

Periodic Status Review for the Gray Whale



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The Washington Department of Fish and Wildlife maintains a list of endangered, threatened, and sensitive species (Washington Administrative Codes 220-610-010 and 220-200-100). In 1990, the Washington Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 220-610-110). These procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

The Washington Department of Fish and Wildlife is directed to conduct reviews of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing by the Washington Fish and Wildlife Commission. These periodic reviews include an update on the species status to determine whether the species warrants its current listing or deserves reclassification. The agency notifies the general public and specific parties interested in the periodic status review, at least one year prior to the end of the five-year period, so that they may submit new scientific data to be included in the review. The agency notifies the public of its recommendation at least 30 days prior to presenting the findings to the Fish and Wildlife Commission. In addition, if the agency determines that new information suggests that the classification of a species be changed from its present state, the Department prepares documents to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act.

The draft periodic status review for the gray whale was reviewed by species experts and was available for a 90-day public comment period from 28 September to 28 December 2020. All comments received were considered during the preparation of this revised draft periodic status review. The Fish and Wildlife Commission voted on 23 April 2021 to maintain the gray whale as sensitive in Washington.

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EXECUTIVE SUMMARY

The gray whale is a large baleen whale that feeds in shallow continental shelf waters and at offshore banks, where benthic (i.e., bottom-dwelling) invertebrate communities are concentrated. Gray whales are the only whale species known to feed extensively on benthic animals. They undertake the longest migration of any mammal, sometimes traveling more than 20,000 km round-trip annually in coastal waters.

Gray whales in the North Pacific are divided into two populations (or stocks) known as the Eastern North Pacific (ENP) and Western North Pacific (WNP) populations. Both populations were severely depleted prior to the mid-20th century by harvest during the whaling era. The ENP population migrates along the Pacific coast of North America between summer feeding grounds in the Bering, Beaufort and Chukchi Seas and wintering sites along western Baja California and the southern Gulf of California in Mexico, where mating and calving occur. This stock has recovered from the impacts of whaling, and was estimated at about 26,960 whales in 2016, when it was believed to exist at or near carrying capacity. However, the most recent estimate (made during the winter of 2019-2020) placed the population's size at 20,580 animals, revealing a substantial decline of 23.7% since 2016. This population was federally delisted by the U.S. in 1994.

Within the ENP population, a small aggregation of about 232 individuals known as the Pacific Coast Feeding Group (PCFG) has been identified. These whales show regular fidelity during the summer and fall feeding season to waters along the coasts of northern California, Oregon, Washington, and Vancouver Island, British Columbia, and occasionally as far north as Kodiak Island, Alaska. Genetic testing indicates some differentiation from the greater ENP population, but PCFG whales likely interbreed with other ENP whales, and the PCFG is still considered a feeding aggregation of the ENP population.

The WNP population, which is federally classified as endangered by the U.S., primarily feeds in summer in the Sea of Okhotsk (mostly near the northeastern coast of Sakhalin Island, Russia) and off the southeastern coast of the Kamchatka Peninsula in the Bering Sea. Although historic records indicate that WNP gray whales migrated through the coastal waters of Japan and the Korean Peninsula to presumed wintering grounds off the coast of China, contemporary records of gray whales off Asia are rare. Abundance, calculated in 2016 to be roughly 271 to 311 individuals one year and older, remains far below pre-whaling numbers. Although considered genetically distinct from the ENP population, research since 2004 has detected some members of this population migrating to the Pacific coast of North America to feeding and wintering grounds traditionally used by the ENP population, and stock identity research is ongoing.

Gray whales face a number of known or potential threats such as entanglement in fishing gear and marine debris, ship strikes, human-generated marine sound, and climate change. These could adversely impact the WNP population because of its small size and precarious conservation status. The PCFG is also a concern due to its small size and the substantial level of uncertainty pertaining to its possible status as a separate stock under the Marine Mammal Protection Act.

The small WNP gray whale population is federally listed as endangered, and individuals have been seen in Washington waters. Research has indicated some genetic divergence in the PCFG from the ENP. However, these uncertainties do not justify any change in status at this time. Given these considerations and the threats and uncertainties described in this report, it is recommended that this species be retained as a state sensitive species in Washington. However, uplisting to a higher level of protection may be warranted in the future if continuing research determines that WNP whales regularly migrate through Washington's waters and/or the PCFG is classified as a separate stock.

INTRODUCTION

This periodic status review summarizes the biology, population status, threats, and recent management actions directed at gray whales (*Eschrichtius robustus*) in Washington and elsewhere in the species' range. This review also assesses whether this species should retain its current sensitive status under state law or be reclassified. The Washington Department of Fish and Wildlife (WDFW) published a status report for the gray whale in 1997 (Richardson 1997). That report resulted in downlisting the gray whale from state endangered to state sensitive.

SPECIES BACKGROUND

This species is a large baleen whale. Adult males reach 15 m and weigh 16,600 kg. Adult females reach 15 m in length and may weigh as much as 34,000 kg when pregnant (Rice and Wolman 1971, Shirihai and Jarrett 2006). Adult gray whales are slate gray and are covered by gray/white patterns (Figure 1), allowing identification of individuals. This mottled coloring occurs naturally as the animal reaches adulthood and is further enhanced as a result of crustaceans ('whale lice', i.e.



Figure 1. Gray whale mother with calf (photo courtesy NOAA).

Cyamidae) and barnacles accumulating on the skin. Newborn calves average 5 meters in length and are born a dark gray color. They gradually attain the patchy gray pattern characteristic of adults. Gray whales lack a dorsal fin but have a series of 6 to 12 small humps along the dorsal ridge of the tail stock. Pectoral fins are short and broad. When viewed from above, the head is V-shaped, with a two-nostril blowhole. Gray whales have only 2 to 5 throat pleats, distinguishing them from other baleen whale species. The baleen is white to yellow, and roughly 5 to 25 cm long (Leatherwood and Reeves 1983, Nowak 1991). During the era of commercial whaling, gray whales gained a reputation as aggressive fighters when attacked, earning the nickname “devilfish” (Scammon 1874).

Taxonomy, populations, and distribution. The gray whale is the sole living member of the family Eschrichtiidae and is the most primitive of extant baleen whale species (Rice and Wolman 1971, Sumich 2014, ITIS 2017, Kimura et al. 2018). It is descended from filter-feeding whales that appeared at the beginning of the Oligocene, over 3 million years ago. Gray whales once occurred in both the North Pacific and the North Atlantic, but the Atlantic population was extinct by the early 18th century (Rice 1998, Swartz 2014). Since 2010, there have been several unexpected sightings of individuals off Israel, Spain, and Namibia, and a pair in the Laptev Sea off Russia's Arctic coast (Scheinin et al. 2011, Shpak et al. 2013, Sumich 2014).

Historically, gray whales in the North Pacific were recognized as two geographically and genetically distinct populations (or stocks) known as the Eastern North Pacific (ENP) and Western North Pacific (WNP) populations (Figure 2; LeDuc et al. 2002, Lang et al. 2011, Weller et al. 2013a, 2013b, Carretta et al. 2019). The ENP population occurs in Washington and migrates along the Pacific coast of North America between summer feeding grounds in the Bering, Beaufort, Chukchi and Okhotsk Seas and wintering sites along western Baja California and the southern Gulf of California in Mexico, where mating and calving occur in

three primary lagoons (Rice and Wolman 1971, Ford 2014, Sumich 2014, Cooke et al. 2017). Animals are occasionally sighted south of the Baja peninsula along Mexico's west-central coastline and near Isla Clarion (Sumich 2014).



Figure 2. Hypotheses of gray whale population structure prior to recent information on movements across the Pacific (IUCN/IWC Conservation Management Plan).

between 41°N and 52°N, excluding sightings within the Salish Sea (IWC 2012, Carretta et al. 2019). In contrast to the main ENP stock, the PCFG does not rely on the dynamics of a sub-arctic ecosystem, and this uniqueness may provide important flexibility to the species as a whole. The PCFG is recognized as a distinct feeding group, but its status as separate from the ENP population remains unresolved (Weller et al. 2013b). Recent genetic data indicate that while some matrilineally driven structure exists between the PCFG and other ENP whales, PCFG whales likely interbreed with other ENP whales (Frasier et al. 2011, D'Intino et al. 2013, Lang et al. 2014, Lang et al. 2019). Calambokidis et al. (2015) identified nine survey regions within the PCFG summer range, six of which are located along the coasts of northern California, Oregon and Washington where PCFG whales are frequently observed. These include areas in Washington off the outer northwest coast and Strait of Juan de Fuca and another area off Grays Harbor.

