Revised 5/31/2018

FIN WHALE (*Balaenoptera physalus physalus*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fin whales are found throughout all oceans and seas of the world from tropical to polar latitudes. They have been considered rare in Hawaiian waters and are absent to rare in eastern tropical Pacific waters (Hamilton *et al.* 2009). Balcomb (1987) observed 8-12 fin whales in a multispecies feeding assemblage on 20 May 1966 approx. 250 mi. south of Honolulu. Additional sightings were reported north of Oahu in May 1976, in the Kauai Channel in February 1979 (Shallenberger 1981), north of Kauai in February 1994 (Mobley *et al.* 1996), and off Lanai in 2012 (Baird 2016). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in five sightings in 2002 and two sightings in 2010 (Barlow 2003, Bradford et al 2017; Figure 1). A single stranding was reported on Maui in 1954 (Shallenberger 1981). Thompson and Friedl (1982; and see Northrop *et al.* 1968) suggested that fin whales migrate into Hawaiian waters mainly in fall and winter, based on acoustic recordings off Oahu and Midway Islands. Although the exact positions of the whales producing the sounds could not be determined, at least some of them were almost certainly within the U.S. EEZ. More recently, McDonald and Fox (1999) reported an average of 0.027 calling fin whales per 1000^2 km (grouped by 8-hr periods) based on passive acoustic recordings within about 16 km of the north shore of Oahu.

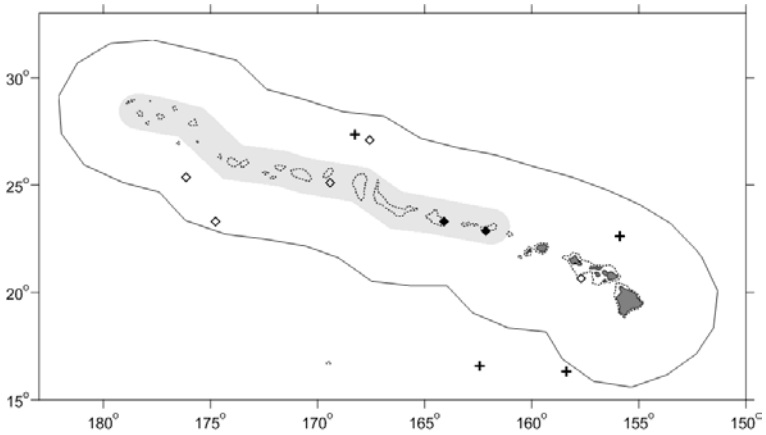

Figure 1. Locations of fin whale sightings from longline observer records (crosses; NMFS/PIR, unpublished data) and sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003, Bradford et al 2017; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000 m isobath.

The International Whaling Commission (IWC) recognized two stocks of fin whales in the North Pacific: the East China Sea and the rest of the North Pacific (Donovan 1991). Mizroch *et al.* (1984) cite evidence for additional fin whale subpopulations in the North Pacific. There is still insufficient information to accurately determine population structure, but from a conservation perspective it may be risky to assume panmixia in the entire North Pacific. In the North Atlantic, fin whales were locally depleted in some feeding areas by commercial whaling (Mizroch *et al.* 1984), in part because subpopulations were not recognized. The Marine Mammal Protection Act (MMPA) stock assessment reports recognize three stocks of fin whales in the North Pacific: 1) the Hawaii stock (this report), 2) the California/Oregon/Washington stock, and 3) the Alaska stock. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Encounter data from a 2010 shipboard line-transect survey of the entire Hawaiian Islands EEZ was recently evaluated using Beaufort sea-state-specific trackline detection probabilities for fin whales, resulting in an abundance estimate of 154 (CV=1.05) fin whales (Bradford *et al.* 2017) in the Hawaii stock. This is currently the best available abundance estimate for this stock within the Hawaii EEZ, but the majority of fin whales would be expected to be at higher latitudes feeding grounds at this time of year. A 2002 shipboard line-transect survey of the same area resulted in an abundance estimate of 174 (CV=0.72) fin whales (Barlow 2003). Species abundances estimated from the 2002

HICEAS survey used pooled small dolphin, large dolphin, and large whale g(0) (the probability of sighting and recording an animal directly on the track line) estimates stratified by group size (Barlow 1995). Since then, Barlow (2015) developed a more robust method for estimating species-specific g(0) values that are adjusted for the Beaufort sea states that are encountered during a survey. This new method was used for analyzing the data from the 2010 survey, but has not yet been used to analyze the 2002 data. Using passive acoustic detections from a hydrophone north of Oahu, MacDonald and Fox (1999) estimated an average density of 0.027 calling fin whales per 1000 km^2 within about 16 km from shore. However, the relationship between the number of whales present and the number of calls detected is not known, and therefore this acoustic method does not provide an estimate of absolute abundance for fin whales.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) around the 2010 abundance estimate or 75 fin whales within the Hawaiian Islands EEZ.

Current Population Trend

Abundance analyses of the 2002 and 2010 datasets used different g(0) values. The 2002 survey data have not been reanalyzed using this method. This change precludes evaluation of population trends at this time. Assessment of population trend will likely require additional survey data and reanalysis of all datasets using comparable methods.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of fin whales is calculated as the minimum population size within the U.S EEZ of the Hawaiian Islands (75) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (the default value for an endangered species with Nmin <1500; Taylor et al 2003), resulting in a PBR of 0.1 fin whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2011 and 2015, one fin whales was observed entangled in the SSLL fishery (100% observer coverage), and none were observed in the DSLL fishery (20-22% observer coverage) (Bradford 2017, McCracken 2017). The SSLL entanglement occurred outside of the Hawaiian Islands EEZ and the whale was judged to be not seriously injured (Bradford 2017). The 5-yr annual mortality and serious injury estimate for fin whales is 0 both inside and outside the Hawaiian Islands EEZ (McCracken 2017).

Historical Mortality

Large numbers of fin whales were taken by commercial whalers throughout the North Pacific from the early 20th century until the 1970s (Tønnessen and Johnsen 1982). Approximately 46,000 fin whales were taken from the North Pacific by commercial whalers between 1947 and 1987 (C. Allison, IWC, pers. comm.). Some of the whales taken may have been from a population or populations that migrate seasonally into the Hawaiian EEZ. The species has been protected in the North Pacific by the IWC since 1976.

STATUS OF STOCK

The status of fin whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Fin whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. Because there have been no reported fishery related mortality or serious injuries within the Hawaiian Islands EEZ, the total fishery-related mortality and serious injury of this stock can be considered to be insignificant and approaching zero. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll *et al.* 2002). Behavioral changes associated with exposure to simulated mid-frequency sonar, including no change in

behavior, cessation of feeding, increased swimming speeds, and movement away from simulated sound sources has been documented in tagged blue whales (Goldbogen *et al.* 2013), but it is unknown if fin whales respond in the same manner to such sounds.

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