Revised 1/19/2011

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Gray whales formerly occurred in the North Atlantic Ocean (Fraser 1970, Mead and Mitchell 1984), but this species is currently found only in the North Pacific (Rice et al. 1984, Swartz et al. 2006). The following information was considered in classifying stock structure of gray whales based on the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: two isolated geographic distributions in the North Pacific Ocean; 2) Population response data: the eastern North Pacific population has increased, and no evident increase in the western North Pacific; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, two stocks have been recognized in the North Pacific: the Eastern North Pacific stock, which lives along the west coast of North America (Fig. 35), and the Western North Pacific or "Korean" stock, which lives along the coast of eastern Asia (Rice 1981, Rice et al. 1984, Swartz et al. 2006).

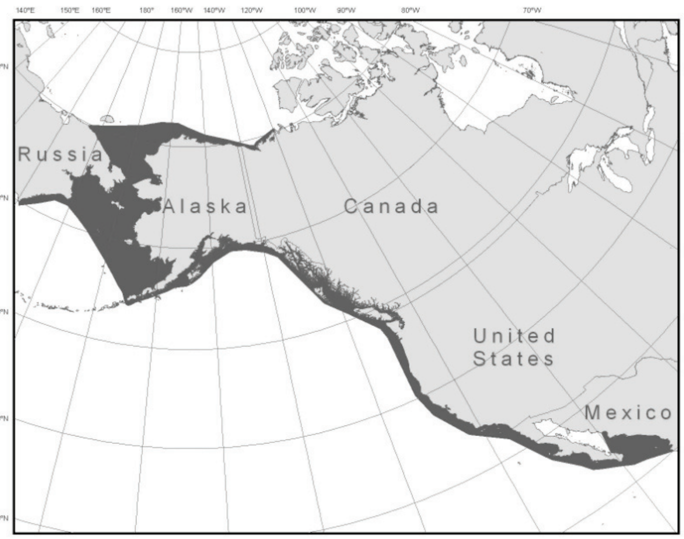

Figure 35. Approximate distribution of the Eastern North Pacific stock of gray whales (shaded area).

Most of the Eastern North Pacific stock spends the summer feeding in the northern and western Bering and Chukchi Seas (Rice and Wolman 1971, Berzin 1984, Nerini 1984). However, gray whales have been reported feeding in the summer in waters near Kodiak Island, Southeast Alaska, British Columbia, Washington, Oregon, and California (Rice and Wolman 1971, Darling 1984, Nerini 1984, Rice et al. 1984, Moore et al. 2007). Photo-identification studies of these animals indicate that they move widely within and between areas on the Pacific coast, are not always observed in the same area each year, and may have several year gaps between resightings in studied areas (Calambokidis and Quan 1999, Quan 2000, Calambokidis et al. 2002, Calambokidis et al. 2004). The so-called "Pacific coast feeding aggregation" defines one of the areas where feeding groups occur. While some animals in this group demonstrate some site-fidelity, available information from sighting records (Calambokidis and Quan 1999, Quan 2000) and genetics (Ramakrishnan et al. 2001, Steeves 1998) indicates that this group is a component of the eastern North Pacific population and is not an isolated population unit. Each fall, the whales migrate south along the coast of North America from Alaska to Baja California, in Mexico (Rice and Wolman 1971), most of them starting in November or December (Rugh et al. 2001). The Eastern North Pacific stock winters mainly along the west coast of Baja California, using certain shallow, nearly landlocked lagoons and bays, and calves are born from early January to mid-February (Rice et al. 1981), often seen on the migration well north of Mexico (Shelden et al. 2004). The northbound migration generally begins in mid-February and continues through May (Rice et al. 1981, Rice et al. 1984; Poole 1984a), with cows and newborn calves migrating northward primarily between March and June along the U.S. West Coast.

