[1] "\r\n\r\n\t\r\n\r\n\r\n \r\n \r\n \r\n Megaptera novaeangliae\r\n — Humpback Whale\r\n \r\n \r\n \r\n \r\n \r\n Glossary\r\n \r\n\r\n\r\n\r\n\r\n\r\n \r\n SPRAT\r\n Profile\r\n \r\n\r\nFor information to assist regulatory considerations, refer to Policy Statements and Guidelines, the Conservation Advice, the Listing Advice and/or the Recovery Plan. \r\n\r\n\r\n\r\n\r\n \r\n EPBC Legal Status and Documents\r\n \r\n \r\n Top\r\n \r\n\r\n\r\n\r\nEPBC Act Listing Status\r\n \r\n\t\r\n\t\t\t\r\n\t\t\t Listed as Vulnerable\r\n\t\t\t \r\n\t\t\t \r\n\t\t\t\t(Date effective 16-Jul-2000)\r\n\t\t\t\r\n\t\t\t Cetacean\r\n\t\t\t \r\n\t\t\t \r\n\t\t\t \r\n\t\t\t\r\n\t\t\t\r\n\t\t\t Listed migratory -\r\n\t\t\t\r\n\t\t\t\t\tEPBC Act, \r\n\t\t\t \r\n\t\t\t\t\tBonn\r\n\t\t\t\r\n\t\t\t\t\r\n\t\t\t\t\r\n\t\t\t\t\r\n\t\t\t\t\r\n\t\t\t\t\r\n\t\t\t\t\r\n\t\t\t\t\tUnder threatened listing assessment, due 30-Oct-2021.\r\n \r\n\t\t Approved Conservation Advice\r\n\t\t\r\n\t\t\r\n\t\t \r\n\t\t\t \r\n\t\t\t \r\n\t\t\t\t\tThreatened Species Scientific Committee (2015). 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The recovery plan (DEH 2005) that was made for this species on 18/05/2005 ceased to be in effect from 1/10/2015.\r\n\t\t\t \r\n\t\t \r\n\t\t\t\r\n \r\n\t\t Adopted/Made Recovery Plans\r\n\t\t\r\n\t\t\r\n\t\t \r\n\t\t\t\tThere is no adopted or made Recovery Plan for this species\r\n \r\n\t\t\r\n \r\n\t\t Adopted/Made Threat Abatement Plans\r\n\t\t\r\n\t\t\r\n\t\t\t\r\n\t\t\t \r\n\t\t\t\t\r\n\t\t\t\t\tDepartment of the Environment and Energy (2018). Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018). Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/marine-debris-2018. In effect under the EPBC Act from 21-Jul-2018.\r\n\t\t\t\t\r\n\t\t\t\t \r\n\t\t\t\t \r\n\t\t\t\t \r\n\t\t\t\t\r\n \r\n\t\t Marine Bioregional Plans\r\n\t\t\r\n\t\t\r\n\t\t \r\n\t\t Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012). 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In effect under the EPBC Act from 27-Aug-2012.\r\n\t\t\t\t \r\n\t\t\t \r\n\t\t\t\r\n \r\n\t \r\n\t\t\tOther Commonwealth Documents\r\n\t \r\n\t \r\n\t\t\tTop\r\n\t \r\n\t\r\n\r\n\r\n\t\r\n\t\r\n\t\t Other EPBC Act Plans\r\n\t\t\r\n\t\t\r\n\t\t \r\n\t\t \r\n\t\t \r\n\t\t\t\tSouth-east marine region profile: A description of the ecosystems, conservation values and uses of the South-east Marine Region (Commonwealth of Australia, 2015) [Information Sheet].\r\n\t\t\t\t\r\n\t\t\t \r\n\t\t\t \r\n\t\t\t\r\n \r\n\t\t Policy Statements and Guidelines\r\n\t\t\r\n\t\t\r\n\t \r\n\t \r\n\t Australian National Guidelines for Whale and Dolphin Watching 2017 (Department of the Environment and Energy, 2017) [Admin Guideline].\r\n\t \r\n\t \r\n\t Industry Guidelines on the Interaction between offshore seismic exploration and whales (Department of the Environment and Water Resources (DEW), 2007) [Admin Guideline].\r\n\t \r\n\t \r\n\t\r\n \r\n\t Information Sheets\r\n\t\r\n\t\r\n\t \r\n\t \r\n\t The Humpback Whales of Eastern Australia (Department of Environment and Water Resources (DEWR), 2007) [Information Sheet].\r\n\t \r\n\t \r\n\t Information Sheet - Harmful marine Debris (Environment Australia, 2003) [Information Sheet].\r\n\t \r\n\t \r\n\t\r\n \r\n\t Federal Register of Legislative Instruments\r\n\t\r\n\t\t\r\n\t\t\tMigratory:List of Migratory Species (13/07/2000) (Commonwealth of Australia, 2000b) [Legislative Instrument]Recovery Plan:Humpback Whale Recovery Plan 2005-2010 (Commonwealth of Australia, 2005aa) [Legislative Instrument]Threat Abatement Plan:Instrument under section 270B of the Environment Protection and Biodiversity Conservation Act 1999 to make a Threat Abatement Plan (Commonwealth of Australia, 2018i)

[Legislative Instrument]Threatened:Declaration under s178, s181, and s183 of the Environment Protection and Biodiversity Conservation Act 1999 - List of threatened species, List of threatened ecological communities and List of threatening processes (Commonwealth of Australia, 2000) [Legislative Instrument]\r\n \r\n\t State Government Documents and Websites\r\n\t\r\n\t\r\n\t NSW:Death or injury to marine species following capture in shark control programs on ocean beaches - factsheet (NSW Department of Environment, Climate Change and Water (NSW DECCW), 2003b) [Information Sheet].NSW:Humpback Whale Information Page (NSW Department of Environment, Climate Change and Water (NSW DECCW), 2008f) [Information Sheet].NSW:Humpback Whale - profile (Office of Environment & Heritage, 2014aa) [Internet].NT:Threatened Species of the Northern Territory-Humpback Whale Megaptera novaeangliae (Woinarski, J., R. Chatto & S. Ward, 2012) [Information Sheet].QLD:Humpback whales Megaptera novaeangliae (Department of Environment and Heritage Protection (DEHP), 2013af) [Database].TAS:Megaptera novaeangliae (Humpback Whale): Species Management Profile for Tasmania's Threatened Species Link (Threatened Species Section (TSS), 2014tn) [State Action Plan].VIC:Flora and Fauna Guarantee Action Statement 247-Humpback Whale Megaptera novaeangliae (Victorian Department of Sustainability and Environment (Vic. DSE), 2009a) [State Action Plan].\r\n \r\n\t Non-government Documents and Websites\r\n\t\r\n\t\r\n\t Impacts of plastic debris on Australian marine wildlife (Ceccarelli, D.M., 2009).