GRAY WHALE (*Eschrichtius robustus*): Western North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Gray whales occur along the eastern and western margins of the North Pacific. In the western North Pacific (WNP), gray whales feed during summer and fall in the Okhotsk Sea off northeast Sakhalin Island, Russia, and off southeastern Kamchatka in the Bering Sea (Weller et al. 1999, 2002; Vertyankin et al. 2004; Tyurneva et al. 2010; Burdin et al. 2013; Figure 1). Some gray whales observed feeding off Sakhalin and Kamchatka migrate during the winter to the west coast of North America in the eastern North Pacific (Mate et al. 2011; Weller et al. 2012; Urbán *et al*. 2013), while others, including at least one whale first identified as a calf off Sakhalin, migrate to areas off Asia in the WNP (Weller et al. 2008; Weller et al. 2013a). Despite the observed movements between the WNP and eastern North Pacific (ENP), genetic comparisons show significant mitochondrial and nuclear genetic differences between whales sampled in the ENP and those sampled on the feeding ground off Sakhalin Island in the WNP (LeDuc et al. 2002; Lang et al. 2011). While a few previously unidentified non-calves are identified annually, a recent population assessment using photo-identification data from 1994 to 2011 fitted to an individually-based model found that whales feeding off Sakhalin Island have been demographically self-contained, at least in recent years, as new recruitment to the population is almost exclusively a result of calves born to mothers from within the group (Cooke et al. 2013).

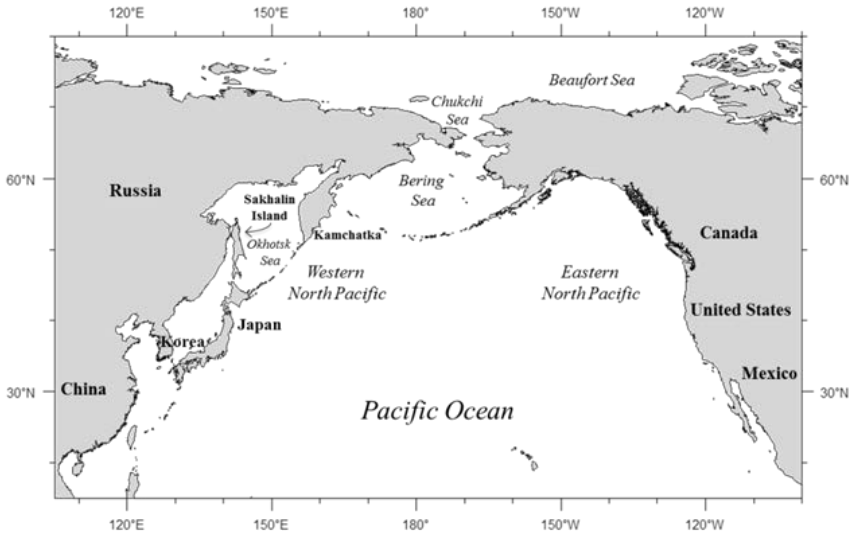

Figure 1. Range map of the Western North Pacific Stock of gray whales, including summering areas off Russia and wintering areas in the western and eastern Pacific.

Historical evidence indicates that the coastal waters of eastern Russia, the Korean Peninsula and Japan were once part of the migratory route in the WNP and that areas in the South China Sea may have been used as wintering grounds (Weller et al. 2002; Weller et al. 2013a). However, contemporary records of gray whales off Asia are rare, with only 13 from Japanese waters between 1990 and 2007 (Nambu *et al*. 2010) and 24 from Chinese waters since 1933 (Wang 1984; Zhu 2002). The last known record of a gray whale off Korea was in 1977 (Park 1995; Kim et al. 2013). While recent observations of gray whales off the coast of Asia are infrequent, they nevertheless continue to occur, including: (1) March/April 2014 - one or possibly two gray whales were sighted and photographed off the Shinano River in Teradomari (Niigata Prefecture) on the Sea of Japan coast of Honshu, Japan (Kato et al. 2014), (2) March 2012 - a gray whale was sighted and photographed in Mikawa Bay (Aichi Prefecture), on the Pacific coast of Honshu, Japan (Kato *et al*. 2012), and (3) November 2011 - a 13 m female gray whale was taken in fishing gear offshore of Baiqingxiang, China, in the Taiwan Strait (Zhu 2012).

