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FIN WHALE (*Balaenoptera physalus*): Northeast Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the U.S. waters in the Pacific, fin whales are found seasonally off the coast of North America and in the Bering Sea during the summer (Fig. 1). Recent information on seasonal fin whale distribution has been gleaned from the reception of fin whale calls by bottom-mounted, offshore hydrophone arrays along the U.S. Pacific coast, in the central North Pacific, and in the western Aleutian Islands (Moore et al. 1998, 2006; Watkins et al. 2000; Stafford et al. 2007). Moore et al. (1998, 2006) Watkins et al. (2000), and Stafford et al. (2007) documented high levels of fin whale call rates along the U.S. Pacific coast beginning in August/September and lasting through February, suggesting that these may be important feeding areas during the winter. While peaks in call rates occurred during late summer, fall and winter in the central North Pacific and the Aleutian Islands, fin whale calls were seldom detected during summer months even though fin whales are regularly seen in summer months in the Gulf of Alaska (Stafford et al. 2007). In addition, fin whale calls were detected in the southeast Bering Sea using an instrument moored there from April 2006 through April 2007, which showed peaks in fin whale call detections from September through November 2006 and also in February and March 2007 (Stafford et al. 2010). While seasonal differences in recorded call rates are in some cases consistent with the results of aerial surveys which have documented seasonal whale distribution, it is not known whether these differences in call rates reflect true seasonal differences in whale distribution, differences in calling rates, or differences in oceanographic properties (Moore et al. 1998). Some fin whale calls have also been recorded in Hawaiian waters in all months except June and July (Thompson and Friedl 1982, McDonald and Fox 1999). Sightings of fin whales in Hawaii are extremely rare: There was a sighting in 1976 (Shallenberger 1981), a sighting by Dale Rice in 1979 (Mizroch et al. 2009), a sighting during an aerial survey in 1994 (Mobley et al. 1996), and 5 sightings during a survey in 2002 (Barlow 2006).

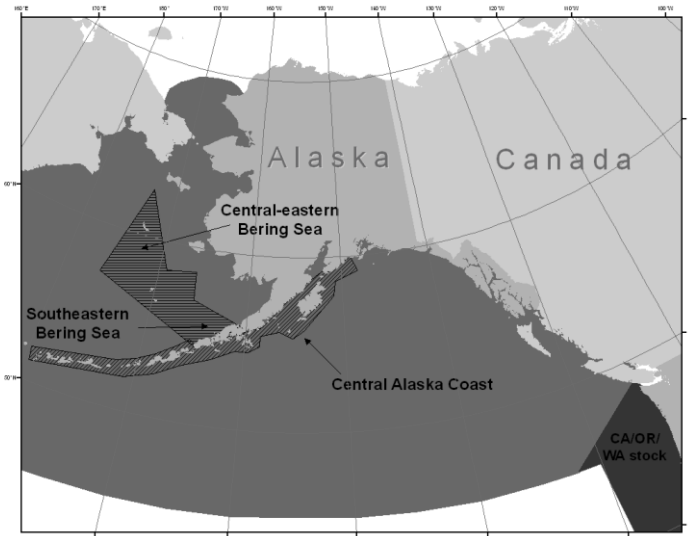

Figure 1. Approximate distribution of fin whales in the eastern North Pacific (shaded area). Striped areas indicate where vessel surveys occurred in 1999-2000 (Moore et al. 2002) and 2001-2003 (Zerbini et al. 2006).

Surveys on the Bering Sea shelf in 1997, 1999, 2000, 2002, 2004, 2008, and 2010 and in coastal waters of the Aleutian Islands and the Alaska Peninsula from 2001 to 2003 provided information about the distribution and relative abundance of fin whales in these areas (Moore et al. 2000, 2002; Zerbini et al. 2006; Friday et al. 2012, 2013). Fin whales were the most common large whale sighted during the Bering Sea shelf surveys in all years except for 1997 and 2004 (Friday et al. 2012, 2013). Fin whales were consistently distributed both in the 'green belt', an area of high productivity along the edge of the EBS continental shelf (Springer et al. 1996), and in the middle shelf with the highest abundances occurring in the 'green belt'. Abundance estimates for fin whales in the Bering Sea were consistently higher in cold years than in warm years (Friday et al. 2012, 2013) indicating a shift in distribution. This is consistent with a fine-scale comparison of fin whale occurrence on the middle shelf between a cold year (1999) and a warm year (2002), which found that the group and individual encounter rates were 7-12 times higher in the cold year (Stabeno et al. 2012).