About a dozen gray whales known as the “Sounders” visit North Puget Sound each year for 2 to 3 months to feed on ghost shrimp (*Callinassa californiensis*). They typically arrive in March and depart by the end of May, continuing north to Arctic waters for the feeding season. These individuals belong to the main ENP population and are not considered part of the PCFG (IWC 2012). The Sounders were first sighted in the early 1990s during a period of high mortality in the gray whale population (Calambokidis et al. 1991, 1992, 2015).

Within the WNP population, the primary summer feeding grounds for gray whales are located in the Sea of Okhotsk (mainly near the northeastern coast of Sakhalin Island, Russia) and off the southeastern coast of the Kamchatka Peninsula in the Bering Sea (Weller et al. 1999, 2002, 2013a, Vertyankin et al. 2004, Tyurneva et al. 2010, Burdin et al. 2013, Lowry et al. 2018). Although historical records indicate that WNP gray whales migrated through the coastal waters of Japan and the Korean Peninsula to presumed wintering grounds off the coast of China, contemporary records of gray whales off Asia are rare (Weller et al. 2002, 2013a). Most of these records, including sightings as recent as 2017, are from Japanese waters (Nambu et al. 2010, Nakamura et al. 2017). Only two records of gray whales in Chinese waters have been documented since the mid-1990s (Zhao 1997, Wang et al. 2015, Zhao et al. 2017), and gray whales have not been recorded in Korean waters since 1977 (Park 1995, Kim et al. 2013).

Within the ENP population, a small group of gray whales known as the Pacific Coast Feeding Group (PCFG) shows regular fidelity during the feeding season to waters from northern California to northern Vancouver Island; they are also occasionally seen as far north as at least Kodiak Island, Alaska (Darling 1984, Gosho et al. 2011, Calambokidis et al. 2015, 2017, Ford 2014). PCFG members are defined as animals seen within this area in more than one year during the months of June through November

Genetic comparisons of the whales feeding off Sakhalin Island with whales considered part of the ENP population revealed significant genetic differences, although a limited degree of genetic exchange between these populations may take place (Lang et al. 2010, 2011). Some whales known to feed off Sakhalin Island have been recorded in Japanese waters during months when they would presumably be migrating (Weller et al. 2008, 2016), whereas others have been detected on ENP migratory routes and wintering grounds (Weller et al. 2012, Urbán et al. 2013, Mate et al. 2015), suggesting that not all gray whales in the WNP population share a common wintering ground (Weller et al. 2012). These data call into question whether the gray whales that currently feed in the WNP are surviving members from a population previously thought to be extinct (Bowen 1974) or are whales born in the ENP that have expanded their feeding range (Mate et al. 2015). Currently most authorities consider the two populations as distinct (Lang et al. 2010, 2011, Weller et al. 2013b, Mate et al. 2015) and the National Marine Fisheries Service (NMFS) classifies them as separate stocks under the Marine Mammal Protection Act (MMPA; Carretta et al. 2019). Stock structure is still under investigation by the International Whaling Commission (IWC) (Cooke et al. 2017).

NATURAL HISTORY

Habitat requirements. Gray whales feed in shallow continental shelf waters and at offshore banks in the sub-Arctic and Arctic, where benthic (i.e., bottom-dwelling) invertebrate communities are concentrated (Rice and Wolman 1971, Nerini 1984, Brower et al. 2016). Abundance of prey is a strong factor influencing summer distribution and habitat use of the whales (Brower et al. 2016). Gray whales are unique from other baleen whales in that they migrate mainly through coastal and shallow shelf waters, although deeper oceanic waters are sometimes crossed (Weller et al. 2002, Sumich 2014, Mate et al. 2015). Both summering and migrating whales are often observed foraging or resting in forests of bull kelp (*Nereocystis luetkeana*) and other giant kelp (*Macrocystis* spp.) in waters 5 to 15 m deep and are also commonly seen near offshore rocks (Ford 2014, Sumich 2014, Scordino et al. 2017). Mating and calving occur in shallow lagoons and bays that provide warm, protected waters (Rice and Wolman 1971, Rice et al. 1981, Ford 2014, Sumich 2014).

Foraging and diet. All or nearly all feeding occurs during the summer and fall (Akmajian et al. 2012, Swartz 2014). Gray whales have the most robust baleen of all the baleen whales, and they are the only whale species known to feed extensively on benthic animals (Rice and Wolman 1971, Ford 2014). They typically forage on mud, sand, silt or gravel bottoms at depths from the tidal zone to less than 50 m (Rice and Wolman 1971, Darling et al. 1998, Nelson et al. 2008, Brower et al. 2016). Gray whales feed by rolling on their side, swimming slowly forward while sucking sediment into the side of their mouth and filtering out prey through their baleen by pushing out water and mud with their powerful tongues. As they swim, they dislodge streams of sediment called mud plumes. This method of feeding produces shallow feeding pits in the ocean floor up to 3 m long and 1.5 m wide that can be seen from aerial photos (Ford 2014, Sumich 2014, Brower et al. 2016). Skim feeding for free-swimming prey such as anchovy at or near the surface is also practiced.

Ninety genera of prey have been found in the stomachs of gray whales (Nerini 1984). Favored prey are typically infaunal benthic species found at densities of 100 to 30,000/m³, and up to 440,000/m³ depending on species (Feyrer and Duffus 2011, Ford 2014, Sumich 2014). Gray whales feed on a variety of amphipods, as well as mysids (small shrimp-like crustaceans), mollusks, bivalves, polychaete worms, shrimp, krill and hydroids (Nerini 1984, Darling et al. 1998, Nelson et al. 2008, Brower et al. 2016). They are also known to feed on anchovy, herring eggs and larvae (Darling et al. 1998, Ford 2014). Gray whales have been found to consume 250 to 1,100 kg of prey every day, depending on their age and size (Feyrer and Duffus

2011). Fasting whales lose 11 to 29 percent of their body weight during migration and the winter (Rice and Wolman 1971).

In Washington, PCFG whales prey mostly upon mysids and cumaceans (small shrimp-like crustaceans) during periods of intense coastal upwelling from early summer to late fall (Brodeur and Ware 1992, Hickey and Banas 2003, Marchetti et al. 2004, Scordino et al. 2013, 2017). Two favored locations for prey in Washington are the coast of northwest Washington and the Grays Harbor area (Calambokidis et al. 2015). In the Salish Sea, a small group of gray whales known as the “Sounders” have been observed foraging heavily on ghost shrimp on sand flats near the shore off Whidbey and Camano Islands. When the Sounders arrive, they are typically emaciated. Foraging on ghost shrimp allows the whales to gain considerable body weight in just a month or two before they continue on to their northern feeding grounds off Alaska. Several new whales have arrived in recent years to feed on ghost shrimp (Weitkamp et al. 1992, Calambokidis et al. 2015).

Movements. Gray whales undertake the longest migration of any mammal, with most ENP whales traveling 15,000 to 20,000 km round-trip (Rice and Wolman 1971, Ford 2014, Sumich 2014). The longest recorded round-trip was made by a WNP female that migrated 22,511 km to Mexico before returning to Sakhalin Island the next spring (Figure 3; Mate et al. 2015). ENP and some WNP whales begin to leave

their summer feeding grounds in October and start arriving at their Mexican breeding sites in December (Rice and Wolman 1971, Rice et al. 1981, Rugh et al. 2001). Southward migration is concentrated in December and January. Swimming around the clock, animals on their southbound migration swim at 7 to 9 km per hour and cover 144 to 185 km per day (Ford 2014). Northward migration extends from late January to July, with a peak in April to July (Calambokidis et al. 2015). At this time of year, the whales move steadily at 4 to 5 km per hour, or 88 and 127 km per day. Most ENP gray whales migrate within 10 km of shore, with northbound travel being closer to land (Calambokidis et al. 2015). Migrating animals pass through Washington waters mainly during November and December and again from March through May (Rice and Wolman 1971, Ford 2014).

