BRYDE'S WHALE (*Balaenoptera edeni*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bryde's whales are distributed worldwide in tropical and sub-tropical waters. In the western Atlantic Ocean, Bryde's whales are reported from off the southeastern United States and the southern West Indies to Cabo Frio, Brazil (Leatherwood and Reeves 1983). Most of the sighting records of Bryde's whales in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) are from NMFS abundance surveys that were conducted during the spring (Figure 1; Hansen *et al.* 1995, 1996; Mullin and Hoggard 2000; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). However, there are stranding records from throughout the year (Würsig *et al.* 2000).

Although there are no confirmed records from Gulf of Mexico waters beyond U.S. boundaries, Bryde's whales may occur in other parts of the Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico.

It has been postulated that the Bryde's whales found in the northern Gulf of Mexico may represent a resident stock (Schmidly 1981; Leatherwood and Reeves 1983), but there is no information on stock differentiation. The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The best abundance estimate available for northern Gulf of Mexico Bryde's whales is 33 (CV=1.07; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

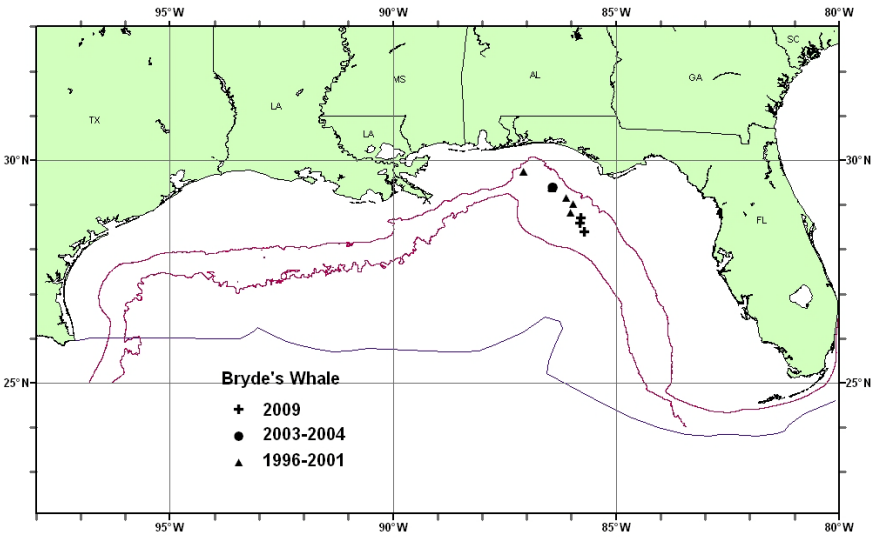

Figure 1. *Distribution of Bryde's whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of Bryde's whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 35 (CV=1.10) (Hansen *et al.* 1995), and for 1996 to 2001, 40 (CV=0.61) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for Bryde's whales, pooled

from 2003 to 2004, was 15 (CV=1.98) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for Bryde's whales in oceanic waters during 2009 was 33 (CV=1.07; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico Bryde's whales. Month, year and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Apr-Jun 1991-1994	Oceanic waters	35	1.10
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	40	0.61
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	15	1.98
Jun-Aug 2009	Oceanic waters	33	1.07

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Bryde's whales is 33 (CV=1.07). The minimum population estimate for the northern Gulf of Mexico is 16 Bryde's whales.

Current Population Trend

Four point estimates of Bryde's whale abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of nearly three but the precision of the estimates is very poor. The vast majority of the small number of Bryde's whale sightings from each survey occurred in a very restricted area of the northeastern Gulf (Figure 1) during surveys that uniformly sampled the entire oceanic northern Gulf. Because the population size is small, in order to effectively monitor trends in Bryde's whale abundance in the future, other methods need to be used, such as line-transect surveys that focus fine scale survey effort specifically on the area they inhabit or mark-recapture studies. Additionally, whales need to be satellite tagged to determine whether they use this area exclusively or travel to other areas.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 16. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Bryde's whale is 0.16.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Annual human-caused mortality and serious injury is unknown for this stock. There is no documented mortality or serious injury associated with commercial fishing. During 2009 there was 1 known Bryde's whale mortality as a result of a ship strike. For the period 2006 through 2010, the minimum annual rate of human-caused mortality and serious injury to Bryde's whales due to ship strikes was 0.2 per year. Detected mortalities should not be considered an unbiased representation of human-caused mortality. Detections are haphazard and not the result of a designed

sampling scheme. As such they represent a minimum estimate of human-caused mortality which is almost certainly biased low.

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There has been no reported fishing-related mortality or serious injury of a Bryde's whale by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

There were 2 reported strandings of Bryde's whales in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). During 2009 a Bryde's whale was found floating in the Port of Tampa (Florida). The whale had evidence of premortem and postmortem blunt trauma, and was determined to have been struck by a ship, draped across the bow and carried into port. The whale was a lactating female and measured 12.65m in length. One Bryde's whale calf live-stranded in Sandestin, Florida, during November 2006. No evidence of human interaction was detected for this stranded animal. Stranding data probably underestimate the extent of human-caused mortality and serious injury because not all of the marine mammals which die or are seriously injured from human interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of vessel collision, entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interactions.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans,the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. For large whales, oil can

foul the baleen they use to filter-feed. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

STATUS OF STOCK

The status of Bryde's whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this stock. Total human-caused mortality and serious injury for this stock is not known but one human-caused mortality was documented during 2009. This is a strategic stock because the average annual human-caused mortality and serious injury exceeds PBR.

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