaptera novaeangliae*) in the Brazilian breeding ground, 2002. Paper SC/55/SH1.

²¹ Zerbini, A. 2004. Status of the Southern Hemisphere humpback whale breeding stock A: preliminary results from a Bayesian assessment. Paper SC/56/SH17.

²² Johnstone, S J and Butterworth, D S, 2004. Updated age-aggregated production modelling assessments of the Southern Hemisphere humpback whale breeding stocks A and C. Paper SC/56/SH20

Population structure/stock identity				Catches	
(1)	(2)	(3)	(4)	(5) Commercial	(6)
BS	Feeding grounds	Migration routes	Breeding grounds		Subsistence/incidental
B	Suggested as Area IIE and Area III ¹ Preliminary connection demonstrated by satellite telemetry ² Genetic analysis comparing breeding and feeding for B and C and Areas II and III underway ³ Some mixing with C and A being tested	West African coast from South Africa to Bight of Benin/Gulf of Guinea, extending from nearshore to >2,000 km offshore ^{4,5,6,7,8,9}	Equatorial waters of central West Africa from ~6°S to 6°N including Angola, Congo, Gabon, Benin and other range states in the Gulf of Guinea ^{4, 5, 6, 7, 8, 9} Large concentrations and breeding activity documented off the coast of Gabon ~4°S to 0° ^{8,9} Significant genetic structure based on mtDNA haplotype frequencies for breeding areas and migratory corridors of B <i>cf</i> A and C ³ Significant variation in haplotype frequencies and Φ_{ST} between west South Africa <i>cf</i> Angola and Gabon, but not between Gabon and Angola ¹⁰ Updated analyses support, or partially so, wintering region designations A, B and C Photographic comparison between Brazil and Gabon coastal waters found no matches	South Africa-Gabon coastal 21,671 (1909-1930) ¹¹ - post 1930 ^{1, 12, 13} , see BIWS (C Lopez, Gabon initial catch, 1949, 1356; 1952, when abandoned, 264 ⁹) Antarctic, 1904-1974 ^{14, 15} , - allocation to be determined	? Aboriginal whaling off Pagalu (Equatorial Guinea) estimated at 1-3 whales/yr from 1950-70s ¹⁶

¹ Budker, P. 1952. Quelques considerations sur la campagne baleiniere 1951 au Cap Lopez (Gabon). *Mammalia* 14(4):54-8. [In French].

² Mate and Rosenbaum, In prep.

³ Rosenbaum, H.C., Best, P.B., Findlay, K.P., Engel, M.H., Pomilla, C., Razafindrakoto, Y., Morete, M.E., Vely, M.E., Freitas, A.C., Baker, C.S., Jenner, C., Jenner, M-N, and Bannister, J. 2000. Mitochondrial DNA variation among humpback whales from the wintering grounds in the South Atlantic and Southwestern Indian Oceans. Paper SC/52/IA11.

⁴ Best, P.B., Sekiguchi, K. and Findlay, K.P. 1995. A suspended migration of humpback whales *Megaptera novaeangliae* on the west coast of South Africa. *Marine Ecology Progress Series* 118:1-12.

⁵ Best, P.B., Reeb, D., Morais, M. and Baird, A. 1999. A preliminary investigation of humpback whales off northern Angola, 1999. Paper SC/51/CAWS33.

⁶ Barendse, J., Thornton, M., Elwen, S. and Best, P.B. 2002. Migrations of humpback whales on the West Coast of South Africa: preliminary results. Paper SC/54/H21.

⁷ Van Waerebeek, K., Tchibozo, S., Montcho, J., Nobime, G., Sohouhoue, P. and Dossou, C. The Bight of Benin, a North Atlantic breeding ground of a Southern Hemisphere humpback whale population, likely related to Gabon and Angola substocks, 2001. Paper SC/53/IA21.

⁸ Walsh, P., Fay, J.M., Gulick, S. and Sounguet, G.P. 2000. Humpback whale activity near Cap Lopez, Gabon. *J. Cetacean Res. Manage.* 2(1):63-67.

⁹ Rosenbaum, H.C., Ersts, P., Razafindrakoto, Y., Sounguet, G., Pomilla, C., Ngouesso, S., and White, L. 2002. Population characteristics, distribution, and relative abundance of humpback whales off the coasts of Madagascar and Gabon: An update on recent and planned research. Paper SC/54/H20.

¹⁰ Rosenbaum, H.C., Best, P.B., and Pomilla, C. 2001. A preliminary analysis of mtDNA variation among humpback whales of the southeastern Atlantic Ocean from the wintering grounds along the coast of west Africa. Paper SC/53/IA32.

¹¹ Best, P.B. A review of the catch statistics for modern whaling in southern Africa, 1908-1930. *Rep. int. Whal. Commn* 44: 467-485.

¹² Budker, P. 1953. Les Campagnes baleinieres 1949-1952 au Gabon. *Mammalia* 17(3) 129-48.

¹³ Budker, P. and Roux, C. 1968. The 1959 summer whaling season at Cape Lopez (Gabon). *Norsk Hvalfangstid.* 6: 141-5.

¹⁴ Findlay, K.P. 2001. A review of humpback whale catches by modern whaling operations in the Southern Hemisphere. *Mem. Qld. Mus.* 47(2):587-598.