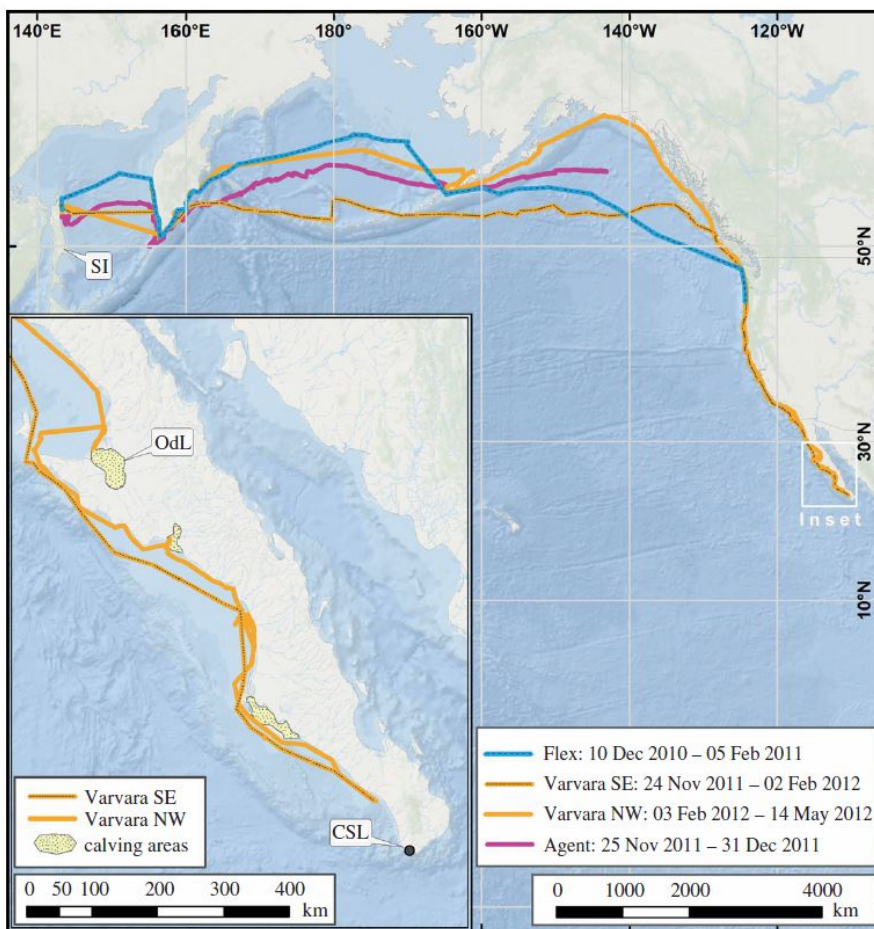


Figure 3. Routes of 3 WNP whales migrating from Sakhalin Island, Russia, to the eastern North Pacific. The legend depicts departure and arrival/end dates (Mate et al. 2015).

Migration occurs somewhat farther offshore in Washington than in Oregon (Green et al. 1995). Some whales enter Willapa Bay, Grays Harbor, the Strait of Juan de Fuca, and Puget Sound during migration. Females, especially those who are pregnant, generally migrate south earlier than males, and those with calves remain longer in breeding/birthing areas before starting northward in March (Rice and Wolman 1971, Sumich 2014). Northbound females with calves remain close to the coastline, navigating through particularly shallow waters and kelp beds to avoid killer whale (*Orcinus orca*) attacks (Rice and Wolman 1971, Sumich 2014). The primary lagoons used by wintering ENP and suspected WNP gray whales are Laguna Ojo de Liebre (Scammon's Lagoon), Laguna San Ignacio, and the Bahia Magdalena complex (Rice and Wolman 1971, Jones 1990, Sumich 2014). Although not well documented, some WNP gray whales are believed to migrate south to winter breeding grounds off Japan, Korea and China (Andrews 1914, Weller et al. 2002, 2008). However, some individuals (provisionally 48 percent of the WNP Sakhalin feeding group; Cooke 2019) migrate to the west coast of North America, which requires a 22,000 km roundtrip to and from Mexico (Mate et al. 2011, 2015, Weller et al. 2012, Urbán et al. 2013). These movements coincide with the annual migration of ENP whales and bring WNP animals through Washington's waters (see **Distribution**).

Social organization. Gray whales are usually solitary or occur in small groups of two or three (Ford 2014). Larger aggregations of as many as 400 individuals may gather at concentrated food sources, but aside from mother-calf pairs, social bonds are not apparent (Shirihai and Jarrett 2006, Ford 2014, Sumich 2014). Calves leave their mothers upon weaning at 7 to 9 months of age (Swartz 2014).

Reproduction. Mating activity occurs between November and January during the southward migration and at the winter breeding and calving grounds (Ford 2014, Sumich 2014), and involves multiple males competing for females. Sexual maturity occurs between 5 and 11 years of age, with an average of 8 years (Rice and Wolman 1971, Rice et al. 1981, Ford 2014). After roughly 13 months of gestation, females give birth to a single calf, which nurses for 7 to 9 months on milk with a particularly high fat content of 53 percent (Rice et al. 1981, Ford 2014). Pregnant females are dependent on their summer fat reserves and do not feed between foraging seasons. Thus, they must rely on their fat stores from the previous summer to provide nourishment to their offspring. During years of limited prey availability, fewer females may reproduce (Rice and Wolman 1971). Gray whale mothers often hold newborn calves to the surface to help them breathe and are fiercely protective of their young, particularly against predators such as killer whales and human whalers (Sumich 2014). Calves are born roughly every 2 years between December and February; however, some may be born during the southward migration (Rice and Wolman 1971). About 5 percent of the total ENP population is typically comprised of calves (Perryman et al. 2017).

Mortality. Mortality rates are highest for young animals, with an average first-year survival rate of about 71 percent (Punt and Wade 2012). About 75 percent of first-year mortalities occur during the first 2 weeks after birth. Mortality records for the ENP population indicate that calves represent about 91 percent of deaths at winter breeding and calving grounds, followed by yearlings (0 to 19.5 percent) and adults (0 to 5 percent) (Jones and Swartz 1984). Annual adult mortality is estimated to be between 0.1 and 5 percent per year (Punt and Butterworth 2002, Wade 2002). Information on the lifespan of gray whales is limited, but estimates range from 25 to 80 years (Rice and Wolman 1971, Ford 2014).

Killer whales and humans are the only known predators of gray whales. Killer whales have been observed attacking individual gray whales both during migration and on feeding grounds (Goley and Straley 1994, George and Suydam 1998), and are a significant cause of calf mortality (Barrett-Lennard et al. 2011).

In 1999 and 2000, the ENP population suffered a major population decline, termed an “unusual mortality event”, or UME. Gray whale strandings along the west coast of North America increased to approximately seven times the annual mean for 1995-1998, with 283 reported in 1999 and 368 reported in 2000 (LeBoeuf et al. 2000, Moore et al. 2001, Gulland et al. 2005). Most strandings occurred along the Mexican coast, but increased strandings were noted in all areas north to Alaska. An unusual aspect of this mortality event was that most mortalities were adults and juveniles rather than calves. As a consequence of the UME, calf production was unusually low for 1999 through 2001. The emaciated condition of many whales in 1999 and 2000 suggested that starvation caused most deaths, resulting from either a decreased availability of prey (Moore et al. 2003) or a disease interfering with foraging. Ultimately, the cause of this UME was undetermined (LeBoeuf et al. 2000, Moore et al. 2001, Gulland et al. 2005; see **Population Status**.)