\r\n State Listing Status\r\n\t \r\n\t NSW:\r\n\t\t\t\r\n\t\t\t\tListed as Vulnerable\r\n\t\t\t\t (Biodiversity Conservation Act 2016 (New South Wales): February 2021 list)\r\n\t\t\t\t\r\n\t\t \r\n\t\t QLD:\r\n\t\t\t\r\n\t\t\t\tListed as Vulnerable\r\n\t\t\t\t (Nature Conservation (Animals) Regulation 2020 (Queensland): August 2020 list)\r\n\t\t\t\t\r\n\t\t \r\n\t\t SA:\r\n\t\t\t\r\n\t\t\t\tListed as Vulnerable\r\n\t\t\t\t (National Parks and Wildlife Act 1972 (South Australia): January 2020 list)\r\n\t\t\t\t\r\n\t\t \r\n\t\t TAS:\r\n\t\t\t\r\n\t\t\t\tListed as Endangered\r\n\t\t\t\t (Threatened Species Protection Act 1995 (Tasmania): November 2020 list)\r\n\t\t\t\t\r\n\t\t \r\n\t\t VIC:\r\n\t\t\t\r\n\t\t\t\tListed as Threatened\r\n\t\t\t\t (Flora and Fauna Guarantee Act 1988 (Victoria): January 2021 list)\r\n\t\t\t\t\r\n\t\t \r\n\t\t WA:\r\n\t\t\t\r\n\t\t\t\tListed as Conservation Dependent\r\n\t\t\t\t (Biodiversity Conservation Act 2016 (Western Australia): September 2018 list)\r\n\t\t\t\t\r\n\t\t \r\n\t\t \r\n Non-statutory Listing Status\r\n\t \r\n\t IUCN:\r\n\t\t\t\r\n\t\t\t\tListed as Least Concern\r\n\t\t\t\t (Global Status: IUCN Red List of Threatened Species: 2020.2 list)\r\n\t\t\t\r\n\t\t\t\r\n\t\t VIC:\r\n\t\t\t\r\n\t\t\t\tListed as Vulnerable\r\n\t\t\t\t (Advisory List of Threatened Vertebrate Fauna in Victoria: 2013 list)\r\n\t\t\t\r\n\t\t\t\r\n\t\t NGO:\r\n\t\t\t\r\n\t\t\t\tListed as Least Concern\r\n\t\t\t\t (The action plan for Australian mammals 2012)\r\n\t\t\t\r\n\t\t\t\r\n\t\t \r\n \r\n \r\n Naming\r\n \r\n \r\n Top\r\n \r\n\r\n\r\nScientific name\r\n \r\n Megaptera novaeangliae [38]\r\n \r\n Family\r\n \r\n Balaenopteridae:Cetacea:Mammalia:Chordata:Animalia\r\n \r\n \r\n Species author\r\n (Borowski, 1781)\r\n \r\n Infraspecies author\r\n \r\n Reference\r\n \r\n \r\n \r\n Distribution Map\r\n \r\n \r\n Top\r\n \r\n\r\n\r\nDistribution map\r\n \r\n \r\n\t\tThe distribution shown is generalised from the Departments Species of National Environmental Significance dataset. This is an indicative distribution map of the present distribution of the species based on best available knowledge. Some species information is withheld in line with sensitive species polices. See map caveat for more information.\r\n\r\n \r\n \r\n \r\n \r\n Illustrations\r\n \r\n \r\n Top\r\n \r\n\r\n\r\n\r\n\r\n\r\nIllustrations\r\n \r\n Google Imageshttp://www.q-net.net.au/~divesss/Humpbackwhalesinthesingingposition.jpg\r\n \r\n \r\n Other Links, Including Superseded Commonwealth Documents\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n Blue Planet Marine (BPM) (2008). Marine Fauna Observation Report for the Maxima 3D Marine Seismic Survey, Revision 2. Project Number 7500063061. Woodside Energy Limited.\r\n \r\n Commonwealth of Australia (2000). Declaration under s178, s181, and s183 of the Environment Protection and Biodiversity Conservation Act 1999 - List of threatened species, List of threatened ecological communities and List of threatening processes. F2005B02653. Canberra: Federal Register of Legislative Instruments. Available from: http://www.comlaw.gov.au/Details/F2005B02653. In effect under the EPBC Act from 16-Jul-2000.\r\n \r\n Commonwealth of Australia (2000b). List of Migratory Species (13/07/2000). F2007B00750. Canberra: Federal Register of Legislative Instruments. Available from: http://www.comlaw.gov.au/Details/F2007B00750.\r\n \r\n Department of the Environment and Heritage (2005e). Australian National Guidelines for Whale and Dolphin Watching. Available from: http://www.environment.gov.au/resource/australian-national-guidelines-whale-and-dolphin-watching-2005.\r\n \r\n Department of the Environment and Heritage (DEH) (2005b). NON-CURRENT Humpback Whale Recovery Plan 2005 - 2010. Department of the Environment and Heritage. Canberra, Commonwealth of Australia. Available from:

http://www.environment.gov.au/biodiversity/threatened/publications/recovery/m-novaeangliae/index.html. In effect under the EPBC Act from 18-May-2005. Ceased to be in effect under the EPBC Act from 01-Oct-2015.\r\n \r\n Department of the Environment, Water, Heritage and the Arts (2009t). Threat abatement plan for the impacts of marine debris on vertebrate marine life. Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/marine/publications/threat-abatement-plan-impacts-marine-debris-vertebrate-marine-life. In effect under the EPBC Act from 01-Jul-2009. Ceased to be in effect under the EPBC Act from 21-Jul-2018.\r\n \r\n \r\n\r\n\r\n\t\r\n\r\n\r\n \r\n Newsletters\r\n \r\n \r\n Top\r\n \r\n\r\n\r\n\r\n\r\n\r\nEPBC Act email updates can be received via the Communities for Communities newsletter and the EPBC Act newsletter.\r\n\r\n\r\n\r\n\r\n \r\n Caveat\r\n \r\n \r\n Top\r\n \r\n\r\n\r\n\r\n\r\nThis database is designed to provide statutory, biological and ecological\r\ninformation on species and ecological communities, migratory species, marine\r\nspecies, and species and species products subject to international trade and\r\ncommercial use protected under the Environment Protection and Biodiversity\r\nConservation Act 1999 (the EPBC\r\nAct). It has been compiled from a range of sources including\r\nlisting advice, recovery plans, published literature and individual experts.\r\nWhile reasonable efforts have been made to ensure the accuracy of the\r\ninformation, no guarantee is given, nor responsibility taken, by the\r\nCommonwealth for its accuracy, currency or completeness. The Commonwealth\r\ndoes not accept any responsibility for any loss or damage that may be\r\noccasioned directly or indirectly through the use of, or reliance on, the\r\ninformation contained in this database. The information contained in this\r\ndatabase does not necessarily represent the views of the Commonwealth. This\r\ndatabase is not intended to be a complete source of information on the\r\nmatters it deals with. Individuals and organisations should consider all the\r\navailable information, including that available from other sources, in\r\ndeciding whether there is a need to make a referral or apply for a permit or\r\nexemption under the EPBC\r\nAct.\r\n\r\n\r\n\r\nCitation: Department of the Environment\r\n(2022).\r\nMegaptera novaeangliae in Species Profile and Threats Database,\r\nDepartment of the Environment,\r\nCanberra.\r\nAvailable from:\r\nhttps://www.environment.gov.au/sprat.\r\nAccessed Tue, 18 Jan 2022 21:18:49 +1100.