POPULATION SIZE

Systematic counts of gray whales migrating south along the central California coast have been conducted by shore-based observers at Granite Canyon most years since 1967 (Fig. 36). The most recent southbound counts were made during the 2000/01, 2001/02, and 2006/07. Recently, Rugh et al. (2008a) evaluated the accuracy of various components of the shore-based survey method, with a focus on pod size estimation. They found that the correction factors that had been used to compensate for bias in pod size estimates have been calculated differently for different sets of years. In particular, the correction factors estimated by Laake et al. (1994) were substantially larger than those estimated by Reilly (1981). The pod size corrections of Reilly (1981) were used for the 1987/88 abundance estimate and the surveys prior to 1987 in the trend analysis were scaled based on the abundance estimate from 1987/88. The larger pod size correction factors of Laake (1992) were used for all of the surveys after 1987/88. This meant that the first 16 abundance estimates used one set of correction factors, and the more recent seven abundance estimates used different (and larger) correction factors which would influence the estimated trend and population trajectory. In addition, there have been other subtle differences in the analysis methods used for the sequence of abundance estimates. Thus, a re-evaluation of the analysis techniques and a reanalysis of the abundance estimates were warranted to apply a more uniform approach throughout the years. Laake et al. (2009) developed a more consistent, approach to abundance estimation that used a better model for pod size bias with weaker assumptions. They applied their estimation approach to re-estimate abundance for all 23 surveys; therefore, the abundance estimates presented here are different from those presented in previous Stock Assessment Reports.

The new abundance estimates between 1967 and 1987 were generally larger than previous abundance estimates; differences by year between the new abundance estimate and the old estimate range from -2.5% to 21%. However, the opposite was the case for survey years 1992 to 2006, with estimates smaller (-4.9% to -29%) than previous estimates. This pattern is largely explained by the differences in the correction for pod size bias which occurred because the pod sizes in the calibration data over-represented pods of two or more whales and underrepresented single whales relative to the estimated true pod size distribution. Re-evaluation of the correction for pod size bias and the other changes made to the estimation procedure yielded a somewhat different trajectory for population growth. The estimates still show the population increased steadily from the 1960s until the 1980s. Previously, the peak abundance estimate was in 1998 followed by a large drop in numbers (Rugh et al. 2008a). Now the peak estimate is a decade earlier in 1987/88. The revised estimates for the most recent years are 16,369 (CV=6.1%) in 2000/01, 16,033 (CV=6.9%) in 2001/02, and 19,126 (CV=7.1%) in 2006/07. Revised estimates from the three years prior are 20,103 (CV=5.6%) in 1993-94, 20,944 (CV=6.1%) in 1995-96, and 21,135 (CV=6.8%) in 1997-98 (Laake et al. 2009).

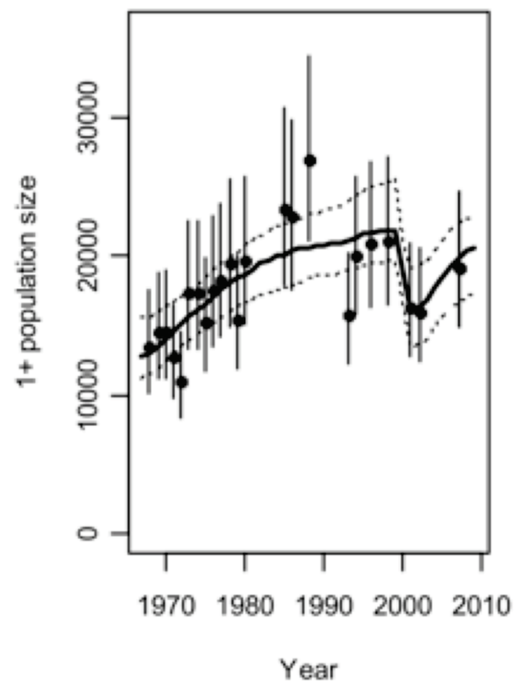

Figure 36. Estimated abundance of Eastern North Pacific gray whales from NMFS counts of migrating whales past Granite Canyon, California. Error bars indicated 90% probability intervals. The solid line represents the estimated trend of the population with 90% intervals as dashed lines (after Punt and Wade 2010).