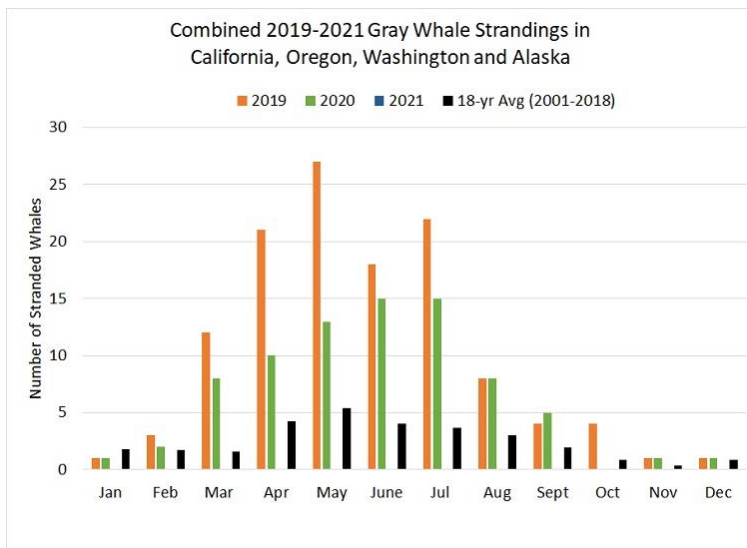


Figure 4. Combined 2019-2021 gray whale strandings in California, Oregon, Washington and Alaska.

In June 2019, the National Oceanic and Atmospheric Administration (NOAA) declared another UME for the ENP population, spurred by another sharp rise in strandings along the west coast of North America. From 2019-March 2021, there have been 203 strandings along the U.S. coast (including 48 in Washington), 199 strandings in Mexico, and 16 strandings in Canada (NOAA Fisheries 2021). Strandings in the U.S. were higher in 2019 (122 strandings) than in 2020 (79 strandings; Figure 4). Although lower than in the 1999-2000 UME, these mortalities provide a stark contrast to the average annual number of strandings from 2001 to 2018. Conditions of the 2019 UME are similar to those of the

earlier event, with some stranded whales showing evidence of starvation and lower calf production in Mexico. In 2021, 30% of live adult and juvenile whales in two Mexican breeding locations showed signs of emaciation, compared to 4.9% to 8.2% during 2008-2018 (LSIESP 2021). Mother-and-calf pairs in 2021 numbered about 20 in Bahia Magdalena and Laguna San Ignacio, contrasting with the 75 to 100 pairs found in these areas in most years (Swartz et al. 2019, LSIESP 2021). Together, these observations suggest that ENP gray whales have recently experienced poor summer feeding conditions in the North Pacific and Arctic or may be suffering from the effects of a combination of environmental factors including disease (Swartz et al. 2019, Christiansen et al. 2021).

Stranding records for gray whales in Washington stand at 284 from 1980 through March 2021 (NOAA Fisheries 2021). Of these, by far the largest number of records per year occurred during the UMEs in 2019 (34 strandings), 1999 (28 strandings), and 2000 (23 strandings). Strandings likely only represent a fraction of the true mortality for the population, as many/most animals don't wash up on shore, or are not reported/counted.

POPULATION STATUS AND TRENDS

ENP population. This population decreased from an estimated 12,000 to 24,000 animals before whaling (Ford 2014) to perhaps just a few thousand animals by the 1930s following intense commercial harvest (see **Commercial and Subsistence Harvest**). Genetic research by Alter et al. (2012) suggests a much larger pre-whaling population of 76,000 to 118,000 whales, but this estimate is not supported by historical harvest records nor the North American west coast's probable carrying capacity for the population in recent decades (Reeves et al. 2010).

Counts made at Granite Canyon south of Carmel, California, since 1967 have produced rigorous estimates of population size. These indicate that numbers grew from about 10,000 to 13,000 whales between 1967 and 1972 (Reilly et al. 1983) to about 25,000 whales in the mid-1980s, then stabilized at about 20,000 whales through most of the 1990s. Large numbers of animals died during the UME in 1999 and 2000 (see **Mortality**), which caused the size of the stock to decline to about 15,000 to 16,000 whales (Laake et al. 2012, Punt and Wade 2012). However, numbers began to recover immediately and stood at an estimated 20,990 whales (95% probability that the number of whales was between 19,230 and 22,900) in 2011 (Durban et al. 2013). Growth continued until at least 2016, when the population was estimated at 26,960 animals (95% probability that the number of whales was between 24,420 and 29,830; Durban et al. 2017). However, the most recent estimate (made during the winter of 2019-2020) placed the population's size at 20,580 animals (95% confidence interval of 18,700 to 22,870), revealing a substantial decline of 23.7% since 2016 (Stewart and Weller 2021).

The ENP population is thought to have existed at or near carrying capacity during most years since the mid-1980s (Moore et al. 2001, Punt and Wade 2012, Carretta et al. 2019). The increase in numbers from 2011 to 2016 may be due to improved feeding conditions caused by warming Arctic waters that have resulted in higher primary productivity and expansion of ice-free habitat, which has been linked to increases in calf production in the ENP population (Perryman et al. 2002, Arrigo and Dijken 2015, Moore 2016, Durban et al. 2017). In contrast, the decline from 2016 to 2020 coincides with the current UME, which is possibly being caused by a decline in food resources (Christiansen et al. 2021).

The pre- and post-whaling sizes of the PCFG are unknown, but the subgroup has always been small since its discovery off British Columbia in the 1970s (Hatler and Darling 1974, Darling 1984, Calambokidis et al. 1994). The most recent analyses indicate that the subgroup increased rapidly from 125 (SE = 10.9) in 1998 to 216 (SE = 16.6) individuals in 2004 (Calambokidis et al. 2017, 2019). Annual estimates remained fairly stable between about 195 (SE = 26.0) and 220 (SE = 12.3) whales through 2012 but increased to an estimated 250 (SE = 18.2) whales in 2015 (Calambokidis et al. 2019). The most recent estimate of the PCFG is 232 (SE = 25.2) whales in 2017 (Calambokidis et al. 2019).

WNP population. The pre-whaling size of this population has been estimated at between 1,500 and 10,000 individuals (Yablokov and Bokoslovskaya 1984). Extensive commercial harvest greatly depleted the stock by the 1930s, with some authors considering it extinct by this time (Bowen 1974, Berzin and Vladimirov 1981, Weller et al. 2002). Hunting continued at low levels until at least 1966 and likely further endangered the stock (Brownell and Chun 1977). Sightings in the 1980s and 1990s confirmed the continued presence of the population, but no reliable estimates of numbers were made during this period (Weller et al. 2002). The 2016 non-calf population was estimated at 271 to 311 individuals, with much of the population (175 to 192 whales) feeding off Sakhalin (Cooke et al. 2018). From 2005 to 2016, the population increased at an estimated rate of 2 to 5 percent per year (Cooke et al. 2017).

FACTORS AFFECTING CONTINUED EXISTENCE

Adequacy of existing regulatory mechanisms. Gray whales have benefited from the protections afforded under a variety of national, international, and state laws. The species is protected under the U.S. federal MMPA, which, subject to certain exceptions, prohibits the taking (defined as harassing, hunting, capturing, killing, or attempting to harass, hunt, capture, or kill) and importation of these animals and products derived from them. The MMPA authorizes take under a variety of circumstances, including Alaska tribal subsistence harvest and incidental take during commercial fishing operations and some other circumstances. Under the MMPA, the WNP stock is considered “depleted” and is treated as a “strategic stock” by virtue of its listing under the Endangered Species Act (ESA); the ENP stock does not carry similar designations. Although PCFG gray whales are considered a distinct feeding group, they currently do not have formal status under the MMPA (Carretta et al. 2019). The species was federally listed as endangered in 1970 under the Endangered Species Conservation Act of 1969, which preceded the Endangered Species Act of 1973. The ENP population was delisted in 1994 (USFWS and NMFS 1994), but the WNP population remains listed as endangered under the ESA. Federal endangered status includes prohibitions on take of listed species similar to those under the MMPA. NMFS has not designated critical habitat for gray whales.

National marine sanctuary regulations (15 CFR 922 Subpart O, 152(a)), which apply to the Olympic Coast National Marine Sanctuary off the outer northwest coast of Washington, contain prohibitions on the taking and possessing of any marine mammal in the sanctuary, except as authorized by the MMPA and ESA, or allowed through tribal treaty rights.