\r\n\r\n\r\n\r\n\r\n\r\nWhere available the sections below provide a biological profile for the species. Biological profiles vary in age and content across species, some are no longer being updated and are retained as archival content. These profiles are still displayed as they contain valuable information for many species. The Profile Update section below indicates when the biological profile was last updated for some species. For information to assist regulatory considerations, please refer to Conservation Advice, the Recovery Plan, Policy Statements and Guidelines.\r\n\r\n\r\n\r\n \r\n \r\n \r\n Description\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n The humpback whale is a moderately large baleen whale. The maximum recorded length is 17.4 m, and females are generally 1.0–1.5 m longer than males (Chittleborough 1965). Southern Hemisphere humpback whales generally have a greater degree of white colouration on their ventral surface compared to darker Northern Hemisphere whales but there is no genetic evidence to support the need for subspecies status (Baker et al. 1990). The humpback whale has distinctive markings on the ventral side and trailing edge of their flukes as well as on their dorsal fins and flanks that are used for individual identification (Katona et al. 1979; Kniest et al. 2010). Their dorsal fin is distinctive from other balaenopterid whales as they have a hump on the leading edge of their dorsal fin.\nThe humpback whale produces a variety of sounds throughout their habitat range. These sounds can be used for foraging, when in distress and in non-mating, social circumstances (Clapham 2000). The most studied vocalisations are songs produced by solitary males. The song frequency ranges from less than 20 Hz to 8 kHz (Payne & McVay 1971; Tyack 1981). A whale can sing for a period of minutes to hours and the song can vary over a range of frequencies with more powerful parts of the song audible over several kilometres underwater (Cato 1991). The exact function of male humpback whale song has yet to be determined but it is believed to be an integral part of male behaviour as a form of sexual display (Tyack 1981). Feeding ground song has only recently been recorded from a Southern Ocean Antarctic feeding area, where song transmission has been hypothesised as a form of cultural transmission between the neighbouring South Pacific populations (Garland et al. 2013).\n\r\n \r\n \r\n \r\n \r\n \r\n Australian Distribution\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n Both the east coast and west coast Australian populations make their annual migrations between breeding areas in tropical waters along the east and west coast of Australia (15° S to 20° S) and feeding areas in the Antarctic (south of 56° S) (Chittleborough 1965; Dawbin 1966). The east Australian population is currently believed to rely predominately on a feeding area that is between 130° E and 170° W and the west Australian population on a feeding area that is between 70° E and 130° E (Chittleborough 1965; IWC 2005, 2006).\nFrom these southern latitudes, the east coast population migrate to their breeding grounds at about 17° S to 27° S around the Great Barrier Reef complex (although some of the east coast whales range further to New

Caledonia (Garrigue et al. 2000), and the west coast humpback whales are often sighted as far north as Ashmore Reef (12° S). Camden sound appears to be the northern most limit for the majority of the west coast whales and is considered to be an important breeding area (Jenner et al. 2001).\nThe migratory habitat for the humpback whale around mainland Australia is primarily coastal waters less than 200 m in depth and generally within 20 km of the coast. In addition, whales are known to travel widely through the waters to the south of Australia during migrations to and from Antarctic feeding areas. There is also evidence that during the southern migration, some west Australia whales appear to split off from the coastal migratory route and head offshore from the coast between Exmouth and Shark Bay. Figure 1 below shows the distribution of humpback whales along the coast of the Australian mainland, including areas of known calving, feeding and resting habitat.\n\nFigure 1 Distribution of the humpback whale in waters off the Australian mainland (taken from TSSC 2015).\n\r\n \r\n \r\n \r\n \r\n Global Distribution\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n The distribution of humpback whale populations throughout the world is severely fragmented. Due to temporal influences on their migration patterns, the Northern and Southern Hemisphere populations never meet. Within hemispheres sharing oceanic waters, the strong matrilineal site fidelity of the species means there is limited genetic exchange between populations (Baker et al. 1990; Palsboll et al. 1995). Baker and colleagues (1998) advocate that Australia's west and east coast humpback whale populations are currently considered genetically distinct with long-term gene flow estimated at only a few females per generation, however, analysis of song has shown links between the west and east coast populations (Noad et al. 2000) and has confirmed links between east Australia, New Zealand, New Caledonia and the Pacific Islands populations (Gill & Burton 1995; Helweg et al. 1998).\nGlobally there are four main regions/areas where the humpback whale is found, 1. North Atlantic, 2. North Pacific, 3. Southern Hemisphere and 4. North India (Bettridge et al. 2015). Seven humpback whale breeding subpopulations, labeled A to G, are recognised in the Southern Hemisphere by the International Whaling Commission (Schmitt et al. 2014). Two subpopulations of humpback whales occur within Australian waters:\n(1) The Western Australian D subpopulation (west coast population)\n(2) The Eastern Australian E1 subpopulation (east coast population)\nIndividuals of another subpopulation of the E group (E2) pass through Australian waters adjacent to Norfolk Island on their way to breeding grounds around New Caledonia. Due to the transitory nature of their presence in Australian waters further information is not provided on this subpopulation.