Southern right whale
(Eubalaena australis)

PHOTO CREDIT: Michaël Catanzariti

5-Year Review:
Summary and Evaluation

National Marine Fisheries Service
Office of Protected Resources
Silver Spring, MD

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TABLE OF CONTENTS

LIST OF FIGURES

5-YEAR REVIEW
Southern right whale (*Eubalaena australis*)

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional or Headquarters Office:
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1.2 Methodology used to complete the review:

A 5-year review is a periodic analysis of a species' status conducted to ensure that the listing classification of a species as threatened or endangered on the List of Endangered and Threatened Wildlife and Plants (List) (50 CFR 17.11 – 17.12) is accurate. The 5-year review is required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (ESA). To achieve this, the National Marine Fisheries Service (NMFS) Office of Protected Resources led the 5-year review with input from NMFS regional offices and science centers. We relied on the last 5 year review (NMFS 2007), peer-reviewed publications, government and technical reports, conference papers, dissertations, and theses. Information was gathered *through April 2015*. The information on the southern right whale biology and habitat, threats, and conservation efforts were summarized and analyzed in light of the ESA section 4(a)(1) factors (see Section 2.3.2.1) to determine whether a reclassification or delisting may be warranted (see Section 3.0).

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

September 8, 2014 (79 FR 53171)

1.3.2 Listing history

Original Listing
FR notice: 35 FR 18319
Date listed: 12/02/1970
Entity listed: *Eubalaena spp.*
Classification: Endangered

In 1970, the U.S. Fish and Wildlife Service listed all members of the genus *Eubalaena* on the List of Endangered Foreign Fish and Wildlife under the Endangered Species and Conservation Act (ESCA) of 1969. In 1974, following the passage of the ESA, all members of the genus *Eubalaena* were transferred to the List of Endangered and Threatened Wildlife under the ESA.

1.3.3 Associated rulemakings:
None

1.3.4 Review history:

S.L. Perry, D.P. DeMaster, and G.K. Silber. 1999. The Great Whales: History and Status of Six Species Listed as Endangered Under the U.S. Endangered Species Act of 1973. Marine Fisheries Review 61:1, pp.44-51. Department of Commerce.

Conclusion: No change in classification indicated.

NMFS. 2007. Southern right whale (*Eubalaena australis*) 5-year review: summary and evaluation. Office of Protected Resources Silver Spring, MD. 43 pages.

Conclusion: No change in classification indicated.

1.3.5 Species' recovery priority number at start of 5-year review:

No recovery priority number has been issued for the southern right whale.

1.3.6 Recovery plan or outline

No recovery plan has been completed for the southern right whale. Section 4(f) of the ESA requires NOAA Fisheries to develop and implement recovery plans for the conservation and survival of all endangered or threatened species, unless such a plan will not promote the conservation of the species. In general, listed species which occur entirely outside U.S. jurisdiction – such as the southern right whale– are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

__X__ **Yes**
_____ **No**

2.1.2 Is the species under review listed as a DPS?

____ **Yes**
__X_ **No**

2.1.3 Is there relevant new information for this species regarding the application of the DPS policy?

__X_ **Yes**
____ **No**

To be considered for listing under the ESA, a group of organisms must constitute a "species," which is defined in section 3 of the ESA to include “any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate fish or wildlife which interbreeds when mature.” NMFS and USFWS jointly published a policy regarding the recognition of DPSs of vertebrate species under the Endangered Species Act (DPS Policy, 61 FR 4722; February 7, 1996).

“DPS” is not a scientifically defined term; it is a term of art that is used in the context of ESA law and policy. Furthermore, when passing the provisions of the ESA that give us authority to list DPSs, Congress indicated that this provision should be used sparingly. We have discretion with regard to listing DPSs and, in order to be consistent with the directive of the Congressional report that followed the introduction of the DPS language in the ESA to identify DPSs sparingly, we will generally not, on our own accord, evaluate listings below the taxonomic species or subspecies level if the best available information indicates that the species or subspecies is in danger of extinction throughout all or a significant portion of its range. We should only identify DPSs if there is an overriding conservation benefit to the species.

The 2007 5-year review reported that sufficient new scientific information had been published indicating that DPSs for the southern right whale may be warranted (NMFS 2007). Information suggested that four DPSs may be warranted: western South Atlantic, eastern South Atlantic, Australia, and New Zealand. The 2007 finding was based largely on Patenaude et al. (2007), which found two maternal clades that differ in frequency between oceans with significant mitochondrial deoxyribonucleic acid (mtDNA) differentiation between the four calving grounds (Argentina, South Africa, Western Australia and New Zealand) and two summer feeding grounds (South Georgia and south of Western Australia). However since the 2007 5-year review, information indicates southern right whales from different ocean basins may be mixing on feeding grounds in the Antarctic (Kanda et al. 2014). No genetic differentiation was found between Argentina and both feeding grounds (South Georgia and southwestern Australia), which may reflect a recent increase in gene flow between populations across ocean basins (Valenzuela et al. 2010a). Further, new information based on nuclear DNA and photo identification indicate breeding between Australia and New Zealand (IWC 2012b; Pirzl et al 2009). See Section 2.3.1.3 for further details.

Although overall limited gene flow between populations in the oceans and in most of the calving grounds occurs through maternal site fidelity (Burnell 2001; Patenaude et al. 2007), consideration of mtDNA haplotype frequencies is only one line of evidence in determining whether a population is discrete. Other lines of evidence, which may indicate reproductive isolation, include nuclear DNA differentiation, physical or behavioral characteristics, habitat use, and migratory patterns. Even if southern right whale populations were found to fit the DPS criteria, for purposes of this 5-year review, we conclude it is unlikely that designation of DPSs would result in an overriding conservation benefit, because the species occurs only outside of U.S. jurisdiction, and the benefits from the global ESA listing would not change with a DPS listing.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

____ Yes
__X_ No

Section 4(f) of the ESA requires NOAA Fisheries to develop and implement recovery plans for the conservation and survival of endangered or threatened species, unless such a plan will not promote the conservation of the species. In general, listed species which occur entirely outside U.S. jurisdiction – such as the southern right whale – are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Survival
Since the 2007 5-year review, demographic data have been published based on long-term aerial surveys conducted from 1971 to 2006 off South Africa. First year survival rate was estimated as 0.713 (CI: 0.529, 0.896), and adult female survival rate was estimated to be 0.990 (CI: 0.985, 0.996)(Brandão et al. 2010c). In Argentina, calf mortality has been high and increasing. From 2003 through 2011, the number of dead calves increased at a much greater rate than that of living calves over the preceding 32 years (Rowntree et al. 2013). During 1971−2002, the number of dead calves increased at average rates between $r = 0.061$ and $r = 0.067$; close to the estimated growth rate of 6.8% annually (Cooke et al. 2003), but from 2003−2011, the number of dead calves appeared to increase at an average rate $(r = 0.122)$, much greater than the growth rate (Rowntree et al. 2013). See Section 2.3.1.2 for further details.

Sex ratios
Sex ratios of individuals (all ages pooled) from winter calving grounds (Argentina, South Africa, Western Australia and New Zealand) and summer feeding grounds (South Georgia and Western Australia) was 1:1 (Patenaude et al. 2007). Sex ratios of stranded whales in Brazil from 2003 through 2010 also were close to 1:1 (IWC 2012b). Although de Oliveira et al. (2009) found two females to one male in skin biopsies of newborn calves off southern Brazil, the ratio was not significantly different from the expected ratio of 1:1; however, the sample size (n = 21) was relatively small and further study is needed in understanding the population sex ratio.

Reproduction
Where and when conception occurs for southern right whales is unclear (Payne 1986), although it is likely that conception and birth take place near the same general wintering grounds. Investigations and scientific knowledge of courtship behavior is also lacking due to the difficulties in determining the sex of individual whales. Studies off South Africa by Best et al. (2003) suggest that southern right whales are most socially active during the winter in coastal

waters where they engage in courtship behavior. Right whales were observed in surface-active groups composed of two to seven individuals where the majority of whales were male but the focal animal was female. This behavior may reflect a female breeding strategy in order to maximize her chances of conceiving with a large male (Best et al. 2003).

The average age of first parturition is 9.1 years estimated from whales off Argentina (Cooke et al. 2003), 7.74 years (95% CI: 7.15, 8.33) off South Africa (Brandão et al. 2010c), and 9.1 years off Australia (Burnell 2008). For South Africa, mean calving intervals were 3.12 years (Best et al. 2001a) and appear to have decreased from 3.2 to 3.12 years somewhere between 1985 and 1990; however, the decrease in calving intervals had no effect on population growth rate (Brandão et al. 2010a, 2010b). For Australia, the mean calving interval was calculated to be 3.38 years (95% CI: 3.29 - 3.46 years) with a slight shortening of the interval from 1986 to 2007 (Burnell 2008). For Argentina, mean calf interval was 3.42 years (Cooke et al. 2003). For New Zealand, the mean calving interval from 2006-2011 was estimated at 2.84 years (CI 2.60-3.08) (Davidson et al. 2013).

Gestation takes approximately one year and newborn calves average 5.5 – 6 m in length (Best 1994; Burnell 2001). In the initial months of lactation, calf length-to-width measurements increase and cow body width decreases, indicating that the mothers expend considerable energy reserves for lactation (Miller et al. 2011, 2012). Calves grow in body length at a rate of 2.8 $\pm$ 0.7 cm per day while in calving habitat (Best and Rüther 1992), yet there is no evidence that mothers are feeding during the initial months of lactation. Pregnant mothers likely rely on endogenous reserves during lactation (Miller et al. 2012).

Lastly, research has suggested that the variability in reproductive success for females may be influenced by the relationships between environmental factors such as global climate signals and the ecological conditions of feeding grounds prior to calving (Cooke et al. 2003; Leaper et al. 2006; Miller et al. 2011; Valenzuela et al 2009). However, further research is needed in this area.

Behavior

Behavioral observations have been limited to calving grounds since the locations of feeding grounds are unknown or not frequently visited by researchers. The behavioral development of southern right whale calves and mother-calf relationships has been studied in nursery grounds in Argentina. In general, these studies indicate that calf development and mother-calf relationships occur in five distinct stages over the course of up to 13 months. Stages one through three occur during the first four months, when mothers and their newborn calves remain in the nursery ground. Stage four begins when mother-calf pairs migrate to feeding grounds for the summer. Little is known about their behavior during this time. Finally, in stage five, which begins six months after leaving the nursing ground, some mothers and their nursing calves return to the nursery and remain together for two to six weeks before finally separating (Taber and Thomas 1982; Thomas and Taber 1984).

Wintering populations off the subantarctic Auckland Islands of New Zealand spend the majority of their time resting or engaging in social interactions regardless of their group type (e.g. single whale, group, and mother-calf pair). Over 35% of mother-calf pairs in the area were seen traveling (Patenaude and Baker 2001).

Southern right whale sounds and their role in communication have been fully described by Clark (1983) and are categorized into three general classes (blow, slaps, and calls). Calls are generally low frequency (peak frequencies < 500 Hertz (Hz)) and one common call—'Up'—has been described to function as a way for individuals to find and make contact with each other. These 'Up' calls were of shorter duration in the southern right whale than those of the North Atlantic right whale and longer than those calls in the North Pacific right whale, which is not surprising given they are different species and reproductively isolated (Dunshea and Gedamke 2010). Calls recorded off Uruguay consisted of Up calls (50Hz to 200Hz); High calls (200–500Hz), and Pulsive calls, a complex mixture made up of amplitude modulated noise and tones, 50–200Hz (Tellechea and Norbis 2012). In an attempt to estimate abundance in Walker Bay, South Africa, using passive acoustics, Hofmeyr-Juritz and Best (2014) found southern right whales tended to vocalize less as density increased in the Bay. The authors suggested several reasons for the change in vocal behavior, including 'eavesdropping,' which is a behavior where silent whales gather information about other whales, avoid predators or harassment by not advertising their presence, and gain access to or avoid (such as females with calves).