¹⁵ Findlay, K.P., Cunningham, C.L. and Butterworth, D.S. 2000. A first step towards a preliminary assessment of Southern Hemisphere humpback whales. Paper SC/52/IA2.

¹⁶ Aguilar, A. 1985. Aboriginal whaling off Pagalu (Equatorial Guinea). *Rep. int. Whal. Commn* 35: 385-386.

Biological parameters

	(7) Pop. abundance	(8) Pop. trend	(9) Age at sex. mat.	(10) Juv. survival	(11) Ad. survival	(12) Environ. concerns	(13) Assess. models
B	<i>Line transect</i> -coast of Gabon: surveys completed in 2002: 1259 (1594-2798) in survey area ¹	Comparing catch rates in the last few years of humpback whaling with current sighting rates, it seems qualitatively that there must have been an increase off west South Africa	?	?	?	Oil and gas exploration, production and transport ^{2,3} Possible risk from PAHs ⁴	?

¹ Rosenbaum, H C, Strindberg, S and Ersts, P J, 2004. Initial estimates of abundance and distribution of humpback whales on their wintering grounds in the coastal waters of Gabon (southeastern Atlantic Ocean, Area B) based on aerial surveys. Paper SC/56/SH2.

² Rosenbaum, H.C., Ersts, P.E. and Findlay, K. 2001. Regional planning workshop on collaborative research and conservation of humpback whales in the Indian and South Atlantic Oceans. Paper SC/53/IA23.

³ Reeves, R., Smith, B.D., Crespo, E.A. and Notarbartolo di Sciara, G. 2003. Project 40. Dolphins, whales and porpoises: 2004-2010 Conservation Action Plan for the World's Cetaceans. IUCN.

⁴ Pomilla, C, Moore, M J, Stegeman, J J and Rosenbaum, H C, 2004. Investigating risk of exposure to aromatic hydrocarbons among the humpback whale population wintering off the coast of Gabon: approach and preliminary data based on cytochrome P450 expression. Paper SC/56/E12

Population structure/stock identity				Catches		
(1)	(2)	(3)	(4)	(5)	(6)	
BS	Feeding grounds	Migration routes	Breeding grounds	Commercial	Subsistence/incid.	
C	Suggested Antarctic 0-50°E, centred on 10-40°E. Possible mixing with B stock ¹ Two mark returns from Area III to South Madagascar ² Genetic analysis linking breeding and feeding for B and C and Areas II and III underway ¹³ Possible connection/exchange with northern Indian Ocean, but further analyses needed ³	C1 – eastern coastal waters of southern Africa ⁴ ; C2- possibly central Mozambique Channel ⁴ ; C3- Star Bank, Walters Shoal and possibly Madagascan Ridge ³ East coast of Madagascar, from southern Madagascar north to Antongil Bay ⁵	C1 – coastal waters of Mozambique (northern limit unknown, probably into Tanzania); C2 –coastal waters of central Mozambique Channel Islands, possibly as far north as southern Seychelles; C3 – coastal waters of Madagascar, W. coast unknown, south and east coasts as far north as Antongil Bay ⁵ Significant genetic structure based on mtDNA haplotype frequencies for some breeding areas and migratory corridors between B and C. Updated analysis supports wintering regions designated A, B, C ¹⁵ Some sub-structure found among C1-C3 comparisons based on mtDNA haplotype frequencies ⁶ Updated analysis partially supports division into C1, C2 and C3 ¹⁵ Several photographic recaptures between C2 (Mayotte) and Madagascar (C3) ⁷	Modern whaling (1908-1963) Cape: 68; Natal: 9,785; Moz: 3,128; Madagascar: 6,181; Antarctic Area III: (BIWS) 7,074; Soviet Fleet (known up to 1974) -1,280 ⁸ Unsubstantiated reports of direct takes in southern Madagascar ⁹	8 hb whales entangled in shark Control nets off Kwazulu-Natal in 2003, all released: another 42 holes in nets attributed to whales, species unknown ¹⁷	

Biological parameters						(13)
(7)	(8)	(9)	(10)	(11)	(12) Environ. concerns	Assess. models
Pop. abundance	Pop. trend	Age at sex. mat.	Juv. survival	Adult surv.		
C1 <i>Shore-based sighting survey</i> – migration stream at Cape Vidal, SA (1990) - 1,777 ¹⁰ C1 – <i>Vessel-based line transect survey</i> - South and central Mozambique (1991) – 1,954 (CV 0.38) ¹¹ C3 - <i>Vessel-based line transect survey</i> - south Madagascar (1994) - 2,532 (CV 0.27) ¹² <i>Photographic Capture-Recapture</i> C3- Antongil Bay, NE Madagascar (1996-1999) 1,746 (CV 0.19) ¹³ C1 – <i>Vessel-based Line transect survey</i> - Mozambique (2003) 5811 (CV 0.15) ¹⁶ Updated estimates from photographic and genetic capture-recapture for C3 available within 2-3 years C – 10880 ¹⁴	7.9% (1991-2003) ¹⁶ assuming g(0) = 1 0.097 s.e .0.049 (1963-75) :p = 0.07 ¹⁸	Potentially available from C3 breeding grounds within 2-3 years	Potentially available from C3 breeding grounds within 2-3 years	Potentially available from C3 breeding grounds within 2-3 years	General concerns about threats and critical habitat discussed in ref ⁹	Age-aggregated production model ¹⁹

¹ Mackintosh, N.A. 1942. The southern stocks of whalebone whales. *Discovery Reports* 22: 197-300.