\nIn 2010, the National Marine Fisheries Service convened the humpback whale Biological Review Team which identifies 15 distinct humpback whale population segments globally (named after their primary breeding locations) (Bettridge et al. 2015):\nWest Indies\r\nCape Verde Islands/North-west Africa\r\nHawaii\r\nCentral America\r\nMexico\r\nOkinawa/Philippines\r\nSecond West Pacific (exact location unknown)\r\nWest Australia (west coast population)\r\nEast Australia (east coast population)\r\nOceania (these animals pass through Australian waters adjacent to Norfolk Island)\r\nSouth-eastern Pacific\r\nBrazil\r\nGabon/South-west Africa\r\nSouth-east Africa/Madagascar\r\nArabian Sea\r\n\r\n \r\n \r\n \r\n Surveys Conducted\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n Humpback whale monitoring along both the east and west coasts has been conducted for many years (Bannister & Hedley 2001; Bryden et al. 1990; Chaloupka & Osmond 1999; Dawbin 1997; Hedley et al. 2011; Jenner et al. 2001; Jenner & Jenner 1994; Noad & Cato 2001; Noad et al. 2011b; Paterson & Paterson 1989; Paterson et al. 2001, 2004; Salgado Kent et al. 2012). There are a number of survey methods used to assess the humpback whale within Australian waters:\nVessel Based\nNumerous sighting surveys have been conducted in Australian Antarctic waters under the Southern Ocean Cetacean Ecosystem Program (SOCEP) (Thiele et al. 2000).\nSatellite tagging\nSatellite tracking has allowed scientists to better understand humpback whale migratory movements along both the east and west coasts of Australia (Double et al. 2010; Gales et al. 2010).\nA total of 23 satellite tags were deployed on south-bound whales in the Kimberly region of Western Australia aimed at describing the migratory distribution and behaviour of nursing females (Double et al. 2010).\nHumpback whale tagging off Evans Head off the east coast provided one of the first detailed movements of individuals within the Great Barrier Reef and gave rise to further research regarding humpback whale breeding and calving habitat (Gales et al. 2010; Smith et al. 2012).\nAerial Surveys\nHumpback whale tagging off the Kimberly Coast, Western Australia, together with aerial and vessel based surveys, have helped understand whale movements within the north west and can be used to assess the impacts of future development within the area (Gales et al. 2010; Double et al. 2012).\nA series of aerial line transects conducted in 1999, 2005 and 2008 were conducted off Western Australia in order to make population estimates of the species migrating along the west coast during their northward migration (Hedley et al. 2011b).\nThe humpback whale was sighted (n=18) most often between May–September during aerial surveys conducted between 2002–2013 in South Australia (Gill et al. 2015). Humpback whale feeding was also observed during aerial observations (Gill et al. 2015).\nPhoto Identification\nPhoto identification surveys

have been conducted along the east coast to help identify individuals during their migration and assist with population abundance estimations (Paton et al. 2011; Burns et al. 2014).\nPhoto identification has found that individual whales spend approximately two months in the northern quarter of the austral winter months during their northern migration (Burns et al. 2014).\n\r\n \r\n \r\n \r\n \r\n Population Information\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n Both the west coast and east coast Australian populations are reported to be recovering after near population collapse caused by whaling in the 1950s and 1960s. The rate of population increase for these two populations is thought to be the highest in the world at a rate of between 10.9–11% per year for the east coast population (Noad et al. 2011a, 2011b; Paton & Kniest 2011) and from between 9.7–13% for the west coast population (Hedley et al. 2009, 2011a; Salgado Kent et al. 2012). The maximum plausible rate of population increase is considered to be approximately 11.8% (Baker et al. 1986), which indicates that both populations are increasing at, or above, maximum rates.\nRecent population estimates for both populations demonstrate that the western Australian population is larger than the eastern Australian population with current absolute abundance estimates for 2008 between approximately 26 100 (95% CI 20 152–33 272) (Salgado Kent et al. 2012) and 28 830 (95% CI 23 710–40 100) (Hedley et al. 2011). For the east Australian population, absolute abundance estimates in 2010 were approximately 14 522 whales (95% CI 12 777–16 504) (Noad et al. 2011b).\n\r\n \r\n \r\n \r\n \r\n Habitat\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n Migration and Resting\nWest Coast Population\nThe migration pathway for the western Australian population is generally within 200 km from shore (Double et al. 2010). Important resting areas have been identified during the southern migration and include:\nAugusta;\r\nGeographe Bay;\r\nShark Bay, Exmouth Gulf; and\r\nthe southern Kimberley region.\r\nThere are additional areas of potential importance as resting areas around Houtman Abrolhos, Montebello and Barrow islands, although this is still to be determined conclusively (Jenner et al. 2001).\nDuring the northern migration, the whales tend to remain further off-shore (Jenner at al. 2001). Data collected from satellite tagged whales found that median distances from shore were less than 25 km and thus in shallow water (<40 m water depth). In the region around Camden Sound however, the median distance from shore was 50 km (<300 m water depth) with the maximum distance recorded over 200 km. Areas such as Shark Bay may also provide resting areas during the northern migration (Jenner at al. 2001).