The Eastern North Pacific population of gray whales experienced an unusual mortality event in 1999 and 2000. An unusually high number of gray whales were stranded along the west coast of North America in those years (Moore et al. 2001, Gulland et al. 2005). Over 60% of the dead whales were adults, and more adults and subadults stranded in 1999 and 2000 relative to the years prior to the mortality event (1996-98), when calf strandings were more common. Many of the stranded whales were in an emaciated condition, and aerial photogrammetry documented that gray whales were skinnier in girth in 1999 relative to previous years (Perryman and Lynn, 2002). In addition, calf production in 1999 and 2000 was less than 1/3 of that in the previous years (1996-98). Several factors since this mortality event suggest that the high mortality rate was a short-term, acute event and not a chronic situation or trend: 1) in 2001 and 2002, strandings of gray whales along the coast decreased to levels that were below their pre-1999 level (Gulland et al. 2005), 2) average calf production in 2002-2004 returned to the level seen in pre-1999 years, and 3) in 2001 living whales no longer appeared to be emaciated. A Working Group on Marine Mammal Unusual Mortality Events (Gulland et al. 2005) concluded that the emaciated condition of many of the stranded whales supported the idea that starvation could have been a significant contributing factor to the higher number of strandings in 1999 and 2000. Perryman et al. (2002) found a significant positive correlation between an index of the amount of ice-free area in gray whale feeding areas in the Bering Sea and their estimates of calf production for the following spring; the suggested mechanism is that more open water for a longer period of time provides greater feeding opportunities for gray whales. Unusual oceanographic conditions in 1997 may also have decreased productivity in the region (Minobe 2002). Regardless of the mechanism, visibly emaciated whales (LeBoeuf et al. 2000, Moore et al. 2001) suggest a decline in the availability of food resources, and it is clear that Eastern North Pacific gray whales were substantially affected in those years; whales were on average skinnier, they had a lower survival rate (particularly of adults), and calf production was dramatically lower. A modeling analysis estimates that 15.3% of the non-calf population died in each of the years of the mortality event, compared to about 2% in a normal year (Punt and Wade 2010). The most recent abundance estimate from 2006/07 suggests the population has nearly increased back up to the level seen in the 1990s before the mortality event in 1999 and 2000 (Fig. 36).

Gray whale calves were counted from Piedras Blancas, a shore site in central California, in 1980-81 (Poole 1984a) and each year since 1994 (Perryman et al. 2002, 2004). In 1980 and 1981, calves passing this site comprised 4.7% to 5.2% of the population (Poole 1984b). From 1994-2000, calf production indices (calf estimate/total population estimate) were 4.2%, 2.7%, 4.8%, 5.8%, 5.5%, 1.7% and 1.1%, respectively (Perryman et al. 2002), and in 2004 the index was 9% (Perryman et al. 2004). Gray whale calves have also been counted from shore stations along the California coast during the southbound migration (Shelden et al. 2004). Those results have indicated significant increases in average annual calf counts near San Diego in the mid- to late-1970s compared to the 1950s and 1960s, and near Carmel in the mid-1980s through 2002 compared to late-1960s through 1980 (Shelden et al. 2004. This increase may be related to a trend toward later migrations over the observation period (Rugh et al. 2001, Buckland and Breiwick 2002), or it may be due to an increase in spatial and temporal distribution of calving as the population increased (Shelden et al. 2004).