Information from tagging, photo-identification and genetic studies show that some whales identified in the WNP off Russia have been observed in the ENP, including coastal waters of Canada, the U.S. and Mexico (Lang 2010; Mate et al. 2011; Weller et al. 2012; Urbán et al. 2013, Mate et al. 2015). In combination, these studies have recorded a total of 27 gray whales observed in both the WNP and ENP. Some whales that feed off Sakhalin Island in summer migrate east across the Pacific to the west coast of North America in winter, while others migrate south to waters off Japan and China. Taken together, these observations indicate that not all gray whales in the WNP share a common wintering ground (Weller et al. 2013a).

In 2012, the National Marine Fisheries Service convened a scientific task force to appraise the currently recognized and emerging stock structure of gray whales in the North Pacific (Weller et al. 2013b). The charge of the

task force was to evaluate gray whale stock structure as defined under the Marine Mammal Protection Act (MMPA) and implemented through the National Marine Fisheries Service's Guidelines for Assessing Marine Mammal Stocks (GAMMS; NMFS 2005). Significant differences in both mitochondrial and nuclear DNA between whales sampled off Sakhalin Island (WNP) and whales sampled in the ENP provided convincing evidence that resulted in the task force advising that WNP gray whales should be recognized as a population stock under the MMPA and GAMMS guidelines. Given the interchange of some whales between the WNP and ENP, including seasonal occurrence of WNP whales in U.S. waters, the task force agreed that a stand-alone WNP gray whale population stock assessment report was warranted.

POPULATION SIZE

Photo-identification data collected between 1994 and 2011 on the gray whale summer feeding ground off Sakhalin Island in the WNP were used to calculate an abundance estimate of 140 (SE = ± 6, CV=0.043) whales for the age 1-plus (non-calf) population size in 2012 (Cooke et al. 2013). Some whales (approximately 70 individuals) sighted during the summer off southeastern Kamchatka have not been sighted off Sakhalin Island, but it is as yet unclear whether those whales are part of the WNP stock (IWC 2014).

Minimum Population Estimate

The minimum population estimate (N_{min}) for the WNP stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{min} = N/\exp(0.842\times[\ln(1 +[CV(N)]^2)]½)$ and the abundance estimate of 140 (CV=0.043) whales from Cooke et al. (2013), resulting in a minimum population estimate of 135 gray whales on the summer feeding ground off Sakhalin Island in the WNP.

Current Population Trend

The WNP gray whale stock has increased over the last 10 years (2002-2012). The estimated realized average annual rate of population increase during this period is 3.3% per annum (± 0.5%) (Cooke et al. 2013).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

An analysis of the ENP gray whale population led to an estimate of R_{max} of 0.062, with a 90% probability the value was between 0.032 and 0.088 (Punt and Wade 2012). This value of R_{max} is also applied to WNP gray whales, as it is currently the best estimate of R_{max} available for any gray whale population.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (135), times one-half the estimated maximum annual growth rate for a gray whale population (½ of 6.2% for the Eastern North Pacific Stock, Punt and Wade 2012), times a recovery factor of 0.1 (for an endangered stock with N_{min} < 1,500, Taylor et al. 2003), and also multiplied by estimates for the proportion of the stock that uses U.S. EEZ waters (0.575) and the proportion of the year that those animals are in the U.S. EEZ (3 months, or 0.25 years) (Moore and Weller 2013), resulting in a PBR of 0.06 WNP gray whales per year, or approximately 1 whale every 17 years (if abundance and other parameters in the PBR equation remained constant over that time period).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguis serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "injury that is more likely than not to result in mortality".

Fisheries Information

The decline of gray whales in the WNP is attributable to commercial hunting off Korea and Japan between the 1890s and 1960s. The pre-exploitation abundance of WNP gray whales is unknown, but has been estimated to be between 1,500 and 10,000 individuals (Yablokov and Bogoslovskaya 1984). By 1910, after some commercial exploitation had already occurred, it is estimated that only 1,000 to 1,500 gray whales remained in the WNP population (Berzin and Vladimirov 1981). The basis for how these two estimates were derived, however, is not apparent (Weller et al. 2002). By the 1930s, gray whales in the WNP were considered by many to be extinct (Mizue 1951; Bowen 1974).

Today, a significant threat to gray whales in the WNP is incidental catches in coastal net fisheries (Weller

et al. 2002; Kato et al. 2012; Weller et al. 2008; Weller et al. 2013a). Between 2005 and 2007, four female gray whales (including one mother-calf pair and one yearling) died in fishing nets on the Pacific coast of Japan. In addition, one adult female gray whale died as a result of a fisheries interaction in November 2011 off Pingtan County, China (Zhu 2012). An analysis of anthropogenic scarring of gray whales photographed off Sakhalin Island found that at least 18.7% (n=28) of 150 individuals identified between 1994 and 2005 had evidence of previous entanglements in fishing gear (Bradford et al. 2009), further highlighting the overall risks coastal fisheries pose to WNP gray whales.