\nEast Coast Population\nThe eastern Australian humpback whales also migrate in close proximity to the coast of Australia on their way to and from their winter breeding areas (Cato 1991; Paterson et al. 1994; Noad & Cato 2001; Noad 2002). As with the western Australian population, the eastern Australian population also tend to migrate further offshore during their northward migration (Paterson et al. 1994; Noad & Cato 2001). Three major aggregation areas have been previously identified for the eastern Australian population in Queensland around the southern end of the Great Barrier Reef, Hervey Bay and in the Gold Coast region (DEH 2005b). The southern end of the Great Barrier Reef is a suspected calving area (Chaloupka et al. 1999; Smith et al. 2012) while Hervey Bay is considered to be an important resting area (Chaloupka et al. 1999; Paterson et al. 2001; Franklin et al. 2010). On the southward migration, as many as 30% of the eastern Australian population may use Hervey Bay as a resting area (Paterson et al. 2001; Franklin et al. 2010).\nBreeding\nWest Coast Population\nMajor breeding areas have been identified for the western Australian population in the Kimberley region and particularly between Lacepede Islands (16.8° S) and Camden Sound (15.38° S) (Jenner et al. 2001). Camden sound appears to be the northern most limit for the majority of west coast whales and is considered to be an important breeding area (Jenner et al. 2001). Double and colleagues (2010) found that satellite tagged whales in the area of Camden sound tended to move in an inconsistent direction, which suggests this area is used for breeding.\nEast Coast Population\nThe breeding area for the eastern population of the humpback whale is presumed to be off the coast between central and northern Queensland (Chittleborough 1965; Dawbin 1966; Smith et al. 2012). Although the exact location is still unknown, recent research using a predictive habitat model developed from incidental sightings data, has isolated two core areas for humpback whale distribution in the southern Great Barrier Reef region: east of Mackay; and further south in the Capricorn and Bunker island groups off Gladstone (Smith et al. 2012). The model identified key habitat parameters of a water depth of 30 to 58 m and sea surface temperatures of 21 to 23 °C. Data collected from satellite tagged whales supported these areas as key areas for the humpback whale in the region. The area east of Mackay (19.5° S to 21.5° S) is thought to be an important breeding area whereas the area further south in the Capricorn and Bunker island groups may be used as an important migratory area (Smith et al. 2012). Although further research is required to conclusively identify critical breeding habitats for the humpback whale, the research by Smith and colleagues (2012) has identified key areas on which to focus future surveys.\nFeeding\nAntarctica\nHumpback whale feeding primarily occurs in summer in Antarctic waters south of about 55° S with krill (in particular Euphausia superba) forming the major part of their diet

(Chittleborough 1965). In general, most feeding occurs between 70° E and 130° E for the west coast population, and 130° E and 170° W for the east coast population (Bannister & Hedley 2001; Paterson et al. 2001). The Balleny Islands in Antarctica has been identified as an important and productive feeding ground for the east coast humpback whales (Constantine et al. 2014).\nFeeding appears to be related to euphausiid density rather than particular bathymetric features (Murase et al. 2002). Euphausiid density is higher where topographic and physical features interact to entrap or entrain swarms. Where these features occur near an ice edge environment, euphausiid densities are likely to be even higher (Thiele et al. 2004). Feeding appears to be connected to the position of the southern boundary of the Antarctic Circumpolar Current relative to other major physical and biological events (i.e. seasonal ice extent) (Thiele et al. 2000). Research has shown the peak feeding season is mid-January to February with dispersal as the season progresses (Kasamatsu et al. 1996). However, there is a great deal of temporal variability in the maximum seasonal abundance of the humpback whale in feeding grounds which is directly related to circumpolar, regional and local scale processes (Sirovic et al. 2004; Thiele et al. 2004).\nAustralian Coastal Waters\nSome feeding has been observed in Australia's coastal waters but this is thought to primarily be opportunistic and forms only a small portion of their nutritional requirements (Thiele et al. 2004).\nFeeding has been observed close to shore off Eden, NSW, from late September until late November. Feeding behaviour has also been reported off Fraser Island, Queensland (Vang 2002). Feeding may also occur in northern waters of the Great Barrier Reef, as well as Victoria, as sightings of humpback whales have been reported in these areas in summer months (Chaloupka & Osmond 1999; Warnecke 1995).\nFaecal matter (indicating whales had been feeding) has been collected off Cape Byron in NSW and at Hervey Bay in Queensland (Paton 2006, pers. comm.). The humpback whale has been observed feeding on zooplankton, including neritic euphausiids (Nyctiphanes australis) off Tasmania's east coast (December 1995), in the Derwent River near Hobart (October 1996) and near Cape Bougainville (November 1996) (Gill et al. 1998).\nFeeding behaviour has been observed off Augusta, Western Australia during the northward migration. Chittleborough (1965) reported evidence of recent feeding in gut samples from a small portion of the harvested whales off Point Cloates, Western Australia (22.5° S).