²Rayner, G.W. 1940. Whale marking: progress and results to December 1939. *Discovery Reports* 19 : 245-284.

- ³Rosenbaum, H.C., Collins, T., Minton, G., Baldwin, R., Glaberman, S., Findlay, K.P. and Best, P. 2002. Preliminary analysis of mtDNA variation among humpback whales off the coast of Oman and their relationships to humpback whales from the wintering grounds in the southwestern Indian Ocean. Paper SC/54/H19.
- ⁴Best, P.B., Findlay, K.P., Sekiguchi, K., Peddemors, V.M., Rakotonirina, B., Rossouw, A. and Gove, D. 1998. Winter distribution and possible migration routes of humpback whales *Megaptera novaeangliae* in the southwest Indian Ocean. *Mar. Ecol. Prog. Ser* 162 : 287-299.
- ⁵Rosenbaum, H.C., Walsh, P.D., Razafindrakoto, Y., Vely, M. and DeSalle, R. 1997. First description of a humpback whale breeding ground in Baie d'Antongil, Madagascar. *Conservation Biology* 11(2): 312-314.
- ⁶Rosenbaum, H.C., Best, P.B., Findlay, K.P., Engel, M.H., Pomilla, C., Razafindrakoto, Y., Morete, M.E., Vely, M.E., Freitas, A.C., Baker, C.S., Jenner, C., Jenner, M-N. and Bannister, J. 2000. Mitochondrial DNA variation among humpback whales from the wintering grounds in the South Atlantic and Southwestern Indian Oceans. Paper SC/52/IA11.
- ⁷Avolio, M., Ersts, P., Vely, M., Bastid, J.J, Wendling, B., Seitre, R., Seitre, J., Darmmangeat, P., Collin-Omnes, P., Razafindrakoto, Y., Pomilla, C. and Rosenbaum, H.C. Humpback whale distribution and marine mammal diversity in the waters of Mayotte. Paper SC/54/H4.
- ⁸Findlay, K.P. 2002. A review of humpback whale catches by modern whaling operations in the Southern Hemisphere. *Mem. Qld. Mus.* 47(2): 411-420.
- ⁹Rosenbaum, H.C., Ersts, P.E. and Findlay, K. 2001. Regional planning workshop on collaborative research and conservation of humpback whales in the Indian and South Atlantic Oceans. Paper SC/53/IA23.
- ¹⁰Findlay, K.P. and Best, P.B. 1996. Preliminary population estimates of humpback whales migrating past Cape Vidal, South Africa, 1988-1991. *Mar. Mammal Sci.* 12(3): 354-370.
- ¹¹Findlay, K.P., Best, P.B., Peddemors, V.M. and Gove, D. 1994. The distribution and abundance of humpback whales on their Mozambique winter grounds. *Rep. int. Whal. Commn* 44: 311-320.
- ¹²Best, P.B., Sekiguchi, K., Rakotonirina, B., and Rossouw, A. 1996. The distribution and abundance of humpback whales off Southern Madagascar, August-September 1994. *Rep. int. Whal. Commn* 46: 323-331.
- ¹³Rosenbaum, H.C., Razafindrakoto, Y., Ersts, P., and Ventresca, G. 2000. A preliminary population estimate for humpback whales from the Antongil Bay, Madagascar wintering ground in the southwestern Indian Ocean. Paper SC/52/IA10.
- ¹⁴Rosenbaum, H C, Pomilla, C, Leslie, M, Best, P B, Collins, T, Engel, M H, Ersts, P J, Findlay, K P, Kotze, P J H, Meyer, M, Minton, G, Barendse, J, Van Waerebeek, K and Razafindrakoto, Y, 2004. Mitochondrial DNA diversity and population structure of humpback whales from their wintering areas in the Indian and South Atlantic Oceans (wintering regions A, B, C and X). Paper SC/56/SH3 presented to the Scientific Committee of the International Whaling Commission, Sorrento, Italy: 10pp
- ¹⁵Pomilla, C, Best P B, Findlay, K P, Kotze, P J H, Engel, M H, Barendse, J, and Rosenbaum, H C, 2004. Population structure of Southern Hemisphere humpback whales from wintering regions A, B and C based on nuclear microsatellite variation. Paper SC/56/SH4 presented to the Scientific Committee of the International Whaling Commission, Sorrento, Italy: 12pp
- ¹⁶Findlay, K, Meyer, M, Elwen, S, Kotze, D, Johnson, R, Truter, P, Uamusse, C, Siteo, S, Wilke, C, Kerwath, S, Swanson, S, Staverees, L, van der Westhuiizen, J, 2004. Distribution and abundance of humpback whales, *Megaptera novaeangliae*, off the coast of Mozambique, 2003. Paper SC/56/SH12 presented to the Scientific Committee of the International Whaling Commission, Sorrento, Italy: 39pp
- ¹⁷South African Prog Rep, IWC 55
- ¹⁸Best, P.B. 2003. How low did they go? An historical comparison of indices of abundance for some baleen whales on the Durban whaling ground. Paper SC/55/SH18 presented to the Scientific Committee of the IWC, Berlin, 11 pp.
- ¹⁹Johnston, S.J. and D.S. Butterworth. 2004. Updated age-aggregated production modelling assessments of the Southern Hemisphere humpback whale Breeding stocks A and C. Paper SC/56/SH20