Fin whales were seen regularly by whaling vessels in the Chukchi Sea in the 1920s-1940s and were taken by whalers at least until the early 1950s. After this time, despite some continued effort to hunt other species, many fewer fin whales were seen through at least until the late 1970s but not thereafter (Nemoto 1959, Sleptsov 1961). Fin whales are again being seen increasingly during sighting surveys in the Chukchi Sea in summer (Funk et al. 2010, Aerts et al. 2012, Clarke et al. 2013) and have been recorded each year from 2007 to 2010 in August and September

on bottom-mounted hydrophones in the Chukchi Sea (Delarue et al. 2013) suggesting they may be re-occupying habitat used prior to large-scale commercial whaling.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous in winter, possibly isolated in summer; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, the International Whaling Commission considers fin whales in the North Pacific to all belong to the same stock (Mizroch et al. 1984), although those authors cited additional evidence that supported the establishment of subpopulations in the North Pacific. Further, Fujino (1960) described eastern and western groups, which are isolated though may intermingle around the Aleutian Islands. Discovery mark recoveries (Rice 1974, Mizroch et al. 2009) indicate that animals wintering off the coast of southern California range from central California to the Gulf of Alaska during the summer months.

Mizroch et al. (2009) provided a comprehensive summary of whaling catch data, Discovery mark recoveries, and opportunistic sightings data and found evidence that suggests there may be at least 6 populations of fin whales: 2 that are migratory (eastern and western North Pacific) and 2 to 4 more that are resident year-round in peripheral seas such as the Gulf of California, East China Sea, Sanriku-Hokkaido and possibly in the Sea of Japan. It appears likely that the two migratory stocks mingle in the Bering Sea in July and August, rather than in the Aleutian Islands as Fujino (1960) concluded (Mizroch et al. 2009). During winter months, fin whales have been seen over a wide geographic area from 23°N to 60°N, but winter distribution and location of primary wintering areas (if any) are poorly known and need further study. As a result, stock structure of fin whales remains uncertain.

For management purposes, three stocks of fin whales are currently recognized in U.S. Pacific waters: 1) Alaska (Northeast Pacific), 2) California/Washington/Oregon, and 3) Hawaii. Mizroch et al. (2009) suggest that this structure should be reviewed and updated, if appropriate, to reflect recent analyses, but the absence of any substantially new data on stock structure makes this difficult. The California/Oregon/Washington and Hawaii fin whale stocks are reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

Reliable estimates of current and historical abundance for the entire Northeast Pacific fin whale stock are currently not available. Two studies provide some information on the distribution and occurrence of fin whales, although they do not provide estimates of population size. A survey conducted in August of 1994 covering 2,050 nautical miles of trackline south of the Aleutian Islands encountered only four fin whale groups (Forney and Brownell 1996). However, this survey did not include all of the waters off Alaska where fin whale sightings have been reported, thus, no population estimate can be made.

Visual surveys for cetaceans were conducted on the eastern Bering Sea shelf during summer in 1997, 1999, 2000, 2002, 2004, 2008 and 2010 (Moore et al. 2000, 2002; Friday et al. 2012, 2013). These surveys were conducted in conjunction with the Alaska Fisheries Science Center echo-integrated trawl survey for walleye pollock which determined the survey area and timing. The surveys included from 789 km to 3,752 km of effort depending on the year and whether the entire area was surveyed for cetaceans. Results of the surveys in 2002, 2008, and 2010, years when the entire pollock area was surveyed, provided provisional estimates of 419 (CV = 0.33), 1,368 (CV = 0.34) and 1,061 (CV = 0.38), respectively (Friday et al. 2013). These estimates are considered provisional because they have not been corrected for animals missed on the trackline, animals submerged when the ship passed, and responsive movement. However, they are expected to be robust as previous studies have shown that only small correction factors are needed for this species (Barlow 1995). This estimate cannot be used as an estimate of the entire Northeast Pacific stock of fin whales because it is based on a survey in only part of the stock's range.

Dedicated line transect cruises were conducted in coastal waters of western Alaska and the eastern and central Aleutian Islands in July-August 2001-2003 (Zerbini et al. 2006). Over 9,053 km of tracklines were surveyed in coastal waters (as far as 85 km offshore) between the Kenai Peninsula (150°W) and Amchitka Pass (178°W). Fin whale sightings (n = 276) were observed from east of Kodiak Island to Samalga Pass, with high aggregations recorded near the Semidi Islands. Zerbini et al. (2006) estimated that 1,652 (95% CI: 1,142-2,389) whales occurred in the area.