\n\r\n \r\n \r\n \r\n \r\n Life Cycle\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n Sexual maturity is reached at four to eight years (average five years). Life expectancy is recorded as at least 48 years but is likely to be significantly longer as shown in other balaenopterids. Rates of natural mortality are unknown but humpback whale calves are particularly vulnerable to predation by the killer whale (Orcinus orca) and may individuals may also die from natural parasitic or disease events (Corkeron & Connor 1999; Naessig & Lanyon 2004).\nFor the humpback whale, breeding peaks in the winter and the gestation period is 11 to 12 months. Lactation extends over 10 to 12 months although calves have been seen independently feeding at six months of age (Clapham 2000). The mean calving interval is 2.4 years (Barlow & Clapham 1997) although it ranges from one year to more than five years.\nThere is a temporal separation of individuals on their migration route related to sex and reproductive status (Brown et al. 1995; Chittleborough 1965; Dawbin 1966, 1997; Vang 2002). On the northern migration, lactating females accompanied by weaning yearlings are first to migrate, followed by immature males and females, followed by mature males together with resting females and then pregnant females. On the southern migration, mixed females (including those in early pregnancy) and immature males and females are first to migrate, followed by mature males and then females with calves in early lactation (Paton 2006, pers. comm.).\n\r\n \r\n \r\n \r\n \r\n Movement Patterns\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n The humpback whale migrates annually between their summer feeding grounds in Antarctica to their tropical breeding grounds in winter. In Australia, there are two migratory populations of the species, a west coast population and an east coast population (known as Group D and Group E respectively in international fora). Photo identification and genetic techniques has identified interchange between Oceania (South Pacific Ocean) wintering grounds and the east coast of Australia, showing variability in the use of migratory corridors (Garrigue et al. 2011; Steel et al. 2014).\nDuring migration, individuals travel alone or in temporary aggregations of generally non-related individuals (cow-calf pairs being the exception) (Valsececchi et al. 2002). The whales aggregate on the breeding grounds, where males compete for access to females in oestrous and females give birth.\nThe exact timing of the migration period can vary from year-to-year depending on water temperature, sea ice, predation risk, prey abundance and the location of the feeding ground (DEWR 2007). In general, the species is sighted in southern Australian waters in May and migrates slowly up the east and west coasts. By October the majority of whales have started their southward migration and sightings are rare after November. In South Australia, there have been sightings from every month, with the possibility that these are whales from both the east and west coast populations (Kemper 2006, pers. comm.). In Victoria, there are reports of the humpback whale in all months except February (Warneke 1995). The species has been sighted in the northern waters of the Great Barrier Reef between

October and January (Simmons & Marsh 1986; Chaloupka & Osmond 1999).\nThey range from their feeding grounds at about 55° S with most feeding occurring between 70° E and 130° E for the west coast population, and 130° E and 170° W for the east coast population (Bannister & Hedley 2001; Paterson et al. 2001). From these southern latitudes, they migrate to their breeding grounds at about 17° S to 27° S around the Great Barrier Reef complex (although some of the east coast whales range further to New Caledonia (Garrigue et al. 2000)), and the west coast whales are often sighted as far north as Ashmore Reef (12° S) on the west coast.\n\r\n \r\n \r\n \r\n \r\n Survey Guidelines\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n The dorsal fin of the humpback whale is distinctive from other balaenopterid whales as they are the only species that has a 'hump' on the leading edge of their dorsal fin. The species has distinctive markings on the ventral side and trailing edge of their flukes as well as on their dorsal fins and flanks that are used for individual identification. They frequently raise their flukes above the surface of the water allowing photographs to be taken of the underside for identification purposes. The humpback whale frequently engage in aerial displays including breaches, pectoral slaps, spy-hopping and tail-slapping the surface of the water (DEWR 2007).\nWhale surveys need to be designed to take into account several important factors including season, weather (e.g. sea state and light conditions), area to be covered (large or small), aim of surveys (abundance estimation or ecological studies), the activities of the whales themselves (e.g. travelling, resting, surface or deep feeding), funding availability and the type of survey platform used. Therefore, surveys need to be designed with specific questions in mind on a case-by-case basis (Thiele 2004, pers. comm.).\nCommon survey methods used for counting humpback whales within Australian waters have been both land-based (theodolite/surveyors tool) and aerial based (aerial surveys) (Hedley et al. 2011; Noad et al. 2011b; Salgado Kent et al. 2012).\n\r\n \r\n \r\n \r\n \r\n Threats\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n The Conservation Advice for the humpback whale (TSSC 2015) identifies the following threats for this species:\nA. Whaling\nThe impacts from commercial whaling on the Australian humpback whale populations have been well documented with commercial whaling targeting humpback whales ceasing in 1963. Illegal unreported and unregulated hunting may have continued through to the early 1970s. There is currently a suspension of commercial whaling under the IWC although, as populations recover, there may be increased pressure to resume whaling.