Population structure/stock identity				Catches		
(1)	(2)	(3)	(4)	(5)	(6)	
BS	Feeding grounds	Migration routes	Breeding grounds	Commercial	Subsistence	
D	Antarctic Area IV, 80-110°E; some mixing with E(i) ¹	Between Antarctic and WA coast ¹	Coastal Western Australia, esp. ca 15-16°S ²	See refs ^{1,3,8}		Possibly 1-2/year from entanglement ⁷
<hr/>						
(7)	(8)	Biological parameters			(12)	(13)
Population abundance	Population trend	(9)	(10)	(11)	Env concerns	Ass. models
		Age at sex. Mat.	Juv. Surv.	Ad. Surv.		
D	<i>Aerial survey</i> : 8,000-14,000 (1999) ⁴ ; <i>Est from catches and increase rate</i> : 8,000 (1999) ⁵ ; <i>Antarctic sightings</i> : 31750 (CV 0.11) (2003/04) ⁹ , SOWER: 17,300 (CV 0.17) (1998/99) ⁶	10.15±4.6% (1982-94) ⁴ ; 16.2% (±6.4%) ⁹	4-5 yrs, both sexes ? (1951-59, assuming 2 laminations/yr) ¹	0.93 (range 0.91-0.95) (1949-62) ¹	Oil and gas exploration/production breeding grounds), ship traffic, entanglement (coastal migration corridor); climate change (feeding grounds)	Age-aggregated production models; models that allow mixing in feeding areas ^{10,11}

References

- ¹Chittleborough, R.G. 1965. Dynamics of two populations of the humpback whale, *Megaptera novaeangliae* (Borowski). *Aust. J. Mar. Freshwat. Res.* 16(1): 33-128
- ²Jenner, K.C. S., Jenner, M.-N., and McCabe, K.A. 2001. Geographical and temporal movements of humpback whales in Western Australian waters. *APPEA Journal* 2001: 749-765.
- ³Findlay, K.P. 2001. A review of humpback whale catches by modern whaling operations in the southern hemisphere. *Mem. Qld. Mus.* 47(2):411-420.
- ⁴Bannister, J.L. and Hedley, S.L. 2001. Southern Hemisphere Group IV humpback whales: their status from recent aerial survey. *Mem. Qld. Mus.* 47(2):587-598.
- ⁵Findlay, K.P., Cunningham, C.L. and Butterworth, D.S. 2000. A first step towards a preliminary assessment of Southern Hemisphere humpback whales. Paper SC/52/IA5.
- ⁶Matsuoka, K., Hakamada, T., Murase, H. and Nishiwaki, S. 2003. Current distribution, abundance and density trend of humpback whales in the Antarctic Areas IV and V. Paper SC/55/SH10.
- ⁷Based on information from D. Coughran, Dept of Conservation and Land Management, W. Australia.
- ⁸Mikhalev, Y. 2004. Trade and the biological characteristics of humpback whales caught by Soviet Antarctic flotillas into the season 1960-61. Paper SC/56/SH9.
- ⁹Matsuoka, K., Hakamada, T. and Nishiwaki, S., 2005. Distribution and abundance of humpback, fin and blue whales in the Antarctic Areas III, IV, V and VIW (35°E -145°W). Paper JA/J05/JR10. 43pp.[Feeding stock estimates: subject to review]
- ¹⁰Johnston, S.J., Butterworth, D.S. and K.P. Findlay. 2001. Further results from a preliminary assessment of southern hemisphere humpback whales. Paper SC/53/IA20.
- ¹¹Johnston, S.J. and D.S. Butterworth. 2002. An assessment of the west and east Australian breeding stocks of Southern Hemisphere Humpback whales using a model that allows for mixing in the feeding grounds. Paper SC/54/H17.

		Population structure/stock identity			Catches		
(1) BS	(2) Feeding grounds	(3) Migration routes	(4) Breeding grounds	(5) Commercial			
E (i)	Antarctic Areas IV-V, 110°E -?	Between Antarctic and eastern Australian coast/ Coral Sea ¹	Coastal eastern Australia, esp. 18-21°S ²	See refs ^{1,3,6}			
E (ii) 1	Antarctic Area V ?-?°E	Within Oceania ² , past eastern Australia and New Zealand Movement between Vanuatu ⁷ , New Caledonia, Tonga ^{1,7} and French Polynesia ¹⁰	New Caledonia 22°S ^{3,8}	?; see also ref ⁶			
E (ii) 2	?	Within Oceania ² (one record between Bellingshausen Sea, Area VI, and Tonga; one between Area V and Tonga ¹)	Tonga ³	Small-scale coastal hunt until 1979 ⁵ ?see also ref ⁶			