Movement

Studies of the movements, migrations, and destinations of southern right whales indicate seasonal migrations, like those of other baleen whales, cover thousands of kilometers. Long range movements for the southern right whale have been recorded between Gough Island and South Africa, and between Argentina and Tristan da Cunha, Brazil and South Georgia (Best et al. 1993). Migrations range from 210-2,287 km and average 1,036 km (Burnell 2001), but individual whales have been documented traveling as far as 4,424 km to 8,200 km (Bannister et al. 1999; Best et al. 1993; Mate et al. 2011). For example, southern right whales satellite-tagged off South African waters traveled 3,800–8,200 km over 53–110 days before transmissions ceased (Mate et al. 2011). Movements made within a calendar year range from 211-1,490 km over a period of 3-59 days and average 730 km over 34 days (n=18). Minimum average traveling speeds for within-year movements were estimated at 1.1 – 3.66 km/h (Burnell 2001). Southern right whales feeding in the Antarctic were found to have made long-distance migrations from the Indo-Atlantic and Indo-Pacific basins (Kanda et al. 2014).

2.3.1.2 Abundance and population trends:

Worldwide

According to the most recent estimate, the southern Hemisphere abundance of the southern right whale was about 15,000 in 2010 (Bannister 2010; Brandão et al. 2010c; IWC 2012b), which is more than double (7,000 in 1997) the abundance reported in the last 5-year review (NMFS 2007). Some breeding stocks have been increasing at estimated annual rates of about 7% (Bannister 2001; Best et al. 2001a; Cooke et al. 2001; IWC 2012b; Patenaude 2003). However, the current population size represents only a fraction of the historical abundance, which was estimated to be about 60,000 (IWC 2001). Baker and Clapham (2004) estimated that, given the observed growth rates and stability in habitat conditions, the southern right whale would likely take 50 to 100 years to grow to pre-exploitation levels of about 60,000 whales (IWC 2001). However, they noted that this estimate depends on the accuracy of current models and estimated growth parameters. In 2008, the International Union for Conservation of Nature (IUCN)

changed the southern right whale status from "Vulnerable" to "Least Concern" under the IUCN Red List, which means the species did not qualify for a status of Critically Endangered, Endangered, Vulnerable or Near Threatened. The justification of the status downgrade from "Vulnerable" to "Least Concern" was the population of mature females in 1997 (1,600) had almost doubled by 2007 and observed rates of increase were seen in some parts of the species' range (Reilly et al. 2013).

Although the best available science indicates the southern right whale is showing signs of improvement both worldwide and on a regional basis, there is considerable uncertainty surrounding the global estimates for abundance, population trends, and historical size. Current models used by the International Whaling Commission (IWC) to calculate pre-exploitation abundance require historical catch records, estimates of intrinsic rates of growth, and current abundance estimates, all of which involve their own uncertainties. For example, Jackson et al. (2008) estimated minimum population size post-whaling based on mtDNA diversity to improve historical abundance estimates and recovery trajectories. The study found that growth rate and catch magnitude had a substantial influence on time to recovery (i.e., current abundance as a proportion of carrying capacity) for the southern right whale, ranging from eight years (i.e. out to the year 2013) under a high growth-rate scenario, to 36 years (i.e. the year 2043) under a low growth-rate scenario. The recovery trajectory nearly doubles (e.g. the years 2026 or 2079 for the high or low growth rates, respectively) if you consider 95% pre-exploitation abundance as a threshold for full ecological recovery. While significant population increase has been demonstrated off South America, South Africa, Australia, and subantarctic New Zealand and some evidence of range repopulation has been observed in Australia and mainland New Zealand, continued research would improve our understanding of current abundance and recovery trends.

Estimates for worldwide abundance and population trends are based on information for different breeding stocks. The status of southern right whales by known breeding populations is provided below.

South Africa
The 2006 estimated abundance for the South African population is 4,100 and is increasing about 7% each year (Brandão *et al.* 2010c, 2011). Based on cumulative catch estimates from 1785-1805, the 2006 population estimate likely represents about 20% of historical abundance; however, the historical estimate ignored recruitment and may under-estimate the extent of population recovery (Brandão et al. 2010c). The population in Saldanha Bay on the west coast of South Africa appears to be increasing at almost double the total population rate, indicating the increased incidence of southern right whales on the west coast is not only a result of overall population growth, but also reflects local and seasonal movement patterns (Barendse and Best 2014).

Argentina
The second largest population of southern right whales occurs in waters off Argentina, centered primarily in the Península Valdés. The total population size was estimated to be 4,000 in 2010 (IWC 2012b). The population growth rate for Argentina is estimated at 6.9% each year (Belgrano et al. 2011). Abundance estimates for Bahia San Antonio, a bay located in the north-western region of the San Matias Gulf, Argentina, were highest in September, with 85$\pm$71,

207±108, and 117±55 whales in 2009, 2010, and 2011, respectively (Vermeulen 2013). Abundance for August and October was almost half that of September, and whales were absent in November 2010 and August 2011, indicating September is a peak season for occupying the area. Long-term monitoring is needed to determine trends in abundance in the area (Vermeulen 2013). Southern right whales may be repopulating areas along the eastern entrance of the Magellan Strait, including Cabo Vírgenes and Punta Dungeness where historical whaling data show catches in the area (Belgrano et al. 2008a). From 1991-2008, sightings of southern right whales along the northern coast of Río Negro province, Northeast Patagonia, have increased, which may be due to reoccupation of the area post-whaling. However, survey effort was not similar in all survey sites and overall had increased over the time period (Failla et al. 2008); thus, the increase in sightings may reflect effort rather than a population increase.

The population growth reported for Argentina is tempered by the death of a number of individuals well above the annual norm, which began in 2003 (Rowntree et al. 2013; Sironi et al. 2014). From 2003 through 2013, 672 right whale deaths were recorded at Peninsula Valdes. Seventy-two percent (482) of the deaths occurred from 2003−2011, of which 430 were dead calves. Preliminary data from 2012 indicate 116 (97% were calves) whales stranded at Península Valdes during the calving season, which is the largest number recorded to date (previous record was 96 in 2008). Preliminary data from 2013 indicate 67 whales stranded, of which 94% were calves (Sironi et al. 2014). From 1971−2002, the number of dead calves increased at average rates from 6.1-6.7% (Rowntree et al. 2013), which is close to the estimated population growth rate of 6.9% per year (Belgrano et al. 2011). However, from 2003−2011, the number of dead calves appeared to increase at an average rate 12.2%, much greater than the 6.9% growth rate of living calves. In some years (2005 and 2007), the calves died late in the season and were at least a meter longer than newborn calves, indicating they were healthy enough to grow in length. Yet in 2008 and 2009, large (>6m) calves died early in the calving season, suggesting factors such as nutritional stress or some other widespread environmental disturbance may have affected mothers. Analysis of tissue samples showed no consistent lesions, pathologic processes, or elevated biotoxins (albeit trace levels of the algal biotoxins saxitoxin and domoic acid were found in 4 tissue samples) that may explain the mortality events (Rowntree et al. 2013; Thomas et al. 2013). Carbon and nitrogen levels in mother and calf skin samples taken from stranded whales varied annually and may indicate nutritional stress in some years when food is limited prior to the nursing season (Valenzuela et al. 2010b). Mothers in poor physical condition would not be able to meet the high energetic demands of their offspring. In those cases, calves would suffer nutritional stress to make up for their mother's insufficient supply and would have to use proteins as well as lipids to meet their energetic demands, which may increase vulnerability to death (Valenzuela et al. 2010b). Attacks by kelp gulls also may be factor in the elevated calf mortality by decreasing food intake and increasing energy expenditure and stress in calves avoiding or under attack (Thomas et al. 2013; see Section 2.3.2.3 for further details).

Brazil

Right whales have been studied off southern Brazil since 1981 and have been the subject of aircraft surveys and photo-identification studies in this area since 1987. From 1987 to 2003, the number of reproductive females has increased annually by 14%; however, this rate of increase is far above the maximum possible for this species, so other factors, such as migration or expansion from other populations, must be at least partly responsible. While there is substantial interchange of right whales between Brazil and Argentina, resightings of females suggest that

right whales may use the area off southern Brazil as a calving ground (Groch et al. 2005). Groch and Flores (2011) updated the survey information from Brazil and 817 adults and 499 calves were counted from 1987-2010. The total number of all whales, females, and calves increased over the years, corroborating Groch et al. (2005) previous data on population trends. Given the reported annual population increase, Figueiredo et al. (2013), examined sightings records from 1981-2011 of southern right whales off southern Brazil. Their analysis indicates sightings have decreased since the late 1990s despite an increase in monitoring. From 1981-1999, sightings per year were 0.74 off São Paula State and 2.63 off Rio de Janeiro State compared to 2000-2011, when sightings per year were 0.58 and 1.92, respectively (Figueiredo et al. 2013). However, the authors did not pool the data across all years, and it is unknown whether the decrease in sightings per year is significant.

Peru and Chile

Southern right whales are known to occur in coastal waters off southern Chile to central Peru during the austral winter and spring and off southernmost Chile in the fall and summer. From 1975-2010, most right whale sightings off Chile and Peru occurred between July and November with two main aggregation areas, one in northern Chile (22 º S to 26 º S) and the other in central and southern Chile (30ºS to 37ºS); however, these aggregated sightings may be an artifact of proximity to cities where observation effort is greater (IWC 2012). Population abundance estimates for Peru and Chile are not available, and the population may be comprised of only about 50 whales (IWC 2007a, 2007b). In 1964 - 2008, 232 southern right whales including 39 calves were sighted off Chile. The first re-sighting of an individual occurred in October 2011 (previously observed in October 2010) off the northwestern coast of the Isla de Chilóe (approximately 41°55′S), and the southernmost mother-calf pair was reported in the area in 2010 (Vernazzani et al. 2014). Whale population size in waters off Chile appears to be not increasing; however, for the area north of 47°S the population appears to have increased between 1976 and 2008, though not significantly (Aguayo-Lobo et al. 2008).

Since the early 2000s, sightings of southern right whales have increased in coastal waters off Peru, indicating the population may be recovering in the area (Van Waerebeek et al. 2009).

Australia

Population size for southern right whales occurring in Australian waters was estimated at about 3,500 in 2010 (Bannister 2010). Annual population increase from 1993-2010 (excluding 1996-1997 where undercounting likely occurred) was 6.79% (95% CI 3.88-9.78); for mother-calf pairs the annual percent increase was 6.82% (95% CI 2.92-10.86) (Bannister 2010). These growth rate estimates are consistent with the increase in abundance estimates from 1,197 in 2001 (IWC 2001), 2,400 in 2007 (Bannister 2007), to 2,900 in 2010 (Bannister 2010). Pre-whaling abundance estimates for Australia and New Zealand combined was 39,603 (95% CI=33,302-47,297) (Jackson et al. 2009 cited in Leaper and Miller 2011). An aerial survey along the coast between Cape Leeuwin, Western Australia and Ceduna, South Australia in 2010 recorded 519 southern right whales, including 134 mother-calf pairs, which was lower than in 2008 and 2009 when 702 and 782 whales were sighted, respectively (Bannister 2010).

New Zealand

Populations around mainland and subantarctic islands of New Zealand are severely depleted from pre-whaling estimates, which range from 10,000 to 17,000 (Dawbin 1986; Stewart and

Todd 2001; Suisted and Neale 2004). However, the populations appear to show signs of recovery.

Recolonization of waters around mainland New Zealand may be occurring by expansion from the New Zealand subantarctic populations (Carroll et al. 2011b; Carroll et al. 2014a). From 2003 to 2010, 28 mother-calf pairs were sighted around mainland New Zealand compared with 11 sightings from 1991 to 2002 reported by Patenaude (2003).

The New Zealand subantarctic islands lie several hundred kilometers to the south of mainland New Zealand and occur between 47° and 52°S. The area includes the Snares, Bounty, Antipodes, Auckland, and Campbell Island/Motu Ihupuku with most right whales occurring in waters off the latter two islands. Southern right whales were observed regularly (but in low numbers) during winter months around Campbell Island/Motu Ihupuku, but this region has not been surveyed for the last 10 years (Baker et al. 2010). Based on capture-recapture (Patenaude 2002) combined with microsatellite genotyping (Carroll et al. 2011a) analysis of individuals during the years 1995-1998, the population was estimated to be about 900 individuals. For 1995-2009, the population estimate was 2,169 whales (95% CL 1,836, 2,563) and was increasing annually at about 7% (95% CL 5%, 9%) (Carroll et al. 2013).

Other areas

In addition to the areas above, right whales also occur off Tristan da Cunha, South Georgia, Namibia, Mozambique, and Uruguay. Less is known about the whales in these areas relative to other locations as their populations are smaller, sightings are infrequent, and little research has been done.