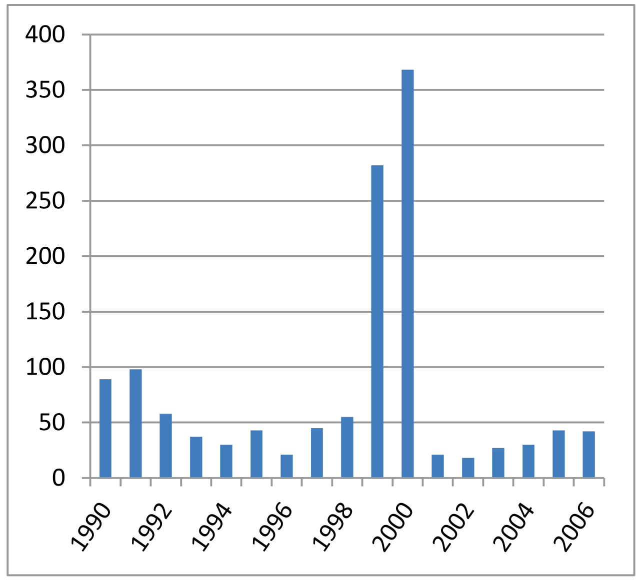

Figure 37. Number of stranded gray whales recorded along the west coast of North America between 1990 and 2006 (data from Brownell et al. 2007).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1 + [CV(N)]^2)]^{½})$. Using the 2006/07 abundance estimate of 19,126 and its associated CV of 0.071, N_{MIN} for this stock is 18,017.

Current Population Trend

The population size of the Eastern North Pacific gray whale stock has been increasing over the past several decades despite an unusual mortality event in 1999 and 2000. The estimated annual rate of increase, based on the unrevised abundance estimates between 1967 and 1988, is 3.3% with a standard error of 0.44% (Buckland et al. 1993); using the revised abundance time series from Laake et al. (2009) leads to an annual rate of increase for that same period of 3.2% with a standard error of 0.5% (Punt and Wade 2010).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The abundance time-series has been revised (Laake et al. 2009), so estimates of productivity rates must be based on the revised time-series. Using abundance data through 2006/07, an analysis of the Eastern North Pacific 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 2010). This estimate came from the best fitting age- and sex-structured model, which was a density-dependent Leslie model including an additional variance term, with females and males modeled separately, that accounted for the mortality event in 1999-2000. NMFS has decided to use the lower 10th percentile of that estimate of 0.040. This has the interpretation that there is a 90% probability that the true value of R_{max} is greater than 0.040. Therefore, the R_{max} for Eastern North Pacific gray whales is the same as the default value of 0.04. Therefore, NMFS will use an R_{max} of 0.040.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0, the value for a stock estimated to be above MNPL and therefore not depleted. Thus, for the Eastern North Pacific stock of gray whales, PBR = 360 animals (18,017 × 0.02 × 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

In previous stock assessments, there were six different observed federal commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of gray whales. In 2004, the definitions of these commercial fisheries were changed to reflect target species: these new definitions have resulted in the identification of 22 observed fisheries in the Gulf of Alaska and Bering Sea that use trawl, longline, or pot gear (69 FR 70094, 2 December 2004). There were no observed serious injuries or mortalities of gray whales in any of those fisheries.

NMFS observers monitored the northern Washington marine set gillnet fishery (coastal + inland waters), otherwise known as the Makah tribal fishery for Chinook salmon, during 1990-98 and in 2000. There was no observer coverage in this fishery in 1999; however, the total fishing effort was only four net days (in inland waters), and no marine mammals were reported taken. One gray whale was observed taken in 1990 (Gearin et al. 1994) and one in 1995 (P. Gearin, AFSC-NMML, unpubl. data). In July of 1996, one gray whale was entangled in the same tribal set gillnet fishery, but it was released unharmed (P. Gearin, AFSC-NMML, pers. comm.). Data from the most recent 5 years indicates that no gray whales were seriously injured or killed incidental to this fishery.