		Biological parameters						
(1) BS	(7) Population abundance	(8) Population trend	(9) Age at sex. mat.	(10) Juv. surv.	(11) Adult surv.	(12) Env. conc.	(13) Ass. mod.	
E (i)	<i>Shore-based survey</i> : 6555 (±389) (2004) ² <i>Antarctic sightings</i> : 2,735 (CV 0.16) (2003) ⁷	10.6 (±0.5%) ² ; 10.08% (SE ??, 1980-2000), 8.52% (SE 0.05, 1986-2000), 8.54% (SE 0.05, 1991-2000) ³ ; 12.2% (7.1-17.3%) ⁷	4-5 years, both sexes (1951-59 assuming 2 laminations/yr) ¹ 3-4 yrs, both sexes ¹	?	0.91 (lower limit, 1957, 1958) ¹	As for D	?	
E (ii) 1	<i>Petersen capture-recapture, photo ID</i> : 327 (CV 0.11) <i>Genotyping</i> : 533 (CV 0.15), both weighted mean of Petersen (1995-2001) ⁴ <i>Sex specific</i> : N _f =248, CV 0.30; N _m =288, CV=0.11 ⁴ ; <i>Gametic recapture</i> : N _m =379, CV=0.30 ⁴ ; <i>Organismal recapture</i> : N _m =382, CV=0.22 ⁴	?	?	?	?	Unregulated whale watching ⁵ Nickel mining	?	
E (ii) 2	<i>Weighted Petersen capture-recapture</i> : 990 (SE 0.15, 1991-2000) ⁴ ; 730 adjusted for 3% adult mortality ⁵ (2000)	?	?	?	?	?	?	

References

Breeding stock E(i)

- ¹Chittleborough, R.G. 1965. Dynamics of two populations of the humpback whale, *Megaptera novaeangliae* (Borowski). *Aust. J. Mar. Freshwat. Res.* 16 (1): 33-128.
- ²Noad, M.J., Cato, D.H., and Paton, D. 2005. Absolute and relative abundance estimates of Australian east coast humpback whales (*Megaptera novaeangliae*). Paper SC/57/SH12 [results to be confirmed]
- ³Findlay, K.P. 2001. A review of humpback whale catches by modern whaling operations in the Southern Hemisphere. *Mem. Qld. Mus.* 47(2):411-420.
- ⁵Brown, M.R., Field, M.S., Brown, C.E. and Bryden, M.M. 2003. Rates of increase for east Australian humpback whales, *Megaptera novaeangliae*, from 1981-2000. Paper SC/55/SH21.[Results to be confirmed, see SC/55/AnnexH p5]

⁶ Mikhalev, Y A, 2004. Trade and the biological characteristic of humpback whales, caught by Soviet Antarctic flotillas into the season 1960-61. Paper SC/56/SH9.

⁷ Matsuoka, K, Hakamada, T. and Nishiwaki, S., 2005. Distribution and abundance of humpback, fin and blue whales in the Antarctic Areas III,IV,V and VIW (35oE -145oW). Paper JA/J05/JR10. 43pp.[Feeding stock estimates: subject to review].

Breeding Stock E(ii) 1

¹Garrigue C., Aguayo, A., Amante-Helweg, V., Baker, C.S., Caballero, S., Clapham, P., Constantine, R., Denking, J., Donoghue, M., Florez-Gonzalez, L., Greaves, J., Hauser, N., Olavarria, O., Pairoa, C., Peckham, H. and Poole, M. 2002. Movements of humpback whales in Oceania, South Pacific. *J. Cetacean Res. Manage.* 4(3):255-260.

²Garrigue, C., Forestell, P., Greaves, J., Gill, P., Naessig, P., Baker, C.S. and Patenaude, N. 2000. Migratory movement of humpback whales (*Megaptera novaeangliae*) between New Caledonia, East Australia and New Zealand. *J. Cetacean Res. Manage.* 2(2):111-115.

³Garrigue, C., Greaves J. and Chambellant M. 2001. Characteristics of the New Caledonian humpback whale population. *Mem. Qld. Mus.* 47(2):539-546.

⁴Garrigue, C., Baker C.S., Dodemont, R. and Steel, D. 2004. Organismal and 'gametic' capture-recapture using microsatellites genotyping confirm low abundance and reproductive autonomy of humpback whales on the wintering grounds of New Caledonia. *Marine Ecology Progress Series*, 274: 251-262.

⁵Garrigue, C. and Virly, S. 2000. Whale watching in New Caledonia: a new industry. Humpback 2000 Conference, 29 August to 1 September 2000, Brisbane, Australia (poster).

⁶ Mikhalev, Y A, 2004. Trade and the biological characteristic of humpback whales, caught by Soviet Antarctic flotillas into the season 1960-61. Paper SC/56/SH9.

⁷ Garrigue, C, Russell, K and Dodemont, R, 2004. A preliminary survey of humpback whales and other cetaceans in Vanuatu, South-West Pacific: a contribution from the South Pacific Whale Research Consortium. Paper SC/56/SH18.

⁸ Garrigue, C, Dodemont, R, Steel, D, and Baker, C S, 2004. Organismal and 'gametic' capture-recapture using microsatellite genotyping confirm low abundance and reproductive autonomy of humpback whales on the wintering grounds of New Caledonia. SC/56/For Information document 9.

¹⁰ Anon, 2005. Report of the Annual meeting of the South Pacific Whale Research Consortium 11-13 March, 2005, Auckland, New Zealand. Paper SC/57/XXX

Breeding Stock E(ii) 2

¹Dawbin W.H. 1959. New Zealand and South Pacific whale marking and recoveries to the end of 1958. *The Norwegian Whaling Gazette*, 5 : 213-238.