Wintering populations of southern right whales off Tristan da Cunha Archipelago in the South Atlantic Ocean have been estimated at 226 whales. The Tristan da Cunha is considered a mid-ocean pelagic feeding ground and nursery area for the southern right whale (Best et al. 2009). From 1991 to 2010, southern right whales were the most frequently sighted whales off South Georgia with a peak of reported sightings from 2001 to 2005, which were concentrated around Shag Rocks, at the northwest tip of South Georgia, and along the north/east coastlines of South Georgia (Richardson et al. 2012). Although the populations in these areas are relatively small, the areas may be important to southern right whale recovery.

Confirmed calving in Namibia waters represents the northernmost established breeding population in the southeast Atlantic (Roux et al. 2001). Abundance and trends are unknown for the Namibia population.

Historically known as a winter ground for southern right whales, Mozambique has a population off its coast that was thought to be essentially extirpated due to overharvest. Survey data between 1997 and 2009 indicate a small (~10 individuals) population exists and the frequency of sightings increased over the survey period with a majority of sightings occurring in 2009 (Banks 2013). However, it is unknown whether this represents a remnant population or a repopulation from the surrounding area. Stock identification through genetic analysis is not available and photo-identification matches have not been attempted with other population catalogues.

Sightings of southern right whales have been reported along the coast of Uruguay since the 1970's. There are no abundance estimates for this area but systematic aerial surveys conducted between 2001 and 2009 sighted a total of 489 individuals along the Uruguayan Atlantic coast. Of the total, 95.5% were unaccompanied whales and 4.5% were mother-calf pairs. Also, the majority of whales were involved in surface active groups, suggesting the Uruguayan coast may be a primary social area (Riet-Sapriza et al. 2011). Based on the proportion of mother-calf pairs observed, Uruguay is likely not used as a calving ground (Costa et al. 2003, 2007; Riet-Sapriza et al. 2011).

2.3.1.3 Genetic diversity and population structure:

Patenaude et al. (2007) analyzed the population structure of southern right whales on four major winter calving grounds (Argentina, South Africa, Western Australia and New Zealand) and two summer feeding grounds (South Georgia and south of Western Australia). Results indicated there are two maternal clades that differ in frequency between oceans with significant mtDNA differentiation between the four calving grounds. Additional statistical tests (F_{ST} and χ^2) were not significant for the South Africa and Argentina populations. Kanda et al. (2014) compared haplotypes from southern right whales feeding in the Antarctic to the 37 haplotypes reported in Patenaude et al. (2007) and found similar clades matching both Atlantic and Pacific Ocean basins. These results suggest that some southern right whales undergo much longer-distance migrations between their feeding and breeding grounds than previously thought, and those individuals from the different ocean basins are mixing on feeding grounds in the Antarctic. In addition, no genetic differentiation was found between Argentina and both feeding grounds (South Georgia and southwestern Australia), but the sample size was small and further analyses are needed to draw conclusions. One hypothesis for the lower differentiation detected between Argentina and the Indo-Pacific basin could be a result from a recent increase in gene flow between populations across ocean basins (Valenzuela et al. 2010a). Nonetheless, these results suggest overall limited gene flow between populations in the oceans and in most of the calving grounds, indicating high maternal site fidelity (Patenaude et al. 2007). This fidelity acts as an isolating mechanism forming subpopulations through matrilineal lines (Burnell 2001).

Western South Atlantic
Southern right whales off Península Valdés, Argentina differ in mtDNA haplotype frequencies from whales off South Africa, Australia, and New Zealand, but are similar to whales feeding off South Georgia (IWC 2012b). Although analysis of mtDNA suggests some differentiation between Brazil and Argentina, nuclear differentiation was not found (IWC 2012b). The difference in the maternally inherited mtDNA may be due to female site fidelity to calving and nursing areas (Burnell 2001; Valenzuela et al. 2009). Isotopic and genetic signatures indicate females calving at Península Valdés return and forage on the same summer feeding grounds, and calves learn these locations from their mothers. The timescale of culturally inherited site fidelity to feeding grounds is at least several generations (Valenzuela et al. 2009). Isotope analysis of bone samples obtained from whaling factories operating in the early 1970s in southern Brazil (n = 72) and from recent strandings in central Argentina (n = 53) indicated significant differences in carbon and oxygen stable isotope signatures between the two sampling areas, and were consistent with the baseline isotopes within the two areas. The difference in stable isotope signatures indicate that southern right whales from southern Brazil use different foraging areas than whales from central Argentina (Vighi et al. 2014). The isotopic difference between

sampling areas also might indicate that intermingling of southern right whales between southern Brazil and central Argentina is limited or non-existent. However, the lack of nuclear differentiation (IWC 2012b) between Brazil and Argentina indicate whales from these areas represent one population. Based on the analysis of mtDNA (69 sequences from mtDNA) and 10 microsatellite loci, collected from specimens of two breeding areas: Southern Brazilian coast (n=48) and Península Valdés, Argentina (n=21) southern right whales in the southwestern Atlantic likely experienced a significant decline in abundance and loss of genetic diversity during the Pleistocene Epoch around 17,000 years ago (de Oliveira et al. 2011).

Eastern South Atlantic

The IWC (2012b) recommended that Namibia and South Africa should be considered one management unit, and Mozambique and Madagascar be considered separate from other populations until further evidence is to the contrary. The stock structure and relationship between southern right whales from Namibia and South Africa is not well understood but there is recent photographic evidence for connectivity between these two areas (Roux et al. 2011).

Australia

Southern right whales from southwest Australia differ in mtDNA haplotype frequencies from breeding populations from southeast Australia (IWC 2012b). Complex population structure across the southern coast of Australia is also possible. For example, mtDNA haplotype frequencies differed significantly between calving areas in the Great Australian Bight and Western Australia (Patenaude and Harcourt 2006 cited in IWC 2012b). Pooling of the data showed significant differences in mtDNA haplotype frequencies between New Zealand, southwest Australia, and southeast Australia (overall $F_{ST}=0.07$, $\Phi_{ST}=0.12$, $p<0.001$). In contrast, microsatellite loci were not significantly different (overall $F_{ST}=0.004$, $G'_{ST}=0.019$, $p=0.07$), suggesting breeding between populations (IWC 2012b). Breeding between populations from Australia and New Zealand is also supported by data on females calving within both populations. Pirzl et al. (2009) compared photo-identifications of whales from Australian and subantarctic New Zealand, and found three between-population movements, including two instances of females calving in each of two population-specific calving grounds. Although the mechanism for gene flow between populations is unknown, Pirzl et al. (2009) stated their data indicate gene flow may arise when a female, having conceived within the population with which it is genetically affiliated, gives birth in a different population's calving grounds, and the offspring then shows fidelity to, and breeds where it was born.

New Zealand

Both mtDNA haplotypes and microsatellite loci frequencies were not significantly different between mainland New Zealand and the subantarctic breeding populations (Carroll et al. 2011b). The lack of genetic differentiation may indicate that southern right whales from the subantarctic are recolonizing waters off mainland New Zealand. Individual whales have been identified to occur in both areas. Based on DNA profiles from whales sampled off mainland New Zealand from 2003-2009, 7 of 43 whales were also sampled in the subantarctic between 2006 and 2008 (Carroll et al. 2011b). Within-year movement between mainland New Zealand and the subantarctic has also been documented through satellite tag data (Childerhouse et al. 2010).

Carroll et al. (2012) conducted a paternity analysis using DNA profiles from 34 mother-calf pairs and over 300 adult males from the New Zealand populations (both mainland and subantarctic) to

determine whether the population is reproductively isolated from the population in southwest Australia. The study estimated male abundance for New Zealand to be 1,085 in 2009 (95% CL 855, 1416), of which 314 or 30% were sampled. The assignment of paternity to 10 of 34 calves represents 30% of the total. The agreement between the proportion of males sampled and paternities assigned is consistent with the hypothesis that the New Zealand population currently is reproductively isolated from southwest Australia. However, Pirzl et al. (2009) found females will calve within both populations from Australia and subantarctic New Zealand, indicating some interbreeding occurs. Also, nuclear DNA was not significantly different between New Zealand and Australia (IWC 2012b), which may reflect a historically larger population with a high degree of gene flow that became restricted as the populations experienced drastic declines due to whaling (Carroll et al. 2012).

2.3.1.4 Taxonomic classification or changes in nomenclature:

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Cetacea
Family: Balaenidae
Genus: *Eubalaena*
Species: *australis*

Right whales were first classified in the *Balaena* genus in 1758 by Carolus Linnaeus, who considered all of the right whales as a single species. The southern right whale was initially described as *Balaena australis* by Desmoulins in 1822, but was classified under the *Eubalaena* genus in 1864. Rosenbaum et al. (2000) proposed separate northern and southern species based on differences in their genetic profile indicating the northern and southern populations had not interbred for millions of years. Three species of *Eubalaena* are recognized: *E. glacialis* (North Atlantic), *E. japonica* (North Pacific) and *E. australis* (Southern Hemisphere) (**Figure 1**).

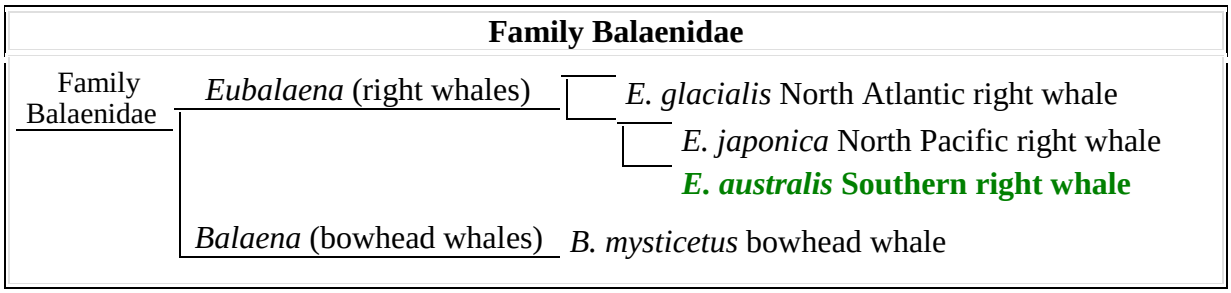

Figure 1. Cladogram of the Family Balaenidae (*source:* Wikipedia)

2.3.1.5 Spatial distribution:

The southern right whale is generally distributed from 20°S - 60°S throughout the Southern Hemisphere, but observations have been made south of 60°S (Bannister et al. 1999; Tormosov et

al. 1998) and evidence suggests the species infrequently travels north of 20°S (Roux et al. 2001; Cesar de Oliveira Santos et al. 2001). See Richards (2009) for review of historical and present distribution.

Southern right whales migrate between low-latitude winter breeding grounds and higher latitude summer feeding grounds. Based on whaling records of catch locations, the IWC has identified the following areas as known or inferred feeding and winter breeding, calving, and nursing grounds (IWC 2012b; Table 1):

Table 1

Structure for a hierarchy of SRW stocks/habitats (note that historically, all calving grounds were also whaling grounds)

Region	Calving ground	Known* or inferred Feeding Ground (s)	Other associated* or inferred Whaling Grounds	Associated habitat (i.e. documented movements)
Southwest Atlantic	Peninsula Valdes	Patagonian shelf, South Georgia*		Uruguay; coastal Argentina, Tristan Da Cunha, Brazil
	Southern Brazil (27° - 29°S) but calves seen to north and south of this	Brazil Banks, Patagonian shelf		Peninsula Valdes
South Central Atlantic	Tristan Da Cunha/Gough Is?	South Tropical Convergence (STC) SE of Tristan Da Cunha	SE of Tristan Da Cunha	South Africa, Peninsula Valdes
Southern Africa	South Africa	West South African coast (Saint Helena Bay)*, southern Benguela, Antarctic (south of 52°S, 13°W-16°E*) and sub-tropical (e.g. STC SE Tristan Da Cunha*)	SE of Tristan Da Cunha*	West South Africa, Namibia, Tristan Da Cunha/Gough Is, Marion Island
	Namibia *(Possibly now extirpated but recolonizing from South Africa)*	(see above)		South Africa
(SW/Central Indian Ocean?)	Mozambique/Madagascar? *(Possible link with/recolonizing from South Africa)*	Crozet Is, Kerguelen	Crozet Is, Kerguelen	
Southwest Pacific	Mainland New Zealand *(Possibly now extirpated but recolonizing from* Sub-Antarctic NZ*)*	Kermadecs[1]/ Louisville Ridge	Kermadecs/ Louisville Ridge	Sub-Antarctic NZ
	Sub-Antarctic NZ	STC south of Australia*, Sub-Antarctic		Mainland New Zealand
Australia	SE Australia *(Very depleted if separate unit)*	Unknown		South Central Australia, SW Australia
	South Central Australia	Antarctic and sub-tropical convergence*		SE Australia, SW Australia, Sub-Antarctic NZ
	SW Australia	Antarctic and sub-tropical convergence*	Coast of New Holland Ground	South Central Australia, SE Australia
Southeast Pacific	15°- 41°S (Chile/Peru)? No specific concentration identified *(Very depleted if separate unit). Lack of information*	West Antarctic Peninsula	Unknown	Coastal Chile/Peru

South Africa

The southern right whale occurs primarily along the coast of South Africa between the southwest coast of Saldanha Bay and around the south Cape to Woody Cape. Four main concentration areas lie within the southwest coast of Saldanha Bay (Barendse and Best 2014) and three areas of the southern Cape coastline: St. Sebastian Bay, De Hoop and Walker Bay (Elwen and Best 2004a; Mate et al. 2011). Saldanha Bay appears to be an especially important feeding and socializing area where whales were observed year-round along the southwest coastline. The whales' bidirectional alongshore movements and extended seasonal presence may all be indicative of reoccupation of their former range along the west coast. Whales observed in this area likely come from points south along the Cape and north along the west coast, including the coast of Namibia (Barendse and Best 2014).