Under Washington state law (WAC 220-610-010), gray whales were listed as endangered in 1981, then downlisted to sensitive status in 1997. A sensitive classification prohibits the intentional taking, harassment, or possession of the species (RCW 77.15.130). Gray whales are considered a priority species under WDFW’s Priority Habitats and Species program, but specific management recommendations for them have not been developed under this program.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) specifies the ENP population is not at risk, but the PCFG is endangered due to genetic differences, and the WNP population is endangered. The species is on the British Columbia Blue List, meaning that it is especially sensitive to natural events or various human impacts. Mexico initiated protections for different lagoons used by gray whales beginning in the 1970s, then declared its territorial seas and Economic Exclusion Zone as a refuge for all species of large whales in 2002. Russia, Japan, South Korea, and China also offer different levels of protection for the species in their territorial seas (Swartz 2014).

Protection from commercial harvest was extended to gray whales under the International Convention for the Regulation of Whaling in 1946 (implemented in the U.S. via the Whaling Convention Act [WCA]). The International Union for the Conservation of Nature (IUCN) categorizes the entire gray whale species as Least Concern, but considers the WNP population as Critically Endangered. Gray whales are also listed on Appendix I of the Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES), which bans international commercial trade in products from this species.

Commercial and subsistence harvest. Commercial whaling during the 19th and 20th centuries decimated many populations of whales worldwide (Roman and Palumbi 2003, Rocha et al. 2014). Commercial

exploitation of the ENP population began after the discovery of its winter breeding and calving grounds in Baja California, Mexico, in 1845-1846. Harvest intensified in the ensuing years and expanded northward to California and beyond, with an estimated 6,100 to 8,300 animals taken by 1874 (Reeves et al. 2010, Punt and Wade 2012). Concentrations of females with calves were particularly vulnerable during these years, which reduced the reproductive capacity of the population. Harvests fell substantially by the mid-1870s and the stock was considered commercially extinct by 1900. Harvest increased again in the 1920s with the advent of modern factory-ship whaling, resulting in more than 1,000 additional whales being killed by 1946 (Reeves et al. 2010, Punt and Wade 2012). Some additional harvest occurred from the late 1940s to 1970s for research and from illegal Soviet whaling (Wolman 1985, Ivashchenko et al. 2013). Harvest was minimal during the shore-whaling era off Washington (1911-1925) and British Columbia (1908-1967), with perhaps just a single gray whale caught by whalers from Bay City, Washington, and about a dozen taken off British Columbia (Scheffer and Slipp 1948, Pike and MacAskie 1969). These small harvests were likely caused by a combination of factors, including the stock's reduced size, the species' lower desirability to whalers and its use of nearshore waters, and because the migration did not strongly overlap with the main whaling season (Scheffer and Slipp 1948).

Commercial hunting of the WNP population from the 1500s until 1966 nearly eliminated this population (Kato and Kasuya 2002, Weller et al. 2002). Although not well documented, commercial whaling may have played a role in the extirpation of gray whales from the North Atlantic by the early 1700s (Swartz 2014).

Gray whales have been hunted for subsistence purposes by coastal native peoples of western North American and Siberia for thousands of years (Jones and Swartz 2002, Ford 2014). Gray whales and humpback whales (*Megaptera novaeangliae*) constituted major food items for the Makah Tribe along Washington's northwest coast for at least 1,500 years, as indicated by oral and written accounts and archaeological evidence (Swan 1870, Scheffer and Slipp 1948, Huelsbeck 1988, 1994). The number of gray whales historically harvested by Native Americans in Washington is not well documented, but some reports suggest it could have been substantial (Collins 1996, Webb 2011). Subsistence hunting of the ENP population continues to the present, primarily by Chukotka Natives in northeastern Russia who have harvested approximately 125 whales per year since 1998 (IWC 2018). The current IWC Schedule for ENP gray whales establishes a 7-year catch limit of 980 whales for 2019 through 2025 (including an annual maximum of 140 whales) for the Russian Federation and the U.S. (Carretta et al. 2019); a bilateral agreement between the two countries allocates up to 135 whales per year to the Chukotka Natives and up to 5 whales per year to the Makah Tribe. This level of harvest is considered sustainable (IWC 2013). Two gray whales have been taken by Makah hunters in recent years, one during an authorized hunt in 1999 and one during an unauthorized hunt in 2007. In 2005 the Makah Tribe submitted a request to NMFS for authorization under the MMPA to resume treaty-based hunting of ENP gray whales, which received extensive NMFS review (NMFS 2015). In April 2019, NMFS published a proposed rule to allow the Makah to hunt one to three whales per year over a 10-year period, with measures included to reduce the likelihood of taking WNP and PCFG whales (NMFS 2019). In February 2020, NOAA Fisheries published a notice of intent to prepare a supplement to the Supplemental Draft Environmental Impact Statement (DEIS) issued on March 30, 2015. Upon release, NMFS will provide a 45-day public review/comment period.

Entanglement in fishing gear and marine debris. A growing concern to whale populations is the level of threat posed by entanglement in active drifting or stationary fishing gear (such as gillnets and vertical lines used in trap/pot fisheries) or in discarded netting and other marine debris (IWC 2010, Williams et al. 2011b, Reeves et al. 2013). Death, injury, or eventual starvation may result when entangled animals fail to free themselves of gear or debris. Risk of entanglement varies with species, the amount of overlap with various

fisheries, and the type of gear used in those fisheries. More entanglements are reported in coastal and continental shelf waters than in waters farther offshore (Saez et al. 2021). In some whale populations, roughly half or more of all individuals show scarring from past entanglements (Neilson et al. 2009, Weller et al. 2009).

Gray whales are especially vulnerable to entanglement because of their use of nearshore coastal waters, where fishing activity is often highest. From 1982 to 2018, gray whales were the most frequently entangled whale species along California, Oregon, and Washington, averaging 6.9 entanglement reports per year (NMFS, unpublished data), although actual numbers of entanglements are likely much higher than indicated by these reports. Most entanglement reports are received from January to May, which coincides with the species’ northbound migration (Saez et al. 2021). The vast majority are documented off California, but this is due in part to California’s larger number of observers on the water and longer coastline than in Washington and Oregon (Carretta et al. 2017, NOAA Fisheries 2019, Saez et al. 2021). Most gray entanglements since the late 1990’s involve trap/fishing gear that cannot be identified, but of the entanglements for which gear can be identified, the majority have been attributed to trap/pot fisheries, especially from commercial Dungeness crab fisheries (NOAA Fisheries 2017, Saez et al. 2021). Entanglements have involved some PCFG whales (Saez et al. 2021). Whales have been known to carry gear for hundreds, or even a thousand or more kilometers, from the site of the entanglement to the location where they are reported (Saez et al 2013).

In Washington, 24 of the 47 large whale entanglements reported since 1990 have involved gray whales. Incident reports have increased since 2000, and more incidents have occurred along the outer coast than in the Salish Sea (Table 1).

Available evidence suggests that entanglements of WNP gray whales off eastern Asia may be an important limiting factor on this population (Weller et al. 2008, 2014, Bradford et al. 2009, Carretta et al. 2017, Lowry et al. 2018) and could be slowing or preventing its recovery (Thomas et al. 2016). Extensive coastal net fisheries occur in parts of the stock’s distribution (Weller et al. 2002).

Table 1. Numbers of gray whale entanglement reports documented in Washington by location and time period, 1990–2020 (NMFS, unpublished data).

	Location		Time period		
	Outer coast	Salish Sea	1990-1999	2000-2009	2010-2020
Total	20	4	2	10	12

Vessel strikes. Whales swimming or resting near the ocean surface can be vulnerable to injury or death from collisions with large and small vessels, especially in areas of frequent vessel traffic such as the U.S. west coast. Collisions can involve either blunt force trauma or propeller strikes. Ship strikes of whales have become more common in recent decades due to increases in shipping traffic, ship speeds, and whale abundance (Laist et al. 2001, Calambokidis 2011, Neilson et al. 2012). Documented collisions and resulting mortalities undoubtedly represent just a small fraction of the total number (Jensen and Silber 2004, Williams et al. 2011a).