In summer 2013, salmon net fishing was observed for the first time on the gray whale feeding ground off Sakhalin Island. Observations of whales within 100 m of salmon fishing nets have been made and a male gray whale was observed dragging fishing gear (rope), with a related injury on the caudal peduncle at the dorsal insertion point with the flukes (Weller et al. 2014).

Given that some WNP gray whales occur in U.S. waters, there is some probability of WNP gray whales being killed or injured by ship strikes or entangled in fishing gear within U.S. waters.

Subsistence/Native Harvest Information

In 2005, the Makah Indian Tribe requested authorization from NOAA/NMFS, under the Marine Mammal Protection Act of 1972 (MMPA) and the Whaling Convention Act, to resume limited hunting of gray whales for ceremonial and subsistence purposes in the coastal portion of their usual and accustomed (U&A) fishing grounds off Washington State (NOAA 2008). Observations of gray whales moving between the WNP and ENP highlight the need to estimate the probability of a gray whale observed in the WNP being taken during a hunt by the Makah Tribe (Moore and Weller 2013). Given conservation concerns for the WNP population, the Scientific Committee of the International Whaling Commission (IWC) emphasized the need to estimate the probability of a WNP gray whale being struck during aboriginal gray whale hunts (IWC 2012). Additionally, NOAA is required by the National Environmental Policy Act (NEPA) to prepare an Environmental Impact Statement (EIS) pertaining to the Makah's request. The EIS needs to address the likelihood of a WNP whale being taken during the proposed Makah gray whale hunt.

To estimate the probability that a WNP whale might be taken during the proposed Makah gray whale hunt, four alternative models were evaluated. These models made different assumptions about the proportion of WNP whales that would be available for the hunt or utilized different types of data to inform the probability of a WNP whale being taken (Moore and Weller 2013). Based on the preferred model, the probability of striking at least one WNP whale in a single year was estimated to range from 0.006 – 0.012 across different scenarios for the annual number of total gray whales that might be struck. This corresponds to an expectation of ≥ 1 WNP whale strike in one of every 83 to 167 years.

HABITAT CONCERNS

Near shore industrialization and shipping congestion throughout the migratory corridors of the WNP gray whale stock represent risks by increasing the likelihood of exposure to pollutants and ship strikes as well as a general degradation of the habitat. In addition, the summer feeding area off Sakhalin Island is a region rich with offshore oil and gas reserves. Two major offshore oil and gas projects now directly overlap or are in near proximity to this important feeding area, and more development is planned in other parts of the Okhotsk Sea that include the migratory routes of these whales. Operations of this nature have introduced new sources of underwater noise, including seismic surveys, increased shipping traffic, habitat modification, and risks associated with oil spills (Weller et al. 2002). During the past decade, a Western Gray Whale Advisory Panel, convened by the International Union for Conservation of Nature (IUCN), has been providing scientific advice on the matter of anthropogenic threats to gray whales in the WNP (see http://www.iucn.org/wgwap/). Ocean acidification could reduce the abundance of shell-forming organisms (Fabry et al. 2008, Hall-Spencer et al. 2008), many of which are important in the gray whales' diet (Nerini 1984).

STATUS OF STOCK

The WNP stock is listed as "Endangered" under the U.S. Endangered Species Act of 1973 (ESA) and is therefore also considered "strategic" and "depleted" under the MMPA. At the time the ENP stock was delisted, the WNP stock was thought to be geographically isolated from the ENP stock. Recent documentation of some whales moving between the WNP and ENP seems to indicate otherwise (Lang 2010; Mate et al. 2011; Weller et al. 2012; Urbán et al. 2013). Other research findings, however, provide continued support for identifying two separate stocks of North Pacific gray whales, including: (1) significant mitochondrial and nuclear genetic differences between whales that feed in the WNP and those that feed in the ENP (LeDuc et al. 2002; Lang et al. 2011), (2) recruitment

into the WNP stock is almost exclusively internal (Cooke et al. 2013), and (3) the abundance of the WNP stock remains low while the abundance of the ENP stock grew steadily following the end of commercial whaling (Cooke et al. 2013). As long as the WNP stock remains listed as endangered under the ESA, it will continue to be considered as depleted under the MMPA.

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