²Garrigue C., Aguayo, A., Amante-Helweg, V., Baker, C.S., Caballero, S., Clapham, P., Constantine, R., Denking, J., Donoghue, M., Florez-Gonzalez, L., Greaves, J., Hauser, N., Olavarria, O., Pairoa, C., Peckham, H. and Poole, M. 2002. Movements of humpback whales in Oceania, South Pacific. *J. Cetacean Res. Manage.* 4(3):255-260.

³Anon, 2003. Report of the Annual Meeting of the South Pacific Whale Research Consortium. Paper SC/55/SH2.

⁴Anon, 1981. Progress Report, Kingdom of Tonga. *Rep. int. Whal. Commn.* 31:113-114.

⁵Baker C.S., Donoghue, M., Constantine R. 2001. Population status and genetic identity of humpback whales on the wintering grounds of Tonga – a slow recovery or colonisation? 14th Biennial Conference on the Biology of Marine Mammals, Vancouver, Canada, 28 November-3 December 2001

⁶Mikhalev, Y A, 2004. Trade and the biological characteristic of humpback whales, caught by Soviet Antarctic flotillas into the season 1960-61. Paper SC/56/SH9.

⁷ Garrigue, C, Dodemont, R, Steel, D, and Baker, C S, 2004. Organismal and 'gametic' capture-recapture using microsatellite genotyping confirm low abundance and reproductive autonomy of humpback whales on the wintering grounds of New Caledonia. SC/56/For Information document 9.

Population structure/stock identity				Catches	
(1) BS	(2) Feeding grounds	(3) Migration routes	(4) Breeding grounds	(5) Commercial	(6) Subsistence/incidental
F	?	Within Oceania ^{1,7}	French Polynesia ² , Cook Islands ³ Significant difference in mtDNA suggests 2 breeding grounds ^{5,6}	Rurutu, Austral Is (22°30'S, 151°15'W). Local capture for food until 1959	Rurutu - entanglements (2)

		Biological parameters					
(1) BS	(7) Population abundance	(8) Population trend	(9) Age at sex. mat.	(10) Juv. surv.	(11) Adult surv.	(12) Env. conc.	(13) Ass. mod.
F	<i>Cook Is/French Polynesia catalogue size: 232 individuals (to 2002)</i> ⁴	?	?	?	?	?	?

Breeding Stock F

¹Garrigue C., Aguayo, A., Amante-Helweg, V., Baker, C.S., Caballero, S., Clapham, P., Constantine, R., Denking, J., Donoghue, M., Florez-Gonzalez, L., Greaves, J., Hauser, N., Olavarria, O., Pairoa, C., Peckham, H. and Poole, M. 2002. Movements of humpback whales in Oceania, South Pacific. *J. Cetacean Res. Manage.* 4(3):255-260.

²Poole, M., 2002. Occurrence of humpback whales (*Megaptera novaeangliae*) in French Polynesia 1988-2001. Paper SC/54/H14.

³Hauser, N., Peckham, H. and Clapham, P. 2000. Humpback whales in the Southern Cook islands, South Pacific. *J. Cetacean Res. Manage.* 2(3):159-164.

⁴Anon, 2003. Report of the Annual meeting of the South Pacific Whale Research Consortium. Paper SC/55/SH2.

⁵Olavarria, C., Poole, M., Hauser, N., Garrigue, C., Caballero, S., Brasseur, M., Martien, K., Russell, K., Oremus, M., Dodemont, R., Florez-Gonzalez, L., Capella, J., Rosenbaum, H., Moro, D., Jenner, C., Jenner, M-N., Bannister, J. and Baker, C.S. Population differentiation of humpback whales from far Polynesia (Group F breeding grounds) based on mitochondrial DNA sequences. Paper SC/55/SH11.

⁶Anon, 2004. Report of the annual meeting of the South Pacific Whale Research Consortium: 2-6 April, 2004, Byron Bay, NSW, Australia. Paper SC/56/SH7.

⁶Anon, 2004. Report of the annual meeting of the South Pacific Whale Research Consortium 2-6 April, 2004, Byron Bay, NSW, Australia. Paper SC/56/SH7

⁷Anon, 2005. Report of the Annual meeting of the South Pacific Whale Research Consortium 11-13 March, 2005, Auckland, New Zealand. Paper SC/57/XXX

(1) BS	Population structure/stock identity			Catches	
	(2) Feeding grounds	(3) Migration routes	(4) Breeding grounds	(5) Commercial	(6) Subsistence/incidental
G	Antarctic Area I, 60-120°W ¹ , recommended shift of eastern limit to 58°W. ² Strait of Magellan ³ possibly Perú and northern Chile ^{4,22}	Migratory connection between Straits of Magellan and Colombia ²³ , Magellan Strait and Ecuador, Colombia, Panama and Costa Rica ²⁴ , and between Antarctic Peninsula and Ecuador/Colombia ²⁵	Coastal waters west South American, between south Panamá and north Perú ⁵ , but mainly Colombia ⁶ and Ecuador ^{7,8}	Antarctic, Chile, Perú. Occasionally Ecuador, Colombia ^{9,10,11} 1,726 (1904-1939) ¹² 1,985 on west coast South America (1912-1967) ¹⁴ 70 off Peru and Chile by pelagic whaling (1935-1951) ¹⁴ 105 off Chile-Peru-Ecuador by Olympic Challenger in 1954 ¹⁵ 8,879 (min) in South Shetland Is (1905-1926) by land and floating factories ¹⁴ 1,295 in Area I by Antarctic Pelagic Whaling (1923-1963) ¹⁴ 414 in Area I by Soviet Antarctic whaling fleet (1948-1973)	Entanglements, vessel strikes in Colombia ¹⁶ and Ecuador ¹⁷