\nWhaling for the purposes of scientific research is currently allowed under Article VIII of the International Convention for the Regulation of Whaling. That provision allows member states to issue special permits to kill, take and treat whales for purposes of scientific research. Since 1986 special permits have been issued for minke (Balaenoptera acutorostrata), fin (B. physalus), sei (B. borealis), sperm (Physeter macrocephalus), Bryde's (B. edeni) and humpback whale species as part of scientific whaling research programs undertaken by IWC members, including Iceland, Japan, Norway and the Republic of Korea. To date, the humpback whale has not been caught under Special Permit whaling.\nB. Climate and Oceanographic Variability and Change\nPotential impacts of climate change include increasing sea surface temperatures, decreasing sea ice cover, rising sea levels, changes to ocean circulations, ocean acidification and changes in salinity (Learmonth et al. 2006). Climate change may lead to changes in species abundance, migration timing and range, species distribution, changes to prey/predator relationships, prey availability and reproductive timing and success, which could impact on the health and survival of species (IWC 2006).\nOcean acidification is of concern for marine species with the increased levels of atmospheric carbon dioxide leading to increased absorption of carbon dioxide into the ocean and a subsequent decrease in the pH of sea water (Levitus et al. 2000). Research has shown that ocean acidification can be detrimental to Antarctic krill (Euphausia superba) reproduction (Kawaguchi et al. 2011).\nC. Overharvesting of Prey\nDepletion of Antarctic krill through over-harvesting may be a potential future threat. The abundance of krill is affected by many key factors including: fisheries, predator-prey nutrient cycling, and climate change. Antarctic krill is the primary Southern Hemisphere species of krill harvested by the krill fishery. The Commission established under the Convention of the Conservation of Antarctic Marine Living Resources manages the krill fishery catch limits using a precautionary, ecosystem-level sustainable approach that aims to prevent or minimise negative impacts of the krill fishery on natural krill predators.\nD. Noise Interference\nThe impacts of anthropogenic noise sources on marine mammals is an area of increasing concern. Anthropogenic noise sources identified as potential problems include seismic exploration, industrial noise (pile driving, some forms of dredging, use of explosives, blasting and drilling), shipping noise, and sonar systems. The potential impacts of increasing anthropogenic ocean noise can include hearing impairment, organ damage or mortality, masking of vocalisations, change in call frequency or amplitude and behavioural disturbance (Nowacek et al. 2007; Southall et al. 2007). Underwater noise can act as a stressor to marine mammals, which may impact on individual health, and population viability (Wright et al. 2007). The extent to which behaviour is impacted may depend on a number of factors such as distance from the

source, prior exposure (habituation), behavioural state, health, gender and age (Nowacek et al. 2007).\nAustralian humpback whale populations are facing a projected increase in coastal development and shipping traffic (Bureau of Resources and Energy Economics 2012; Clifton et al. 2007); particularly due to increasing oil and gas exploration and new port developments. These activities will undoubtedly increase the levels of noise in the marine environment and may have adverse effects on the seasonal use, displacement from these areas, or the alteration of behaviour by humpback whales.\nE. Habitat Degradation including Coastal Development and Port Expansion\nHabitat degradation and modification in areas of importance to the humpback whale may result in reduced occupancy, compromised reproductive success and even mortality. If there are enough habitats impacted there may be wider reaching implications for the health and growth of populations. This would be more likely to arise where activities that cause habitat degradation occurred cumulatively or intensively. At this time, both of the humpback whale populations using Australian waters are increasing at, or close to, the maximum biological rate (Salgado et al. 2012; Hedley et al. 2011a; Noad et al. 2011b). This suggests that to date habitat degradation has not had a negative impact on population or species recovery. Nevertheless, as the population grows and competition for habitat increases this may become a greater issue, and ongoing monitoring and management are required.\nF. Entanglement\nAn entanglement occurs when a whale is caught in fishing equipment, shark nets, or marine debris and is unable to free itself. Entanglements can cause serious injury and distress to whales, and in some cases lead to the death of the animal. The increased reports of entanglements in Australian waters coincide with an increase in humpback whale populations. Currently eastern and western Australian populations are increasing strongly and therefore the impacts from these factors may be minor in terms of overall species recovery. Nonetheless, as humpback whale populations and coastal development increases, and fisheries activities continue around Australia, there will be an increased chance for negative impacts on individuals.\nCommercial Fisheries or Aquaculture Equipment\nMany of the commercial fisheries (pot / trap) and aquaculture farming sites around Australia are a potential threat to large whales as the nets, cages and lines used for fishing provide opportunities for entanglements. There have been an increased number of entanglements reported in rock lobster pot lines, and the Commonwealth, state agencies and industry are working to reduce whale entanglements through changes to fishing gear and practices.