Although not historically reported from the Prince Edward Islands, Postma et al. (2011) observed southern right whales off Marion Island five times from 1974 through 2009. The location of Marion Island in the Southern Ocean may serve as a sheltered resting stop for whales migrating from Crozet Islands feeding ground to the winter calving grounds off South Africa (Postma et al. 2011).

Argentina

Southern right whales in the southwest Atlantic have been recorded from May to September in Golfo San Jorge, Patagonia, Argentina, from La Lobería (46º07´S/67º38´W) to Caleta Olivia (46º26´S/67º31´W), and the number of whales sighted in this area increased from 16 observed in 2004 to 33 observed in 2006 (Belgrano et al. 2008b). The major nursery and calving ground for southern right whales in waters off South America is Península Valdés. Located along the central Argentinean coastline (42°S), the Península has two major bays (Golfo Nuevo and Golfo San José) where whales congregate. Whales occurring in this area have been well studied since 1970 (Payne 1986). Southern right whales aggregate in distinct regions of the Península; however, these regions have changed over the last 30 years. Whales have essentially abandoned areas along the outer coast of the Península and shifted into the bays (Rowntree et al. 2001). In addition, whales have shifted from Golfo San José to Golfo Nuevo and a much larger percentage of the population now congregates in Golfo Nuevo. From 1971-1990, 68% of females with calves were sighted along the outer coast followed by Golfo San José (36%) and Golfo Nuevo (9%). From 1991-1997, 63% of females with calves occurred in Golfo Nuevo (Rowntree et al. 2001). The shift occurred despite the fact that development pressures are greater in Golfo Nuevo and Golfo San José has been protected as a marine park since 1974. The causes of these shifts are not well understood. Avoidance of killer whales (*Orcinus orca*), a known predator, may have contributed to the change in distribution (Sironi et al. 2008). Zooplankton patches in the spring within the Gulfo Nuevo were dense enough to support cows feeding at the end of the fasting period in the nursery ground (Hoffmeyer et al. 2010), and there have been no observed negative impacts on population growth due to the shift. Instead, the change in distribution may indicate the southern right whale is capable of behavioral and ecological flexibility (Rowntree et al. 2001).

Brazil
Brazil represents an important southern coast wintering habitat for southern right whales. Whales arrive in July with a peak seasonal abundance in September followed by a decline in November (Groch and Flores 2011). Most groups (58.3%, n=130) consisted of single females with calves. Sightings data indicate whales aggregate in areas in the central-southern coast from Santa Catarina Island (27º25'S, 48º30'W) to Santa Marta Cape, Laguna (28º36'S, 48º48'W) where the coastline contains numerous bays (Espírito Santo et al 2009, 2013; Groch and Flores 2011).

Isotope analysis of bone samples obtained from whaling factories operating in the early 1970s in southern Brazil (n = 72) and from contemporary strandings in central Argentina (n = 53) indicated significant differences in levels of carbon and oxygen stable isotopes between the two sampling areas, and were consistent with the baseline isotopes from the two areas. The difference in stable isotope levels indicate that southern right whales from southern Brazil use foraging areas different from whales from central Argentina (Vighi et al. 2014). Previous studies suggested that the Antarctic area was the main feeding area for right whales in the southwest Atlantic; however, results from Vighi et al. (2014) suggest some individuals are feeding on their breeding grounds.

Australia
Main aggregation areas in Australia are along the southern coast, which is occupied regularly from May through November, with peak abundance around September (Burnell 2008). The greatest concentrations are observed along the southwestern coast from Albany, Western Australia to the Head of the Bight, South Australia, and sightings are also common off the southeastern coast of Tasmania. Smaller concentrations are known to occur along the coasts of South Australia and Victoria between Port Lincoln and Warrnambool (Bannister 2001) and off the southeastern coast of Tasmania. Southern right whales have been reported in the coastal waters of all States, with sightings ranging from Stradbroke Island and Hervey Bay in Queensland and along the entire southern coastline, including Tasmania to Exmouth in Western Australia. But the species has not been sighted in the Northern Territory (Department of the Environment and Heritage 2005).

In general, observations north of 34°S are infrequent. However, in recent years there has been an increase in sightings of southern right whales in northern, sub-tropical waters along the eastern and western coasts. This trend suggests that either the southern right whale range is expanding or whales are repopulating the area likely due to post-whaling population recovery (Allen and Bejder 2003).

New Zealand
Based on whaling records, southern right whales were likely distributed throughout all New Zealand waters, including those areas off the Kermadec Islands (approximately 30° S, 800 km northeast of mainland New Zealand), the subantarctic Islands (approximately 50° S, over 400 km south of mainland New Zealand), and both the North and South Islands of mainland New Zealand. This distribution spanned nearly 20 degrees of latitude.

The range of the southern right whale today is a fraction of its historical range. The species is considered extirpated around the Kermadec Islands and was rarely observed off the coast of

mainland New Zealand. No mother-calf pairs were sighted around mainland New Zealand from 1976 to 1991 and only 11 were reported between 1992 and 2002 (Patenaude 2003). However, recolonization of mainland New Zealand may be occurring by expansion from the New Zealand subantarctic populations (Carroll et al. 2011b; Carroll et al. 2014a). From 2003 to 2010, 28 mother-calf pairs were sighted in waters off mainland New Zealand (Carroll et al. 2011b; Carroll et al. 2014a) compared to the 11 sightings from 1991 to 2002 reported by Patenaude (2003). Photo identification and recapture data indicated that females observed along the mainland were also observed in the sub-Antarctic region (Carroll et al. 2014a). Waters off mainland New Zealand may also be a wintering calving site as evidenced by two females that were observed in two different years around the mainland with calves, but the possibility they migrated from subantarctic islands cannot be ruled out (Carroll et al. 2014a).
Compared to mainland New Zealand, a larger population is found off the subantarctic islands. This distribution may represent a shift in habitat use from pre-exploitation times when whaling efforts were successful off mainland New Zealand but largely unsuccessful in the subantarctic (Patenaude and Baker 2001). Within subantarctic New Zealand, the two primary winter concentrations occur off the Auckland Islands and Campbell Islands. Although these islands are located at high-latitudes typically associated with feeding grounds, they are considered the primary calving area and represent one of the few breeding grounds remaining in the South Pacific (IWC 2001). Wintering whales at Auckland Island concentrate around Port Ross, considered a principal calving area, located on the northeast shore (Rayment et al. 2012). Whales at Campbell Island have been observed from Perseverance Harbor and Northwest Bay located on the eastern and western shoreline, respectively (Patenaude and Baker 2001).

Other areas
Less is known about the distribution of the southern right whale outside of the major wintering areas discussed above.

The Tristan da Cunha Archipelago in the South Atlantic Ocean, located within the vicinity of the sub-tropical convergence, is considered a mid-ocean pelagic feeding ground and nursery area for the species (Best et al. 2009). The area is rich in biota influenced by eddies and currents with sea surface temperatures ranging seasonally between 15°C and 19 °C in summer and 13°C –18°C in winter. Southern right whales were generally observed in the area from July through November, with a peak presence in September and October. Historical whaling data indicated most kills occurred from late spring into summer (October through to January). Whales may have overwintered in coastal waters adjacent to continents and migrated offshore to foraging grounds in spring and summer. Also, the high incidence of mother–calf pairs in sightings at the Tristan da Cunha Archipelago indicate that the area represents a mid-oceanic nursery for southern right whales (Best et al. 2009).

There were 36 incidental sightings of southern right whales off the Namibian coastline since 1971, and calving was recorded 1996 to 1999. The southern right whale is known to have occurred along this shoreline historically, and was hunted to near extinction there in the early 1800s. Sightings of right whales off Namibia have been as far north as 17°S and represent the northernmost calving area for the southeastern Atlantic (Roux et al. 2001).

In 1997 and 1999, three southern right whales were sighted were off the eastern coast of Madagascar in Antongil Bay (approximately 15°S) and south of Fort Dauphin (approximately 25°S). Southern right whales are rarely observed near Madagascar and there are no whaling records documenting a strong historical presence. It is also unclear whether the sightings in the 1990s represent a long-range migration from South Africa or a remnant population from the pre-whaling era (Rosenbaum et al. 2001). The observation in Antongil Bay is one of the northernmost sightings of the southern right whale in the Southern Hemisphere.

Southern right whale distribution includes Uruguay. Aerial surveys conducted along the Uruguayan coastline between July and November from 2001 to 2009 documented a total of 489 individual whales. Out of the total, 95.5% were unaccompanied whales and 4.5% were mother-calf pairs. In addition to the high proportion of unaccompanied whales, about 70% of the whales were observed to engage in social behavior, indicating Uruguay likely is a breeding ground (Riet-Sapriza et al. 2011).

2.3.1.6 Habitat or ecosystem conditions:

Southern right whale habitat includes coastal and open ocean waters in the Southern Hemisphere primarily between 20°S - 60°S, though they have been recorded beyond these latitudes. In winter their habitat includes shallow, protected, and nearshore waters for calving and nursing off Australia, New Zealand, South America, Southern Africa, and various mid-oceanic islands. In summer, southern right whales feed in productive coastal and open ocean waters where they forage primarily on krill and copepods. The location of summer feeding grounds is known with lesser certainty; however, feeding right whales have been recorded at approximately 45°S south of Western Australia, around South Georgia, and near the Antarctic Peninsula. Preferred summer habitat includes areas where oceanographic and bathymetric features such as steep bottom topography, relatively cool water temperature, water column stratification, and ocean currents concentrate zooplankton (Kenney 2002). For example, the distribution of southern right whales in South Africa has been linked to environmental factors at both large and fine scales. Broad scale patterns show whales prefer shallow, calm waters with sandy bottoms. This applies to both mother-calf pairs and unaccompanied adults although mother-calf pairs are more likely to avoid rocky exposed areas than are unaccompanied adults (Elwen and Best 2004a). At the within-bay level, the correlation of whale distribution with environmental factors is not as strong. However, goodness of fit tests show mother-calf pairs are found more often than expected near shallow waters, sandy and gently sloping beaches, and protected areas than a random distribution would predict (Elwen and Best 2004b). Southern right whales in coastal waters of Brazil preferred habitats where the shelf downward slope is in relatively high relief, and where the coastline consist of numerous bays (Espírito Santo et al. 2009, 2013). In the subantarctic Auckland Islands, breeding females sought sheltered, nearshore waters during the early life-stages of their calves and were more selective of these habitats than non-calving whales (Rayment et al. 2015). The preference for these environmental features has been found for other breeding areas in New Zealand, Argentina, and Australia. Southern right whales may prefer these habitat conditions to conserve energy, avoid predators, avoid harassment by conspecifics, and reduce exposure to elements of the open ocean to enhance calf survival (Best et al. 2003; Elwen and Best 2004c; Payne 1986; Taber and Thomas 1982; Thomas and Taber 1984).