NMFS observers monitored the California/Oregon thresher shark/swordfish drift gillnet fishery from 1993 to 2003 (Table 33; Julian 1997; Cameron 1998; Julian and Beeson 1998; Cameron and Forney 1999, 2000; Carretta 2001, 2002; Carretta and Chivers 2003, 2004). One gray whale mortality was observed in this fishery in both 1998 and 1999. Overall entanglement rates in the California/Oregon thresher shark/swordfish drift gillnet fishery dropped considerably after the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders on buoy lines (Barlow and Cameron 1999). Data from the most recent 5 years indicates that no gray whales were seriously injured or killed incidental to this fishery.

It should be noted that no observers have been assigned to most Alaska gillnet fisheries, including those in Bristol Bay that are known to interact with this stock, making the estimated mortality from U.S. fisheries a minimum figure. Further, due to a lack of observer programs there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries, which are analogous to U.S. fisheries that are known to interact with gray whales. Data regarding the level of gray whale mortality related to commercial fisheries in Canadian waters, though thought to be small, are not readily available or reliable which results in an underestimate of the annual mortality for this stock. However, the large stock size and observed rate of increase over the past 20 years makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to U. S. commercial fisheries (6.7 whales) is not known to exceed 10% of the PBR (44.2) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.

Table 33. Summary of incidental mortality of Eastern North Pacific gray whales due to commercial fisheries from 2003-2007 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from stranding data. Data from 2003-2007 (or the most recent 5 years of available data) are used in the mortality calculation. N/A indicates that data are not available.

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Unknown west coast fisheries	2003-2007	strand data	N/A	N/A, 1, 1, 1, 0	N/A	[≥0.6]
AK salmon purse seine	1999-2003	strand data	N/A	1, N/A, N/A, N/A, N/A	N/A	[≥0.5]
Pot fisheries	2003-2007	strand data	N/A	3, 0, 0, 1, 0	N/A	[≥0.8]

Fishery name	Years	Data type	Observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
CA yellowtail/ barracuda/white seabass gillnet fishery	1999-2003	strand data	N/A	N/A, 1, N/A, N/A, N/A	N/A	[≥0.2]
Other entanglements	1999-2003	strand data	N/A	1, 2, N/A, 2, 1	N/A	[≥1.2]
Minimum total annual mortality						≥3.3

Strandings and Entanglements

Reports of entangled gray whales found swimming, floating, or stranded with fishing gear attached occur along the U.S. west coast and British Columbia. Details of strandings that occurred in 1993-95 and 1996-98 in the United States and British Columbia are described in Hill and DeMaster (1999) and Angliss et al. (2002), respectively. Table 34 presents data on strandings that occurred on the U. S. west coast from 2005 to 2009; . The strandings resulting from commercial fishing are listed as unknown west coast fisheries in Table 34, unless they could be attributed to particular fisheries. During the 5-year period from 2005 to 2009, stranding network data indicate a minimum annual mean of 2.4 gray whale mortalities resulting from interactions with commercial fishing gear.

Table 34. Human-related gray whale strandings and entanglements, 2005-2009. An asterisk in the "number" column indicates cases that were not considered serious injuries. Note: NMFS convened a workshop in 2007 to review and update the guidelines for what constitutes "serious injury". Changes to the agency's guidelines resulting from this workshop may affect whether injured animals identified are considered "seriously injured" in future SARs.