Minimum Population Estimate

Although the full range of the northeast Pacific stock of fin whales in Alaskan waters has not been surveyed, a rough estimate of the size of the population west of the Kenai Peninsula has been calculated in previous SARs by summing the estimates from Moore et al. (2002) and Zerbini et al. (2006) (n = 5,700). However, new information indicates that whales surveyed in the Aleutians (Zerbini et al. 2006) could migrate into the Bering Sea

and be counted during the Bering Sea surveys (Mizroch et al. 2009). There are also indications that fin whale distribution in the Bering Sea is related to oceanographic conditions (Stabeno et al. 2012, Friday et al. 2013), making it possible that whales could be double counted when estimates from different years are summed (Moore et al. 2002). Therefore, our best provisional estimate of the fin whale population west of the Kenai Peninsula would be 1,368, the greater of the minimum estimates from the 2008 and 2010 surveys (Friday et al. 2013). This is a minimum estimate for the entire stock because it was estimated from surveys which covered only a small portion of the range of this stock. This is considered a minimum estimate for a portion of the range of this stock; therefore, the N_{MIN} for the entire stock is unknown.

Current Population Trend

Zerbini et al. (2006) estimated rates of increase of fin whales in coastal waters south of the Alaska Peninsula (Kodiak and Shumagin Islands). An annual increase of 4.8% (95% CI: 4.1-5.4%) was estimated for the period 1987-2003. This estimate is the first available for North Pacific fin whales and is consistent with other estimates of population growth rates of large whales. It should be used with caution, however, due to uncertainties in the initial population estimate for the first trend year (1987) and due to uncertainties about the population structure of the fin whales in the area. Also, the study represented only a small fraction of the range of the northeast Pacific stock.

Friday et al. (2013) estimated a 14% (95% CI = 1.0-26.5%) annual rate of change in abundance of fin whales between 2002 and 2010. However, this apparent rate of change in abundance is higher than most plausible estimates of rates of change for large whale populations (see Zerbini et al. 2010 for a discussion of maximum rates of increase for humpback whale populations). It is likely that the apparent rate of change in abundance in the study area is due at least in part to changes in distribution and not just to changes in overall population size. Friday et al. (2013) found that the abundance of fin whales in the survey area increased in colder years, likely due to shifts in the distribution of prey. Stafford et al. (2010) provided evidence of prey-driven distribution where fin and right whale call rates in the vicinity of mooring M2 (approximate location: 57.9°N, 164.1°W) increased following peaks in euphausiid and copepod biomass.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Zerbini et al. (2006) estimated an annual increase in coastal waters south of the Alaska Peninsula of 4.8% (95% CI: 4.1-5.4%) for the period 1987-2003. However, there are uncertainties in the initial population estimate from 1987, as well as uncertainties regarding fin whale population structure in this area. A reliable estimate of the maximum net productivity rate is currently unavailable for the Northeast Pacific fin whale stock. Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

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 0.1, the recommended value for cetacean stocks which are listed as endangered (Wade and Angliss 1997). However, because an estimate of minimum abundance is not available, the PBR level for the Alaska fin whale stock is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Between 2008 and 2012, there was one observed incidental mortality of a fin whale in due to entanglement in the ground tackle of a commercial mechanical jig fishing vessel (Helker et al. 2015; Table 1).

Table 1. Summary of the Northeast Pacific stock of fin whale mortalities and serious injuries by year and type reported to the Alaska Regional Office, marine mammal stranding database, for the 2008-2012 period (Allen et al. 2014, Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of Injury	2008	2009	2010	2011	2012	Mean Annual Mortality
Ship strike	0	1	1	0	0	0.4
Entangled in ground tackle of commercial mechanical jig fishing vessel	0	0	0	0	1	0.2
Minimum total annual mortality						0.60

Subsistence/Native Harvest Information

Subsistence hunters in Alaska and Russia have not been reported to take fin whales from this stock.

Other Mortality

Between 1911 and 1985, 49,936 fin whales were reported killed throughout the North Pacific (Mizroch et al. 2009), although newly revealed information about illegal Soviet catches indicates that the Soviets over-reported catches of about 1,200 fin whales, presumably to hide catches of other protected species (Doroshenko 2000). Two ship-strike mortalities of fin whales occurred in Alaska waters between 2008 and 2012 (one in 2009 and one in 2010) and have been reported in the Alaska Region stranding database (Allen et al. 2014), resulting in a mean annual mortality rate of 0.4 fin whales.

STATUS OF STOCK

The fin whale is listed as "endangered" under the Endangered Species Act of 1973, and therefore designated as "depleted" under the MMPA. As a result, the Northeast Pacific stock is classified as a strategic stock. While reliable estimates of the minimum population size and population trends are available for a portion of this stock, much of the North Pacific range has not been surveyed. Therefore the status of the stock relative to its Optimum Sustainable Population size is currently not available. The total estimated annual rate of mortality and serious injury for this stock is 0.6 based on takes incidental to U.S. commercial fisheries (0.2) and ship strikes (0.4). Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown.

HABITAT CONCERNS

Potential impacts on fin whale habitat include possible changes in prey distribution with climate change, range extension and increased shipping in higher latitudes with changes in sea ice coverage, as well as oil and gas activities in the Chukchi and Beaufort seas.

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