(1) BS	(7) Population abundance	(8) Population trend	Biological parameters				
			(9) Age at sex. mat.	(10) Juv. surv.	(11) Adult surv.	(12) Env. conc.	(13) Ass. mod.
G	Colombia: <i>Petersen capture recapture:</i> Gorgona Island: 170-450 (1986-1988) ⁶ Gorgona Island: 1,495 (1994-1995, 95% CI= 919-2,071) Málaga Bay: 857 (1994-1995, 95% CI=547-1,167) Colombia: 1,655 (1994-1995, 95% CI= 1,120-2,190) ¹⁸ Ecuador: <i>Bailey-modified Petersen capture recapture:</i> 1,922 (1996-1997, 95% CI= 77-3,767) ¹⁹ 2,683 (1991-1997, 95% CI= 397-4,969) ¹⁹ <i>Chapman-modified Petersen capture recapture:</i> 405 (1998-1999, 95% CI= 221-531) ⁸	?	?	?	?	?	Age-aggregated production models ²⁶

References

- ¹Mackintosh, N.A. 1965. *The Stocks of Whales*. Fishing News International, London, 232pp.
- ²Olavarria, C., Baker, C.S., Medrano, L., Aguayo, A., Caballero, S., Flórez-González, L., Capella, J., Rosenbaum, H.C., Garrigue, C. and Graves, J. 2000. Stock identity of Antarctic Peninsula Humpback whales inferred from mtDNA variation. Paper SC/52/IA15.
- ³Gibbons, J., Capella, J. and Valladares, C. 2003. Rediscovery of a humpback whale, *Megaptera novaeangliae*, summering ground in the Strait of Magellan, Chile. *J. Cetacean Res. Manage.* 5(2):203-08
- ⁴Papastavrou, V. and Van Waerebeek, K. 1997. A note on the occurrence of humpback whales (*Megaptera novaeangliae*) in tropical and subtropical areas: the upwelling link. *Rep. int. Whal. Commn.* 47: 945-947.
- ⁵Flórez-González, L., Capella, J., Haase, B., Bravo, G.A., Félix, F. and Gerrodette, T. 1998. Changes in winter destinations and the northernmost record of southeastern Pacific humpback whales. *Marine Mammal Science* 14: 189-196.
- ⁶Florez-González, L. 1991. Humpback whales *Megaptera novaeangliae* in the Gorgona island, Colombian Pacific breeding waters: population and pod characteristics. *Mem. Qld. Mus.* 30(2): 291-295.

²²Acevedo, J., Acuña, P., Olavarria, C., Aguayo-Lobo, A and Pastene, L., 2004. Paper SC/56/O7.

²³Sabaj, V., Vilina, Y A, Guerrero, S L, Capella, J J, Gibbons, J, and Vallardes, C, 2004. Genetic structure of the recently discovered feeding ground of humpback whales at Straits of Magellan, Chile. Paper SC/56/SH19.

²⁴Acevedo, J., Aguayo-Lobo, A, Rasmussen, K, Felix, F, Llano, M, Allen, J, Olavarria, C, Acuña, P and Pastene, L A, 2004. Migratory destination of humpback whales, *Megaptera novaeangliae* (Borowski, 1781), of the Magellan Strait feeding ground. SC/56/SH22.

²⁵Stevick, P T, Aguayo, A, Allen, J, Avila, I C, Capella, J, Castro, C, Chater, K, Dalla Rosa, L, Engel, M H, Felix, F, Florez-Gonzalez, L, Freitas, A, Haase, B, Llano, M, Lodi, L K, Munoz, E, Olavarria, C, Secchi, E, Scheidat, M and Siciliano, S, In Press. JCRM.

²⁶Johnston, S.J., Butterworth, D.S. and K.P. Findlay. 2001. Further results from a preliminary assessment of southern hemisphere humpback whales. Paper SC/53/IA20.