Year	Number	Area	Condition	Description
2005	1	Grayland, WA	Dead	Entanglement lines on head
2005	1	Horsefall Beach, OR	Dead	Entanglement; fishing line wrapped around animal
2006	1	Grays Harbor, WA	Dead	Entangled in crab pot; rope wrapped around fluke, tailstock, mid-body, and through baleen; rope scarring on head and left side
2006	1	San Francisco Bay, CA	Dead	Fresh floating carcass; propeller wounds evident
2006	1	Cape Lookout, OR	Live	Entangled whale observed from shore; netting over rostrum and trailing long line (8-10 times length of animal) and 2 bright orange floats
2006	1	Lakeside, OR	Live/ Dead	Calf initially sighted alive entangled with crab pot and gear wrapped around tail stock and mouth; found dead 1 month later
2006	1	Bristol Bay, AK	Alive	Trailing gear; able to swim but not dive; ropes, buoys, and single line with buoys around mid-section; possible Bristol Bay gillnet
2007	1	Newport, OR	Alive	Adult found entangled in crab gear; 8 pots removed, but unable to remove 8 other buoys and several wraps of line around mid-section, left pectoral flipper, and through mouth
2007	1	Bering Sea, AK	Alive	Emacited juvenile; "S"-shaped spinal deformity; trailing 40-50 ft of line w/3 buoys; line wrapped at insertion of flukes 1-2 times; partial disentanglement, but 20-30 ft. of trailing gear remained

2008	1	Huntington Beach, CA	Dead	Calf w/propeller wounds to left dorsum from mid-body to caudal peduncle; deep external bruising on right side of head; necropsy revealed multiple cranial fractures
2009	1	Offshore Seal Beach, Orange County, CA	Alive	Gillnet wrapped around head in front of blowholes; apparent wound near net on top of head; trailing 4 ft. of netting in water
2009	1	Off Trinidad Head, CA	Alive	Adult female (mom), free-swimming w/green net w/ black floats wrapped around peduncle; gear trailing 2-3 m

In 1999 and 2000, a large number of gray whale strandings occurred along the west coast of North America between Baja California, Mexico, and the Bering Sea (Norman et al. 2000, Pérez-Cortés et al. 2000, Brownell et al. 2001, Gulland et al. 2005). A total of 273 gray whale strandings was reported in 1999 and 355 in 2000, compared to an average of 38 per year during the previous 4 years (Fig. 36). Gray whale strandings occurred throughout the year in both 1999 and 2000, but regional peaks of strandings occurred where and when the whales were in their migration cycle. Since then, stranding rates have been low (21, 18, 27, 30, 43, and 42 whales in 2001-2006, respectively; Brownell et al. 2007). Hypothesized reasons for the high stranding rate in 1999 and 2000 include starvation, effects of chemical contaminants, natural toxins, disease, direct anthropogenic factors (fishery interactions and ship strikes), increased survey/reporting effort, and effects of wind and currents on carcass deposition (Norman et al. 2000). Since only 16 animals showed conclusive evidence of direct human interaction in 1999-2000, it seems unreasonable that direct anthropogenic factors were responsible for the increase in strandings. In addition, although survey effort has varied considerably in Mexico and Alaska, it has been relatively constant in Washington, Oregon, and California, so the high rates were not a function of increased observational effort. The other hypotheses have not yet been conclusively eliminated. However, assuming a 5% mortality rate for gray whales (Wade and DeMaster 1996), it would be reasonable to expect that approximately 1,300 gray whales would die annually of natural causes; therefore, the high rate of strandings does not seem to be an area of concern.

Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia have traditionally harvested whales from this stock. The only reported takes by subsistence hunters in Alaska during this decade occurred in 1995, with the take of two gray whales by Alaska Natives (IWC 1997). Russian subsistence hunters reported taking 43 whales from this stock in 1996 (IWC 1998a) and 79 in 1997 (IWC 1999). In 1997, the IWC approved a 5-year quota (1998-2002) of 620 gray whales, with an annual cap of 140, for Russian and U.S. (Makah Indian Tribe) aboriginals based on the aboriginal needs statements from each country (IWC 1998b). The U.S. and Russia have agreed that the quota will be shared with an average annual harvest of 120 whales by the Russian Chukotka people and 4 whales by the Makah Indian Tribe. Total takes by Russian aboriginalwere 126 in 2003 (IWC 2005), 110 in 2004 (IWC 2006), 115 in 2005 (IWC 2007), 129 in 2006 (IWC 2008), and 126 in 2007 (IWC 2009). Based on this information, the annual subsistence take averaged 121 whales during the 5-year period from 2003 to 2007.