Gray whales are one of the whale species most commonly struck by ships between California and Washington (Jensen and Silber 2004, Douglas et al. 2008, DeAngelis et al. 2011), whereas fewer collisions are known from Alaska (Neilson et al. 2012). Along Washington’s outer coast, major shipping lanes converge from several directions into the mouths of the Strait of Juan de Fuca and Columbia River, and another follows a north-south route to California. Douglas et al. (2008) listed six gray whale strandings in

Washington involving collisions from 1980 to 2006, and Carretta et al. (2017, 2018) reported 11 known deaths and eight injuries from vessel collisions across the full range of the ENP population from 2008 to 2016, including three possible members of the PCFG. Vessel strike risk along Washington's coast is highest during the feeding period (June to October) (Silber et al. 2021). The Salish Sea is also an area of heavy vessel traffic. Extensive shipping traffic within widespread portions of the range of WNP population means that ship strikes are an important threat for these whales as well (Silber et al. 2021).

Disturbance from sound and vessels. Marine mammals in all oceans are exposed to increasing levels of underwater sound from vessels, seismic surveys, sonar, marine construction, and other human-related sources (Nowacek et al. 2007, 2015). Marine ambient noise levels at frequencies below 500 Hz, which overlap with the low-frequency calls of baleen whales, have increased by at least 20 dB (re 1 μ Pa) since pre-industrial conditions (Hildebrand 2009), including along much of the North American west coast (Andrew et al. 2011, Redfern et al. 2017). Baleen whales rely on their acoustic sensory system for communicating with other individuals, sometimes at distances of hundreds of kilometers. Significant levels of anthropogenic sound can therefore interfere with communication by masking vocalizations (Erbe et al. 2016). Intense sound can also cause changes in surface, foraging, and vocal behavior, displace animals from occupied areas, and produce temporary or permanent hearing damage and physiological stress (e.g., Nowacek et al. 2007, Castellote et al. 2012, Risch et al. 2012, Rolland et al. 2012). Where sound-related impacts are severe, reproduction and survival of animals may be affected (Clark et al. 2009). Nevertheless, responses by whales can vary depending on localized circumstances, sometimes with no observable reactions recorded (Nowacek et al. 2007). For the past ten years and the next seven years (at a minimum), the U.S. Navy has authorized incidental take (i.e., harassment) of Gray Whales, Humpback Whales, and other marine mammals resulting from its training and testing activities including the use of sonar and other transducers, in-water detonations, and potential vessel strikes.

Throughout their range, gray whales face increasing sound levels associated with expanding vessel traffic, oil and gas exploration and development, wind farm construction, other coastal development, and military training (Ford 2014, Swartz 2014, Muir et al. 2016). Noise from these activities has been shown to cause avoidance behavior and changes in acoustic call characteristics of this species (Moore and Clarke 2002, Dahlheim and Castellote 2016).

The tremendous growth in whale watching in recent decades (O'Connor et al. 2009) has brought increasing concern over disturbance caused to cetaceans, which can result from the physical presence and sound of whale-watching vessels (Parsons 2012, Hoyt and Parsons 2014). Whale watchers frequently target gray whales on their Mexican breeding and calving grounds and during migration past California, but viewing pressure from Oregon to Alaska is generally limited to areas near a few ports with whale-watching companies (O'Connor et al. 2009). The small numbers of gray whales using the Salish Sea are regularly targeted, but much less so than killer whales, although viewing pressure may increase with the implementation of new regulations aimed at protecting southern resident killer whales. Vessel-based whale watching has been documented to cause changes in the species' swimming behavior (Heckel et al. 2001, Moore and Clarke 2002, Sullivan and Torres 2018), but overall the activity does not appear to be an important concern in the conservation of the species.

Climate change. Global climate change is likely to be one of the greatest threats to many species of marine mammals in the coming decades from alteration of marine ecosystems and food webs through changes in ocean temperatures, currents, stratification, and nutrient cycling, and increased frequency of unusual ocean conditions such as strong El Niño events (Doney et al. 2012) and marine heatwaves. Climate

change effects on oceans will probably occur unevenly, with some areas affected more severely than others. Declining summer sea ice and warming ocean temperatures may allow gray whales to expand their foraging range farther into the Arctic, but will also likely bring changes in prey abundance and availability and possibly increased competition for prey with other baleen whale species as they also expand northward (Brower et al. 2016, Moore 2016). However, the adaptable feeding strategies of gray whales may limit the negative impacts from these concerns (Swartz 2014). Reductions in sea ice are also expected to boost human activity in the Arctic (e.g., oil and gas exploration, shipping traffic, commercial fishing), resulting in increased ocean noise levels and a greater likelihood of oil spills, other forms of environmental degradation, and ship strikes (Clarke et al. 2013). Increased exposure to novel diseases throughout the species' range is an additional possible outcome of climate change (Simmonds and Elliott 2009). A concern related to climate change, increasing ocean acidification, is currently not considered an important future threat to marine mammals off western North America (Marshall et al. 2017).

Small population size. The small size of the WNP population imparts a higher risk of inbreeding, loss of genetic variability, and occurrence of chance events such as demographic fluctuations and population-level impacts from ship strikes and entanglements, all of which could negatively affect the stock. The PCFG is also relatively small and could be affected in similar ways.

Environmental contaminants. Marine mammals are susceptible to a variety of environmental contaminants that bioaccumulate upward through marine food webs (O'Hara and O'Shea 2001, Buckman et al. 2011, Mongillo et al. 2016). These substances include organochlorines (e.g., polychlorinated biphenyls [PCBs], dioxins, dichloro-diphenyl trichloroethane [DDT] and its derivatives, and various other pesticides and herbicides), polybrominated diphenyl ethers (PBDEs), polycyclic aromatic hydrocarbons, trace metals (e.g., mercury, cadmium, copper), and other emerging pollutants (O'Shea 1999, O'Hara and O'Shea 2001). High contaminant levels can be harmful to the health of marine mammals, but baleen whales typically carry smaller pollutant loads than toothed whales because of their lower position in food chains. As with most other baleen whales, gray whales appear to possess relatively low toxicant loads that are beneath those associated with health disorders in other species (Wolman and Wilson 1970, Varanasi et al. 1994, Krahn et al. 2001, Tilbury et al. 2002). Contaminant concentrations can vary among individuals and may be higher in diseased or aged animals in poor nutritional health. Small numbers of gray whales harvested by Chukotka Natives in northeastern Russia are known as "stinky whales" and possess a medicinal odor to their tissues, making them inedible (NMFS 2015). This phenomenon remains under investigation but may possibly be caused by diet or exposure to hydrocarbons (NMFS 2015).

Oil spills. At the population level, marine oil spills are generally considered a relatively minor threat for large whales, with few if any harmful impacts reported in the literature. Nevertheless, when exposed to oil, individual whales can experience baleen fouling, ingestion of oil, respiratory distress from inhalation of vapors at the water's surface, and contaminated food sources (Geraci 1990, Takeshita et al. 2017), all of which may produce physiological effects that remain poorly understood. Major spills may cause lingering reproductive and health impacts (Kellar et al. 2017, Smith et al. 2017), as well as direct mortality of prey and displacement from feeding areas.

As a shipping and oil-refining hub, Washington experienced seven major oil spills ranging from 0.1–2.3 million gallons along the outer coast, the Strait of Juan de Fuca, and the lower Columbia River between 1964 and 1991 (Neel et al. 2007). It is unknown whether any of these harmed gray whales. Increased safety measures and prevention programs since the 1990s have helped reduce the number and scale of vessel spills in Washington, where no spills exceeding 100,000 gallons have occurred since 1991 (Etkin and Neel 2001,

Neel et al. 2007). However, the sheer volume of shipping traffic (i.e., nearly 7,100 vessel transits in 2018; WSDOE 2019) makes oil spills a persistent threat in the state. Shipping routes for major ports in Seattle, Tacoma, and Vancouver, B.C., as well as several major oil refineries and the third largest naval base in the U.S., all traverse waters used by gray whales in Washington. A 2015 risk assessment of oil spills from vessels transiting the Salish Sea and northern outer coast of Washington found that the region remains at risk of a large spill (Van Dorp and Merrick 2017). Spill risk in Washington's marine habitats is expected to increase substantially in the future as tanker traffic from ports in British Columbia and possibly Washington increases due to expanded oil and natural gas production in the interior of North America, and expansion of the TransMountain oil pipeline that terminates at Burnaby, BC.