More exposed habitats include the west coast of South Africa, which experiences prevailing westerly swells and winds, and consists of few large or sheltered bays, apart from the stretch between St. Helena Bay and Saldanha Bay. The west coast habitat is influenced by the upwelling associated with the Southern Benguela system with high copepod biomass, which is ideal for foraging (Barendse and Best 2014; Mate et al. 2011). Offshore areas include the Subtropical Convergence (41°40'S) and the Antarctic Polar Front (average location 52°S - 53°S), where northward-moving Antarctic water sinks below warmer subantarctic water, forming strong horizontal gradients in temperature and salinity. These areas are highly productive and southern right whales have been observed associated with these oceanic features (Mate et al. 2011).

Ocean conditions relevant to southern right whales change within the ecosystem of the South Atlantic Ocean (IWC 2010). The Scotia Sea is a highly productive with high densities of krill, which support important feeding areas for southern right whales. However, krill abundance depends, in part, on sea-ice cycles and climate variability such as the ENSO (El Niño Southern Oscillation) and the Southern Annular Mode. These climate variability modes are linked to temperatures over Antarctica, sea surface temperature, and the distribution of sea-ice around the Antarctic continent. Shifts in the periodicity of sea-ice cycles and climate processes can affect recruitment and krill availability for southern right whales (see IWC 2010). Reproductive failure at Península Valdés, Argentina increased in years following elevated sea surface temperatures off South Georgia, indicating reduced prey availability may have led to poor nutritional status in pregnant females (Leaper et al. 2006; Valenzuela et al 2009).

2.3.1.7 Other:

No other relevant information is available.

2.3.2 Five-Factor Analysis

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

No new habitat threats have been identified since the last 5-year review of (NMFS 2007). Threats to habitat continue to include local activities and global processes. For example, coastal and marine development, chemical pollution, climate change, and tourism may all adversely impact habitat.

Coastal and marine development has broad implications for southern right whale habitat. Development pressures occur in all countries where the species occurs, and the impacts can be both direct and indirect. In New Zealand, the Department of Conservation has identified coastal development as the main issue threatening the habitat of the southern right whale (Suisted and Neale 2004). For example, in mainland New Zealand aquaculture applications cover nearly 50,000 hectares of coastal marine area, and these projects have the potential to directly impact habitat by affecting water quality and increasing the risk of whale entanglement. Offshore mineral resources in New Zealand may provide billions of dollars to the economy, and interest in these resources has increased from both local and overseas companies. In 2007, the Ministry of Economic Development received only a single permit application for both marine and terrestrial

mining compared to 42 permit applications received in 2011. Three companies are actively engaged in exploration adjacent to or within the North Island Marine Mammal Sanctuary, which was established to protect the Maui's dolphin (*Cephalorhynchus hectori maui*) but also covers all marine mammals including the southern right whale (Thompson 2012). In the subantarctic islands these pressures are reduced due to the islands' remote location and legal protections which prohibit certain developments.

Major developments in Argentina and Namibia near southern right whale habitat have also been documented. Golfo Nuevo is one of the most industrialized bays in Patagonia. Sewage treatment facilities, fish processing plants, and industrial factories all are located along the coastline. An aluminum smelter is located in the city of Puerto Madryn on Golfo Nuevo, the southern gulf of the Peninsula (Martino et al. 2013). Puerto Madryn, in Golfo Nuevo, is one of the most industrial ports and fastest growing cities in Patagonia. Sewage facilities release waste water into the Gulf, industrial fish and aluminum processing plants generate pollution, fishing gear introduces obstacles that can entangle migrating whales, and large ship traffic and small boat activities in the water are common and are expected to increase in the coming years (Hoyt 2005; Payne 1995; Rivarola et al. 2001; Rowntree 2007). All of these anthropogenic factors may degrade habitat. Martinez and Guzman (2008) report that the human population in the city of Puerto Madryn on the Península Valdes has grown approximately 7% annually from 1974 to 2004 increasing the probability of vessel strikes and other human interactions with southern right whales. In Namibia, three of the historic calving bays (Walvis Bay, Lüderitz Bay, and Elizabeth Bay) have undergone major habitat alterations. Walvis and Lüderitz Bay are now major harbors, and diamond mining operations occur near Elizabeth Bay. Vessel traffic, coastal development, oil exploration, and marine mining have also increased in these areas (Roux et al. 2001).

Few studies have investigated the impacts of chemical pollutants on southern right whales. Non-essential and essential metals and an essential element (selenium) were analyzed from skin biopsies (n=10) from female southern right whales in Península Valdes, Argentina. Overall, metal concentrations were generally low, but this may be a result of the types of tissues examined. Metals are known to accumulate more in internal organs compared to skin (Martino et al. 2013). Rosas et al. (in press) examined liver (n=26) and kidney (n=42) samples for essential metals from dead calves stranded in Península Valdes. The study found essential metals were similar to those reported for mysticetes in other locations and suggests that trace metals are probably not a significant cause in the increased calf mortality observed at Península Valdes. The overall impact of these contaminants on reproduction or individual health is not known.

The effects of climate and oceanographic change on southern right whales is uncertain, but these changes have the potential to greatly affect habitat and food availability. It is recognized that climate change will substantially alter ocean conditions (Intergovernmental Panel on Climate Change 2007). For example, climate change will be accompanied by changes in sea surface temperature, salinity, ocean circulation, precipitation, upwelling, ice coverage, and sedimentation. As a result, these changes may alter food availability, migration routes, reproductive rates, and trophic relationships for whale species. See Section 2.3.2.5 for further details.

Summary
Habitat threats are not currently a significant cause of southern right whale mortality, and populations continue to grow near 7% each year. It is unknown whether these threats will affect population recovery.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Commercial
Commercial whaling during the 18th, 19th and early 20th century depleted southern right whale populations throughout the Southern Hemisphere. Primarily hunted by French, U.S., and British whalers, southern right whales were caught in large numbers off Brazil, Argentina, Southern Africa, New Zealand, Australia and Tristan da Cunha. These efforts reduced some populations to near extirpation (IWC 2001; Perry et al. 1999). Historical estimates of whaling kills are also being revised for some areas. For example, Carroll et al. (2014b) revised the estimated kills of southern right whales off eastern Australia and New Zealand by incorporating shore-based, bay, and offshore fisheries as well as struck and loss rates. The revised total estimate increased from 26,000 to 53,000-58,000 southern right whales killed in the 19th and 20th centuries. Over 80% of these whales were killed between 1830 and 1849, indicating an intensive fishery that collapsed in just two decades.

By the beginning of the 20th century commercial whaling had reduced southern right whale populations to a fraction of their historical size. In 1935, the southern right whale received international protection from commercial whaling, and today, the IWC designates all right whales as a "Protection Stock" and their commercial catch quotas are set as zero. However, since 1935, illegal catches of southern right whales have been documented in the Southern Hemisphere as recently as the 1970's. These catches have occurred throughout the southern hemisphere including off southern Africa, Brazil, New Zealand, Argentina, and the Antarctic (IWC 2001). From 1950-1971, Soviet whalers killed 3,364 southern right whales illegally in the Antarctic (Brownell and Yablokov 2009 cited in Leaper and Miller 2011). The largest of these documented illegal catches was 1,335 right whales off Patagonia during the 1960s by Soviet vessels (Tormosov et al. 1998). However, there is no evidence of directed killing since the 1980s (IWC 2012b), and direct kill for human consumption has not been documented since the 1990s (Robards and Reeves 2011). In addition to international protection, commercial whaling of southern right whales is prohibited by various state and national laws.

Recreational
The growth of whale-based tourism is both a catalyst and product of coastal development. Major whale tourism industries operate in Argentina (Península Valdés), South Africa (Walker Bay and Hermanus), Brazil (Santa Catarina), and Australia (Head of the Bight and Warrnambool). Whale watching attracts tourists from around the world and generates millions of dollars in revenue for national governments and local businesses. In Argentina, whale watching is a popular and increasing tourism activity. In 2008, over 350,000 tourists participated in whale-watching activities involving primarily the southern right whale in the Península Valdes World Heritage site (Lasano and Taglioret 2009 as cited in Dans et al. 2012). In South Africa and Australia, where shore and boat-based whale watching industries are well developed, over 800,000 tourists a year travel to watch southern right whales and generate over US $135 million in total

expenditures. In Brazil, whale watching grew 4% each year from 1999-2008, and the number of whale watchers exceeded 228,000 in 2006 (Groch et al. 2009). Overall, whale-oriented tourism provides a vast range of socioeconomic and educational benefits to communities around the world and, in most places, is expected to continue to grow and develop (Hoyt 2001). The possible adverse impacts of tourist activities on whale populations are inconclusive. For example, in Argentina studies have shown that some whales increase their speed and move away from boats, some whales are not affected, and in some cases whales have actually moved to areas with greater boat activity (Groch et al. 2009; Hoyt 2005; Rivarola et al. 2001; Rowntree et al. 2001; Senigaglia et al. 2013; Suisted and Neale 2004). Cammareri and Vermeulen (2010) found that southern right whales doubled their time resting and decreased their time socializing in the presence of boats, but the behavior change was not significant. Vermeulen et al. (2012) found southern right whales off Bahía San Antonio, Argentina significantly altered their behavior by decreasing social interactions (on average 13%) when confronted with a research vessel at short-range, but their social behavior patterns returned to normal levels soon after the boat departed. The study also found that whales will significantly increase their tendency to continue travelling rather than starting to rest during a vessel approach. When exposed to boats and swimmers at Península Valdes, whales were significantly more likely to begin traveling and cease resting, socializing, or engaging in surface active behaviors. Changes in behavior lasted throughout interactions and varied in magnitude with group composition, age and sex class. Mother-calf pairs were particularly responsive to disturbance, and changed their direction of travel, indicating that they may have been forced to move away from preferred water depths and sheltered areas along the coast (Lundquist et al. 2013).

Whale watching is regulated by a variety of laws, guidelines, and policies throughout the Southern Hemisphere. Nations take varied approaches to regulating whale watching within their waters. In Argentina, the Province of Chubut passed several provincial regulations (e.g. Provincial Law 2618/85, Provincial Regulation Decree 916/86, and Provincial Termination 111 OPT/97) which restrict the number, activities, approach distance, and conduct of whale watching boats. In Australia, whale watching guidelines have been incorporated into federal legislation. The guidelines set national standards to minimize the impacts of these activities on whale populations and aim to help local governments develop consistent whale watching regulations. In New Zealand's subantarctic islands, whale tourism has been banned to protect southern right whales. A detailed review of whale watching guidelines and regulations for Argentina, Australia, Brazil, New Zealand, South Africa and other nations within the Southern Hemisphere summary is provided in Carlson (2007).

Although not commonly seen in the Antarctica, southern right whales have been documented in the area (e.g., Murase et al. 2010). Tourism, especially by tour boats, in the Antarctic has increased since it began in the late 1950s, which may disturb whales or increase the possibility of vessel collision (Fox 2014).

Scientific Research

Deep tissue application of satellite tags to cetaceans can be invasive, which may result in potential tissue damage and infection. Sixteen southern right whales were tagged to determine tag retention, injury, and healing from tag application, and compare reproductive output between tagged and untagged females (Best 2015). Tags were shed within 36 months of application, with one exception where a tag was present after 11 years. Healing at the tag site occurred gradually

within 5 years of tagging and 2 years after tag shedding. Calving frequency was similar between 12 tagged and 382 untagged females. The results from this study are similar to Best and Mate (2007), which compared calving frequencies before and after tagging in seven satellite-tagged southern right whales off South Africa and found no significant differences between tagged and untagged animals, but the samples sizes were too small to detect possible long-term effects. Nonetheless, six out of seven tagged cows with calves gave birth to a subsequent calf within intervals comparable to those prior to tagging suggesting the procedure had no major negative impact on reproduction (Best and Mate 2007).

Summary
Take is prohibited throughout the Southern Hemisphere, and illegal catches have not been documented or known to occur in the last thirty years. Whale watching has increased in some areas, but the possible adverse impacts of these activities on whale populations are equivocal, and many nations have adopted regulations to minimize impacts. The available information does not support adverse effects resulting from scientific research activities. Thus, overutilization is not considered a significant threat to the species.

2.3.2.3 Disease or predation:

Between 2003 and 2009, 366 whales, including 333 calves less than 4 months old, were found dead at Península Valdés (IWC 2010). The cause of death was unknown in the majority of these strandings. Probable causes of calf death included poor nutritional state of mothers; exposure to harmful algae blooms and/or bacteria-associated biotoxins either *in utero* in the feeding ground or the calving/nursery ground; or infectious disease (IWC 2012b). Of particular concern is the possibility of disease transmission or other physiological adverse effects from kelp gull attacks.