Other Mortality

The nearshore migration route used by gray whales makes ship strikes another potential source of mortality. Between 1999 and 2003, the California stranding network reported 4 serious injuries or mortalities of gray whales caused by ship strikes: 1 each in 1999, 2000, 2001, and 2003 (J. Cordaro, NMFS-SWR, pers. comm.). One ship strike mortality was reported in Alaska in 1997 (B. Fadely, AFSC-NMML, pers. comm.). Additional mortality from ship strikes probably goes unreported because the whales either do not strand or do not have obvious signs of trauma. Therefore, it is not possible to quantify the actual mortality of gray whales from this source, and the annual mortality rate of 1.2 gray whales per year due to collisions with vessels represents a minimum estimate from this source of mortality.

In 1999 and 2000, the California stranding network reported gray whale strandings due to harpoon injuries (Table 35). A Russian harpoon tip was found in a dead whale that stranded in 1999 (R. Brownell, NMFS-SWFSC, pers. comm.), and an injured whale with a harpoon in its back was sighted in 2000. Since these whales were likely harpooned during the aboriginal hunt in Russian waters, they would have been counted as “struck and lost” whales in the harvest data.

One gray whale was illegally killed by hunters in Neah Bay in 2007.

STATUS OF STOCK

In 1994, due to steady increases in population abundance, the eastern North Pacific stock of gray whales was removed from the List of Endangered and Threatened Wildlife (the List), as it was no longer considered endangered or threatened under the Endangered Species Act (ESA). As required by the ESA, NMFS monitored the status of this stock for 5 years following delisting. A workshop convened by NMFS on 16-17 March 1999 at the AFSC's National Marine Mammal Laboratory in Seattle, WA, reviewed the status of the stock based on research conducted during the 5-year period following delisting. Invited workshop participants determined that the stock was neither in danger of extinction, nor likely to become endangered within the foreseeable future, therefore there was no apparent reason to reverse the previous decision to remove this stock from the List (Rugh et al. 1999). This recommendation was subsequently adopted by NMFS.

Prior to the revised abundance estimates of Laake et al. (2009), Wade (2002) conducted an assessment of the Eastern North Pacific gray whale stock using survey data through 1995-96. Wade and Perryman (2002) updated the assessment in Wade (2002) to incorporate the abundance estimates from 1997-1998, 2000-2001, and 2001-2002, as well as calf production estimates from the northward migration (1994 to 2001), into a more complete analysis that further increased the precision of the results. All analyses concluded that the population was within the stock's optimum sustainable population (OSP) level (i.e., there was essentially zero probability that the population was below the stock's maximum net population level), and estimated the population in 2002 was between 71% and 102% of current carrying capacity. Similar results were found in a separate assessment (Punt et al. 2004). The Scientific Committee of the International Whaling Commission reviewed both assessments and agreed that management advice could be formulated from the results. Both assessments indicated that the population was above MSYL, and was likely close to or above its unexploited equilibrium level (IWC 2003).

Using assessment methods similar to those of Wade (2002), Wade and Perryman (2002), and Punt et al. (2004), Punt and Wade (2010) conducted the first assessment of the Eastern North Pacific gray whale stock to use the revised abundance estimates from Laake et al. (2009). From that assessment, the population is estimated to be at 91% of K, and at 129% of MNPL, with a probability of 0.884 that the population is above MNPL. Those results were consistent across all the model runs. Therefore, the assessment using the revised abundance time-series is consistent with previous assessments, and estimates the population is within OSP.