- ⁷Félix, F. and Haase, B. 2001. The humpback whale off the coast of Ecuador, population parameters and behaviour. *Revista de Biología Marina y Oceanografía* 36(1): 61-74.
- ⁸Scheidat, M., Castro, C., Denking, J., Gonzalez, J. and Adelung, D. 2000. A breeding area of humpback whales (*Megaptera novaeangliae*) off Ecuador. *J. Cetacean Res. Manage.* 2(3):165-171.
- ⁹Townsend, C.H. 1935. The distribution of certain whales as shown by the logbook records of American Whaleships. *Zoologica*, NY 19: 1-50.
- ¹⁰Clarke, R. 1962. Whale observation and whale marking off the coast of Chile in 1958, and from Ecuador towards and beyond the Galapagos Islands in 1959. *Norsk Hvalfangst. Tidende* 51: 265-287.
- ¹¹Ramírez A., P. 1988. La ballena jorobada, *Megaptera novaeangliae*, en la costa norte del Perú: períodos 1961-1965 y 1975-1985. *Boletín de Lima* N° 56: 91-96.
- ¹²Mackintosh, N.A. 1942. The southern stocks of whale whales. *Discovery Rep.* Vol XXII: 197-300
- ¹³Aguayo-Lobo, A., Torres, D. and Acevedo, J. 1998. Los mamíferos marinos de Chile: I. Cetacea. Serie Científica INACH 48:19-159.
- ¹⁴Findlay, K.P. 2000. A review of humpback whale catches by modern whaling operations in the Southern Hemisphere. *Mem. Qld. Mus.* 47(2): 411-420.
- ¹⁵Barthelmess, K., Kock, K.H. and Reupke, E. 1997. Validation of catch data of the Olympic Challenger's whaling operations from 1950/51 to 1955/56. *Rep. int. Whal. Commn.* 47: 937-940.
- ¹⁶Capella, J., Flórez-González, L. and Falk, P. 2001. Mortality and anthropogenic harassment of humpback whales along the Pacific coast of Colombia. *Mem. Qld. Mus.* 47(2): 547-553.
- ¹⁷Félix, F., Haase, B., Davis, J.W., Chiluiza, D. and Amador, P. 1997. A note on recent strandings and bycatches of sperm whales (*Physeter macrocephalus*) and humpback whales (*Megaptera novaeangliae*) in Ecuador. *Rep. int. Whal. Commn.* 47: 917-919.
- ¹⁸Capella, J., Flórez-González, L., Falk, P. and Celis, G. 1998. Population size of southeastern Pacific humpback whale stock. Is it recovering? The World Marine Mammal Science Conference (Mónaco), p.23 [Abstracts].
- ¹⁹Félix, F. and Haase, B. 2001. Towards an estimate of the Southeastern Pacific humpback whale stock. *J. Cetacean Res. Manage.* 3(1): 55-58.
- ²⁰Bravo, G., Flórez-González, L. and Capella, J. 1994. Natalidad y frecuencia estacional de crías de ballena jorobada, *Megaptera novaeangliae*, en el Pacífico colombiano. Abstracts Anais da VI Reuniao de Trabalho de Especialistas em Mamíferos Aquáticos da América do Sul. Florianópolis, Brasil, p.76.
- ²¹Flórez-González, L., Capella, J., Falk, P., Avila, I. et al. 2002. Uso del hábitat y aspectos poblacionales de la ballena jorobada en el sector de Bahía Málaga, Pacífico colombiano. Final Report WWF-UK, Contract 9L0808.07-5253. 42 pp.

(1) BS Breeding Stock	(2) Feeding grounds	(3) Migration routes	(4) Breeding Grounds	(5) Commercial catches	(6) Subsistence/ Incidental catches	(7) Pop Abundance	(8) Pop Trend	(9) Age at Sex Matur	(10) Juv Survival	(11) Adult Survival	(12) Environ. Concerns	(13) Assessment Models
“X” Arabian Sea	Arabian Sea ¹⁻⁵ Coasts of Oman, Pakistan and India	Within Arabian Sea? Mounting evidence that discrete from SH IO populations ⁴⁻⁸	Arabian Sea (Song recorded off Oman and Sri Lanka betw. Jan and March and small calves off Oman Dec- Apr) ^{5,8,9} .	242 (1965-66) ^{1,2}	3 (beach cast specimens) also 8 live entanglements betw. 1990 and 2000 ⁹ .	<i>Mark- Recapture: Chapman corrected Petersen for Oman study areas^{4,6,6}</i> (2000-2003) between year re-sights: 56 (95% CI = 35-255) between study area re-sights: 45 (95% CI = 46-154)	?	?	?	?	? (unknown how global warming will affect Arabian Sea)	None

References

1. Mikhalev, Y.A, 1997. Humpback whales *Megaptera novaeangliae* in the Arabian Sea. *Marine Ecology Progress Series* **149**, 13-21.
2. Mikhalev, Y.A, 2000. Soviet Whaling Data [1949-1979]. Tormosov,D.D. *et al.* (eds.), pp. 141-181 (Center for Russian Environmental Policy, Marine Mammal Council, Moscow.
3. Baldwin, R, 2000. Oman's humpback whales (*Megaptera novaeangliae*). *The Journal of Oman Studies* **11**, 11-18.
4. Minton, G., Collins,T.J.Q. and Findlay, K.P, 2003.. A note on re-sights of individually identified humpback whales (*Megaptera novaeangliae*) off the coast of Oman. SC/55/O10, 1-7. Document presented to the 55th meeting of the International Whaling Commission.
5. Minton, G. *et al.* 2002. Preliminary investigations of humpback whale (*Megaptera novaeangliae*) distribution and habitat use off the coast of Oman. SC/54/H3, 1-19.. Document presented to the 54th meeting of the International Whaling Commission.
6. Minton, G. Ecology and Conservation of Cetaceans in Oman, with particular reference to humpback whales (*Megaptera novaeangliae*). 2004. PhD thesis University of London, University Marine Biological Station, Millport.
7. Rosenbaum, H.C. *et al.* 2002. Preliminary analysis of MtDNA variation among humpback whales off the coast of Oman and their relationships to whales from wintering grounds in the southwestern Indian Ocean. SC/54/H4, 1-10. Document presented to the 54th meeting of the International Whaling Commission.
8. Whitehead, H. 1985. Humpback whale songs from the North Indian Ocean. *Investigations on Cetacea* **17**, 157-162).
9. Oman Whale and Dolphin Research Group 2004.. Oman Cetacean Database (OMCD).