In the late 1970's kelp gulls were occasionally observed feeding on the skin and blubber of southern right whales along Península Valdés. These attacks resulted in skin lesions and other injuries (Bertellotti et al. 2008). Since the 1970's the frequency of gull attacks and the number of whales observed with lesions induced by gull attacks has increased despite the gull population remaining steady in the area, possibly indicating the gulls are learning the attack behavior. In the 1990s, the number of gull attacks increased five times compared to the 1980s, and mother-calf pairs were the most vulnerable to attacks (Rowntree et al. 1998). The presence of lesions due to gull attacks has also increased from 1% of whales in 1974 to 68% in 2000 (Sironi unpublished data 2004) and 77% in 2008 (Sironi et al. 2008). Attack rates along Península Valdés were highest for mother–calf pairs, particularly during August and September when pairs are closer to the shore, and wind velocity is slow (Fazio et al. 2012). Sironi et al. (2009) found that mother-calf pairs received 81% of the attacks and were attacked five times more often than juvenile whales during calving seasons from 1999 through 2001. The wounds inflicted do not seem to be life threatening, but because gulls also feed on garbage and sewage in nearby cities, they carry pathogens that could cause skin diseases in whales. Biopsies of skin lesions obtained from living and dead southern right whales at Península Valdés showed the presence of poxvirus, which is linked to stress due to environmental degradation (Fiorito et al. 2014). Swabs of wounds caused by the kelp gulls revealed anaerobic bacteria, *Erysiphelotrix* spp, which results in a disease called erysipelas in birds and mammals. The bacteria has been reported in cetaceans and is thought to be acquired through their diet, but opportunistic colonization could occur in the wounds from kelp gull attacks (Fiorito et al. 2014). Necropsies through 2012 did not reveal histology,

biotoxin, pollutants or infectious disease patterns that could fully explain the elevated calf mortality in the region. The most consistent pattern in the gross necropsy findings for the 151 calves examined was the presence of lesions resulting from gull attacks in 53 dead calves (Thomas et al. 2013).

Southern right whales react negatively and alter their behavior in response to gull attacks. The whales submerge their backs when resting on the surface, and they only expose their head and blowhole when emerging to breathe (Fazio et al. 2015). It is unknown whether the attacks are having an effect on the southern whale population in the area. However, the population of whales was increasing about 7% annually (Cooke et al. 2001) but decelerated to 5% annually through 2010-2011 in the Península Valdés (Crespo personal communication as cited in Fazio et al. 2012). Gull harassment may be a serious threat to southern right whales and could impact calf development and possibly cause whales to abandon calving grounds on Península Valdés (Rowntree et al. 1998, 2001) Government authorities are culling the gull population of whale attackers, but data are not available on the success of this elimination program.

Possible diseases include skeletal system diseases. A southern right whale, which stranded dead on the coast of Golfo Nuevo, Península Valdés, Argentina, exhibited extensive orthotopic and heterotopic ossification, osteochondroma-like lesions, and early degenerative joint disease (La Sala et al. 2012). Symptoms were similar to fibrodysplasia ossificans progressive, which is a human genetic disorder, but no definitive diagnosis could be drawn from the necropsy. The first report of the fungus, *Candida zeylanoids,* in a cetacean was reported from a southern right whale that stranded in South Africa. The fungus was found to be virulent; however further research on the fungi associated with the disease is needed to evaluate the frequency of infections (Mouton et al. 2009). Fungi belonging to the genus *Chaetomium,* which are well known to occur in marine environments, was found in a neonate southern right whale that stranded in South Africa. *Chaetomium* spp. are known to cause infections in humans The presence of these fungi may indicate immune responses to environmental stress (Reeb et al. 2010).

Potential predators include killer whales and large sharks. Analysis of scarring patterns indicates killer whales and sharks target calves and juveniles (Kenney 2002). Southern right whales have changed their distribution over the last several decades in coastal waters off Península Valdés, Argentina by moving into bays possibly to avoid killer whales and sharks. Between 1972 and 2000, 117 encounters between southern right whales and killer whales were observed, and the majority (56.3%) of the encounters did not result in apparent changes in the behavior of either species. In 33% of the encounters, obvious behavioral changes were seen, and 12 (10.7%) encounters resulted in actual attacks (Sironi et al. 2008). Most encounters (90.6%) occurred along the outer coast of the Península, and the overall number of encounters decreased from 68 during 1972-1980, to 26 during 1981-1990, and to 23 during 1991-2000. The shift from outer coast to bays by southern right whales has resulted in fewer encounters with killer whales, a fact which supports the theory that predator avoidance, in part, may explain the shift in distribution (Sironi et al. 2008).

Summary

Attacks by kelp gulls are a significant threat to individual southern right whales in coastal waters off Argentina. However, it is unknown whether the attacks are affecting the population, which

continues to increase despite the attacks. Although population growth for Península Valdés decreased in 2010-2011, it is unknown whether gull attacks were a causal factor. Predation by killer whales and sharks may cause southern right whales to shift distribution in order to avoid attacks. Given overall population increases for major breeding populations, threats from disease or predation are not a significant threat to the species.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

The southern right whale is protected and managed under a number of international instruments, federal, national, and state laws, regulations, policies, plans, strategies, and protected areas throughout the Southern Hemisphere. The adequacy of these regulatory mechanisms varies by nation and region. In general, the relevant management authorities have established either (a) comprehensive protection of southern right whales or (b) a regulatory framework which could lead to comprehensive protection. These regulatory mechanisms are independent of the listing status of the southern right whale under the ESA and would continue irrespective of a status change.

International
At the international level, the southern right whale receives several protections from the IWC. Under the 1946 International Convention for the Regulation of Whaling, the IWC can designate sanctuaries for the conservation of whale resources (Article V(1)(c)). In 1979, the IWC created the Indian Ocean Sanctuary, essentially closing the entire Indian Ocean to commercial whaling. Several decades later, the IWC established the Southern Ocean Sanctuary, which prohibited all commercial whaling within a 50 million km^2 area surrounding Antarctica. In addition, southern right whales received international protection in 1935 when the 1931 Geneva Convention for the Regulation of Whaling entered into force and prohibited the taking or killing of right whales by all nations bound by the Convention. A conservation plan was developed for the south Atlantic populations with the objective to protect southern right whale habitat and minimize anthropogenic threats to maximize the likelihood that southern right whales will recover to healthy levels and recolonize their historical range (IWC 2012a). The conservation plan calls for increasing public awareness and building capacity in range states; determining movements, migrations, and location of feeding grounds; and developing a GIS database on human activities that may have adverse effects to southern right whales (IWC 2012a, 2013). In 1998, the IWC divided the southern right whale into 11 management units based on their distribution, breeding aggregations, and population separation, as follows: (1) sub-Antarctic New Zealand, (2) mainland New Zealand/Kermadec Islands, (3) Australia, (4) Central Indian Ocean, (5) Mozambique, (6) South Africa, (7) Namibia, (8) Tristan da Cunha, (9) Brazil, (10) Argentina, and (11) Chile/Peru (IWC 2001). The effectiveness of the IWC depends on the ability to inspect and enforce provisions. The illegal kills documented through the 1970s indicate self-regulation alone is inadequate for the long-term conservation of whales (Clapham and Ivanchenco 2009).

The southern right whale is also protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on the Conservation of Migratory Species of Wild Animals (CMS), and the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR).

CITES regulates the international trade of over 35,000 species to ensure their survival is not threatened. Under CITES, the southern right whale is listed as an Appendix I species, meaning the species is threatened with extinction and trade of the species (whole or parts) is prohibited except in exceptional cases such as scientific research. There are 181 Parties to the Convention, including the four nations known to contain primary wintering grounds for the species (Argentina, Australia, New Zealand, and South Africa).

The CMS also aims to conserve migratory species on a global scale and promotes conservation action among nations. The southern right whale is listed as an Appendix I species, meaning it is threatened with extinction, and as a result, nations are obligated or strive to protect, conserve, and restore the species and their habitat and mitigate any threats or impacts. There are 119 parties to the CMS including South Africa, Australia, New Zealand, and Argentina.

CCAMLR was adopted in 1980 and entered into force in 1982. CCAMLR applies to the Antarctic marine living resources of the area south of 60°S and to the Antarctic marine living resources of the area between that latitude and the Antarctic Convergence, which form part of the Antarctic marine ecosystem. CCAMLR's purpose is to conserve the living resources of the Southern Ocean, but not to exclude harvesting carried out by nations. CCAMLR can contribute to recovery of the southern right whale through management of krill stocks, establishment of marine protected areas (MPAs), and management of other human activities that may affect the Antarctic ecosystem. There are 25 Members and 11 Acceding States to CCAMLR including South Africa, Australia, New Zealand, and Argentina.

South Africa

Protection of southern right whales within waters belonging to South Africa primarily falls under the 1998 Marine Living Resources Act (MLRA). By regulation, the MLRA prohibits the taking of whales without a permit. Under Section 43 of the MLRA the Minister of the Department of Environmental Affairs and Tourism (DEAT) may designate waters as MPAs for the conservation and protection of species and their habitat. Nineteen MPAs have been established encompassing over 1,800 km^2 of marine area and nearly 20% of the South African coastline. Nearly all of the MPAs include known southern right whale habitat. MPAs designated under the MLRA prohibit any activity that may adversely impact the ecosystem such as fishing, dredging, or construction, unless such activity has been permitted by the Minister. In addition to MPAs, Section 77 of the MLRA allows the Minister to designate closed areas by regulation. Closed areas strongly regulate fishing or prohibit these activities completely. There are ten designated closed areas. Typically these areas either prohibit the setting of rock lobster traps, which are one of the leading causes of whale entanglements, or only allow shore fishing from limited areas.

Despite the number and extent of MPAs, the protection for southern right whales and their habitat may be limited. An assessment of MPAs in South Africa concluded that many of the parks lack a management plan, trained staff, adequate enforcement capabilities or a budget and, as a result, are unable to effectively manage or protect their resources. Many of these problems have been linked to (1) the MLRA's focus on fisheries enforcement rather than ecosystem conservation, and (2) the lack of communication and coordination between the Marine and Coastal Management Branch of the DEAT, which holds legislative authority over MPAs, and the regional conservation agencies that are responsible for day-to-day management (Lemm and Attwood 2003).

Although southern right whales are not listed under South Africa's Biodiversity Act of 2004, the Act was amended in 2013 to emphasize the need to protect the ecosystems, including species which are not listed or targeted for exploitation. The Act can help protect ecosystems and habitats upon which threatened species depend through the development of bioregional plans (Sec. 40) or biodiversity management plans (Sec. 44). However, no bioregional plans or biodiversity management plans have been established for southern right whales (NMFS 2007).

Protection of southern right whales could also be potentially addressed through the South African National Biodiversity Institute (SANBI). The Biodiversity Act established SANBI and charged the Institute with monitoring the status of the nation's biodiversity and the conservation status of all listed threatened or protected species (Sec. 11(1)(a)). SANBI manages a number of conservation, research, and education programs regarding biodiversity, but the majority focus on terrestrial species. No programs address the conservation, protection, or management of southern right whales, but the marine program is considering including this species in its efforts to establish offshore MPAs and to develop an offshore conservation plan (NMFS 2007).

Argentina

The southern right whale is protected at both the national and provincial level in Argentina, but these regulatory mechanisms are not as extensive as those of other nations. In 1988, the Argentine National Congress declared the species a Natural Monument (Law 23094). The designation only applies in national territorial waters, and in 2006 the law was ratified by the Northeast Patagonian province Río Negro (Cammareri and Vermeulen 2008), but other provincial governments have not ratified the law (Rivarola et al. 2001; Sironi et al. 2005). Locally, whale watching activities are regulated by the government of the Chubut Province and Río Negro. Whale watching was first regulated by the Provincial government in 1984, and is now subject to several laws and decrees. The Organismo Provincial de Turismo of Chubut and the Prefectura Naval Argentina are both responsible for enforcing these regulations (Rivarola et al. 2001). However, there is a high degree of non-compliance from the industry due to the lack of effective enforcement and the inadequacies of current regulations. Government officials have acknowledged that new regulations need to be created and that these regulations should be based on the findings of studies investigating the adverse impact of whale watching (Sironi et al. 2005). In Río Negro, a commercial whale-watching activity was approved and regulated strictly by provincial authorities, as was the first legalization on 'immersion with whales' in Argentina (Cammareri and Vermeulen 2008). See Section 2.3.2.2 for further details on whale watching activities.