Harmful algal blooms. Harmful algal blooms, also known as “red tides,” result from rapid, temporary increases in local populations of particular dinoflagellates, protists, or other phytoplankton. Two of the most common toxins produced by algal blooms along the west coast of North America are the neurotoxins domoic acid and saxitoxin, both of which can be toxic to marine mammals, especially pinnipeds (Torres de la Riva et al. 2009, Lewitus et al. 2012). Although few known cases of acute algal poisoning have been confirmed among gray and other large whales (Gulland et al. 2005, Fire et al. 2010, Lewitus et al. 2012), there have been increasing reports of both toxins being detected in whales and blooms coinciding with whale mortalities (Lefebvre et al. 2016, Wilson et al. 2016). Harmful algal blooms are projected to become increasingly common in the future with warming ocean conditions (McKibben et al. 2017) and therefore could represent a possible emerging concern for gray whales.

MANAGEMENT ACTIVITIES

Management of whaling. International moratoriums on the commercial harvest of gray whales (in 1946) and all large whales (in 1986) were established by the IWC and remain in effect as a primary conservation tool. Subsistence harvest of gray whales by native peoples of the Russian Federation (Chukotkans) and the U.S. (Makah) is based on a joint request by the two countries and managed through a quota system established by the IWC for aboriginal whaling. That system relies on advice from an IWC scientific committee to establish a 6-year quota with annual catch limits. The Makah Tribe reserved the right to hunt gray whales at its usual and accustomed grounds under the Treaty of Neah Bay in 1855. A combination of factors (including the ENP population decline noted above) led to the suspension of Makah whaling in the 1920s. The Tribe resumed whaling in 1999 and 2000 but has not been authorized to hunt since 2004 due to court rulings requiring that the waiver and permit provisions of the MMPA be satisfied before NMFS can authorize a hunt. In 2005 the Tribe applied for authorization under the MMPA and WCA to harvest up to 20 ENP gray whales over a 5-year period, with no more than five taken per year and to target only whales migrating through the Tribe's usual and accustomed fishing grounds off the northwestern end of the Olympic Peninsula (NMFS 2015). Two main concerns with the proposed hunt include the possible impact on the PCFG as well as the possible taking of migrant individuals from the endangered WNP population. In 2015, NMFS released a revised draft environmental impact statement analyzing the Tribe's proposal and other alternatives (NMFS 2015) and continues to review the Tribe's request.

Species management and recovery planning. In addition to the WCA responsibilities noted above, NMFS manages both stocks in U.S. waters under the MMPA and regularly assesses population sizes, trends, and sources of mortality to guide conservation of the species (Carretta et al. 2019). NMFS also has ESA jurisdiction for WNP gray whales. A draft conservation plan for the WNP population was prepared under the auspices of the IWC and IUCN in 2010, with an update underway. The IUCN has also established a

Western Gray Whale Advisory Panel to provide recommendations to a Russian energy company on steps needed to protect the stock in its summer feeding range (IUCN 2017).

Entanglement in fishing gear and marine debris. NMFS, in collaboration with stakeholders, has led national efforts to mitigate the problem of whale entanglements (NOAA Fisheries 2017). On the U.S. East Coast, this has led to the development and implementation of restrictions on when and how fishing gear can be set, including closures and gear modifications. Restrictions have recently been implemented in some fisheries off the U.S. West Coast (e.g. all three West Coast Dungeness crab fisheries; Victoria Knorr pers. comm. 2021). NMFS is working with partners to conduct outreach to commercial and recreational fishing communities promoting consideration of changes in fisheries and gear along with other best practices for avoiding entanglements. Outreach has also targeted the broader marine community to encourage the prompt reporting of entangled animals and to improve report quality. These efforts together with expanding the response capabilities of permitted organizations and response teams may result in more successful rescue attempts to disentangle whales. Ongoing research and improved documentation of entanglements will also help inform future management efforts. In Washington, NMFS has held disentanglement training workshops and cached disentanglement equipment at various sites in the state to enhance response efforts. The Cascadia Research Collective, WDFW, the Makah Tribe, and other entities have participated in many of the disentanglement attempts made in the state. The Northwest Straits Commission carries out regional conservation projects and supports the work of seven Marine Resources Committees through funding, technical support, training and regional coordination. The Coastal Dungeness Crab Conservation Plan provides management measures that reduce the risk of entanglement, a monitoring program, and an adaptive management strategy. Various projects to remove derelict crab pots and lines have also been conducted, including projects by the Quileute Nation, Quinault Indian Nation, and The Nature Conservancy along sections of the outer coast (e.g., Antonelis 2014; WDFW, no date).

A multi-stakeholder Washington Whale Entanglement Working Group has met since November 2017 to examine possible methods for reducing the risk of entanglements in state waters. In January 2020, the Washington Fish and Wildlife Commission approved new rules for the 2020 Dungeness crab season to reduce the potential for gray whale entanglements. The rule changes included requiring only the amount of line reasonably necessary to conduct fishing activities, reducing the pot limit during summer months when whales are present, reducing the allocation of replacement buoy tags available to fishers who lose gear, expanding the permitted gear recovery program to get gear out of the water before whales enter Washington waters, and requiring line marking specific to Washington. Additional rule changes to complement these are planned for future implementation and described in more detail in WDFW's Dungeness crab fishery Conservation Plan.

Ship strikes. NMFS, the International Maritime Organization, and others have implemented various measures in specific locations to reduce the risk of vessel collisions with large whales. These include the re-routing of shipping lanes, creation of areas to be avoided by ships, mandatory or voluntary speed restrictions for ships, using ship crew as lookouts for whales, and increasing the awareness of ship crews about whale strikes (Calambokidis 2013, Ritter and Panigada 2014). Several of these actions have been undertaken in areas of California and Alaska, but none have yet been implemented in Washington. Existing laws (e.g., the MMPA) and whale-watching guidelines help keep vessels at reasonable distances from gray whales, thus reducing the risk of collisions. NMFS has also expanded its efforts to document vessel strikes of all large whales in the eastern North Pacific.

Reduction of marine noise. There is growing recognition that current levels of human-generated noise in oceans require mitigation to reduce impacts on marine fauna. Implementing noise-reduction actions requires government engagement with industry, the military, and other stakeholders. NOAA has recently completed an ocean noise reduction strategy to help address concerns in U.S. waters (NOAA 2016). Existing mitigation actions can include steps to (1) detect and limit impacts to animals (e.g., closing areas to certain technology, avoiding use during specified seasons or times of day, discontinued use if animals are detected, and gradual powering up of equipment to warn animals away) and (2) reduce sound levels at the source (e.g., applying noise abatement measures). One example of such mitigation are the measures agreed upon by the U.S. Navy and NMFS to reduce naval training impacts on marine mammals in the Northwest Training and Testing Offshore Area along the Washington, Oregon, and northern California coasts (NMFS 2015b). The Washington Southern Resident Orca Task Force’s sound mitigation work also benefits other whale species. Internationally, efforts are underway to design and implement quieting technologies in shipping, oil and gas exploration, and marine construction (IMO 2014, Hatch et al. 2016). Existing laws (e.g., MMPA) and viewing guidelines help keep whale-watching vessels at reasonable distances from gray whales, thus reducing the effects of vessel presence and sound.

Monitoring and research. Ongoing surveys performed by NMFS, WDFW, Fisheries and Oceans Canada, and partner groups in North America (e.g., Cascadia Research Collective, the Makah Tribe) and eastern Asia help monitor the population size, trend, and distribution of gray whales keep stock assessments up to date (Carretta et al. 2019). NMFS also monitors gray whale injuries and mortalities from entanglements, ship strikes, and other causes (Carretta et al. 2017). Citizen science platforms such as Happywhale are playing an increasing role in survey activities (Calambokidis and Barlow 2020). Numerous research projects have been conducted in recent years or are underway. These include analyses of gray whale stock structure, genetics, life history, and ecology, as well as the impact and extent of different threats. The PCFG has been the focus of some of this research.