\nShark Safety Equipment\nA number of state jurisdictions use shark safety equipment at popular swimming beaches to reduce the number of large sharks present in the area. This equipment can consist of both drumlines and/or nets depending on local tidal and marine conditions. There have been a number of whales, including humpback whales, entangled in shark nets over the past few years.\nMarine Debris\nMarine debris is of human origin and includes plastic garbage such as bags, bottles, ropes etc., derelict fishing gear and non-biodegradable floating materials lost or disposed of at sea. The interaction between marine species and marine debris is listed as a key threatening process under the EPBC Act. Marine debris has the potential to cause negative impacts through entanglement or ingestion. There have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998. The vast majority (92.2%) of cetacean incidents relate to entanglement (Ceccarelli 2009), and the humpback whale dominated the available records, with around 48 entanglement incidents recorded.\nG. Vessel Disturbance and Strike\nCollisions with vessels are one of the main (known) causes of mortality to baleen whales (Vanderlaan & Taggart 2007). There has been a significant increase in the number of commercial, industrial and recreational vessels in coastal waters. Thus, the threat of ship strikes to whales may also increase. Laist and colleagues (2001) showed that high speed vessels, travelling faster than 14 knots, were involved in 15% of the 40 accounts of ship strikes reported worldwide. The humpback whale is one of the most frequently reported whale species involved in vessel strikes worldwide (Laist et al. 2001; Jensen & Silber 2003). The increase in vessel numbers (Silber & Bettridge 2012) is not only a threat to the species in relation to causing injury or death but also in terms of disturbance and displacement from key habitats.\nWhale watching in general is beneficial for the conservation of species through education and observation of animals in their natural habitat, however, there is increasing concern about the number of whale watch operators and recreational vessels interacting with whales within certain times and areas, and the potential for cumulative impacts on individuals as the whales migrate. In addition the emergence of swim-with operations may result in greater disturbance to this species.\n\r\n \r\n \r\n \r\n \r\n Threat Abatement and Recovery\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n The conservation advice prepared for the humpback whale (TSSC 2015) identifies the following actions to address threats and facilitate recovery:\nmaintain and improve existing legal and management protection\r\nunderstand impacts of climate variability and change\r\nassess and address anthropogenic noise; shipping, industrial and seismic surveys\r\naddress infrastructure and coastal development impacts\r\nreduce commercial fishing entanglements\r\nminimise vessel collisions.\r\n\r\n \r\n \r\n \r\n Marine Bioregional Plans\r\n

\r\n \r\n Top\r\n \r\n \r\n \r\n Marine bioregional plans have been developed for four of Australia's marine regions - South-west, North-west, North and Temperate East. Marine Bioregional Plans will help improve the way decisions are made under the EPBC Act, particularly in relation to the protection of marine biodiversity and the sustainable use of our oceans and their resources by our marine-based industries. Marine Bioregional Plans improve our understanding of Australia's oceans by presenting a consolidated picture of the biophysical characteristics and diversity of marine life. They describe the marine environment and conservation values of each marine region, set out broad biodiversity objectives, identify regional priorities and outline strategies and actions to address these priorities. Click here for more information about marine bioregional plans.\nThe humpback whale has been identified as a conservation value in the South-west (DSEWPaC 2012z), North-west (DSEWPaC 2012y) and Temperate East (DSEWPaC 2012aa) marine regions. See Schedule 2 of the South-west Marine Bioregional Plan (DSEWPaC 2012z), the North-west Marine Bioregional Plan (DSEWPaC 2012y) and the Temperate East Marine Bioregional Plan (DSEWPaC 2012aa) for regional advice. Maps of Biologically Important Areas have been developed for humpback whale in the South-west (DSEWPaC 2012z), North-west (DSEWPaC 2012y) and Temperate East (DSEWPaC 2012aa) marine regions and may provide additional relevant information. Go to the conservation values atlas to view the locations of these Biologically Important Areas. The \"species group report card - cetaceans\" for the South-west (DSEWPaC 2012z), North-west (DSEWPaC 2012y) and Temperate East (DSEWPaC 2012aa) marine regions provide additional information.\nMarine bioregional plans have not been developed for the Great Barrier Reef Marine Park, the Coral Sea Commonwealth Marine Reserve, the South East marine bioregion or the Torres Strait. Preliminary work has been undertaken to identify conservation values, Key Ecological Features and Biologically Important Areas in these areas, but these data are currently not complete.\n\r\n \r\n \r\n \r\n \r\n Management Documentation\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n Management documents relevant to the humback whale are at the start of the profile.\n\r\n \r\n \r\n\r\n\r\n\r\n \r\n \r\n Species Profile References\r\n \r\n \r\n Top\r\n \r\n \r\n \r\n \r\n Baker, C.S., L. Florez-Gonzalez, B. Abernethy, H.C. Rosenbaum, R.W. Slade, J. Capella & J.L. Bannister (1998). 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