Even though the stock is within OSP, abundance will rise and fall as the population adjusts to natural and man-caused factors affecting the carrying capacity of the environment (Rugh et al. 2005). In fact, it is expected that a population close to or at the carrying capacity of the environment will be more susceptible to fluctuations in the environment (Moore et al. 2001). The recent correlation between gray whale calf production and environmental conditions in the Bering Sea (Perryman et al. 2002) may be an example of this. For this reason, it can be predicted that the population will undergo fluctuations in the future that may be similar to the 2-year event that occurred in 1999-2000 (Norman et al. 2000, Pérez-Cortés et al. 2000, Brownell et al. 2001, Gulland et al. 2005). Overall, the population increased (nearly doubled in size) over approximately the first 20 years of monitoring, and then has fluctuated for the last 30 years around its average carrying capacity. This is entirely consistent with a population approaching K.

Alter et al. (2007) used estimates of genetic diversity to infer that North Pacific gray whales may have numbered ~96,000, including animals in both the western and eastern populations, 1,100-1,600 years ago. The authors recommend that because the current estimate of the eastern stock of gray whales is at most 28-56% of this historic abundance, the stock should be designed as "depleted" under the MMPA. NMFS does not accept the recommendation made by Alter et al. (2007) for the following reasons. First, their analysis examines the population of the entire historical Pacific population of gray whales, while MMPA management occurs at the level of a stock, which in this case is the eastern north Pacific stock. It is speculative to try to determine what proportion of the estimated abundance may have been the eastern or western populations. It is also uncertain whether Alter et al.'s estimates include the Atlantic population (Palsboll et al. 2007). Second, NMFS relies on current carrying capacity in making MMPA determinations. Ecosystem conditions change over time and with those changes the carrying capacity of the ecosystem for different species will also change. NMFS adopted the practice of interpreting carrying capacity to mean "current" carrying capacity in part because it is not reasonable to expect ecosystems to remain static over a time span of thousands of years, even in the absence of human activity. Thus an estimate of stock abundance 1,100-1,600 years ago is not relevant to MMPA decision-making, even if such an estimate were available.

At present, U.S. commercial fishery-related annual mortality levels less than 36.0 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual level of human-caused mortality and serious injury (127.7), which includes mortalities from commercial fisheries (3.3), Russian harvest (121), unlawful hunt (1), and ship strikes and entanglements (2.4), does not exceed the PBR (360). Therefore, the Eastern North Pacific stock of gray whales is not classified as a strategic stock.

HABITAT CONCERNS

Eastern North Pacific gray whales range from subtropical lagoons in Baja Mexico to arctic seas around Alaska and eastern Russia (Braham 1984). Evidence indicates that the Arctic climate is changing significantly and that one result of the change is a reduction in the extent of sea ice in at least some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). These changes are likely to affect marine mammal species in the Arctic, including the gray whale, due to the impacts of a changing Arctic environment on the species' benthic food supply. With the increase in numbers of gray whales (Rugh et al. 2005), in combination with changes in prey distribution (Grebmeier et al. 2006; Moore et al. 2007), some gray whales have moved into new feeding areas, spreading their summer range (Rugh et al. 2001). Moore and Huntington (2008) observed that "gray whales are perhaps the most adaptable and versatile of the mysticete species," are opportunistic foragers, and have recently been documented feeding year-round off Kodiak, Alaska. Bluhm and Gradinger (2008) examined likely trends in the availability of pelagic and benthic prey in the arctic and concluded that pelagic prey is likely to increase while benthic prey is likely to decrease. They noted that marine mammal species that feed both pelagically and benthically (such as gray whales) will fare better than those that only feed benthically. For gray whales, they observed that the composition of gray whale prey may be less important than the energy density at feeding sites.

Global climate change is also likely to lead to increased human activity in the arctic as sea ice decreases, including oil and gas exploration and shipping (Hovelsrud et al. 2008). This increased activity will increase the chance or oil spills and ship strikes in this portion of the whales' range. Shipping and some O&G activities have been occurring throughout the whales' range over the past several decades but have not prevented the species' recovery.

Ocean acidification is another future development that could affect gray whales by affecting their prey. Increased acidity in the ocean will 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, Moore and Huntington 2008).

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