The Whale Conservation Institute/Ocean Alliance (WCI/OA) and the Wildlife Conservation Society and Fundación Patagonia Natural direct the Argentine Right Whale Stranding Project. The Project has multiple objectives including collecting data and tissue samples from stranded right whales and developing a health assessment protocol for global comparison of right whale populations (Mohamed et al. 2007; Uhart et al. 2005). The WCI/OA began recording stranding data in 1971 and in 1994 began systematically surveying the Península.

In 1999 the United Nations Educational, Scientific, and Cultural Organization (UNESCO) inscribed Península Valdés as a World Heritage Site. The Península was established specifically for conservation of breeding right whales and their habitat. UNESCO also recognized the site

for its in-situ conservation of biological diversity. Designation as a World Heritage Site does not automatically confer protections for southern right whales. Rather it encourages management agencies to address issues that adversely impact these sites. The northernmost bay, Golfo San José, was designated a Provincial Marine Park in 1975 by the Provincial Chubut government (Provincial Law 1238). The purpose of the park is to provide protection to a critical breeding area for southern right whales. In 1979, the government modified the original law (Decree 1713) to allow multiple uses within the park. Some commercial activities are allowed within the park, primarily fishing and some aquaculture, but the park provides strong protections for wintering right whales (Hoyt 2005; Rivarola et al. 2001; Rowntree et al. 2001). Other protected areas include the Natural Protected Area Bahía de San Antonio in Northeast Patagonian province. Despite the establishment of MPAs in known southern right whale habitat, MPAs in South America only cover 0.25% of the area used by southern right whales (Gómez and Mendez 2007).

Brazil

Federal Law no. 7.643/87, instituted in 1987, prohibits whaling including southern right whales. In 1995, the Governor of the State of Santa Catarina declared the southern right whale a State Natural Monument, and the species is listed under the Ministry of the Environment's National Endangered Species List. Listed species are protected by federal law from being hunted, captured, or commercialized, and agencies may develop recovery plans, establish conservation areas, or stimulate research programs. In 2000, Brazil established the Southern Right Whale Environmental Preservation Area off Santa Catarina. The Brazilian Environmental Institute (IBAMA), Brazil's national environmental authority, is responsible for issuing permits for conducting activities in the marine environment. For example, in 2005 IBAMA denied a permit for oil and gas exploration in shallow water in Boipeba, Bahia, due to adverse impacts to southern right whales and other species that occur in the area.

In Brazil, there are eight MPAs spread along the southeastern coastline where southern right whales occur: (1) Arraial do Cabo Sustainable Reserve, (2) Laje de Santos State Marine Park, (3) Tupiniquins Ecological Station, (4) Tupinambás Ecological Station, (5) Ilhabela State Marine Park, (6) Ilha Anchieta State Marine Park, (7) Anhatomirim Environmental Protection Area, and (8) Right Whale Environmental Protection Area (Hoyt 2005). These include both state and federal MPAs, and sizes range from 0.3 – 1560 km^2. Protection for southern right whales is ancillary for the majority of these MPAs. Only one, the Right Whale Environmental Protection Area established in 2000 by Federal Law No. 6.902 and 6.938, is focused on the protection of the southern right whale.

Australia

Two main federal laws protect southern right whales within Australian waters: the Environment Protection and Biodiversity Conservation Act of 1999 (EPBCA) and the Antarctic Living Marine Resources Act of 1981. Under the EPBCA, the southern right whale was listed as endangered in 2000. Endangered is defined as any native species that is facing a very high risk of extinction in the wild in the near future (Sec.179(4)). The EPBCA prohibits any action that will have or is likely to have a significant impact on southern right whales and a recovery plan must be developed. The southern right whale recovery plan, published in 2005, outlines three recovery objectives including restoring the species to population levels that are considered secure in the wild. The plan also specifies six actions to achieve these objectives, such as implementing

population monitoring programs, protecting habitat, and preventing expansion of commercial and scientific whaling (Department of the Environment and Heritage 2005). Progress on meeting the recovery plan objectives is indicated by the increasing population size (Department of the Environment and Heritage 2010).

The EPBCA allows the Minister to designate critical habitat for listed threatened species. Critical habitat is defined as habitat that is critical for the survival of a listed species (Section 207A). Any action that will significantly damage critical habitat is prohibited (Section 207B). However, due to information gaps regarding the adaptability of southern right whales and the importance of current habitat, no critical habitat has been designated for the southern right whale. Instead, the Department of the Environment and Water Resources has identified habitat important to the survival of the southern right whales. This includes all areas known to seasonally support significant portions of the species (Department of the Environment and Heritage 2005; Iqbal 2007).

The EPBCA also authorizes the creation of the Australian Whale Sanctuary. The Sanctuary includes all commonwealth waters within the Exclusive Economic Zone, excluding coastal waters of the States and Northern Territory, and prohibits the killing or injuring of any cetacean within these waters. The Act also prohibits Australians from carrying out these actions in international waters (Sec. 229). All states and territories have enacted similar protections for whales within their coastal waters.

The Antarctic Living Marine Resources Act of 1981 prohibits the harvesting of right whales in waters south of the Antarctic Convergence (Sec. 8(1A)). The Act was passed after Australia became a signatory State to CCAMLR.

Several MPAs have been established in state waters that afford southern right whale habitat some level of protection. The most significant is the Great Australian Bight Marine National Park, which protects over 1,200 km^2 of coastal waters for wintering southern right whales. The State of South Australia established the Park in 1996, and the park was extended into Commonwealth waters in 1998. The park excludes activities that may negatively affect whales and prohibits mining from certain areas but allows fishing and boating access. There are over a dozen smaller MPAs along the Australian coastline that offer some degree of protection for southern right whales and their habitat (Hoyt 2005). No MPAs have been established in territorial waters (beyond 3nm) as wintering whales are observed most commonly in state waters.

New Zealand

Under the Department of Conservation (DOC) New Zealand Threat Classification System, the southern right whale was listed in 2002 as Nationally Endangered in New Zealand. In 2008, a reassessment concluded the species should remain as Endangered due to a lack of a positive trend in abundance, its small subantarctic population, and its history of intense exploitation (Baker et al. 2010). However, new information indicates the population is increasing (see Section 2.3.2.2 for further details). Under the New Zealand Threat Classification System, no specific protective measures are provided to listed species. Instead, the list is a management tool to assist wildlife managers in allocating resources to species recovery and site-based management programs (Hitchmough et al. 2007; Molloy et al. 2002).

New Zealand's 1978 Marine Mammal Protection Act (MMPA) prohibits persons from taking or attempting to take any marine mammal within territorial waters or from importing or exporting marine mammal products (Sec. 4). The MMPA also allows for the designation of Marine Mammal Sanctuaries. Pursuant to this authority, the Auckland Islands Marine Mammal Sanctuary was established in 1993. The Sanctuary includes all waters within 12 nautical miles (nm) of the mean low water mark of each island and exposed rock of the Auckland Islands and is managed as an IUCN Category 1a protected area for science and wilderness protection (Hoyt 2005). Within the Sanctuary, all commercial fishing is prohibited (McConnell 2007).

Southern right whales and their habitat may also be protected under the Marine Reserves Act (MRA) of 1971. The Act authorizes the Minister of the Department of Conservation to designate any area within the territorial waters of New Zealand a marine reserve and to develop conservation management strategies and conservation management plans for these reserves (Sec.4, Sec.7, and Sec.8). In 2003, the area of the Auckland Islands Marine Mammal Sanctuary was also designated a Marine Reserve under the MRA. The Reserve prohibits the taking of all marine life within this area. However, protection for the southern right whale is limited under the MRA for two reasons. First, most of the reserves are located in areas where southern right whales have been essentially extirpated. Less than 0.1% of territorial waters (waters within 12 nm of the shoreline) where right whales have been recorded are designated as reserves. Second, the MRA's primary focus is on conservation for scientific study rather than species or habitat protection and conservation (Department of Conservation 2000).

In 1998 the UNESCO inscribed the New Zealand Sub-Antarctic Islands as a World Heritage Site. The site includes all lands and waters extending 12 nm from five island groups (Snares, Bounty Islands, Antipodes Islands, Auckland Islands, and Campbell Islands) and was inscribed for its high level of biodiversity, pristine habitats, endemism, and for its conservation, scientific and natural values. Designation of the islands as a World Heritage Site does not automatically confer protections for southern right whales. Rather it encourages management agencies to address issues that adversely impact these sites. For example, in the nomination document UNESCO encouraged the Ministry of Fisheries to regulate commercial fishing within the Sub-Antarctic World Heritage Site.

The New Zealand Biodiversity Strategy also has implications for the conservation of southern right whales. However, the Strategy does not provide protections for whales but rather establishes a framework to conserve New Zealand's coastal and marine biodiversity. The framework defines desired outcomes for enhancing marine biodiversity and outlines specific actions to achieve these outcomes. Actions include improving monitoring systems to better identify, understand, and assess species and their habitats, mitigating adverse fishing impacts, identifying protected species, and developing recovery plans (Department of Conservation 2000).

Other

The southern right whale is part of Mozambique's national biodiversity strategy under Convention on Biological Diversity (Republic of Mozambique 2009). Other domestic instruments include the Coastal Zone Management Strategy, Fisheries Law and Regulations, and

Forest and Wildlife Law, which list whales as species that cannot be exploited or killed. However, specific management measures for southern right whales are not included in these instruments (Banks 2013). There are two MPAs in Madagascar located near recent sightings of southern right whales but neither address the species explicitly. No MPAs exist in Namibia (Hoyt 2005).

Summary
Protections for southern right whales include a number of international, national, provincial, and state laws and policies. Within territorial waters, the level of protection and enforcement varies from extensive in some locations to non-existent in others. While a majority of countries have established federal legislation prohibiting the take of southern right whales, many lack comprehensive management or recovery plans for the conservation of right whales and their habitat. A variety of MPAs have been created in the Southern Hemisphere to protect southern right whales. These include the prime calving grounds around Península Valdés (Argentina), Walker Bay (South Africa), and Head of the Bight (South Australia). However, many of the these MPAs lack management plans, adequate staffing, funding and enforcement capabilities and it is difficult to assess whether these areas are effective in conserving and protecting southern right whale habitat. There is no definitive evidence to conclude that the existing measures are sufficient to counter threats to the species.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Ship strikes
Collisions with vessels and entanglements in fishing gear are the leading causes of human-induced mortality for southern right whales. From 1970-2010, 62 known or suspected ship collisions with southern right whales were reported in the Southern Hemisphere (IWC 2012b). Argentina and South Africa had the most reported known or suspected collisions. For example, Saldanha Bay, South Africa, is a large natural port where millions of tons of iron ore (>90% are exported) are shipped each year. In the fiscal year 2011/2012, the port reported 528 ships and total cargo exceeding 58 million tons of ore, which implies an average of three transits of the bay every 24-hours by ore-bearing ships. The area has been designated as an Industrial Development Zone by the South African Government, with a strong emphasis on expanding oil and gas developments along this coast. Thus, ship collisions with southern right whales will likely increase as the population expands into the area (Barendse and Best 2014). Because ship strikes of southern right whales can go undetected or unreported, it is likely that the number of collisions is greater than documented (IWC 2001; Jensen and Silber 2003; Laist et al. 2001). Also, population recovery for right whales in South Africa is occurring despite human caused mortalities due to ship strikes and entanglements in fishing gear (Best et al. 2001b).

Ship strikes are not considered an immediate problem in Australia; however, if whales repopulate the southeastern coastline of Australia, where shipping traffic is more prevalent than other areas of the country, incidents are likely to increase (NMFS 2006). The threat of entanglements and ship strikes may also increase if southern right whales repopulate northerly portions of the eastern and western coastline. In the last decade, sightings of southern right whales north of 37ºS off eastern and western Australia have suggested that the species' range is expanding. Because right whales have not been frequently observed there in the past, marine

development projects often overlook the presence of right whales in the northern latitudes and fail to address the potential impacts on southern right whales in their impact assessments. For example, an Environmental Impact Statement for a proposed finfish sea cage project in Moreton Bay, Queensland, makes no reference to southern right whales despite documented sightings in the area (Allen and Bejder 2003). Greater interactions with nearshore aquaculture facilities, fishing gear, coastal developments, and marine traffic may occur as right whales repopulate the eastern and western coastline and precautionary measures will need to be adopted by regulatory agencies (Allen and Bejder 2003).