Stranding responses. NMFS coordinates responses to strandings of gray whales through the West Coast Marine Mammal Stranding Network, which is comprised of cooperating scientific investigators, institutions, organizations, and state and federal agencies. Cascadia Research, WDFW, and other collaborators sample or necropsy many of these animals to determine cause of death, animal condition and health, emerging and re-emerging diseases, and other traits. Stranding data are maintained in a national database.

Oil spill prevention and response. State and federal agencies, industry, and other stakeholders continue their efforts to prevent oil spills from occurring in Washington. In 2010, a rescue tug was permanently deployed at Neah Bay with funding provided by the petroleum and shipping industries under a new state law. Year-round access to the tug greatly reduces the threat of spills associated with impaired vessels and barges near the entrance of the Strait of Juan de Fuca and along a portion of the outer coast. Establishment of an Area To Be Avoided off the northwestern coast encourages large vessels to stay well offshore during transit (WSDOE 2017). Use of single-hull tanker vessels and barges was phased out in the U.S. in January 2015 to reduce the risk of spills. Spill response planning, participation in oil spill drills, training of oil response volunteers, and outreach are ongoing. Measures to haze killer whales away from spills (NMFS 2012) could be extended to gray whales on a case-by-case basis (D. Noviello, pers. comm.). Improved regulations have been enacted in both the U.S. and Canada to minimize the risk of accidental spills.

CONCLUSIONS AND RECOMMENDATION

Both gray whale populations in the North Pacific became severely depleted prior to the mid-20th century by unregulated harvest during the commercial whaling era. Since that time, the ENP population has recovered and been at or near its carrying capacity for several decades, with abundance estimated at about 27,000 whales in 2016. Most recently, however, population size declined to an estimated 20,870 animals in early 2020 coinciding with the current UME. Based on improvements in status, this population was federally delisted in 1994, and the entire species was downlisted in Washington from state endangered to state sensitive in 1997. It has been maintained as a state sensitive species due to concerns about two other groups of gray whales that occur in Washington's waters. One of these is the PCFG, which is a small subgroup of the ENP population and numbers approximately 232 individuals. This subgroup's main summer and fall feeding range includes the area from northern California to northern British Columbia, with whales occasionally sighted as far north as Kodiak Island, Alaska. The other group of concern is the WNP population, which totaled roughly 271 to 311 animals one year and older in 2016 and remains federally classified as endangered. Recent research has shown that some members of the WNP migrate into the eastern North Pacific and travel through Washington waters to winter breeding and calving sites off Mexico. It is not definitively known what percentage of this population moves through Washington waters. Research on stock identity for this population is ongoing.

Throughout their range, gray whales face a number of known or potential threats such as entanglement in fishing gear and marine debris, ship strikes, human-generated marine sound, and climate change. These are most likely to adversely impact the WNP population because of its small size and precarious conservation status. The PCFG is also a concern due to its small size and the substantial level of uncertainty pertaining to its possible future status as a separate stock under the MMPA.

The small WNP gray whale population is federally listed as endangered, and individuals have been seen in Washington waters. Research has indicated some genetic divergence in the PCFG from the ENP. However, these uncertainties do not justify any change in status at this time. Given these considerations and the threats and uncertainties described in this report, it is recommended that this species be retained as a state sensitive species in Washington. However, uplisting to a higher level of protection may be warranted in the future if continuing research determines that WNP whales regularly migrate through Washington's waters and/or the PCFG is classified as a separate stock.

REFERENCES CITED

The references cited in the Periodic Status Review for the Gray Whale are categorized for their level of peer review pursuant to section 34.05.271 RCW, which is the codification of Substitute House Bill 2661 that passed the Washington Legislature in 2014. A key to the review categories under section 34.05.271 RCW is provided in Table A. References were categorized by the author in 2020.

Individual papers cited cover a number of topics discussed in the report, including information on: 1) the species' description, taxonomy, distribution and biology; 2) habitat requirements; 3) population status and trends; 4) conservation status and protections; 5) research, monitoring, and restoration activities; and 6) factors affecting the continued existence of the species.

Table A. Key to 34.05.271 RCW Categories:

34.05.271(1)(c) RCW	Category Code
(i) Independent peer review: review is overseen by an independent third party.	i
(ii) Internal peer review: review by staff internal to the department of fish and wildlife.	ii
(iii) External peer review: review by persons that are external to and selected by the department of fish and wildlife.	iii
(iv) Open review: documented open public review process that is not limited to invited organizations or individuals.	iv
(v) Legal and policy document: documents related to the legal framework for the significant agency action including but not limited to: (A) federal and state statutes; (B) court and hearings board decisions; (C) federal and state administrative rules and regulations; and (D) policy and regulatory documents adopted by local governments.	v
(vi) Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under the processes described in (c)(i), (ii), (iii), and (iv) of this subsection.	vi
(vii) Records of the best professional judgment of Department of Fish and Wildlife employees or other individuals.	vii
(viii) Other: Sources of information that do not fit into one of the categories identified in this subsection (1)(c).	viii

Reference	Category
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Alter, S. E., S. D. Newsome and S. R. Palumbi. 2012. Pre-whaling genetic diversity and population ecology in eastern Pacific gray whales: insights from ancient DNA and stable isotopes. PLOS One 7(5):e35039.	i
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APPENDIX A. PUBLIC COMMENTS.

WDFW received public comments during the 90-day public review period for the draft Status Review for the Gray Whale. WDFW received 3 individual comment letters; two response letters indicated support for WDFW's status recommendation to maintain the Gray Whale as a sensitive species in Washington. One response letter was neutral.

Washington State Status Reports, Periodic Status Reviews, Recovery Plans, and Conservation Plans

Periodic Status Reviews

2020	Mazama Pocket Gopher
2019	Tufted Puffin
2019	Oregon Silverspot
2018	Grizzly Bear
2018	Sea Otter
2018	Pygmy Rabbit
2017	Fisher
2017	Blue, Fin, Sei, North Pacific Right, and Sperm Whales
2017	Woodland Caribou
2017	Sandhill Crane
2017	Western Pond Turtle
2017	Green and Loggerhead Sea Turtles
2017	Leatherback Sea Turtle
2016	American White Pelican
2016	Canada Lynx
2016	Marbled Murrelet
2016	Peregrine Falcon
2016	Bald Eagle
2016	Taylor's Checkerspot
2016	Columbian White-tailed Deer
2016	Streaked Horned Lark
2016	Killer Whale
2016	Western Gray Squirrel
2016	Northern Spotted Owl
2016	Greater Sage-grouse
2016	Snowy Plover
2015	Steller Sea Lion

Conservation Plans

2013	Bats
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Status Reports

2019	Pinto Abalone
2017	Yellow-billed Cuckoo
2015	Tufted Puffin
2007	Bald Eagle
2005	Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot
2005	Aleutian Canada Goose
1999	Northern Leopard Frog
1999	Mardon Skipper
1999	Olympic Mudminnow
1998	Margined Sculpin
1998	Pygmy Whitefish
1997	Aleutian Canada Goose
1997	Gray Whale
1997	Olive Ridley Sea Turtle
1997	Oregon Spotted Frog

Recovery Plans

2020	Mazama Pocket gopher
2019	Tufted Puffin
2012	Columbian Sharp-tailed Grouse
2011	Gray Wolf
2011	Pygmy Rabbit: Addendum
2007	Western Gray Squirrel
2006	Fisher
2004	Sea Otter
2004	Greater Sage-Grouse
2003	Pygmy Rabbit: Addendum
2002	Sandhill Crane
2001	Pygmy Rabbit: Addendum
2001	Lynx
1999	Western Pond Turtle
1996	Ferruginous Hawk
1995	Snowy Plover

Status reports and plans are available on the WDFW website at:

<http://wdfw.wa.gov/publications/search.php>