Entanglements

In South Africa from 1975- 2009, 58 southern right whales were reported entangled in static large-mesh gillnets**,** mainly used in the rock lobster (*Jasus lalandii*) industry to reduce depredation by sharks (referred to as shark nets) (Meÿer et al. 2011). However from 1999-2009, only one right whale is known to have died from entanglement in a shark net, which may be due to the fact that the fishery changed to baited drumlines to minimize accidental entanglement of non-targeted species (IWC 2012b). The number of reported incidents of southern right whales entangled in gear other than shark nets increased 10.3% per year (95% CI = 4.1–16.4%) from 2000 to 2009, which is likely due to the increasing southern right whale population in waters off South Africa (Meÿer et al. 2011).

In the Gulfo Nuevo, Argentina, 12 southern right whales were reported entangled in 2002 - 2011 (Bellazzi et al. 2012). Of these, the majority were entangled in moorings followed by marine debris, including lost fishing gear. A southern right whale became entangled in the line from an anchor for a kayak off Argentina in 2010. The whale dragged the kayak approximately 200m offshore before finally becoming untangled (Iñíguez and Gasparrou 2011). Zappes et al. (2013a,b) interviewed local artisanal fishermen in Santa Catarina, Brazil, to determine their beliefs about fisheries interactions with *E. australis*. Fishermen reported vessel collisions and entanglement of southern right whales in their gear, comprised mostly of gillnets. Fishermen suggested that a ban on gillnet use from July to November, when whales migrate along coastal waters would reduce entanglements. They felt that whale watching tourism would be a feasible economic alternative to fishing during that period (Zappes et al. 2013b).

In Brazil, from 1993-2005, along 400 km of coastline between Paraty Bay and Macaé, Brazil, three southern right whales were reported killed following entanglement with fishing gear (Lodi and Rodriques 2007). From 2002-2010, total of 16 southern right whales were reported stranded, but not all of these were attributed to entanglement. However, approximately 3-4 non-fatal entanglements of southern right whales in fishing gear occur each year (Groch personal communication and Groch et al. 2011 as cited in IWC 2012b). Thus, it is reasonable to expect that some of the dead stranded whales reported in Brazil were due to entanglement.

In Australia from 1950 - 2006, 44 records of southern right whale mortalities and non-fatal anthropogenic interactions have been documented (Kemper et al. 2008). The majority of these records occurred from July to October, and the number of anthropogenic incidents have increased 4-fold since the 1970s. Causes of the interactions included non-lethal shooting, vessel strikes, and entanglement in fishing gear. In Western Australia from 1982 - 2010, five southern

right whales were reported entangled in fishing gear, mainly in the lines of pot fisheries (Groom and Coughran 2012).

Anthropogenic Noise

Humans have introduced sound intentionally and unintentionally into the marine environment for many purposes, including oil exploration, navigation, and research. Noise exposure can result in a multitude of effects, ranging from little or no effect to those being potentially severe, depending on source level and on various other factors. Marine mammal response to noise varies due to many factors, including type and characteristics of the noise source, distance between the source and the receptor, receptor characteristics (e.g., sensitivity, behavioral context, age, sex, and previous experience with sound source) and time of the day or season. Noise may be intermittent or continuous, steady or pulsatile, and may be generated by stationary or transient sources. As one of the potential stressors to marine mammal populations, noise may disrupt marine mammal communication, navigational ability, and social behavior. Marine mammals use sound, both passively (i.e., listening) and actively (i.e., sound generation), to communicate, navigate, locate prey, and sense their environment. Both anthropogenic and natural sounds may cause interference with these functions.

Parks et al. (2007) analyzed southern right whale calls in the presence of vessels and found behavioral change in sound production (increased frequency, decreased call rate) as noise levels increased. Changes in call duration were found to be significant between quiet (no audible vessel noise), mid-range (audible vessel noise), and high (continuous audible vessel noise) noise level categories, but there was no clear trend in call duration with increasing vessel noise. The study results also indicate that right whales may shift call frequency to compensate for increased band-limited background noise. Finally, the study compared southern right whale call recordings from 1977 to calls recorded from 2000-2004 to determine whether calling behavior had changed over time based on the assumption that ambient noise within the frequency of right whale calls also increased between those time periods. Calls were higher in frequency in the more recent recordings compared to the 1977 recordings. However, factors other than ambient noise may have caused changes in sound production, including differences in individual whale calls, changes in population demographics with a greater proportion of younger animals producing a greater proportion of higher frequency calls (Parks et al. 2007). Further research is needed to determine whether southern right whales change sound production when exposed to anthropogenic noise sources.

Climate Change

Southern right whales are both cool-and warm-water limited, and primarily feed on copepods and krill along the shelf waters of the eastern Tropical Pacific, which are characteristics that put the species at a high risk of being negatively impacted by warming ocean temperatures due to climate change (MacLeod 2009). As water temperatures increase due to climate change, the geographic range of the southern right whale may contract due to thermoregulation, effects on prey abundance and distribution, changes in competition with other species, or some combination, but further studies are needed to test any one of these hypotheses (MacLeod 2009).

Increasing dioxide uptake in oceans is expected to alter carbonate chemistry of seawater, with potentially negative consequences for many calcifying marine organisms. Griffith et al. (2012) modelled different levels of ocean acidification and fisheries exploitation for 61 groups of

species including the southern right whale that occur within the southeast Australian marine ecosystem. Both additive and synergistic effects could potentially cause restructuring of the pelagic and demersal food webs by 2040 with significant synergistic effects by 2050.

Krill abundance in the south Atlantic has been linked to sea surface temperature (SST). Climate models indicate that a rate of increase of 1°C in mean SST in the western South Atlantic over the next 100 years could reduce Antarctic krill abundance by 95% (Murphy et al. 2007). Ecosystem processes in the Scotia Sea respond to variability in the ENSO and Southern Annular Mode, which affect krill abundance (Trathan et al. 2007, 2012). Further, variability in these oceanic processes is increasing. Declines in krill abundance has been linked to the spatial extent and duration of sea ice, which provides habitat for the early life-history stages of krill. However, recovery of top-down krill predators such as the southern right whale also affect krill abundance. Climate change could exacerbate changes in krill abundance in light of increased predation pressure (Trathan and Reid 2009). Decreases in krill abundance could devastate krill predators including the southern right whale, which may not be able to switch to other prey species (Trathan et al. 2007). As discussed earlier, reproductive failure at Península Valdés, Argentina, increased in years following elevated sea surface temperatures off South Georgia, indicating reduced prey availability may have led to poor nutritional status in pregnant females (Leaper et al. 2006; Valenzuela et al 2009).

Summary
Ship strikes and entanglement in fishing gear result in southern right whale deaths. Despite current levels of ship strikes and entanglements, wintering populations at the primary calving grounds (South Africa, Argentina, Australia, and subantarctic New Zealand) are recorded as increasing at annual rates of nearly 7%. However, the frequency of adverse events will likely increase as nations continue to develop their coastlines and as the southern right whale repopulates sections of its historical range. Little information on anthropogenic noise effects on southern right whales exists. However, whale sound production may change in the presence of vessel noise. Although it is unknown whether climate change is currently affecting southern right whales, the possible collapse of krill populations in the South Atlantic due to warming temperatures and loss of sea ice could have major consequences for the southern right whale, which may not be able to switch to other prey species, leading to nutritional stress and lowered reproductive success. For these reasons, threats from other natural or manmade factors may affect the southern right whales' continued existence.

2.4 Synthesis:

Commercial whaling in the 18th, 19th and 20th century significantly reduced the global population of southern right whales. According to the most recent estimate, worldwide abundance of the southern right whale was about 15,000 in 2010 (Bannister 2010; Brandão et al. 2010c; IWC 2012b), which is more than double (7,000 in 1997) the abundance reported in the last 5-year review (NMFS 2007). The best available science indicates the southern right whale is exhibiting signs of improvement both worldwide and on a regional basis. Some breeding stocks have been recovering at annual rates of about 7% (Bannister 2001; Best et al. 2001a; Cooke et al. 2001; IWC 2012b; Patenaude 2003). Significant population increases have been observed in waters off South America, South Africa, Australia, and subantarctic New Zealand. In addition, the species appears to be re-populating its historical range in waters off Australia, mainland New Zealand,

and along the entrance of the Magellan Strait. However, despite reported population increases in Argentina, calf mortality is increasing and may be surpassing the population growth rate. Finally, the current overall population size represents only a fraction of the historical abundance, which was estimated to be about 60,000 (IWC 2001).

The southern right whale continues to face a number of threats throughout its range. Ship strikes, entanglement in fishing gear, coastal development, kelp gull harassment (including infectious disease transmission), and climate change are threats that could affect the recovery of right whales. Despite these threats, wintering populations at primary calving grounds (South Africa, Argentina, Australia, subantarctic New Zealand) are increasing, which indicates that current threats are not impacting population growth. However, the frequency of these threats will likely increase as nations continue to develop their coastlines and as the southern right whale repopulates sections of its historic range. Changes in ocean conditions caused by climate change may pose a significant threat to southern right whales in the future by decreasing prey availability.

Southern right whales are protected and managed under a variety of international, national, provincial, and state laws and policies. Within territorial waters, the level of protection and enforcement varies from comprehensive to nonexistent. While the majority of countries have established national legislation prohibiting the take of southern right whales, many lack comprehensive management or recovery plans for the conservation of right whales and their habitat. A variety of MPAs have been created in the Southern Hemisphere to protect southern right whales. These include the prime calving grounds around Península Valdés (Argentina), Walker Bay (South Africa) and Head of the Bight (South Australia). However, many of the these MPAs lack management plans, adequate staffing, funding and enforcement capabilities and it is difficult to assess whether these areas are effective in conserving and protecting southern right whale habitat, or their overall objectives may be ill-defined.

In summary, southern right whales have exhibited substantial increases in abundance and are repopulating historical areas. Although still a fraction of its historical abundance, the population in 2010 was estimated to be 15,000, which is more than double the abundance reported in the previous 5-year review (in 2007). The former main threat, directed harvest, has been eliminated. Other threats remain, but are not currently affecting population abundance and trends. Increasing threats such as coastal development, vessel traffic, and climate change may affect long-term recovery. For these reasons, we conclude the southern right whale is not currently in danger of extinction throughout all or a significant portion of its range, but is likely to become so within the foreseeable future.

3.0 RESULTS

3.1 Recommended Classification:

___X_ Downlist to Threatened
____ Uplist to Endangered

____ Delist
__ __No change is needed

3.2 New Recovery Priority Number: NA

3.3 Listing and Reclassification Priority Number: 6

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

This 5-year review indicates that, based on a review of the best available scientific and commercial information, that the southern right whale should be downlisted from endangered to threatened. If feasible within the context of agency resources and priorities, we recommend the agency commence a rulemaking at some point in the future to reclassify the southern right whale from endangered to threatened

Further, NMFS recommends additional and continued research to improve upon available information regarding southern right whales, focusing on the following areas:

- Determine gene flow between putative breeding stocks using microsatellites and other genetic markers.
- Improve understanding of the feeding distribution throughout the subantarctic range.
- Determine migratory movements and location of key habitats and improve understanding of known populations using isotopic analysis and satellite tagging.
- Document ongoing reoccupation of historic range in areas near Brazil, Madagascar, Namibia, Uruguay and other regions.
- Assess long-term threat of habitat degradation caused by climate change and coastal/marine development.
- Develop estimates of pre-exploitation population size and recovery rates on a stock-by-stock basis, where possible, through various modeling studies.
- Assess impact and threat of disease on population recovery.

Lastly, NMFS recommends that nations with jurisdiction over waters where southern right whale populations or habitats are known to occur continue to manage the species under their current regulatory mechanisms, and, where these mechanisms are lacking or inadequate (e.g., increased enforcement of whale watching activities in Argentina; comprehensive conservation plans for Marine Protected Areas in South Africa), take actions to improve the protection of southern right whales within their territorial waters.

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
Eubalaena australis

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

___X_ Downlist to Threatened
____ Uplist to Endangered
____ Delist
___ No change is needed

Review Conducted By: Therese Conant. Office of Protected Resources, Silver Spring, MD.

HEADQUARTERS APPROVAL:
Director, Office of Protected Resources

Approve: PERRY GAYARDO Date: _____
for Donna S. Wieting

Assistant Administrator, NOAA Fisheries

✓ Concur ____ Do Not Concur

Signature: _____ Date: 10/21/15

✓ Eileen Sobeck,
Assistant Administrator for Fisheries,
National Marine Fisheries Service