UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

March 24, 2021

MEMORANDUM FOR: Protected Resources Division, West Coast Region

FROM: Chris Yates
Assistant Regional Administrator
for Protected Resources

SUBJECT: West Coast Region's revised Endangered Species Act implementation and considerations about "take" given the September 2016 humpback whale DPS status review, species-wide revision of listings, and updates to best available scientific information

The purpose of this memo is to document the best available scientific evidence on the presence of the different Distinct Population Segments (DPSs) of humpback whales (*Megaptera novaeangliae*) off the coasts of Washington (WA), Oregon (OR), and California (CA) and to describe our revised approach to assessing the effects of various human activities on those DPSs pursuant to sections 7, 9, and 10 of the Endangered Species Act of 1973, as amended (ESA). With the revised ESA status of humpback whales documented off the U.S. west coast (all humpback whales are still protected under the Marine Mammal Protection Act (MMPA)), NMFS West Coast Region (NMFS-WCR) will use this approach in all ESA analyses following the final listing decision of September 8, 2016 (81 FR 62260) and updated information presented in Wade (2017), Carretta et al. (2020), Calambokidis and Barlow (2020), and Martien et al. (2020). This approach applies to those cases where the DPS origin of an animal that may be affected by human activities cannot otherwise be assigned based on photos or other samples taken from the affected animal.

NMFS has identified three DPSs of humpback whales that are found off the coasts of Washington, Oregon and California. These are: the Hawaii DPS (found predominately off Washington and southern British Columbia (SBC)), which is not listed under the ESA; the Mexico DPS (found all along the west coast), which is listed as threatened under the ESA; and the Central America DPS (found all along the west coast, but most common off California and Oregon), which is listed as endangered under the ESA.

Identification of Humpbacks on Wintering and Foraging Grounds

NMFS-WCR reviewed the best available scientific information on the distribution and abundance of these different DPSs off the west coast of the U.S. There are two primary lines of evidence for the origin of humpback whales found off the west coast: photo identification catalogues and genetic identification of sampled individuals.

Genetic Information

Genetic analysis alone cannot yet conclusively assign an individual whale to one DPS over another due to overlapping haplotype occurrences in mitochondrial DNA. Recently, Martien et al. (2020) generated two new data sets to genetically characterize two "migratory herds" (Mexico and Central America) that use the California/Oregon feeding ground to both compare them to each other and to the wintering breeding aggregations to which they may belong. While their results showed that the Central America-CA/OR herd and the mainland Mexico-CA/OR herd are significantly genetically differentiated from each other, the herds share a high proportion of haplotypes, even when using full mitogenome sequences. Consequently, many individuals cannot be reliably assigned to a herd using just mitochondrial data. Importantly, they found evidence that animals that are photographically identified as being part of the mainland Mexico-CA/OR herd are not genetically fully representative of that herd. The authors postulate two possible reasons: 1) a potential bias due to Central America animals that are photographed as they migrate past mainland Mexico and mistakenly assigned to the Mexico DPS, and 2) a spatial or temporal segregation of mainland Mexico animals on the wintering ground such that some portion of the wintering aggregation is being over- or under-represented in the photographic catalog. The authors note that future work should investigate the level of nuclear genetic differentiation between herds.

Photo Identification

Whales identified via photo identification can, in general, be affirmatively assigned to one DPS or another based on matches to photographs taken on the breeding grounds. We note, however, that photo identification is limited to the robustness of the sampling of whales on the breeding grounds. Regular sampling on the breeding grounds must be sufficient enough to achieve the necessary sample sizes and account for new individuals recruiting into the population and animals passing through the breeding area to or from other breeding areas. In Wade (2017), a multi-strata mark recapture model was fit to photo-identification data using a six-month time-step, with the four winter areas and the six summer areas (including Alaska) defined to be the sample strata. The four winter areas corresponded to the four North Pacific DPSs: Western North Pacific, Hawaii, Mexico and Central America. The analysis was used to estimate abundance within all sampled winter and summer areas in the North Pacific, as well as to estimate migration rates between these areas. The migration rates were used to estimate the probability that whales from each winter/breeding area were found in each of the six summer feeding areas.

There are two recognized feeding areas along the U.S. west coast: CA/OR and WA/SBC (Calambokidis et al. 2017). Based on photo identification work, we know that humpback whales that forage off California and Oregon originate both from the Central America breeding population (listed as an endangered DPS, of which nearly 90 percent feed off CA/OR) and the Mexico breeding population (listed as a threatened DPS and which feed off CA/OR, WA/SBC, northern BC and Alaska (Wade (2017)). The proportion of whales from the Central America DPS appears to be highest in southern California (south of the Gulf of the Farallones, west of San Francisco) and decreases to very low rates off WA/SBC (Calambokidis et al. 2017). Humpback whales foraging off northern WA and SBC, comprise a mix of the Central America DPS, the Mexico DPS and the non-listed Hawaii DPS, which primarily migrate to Alaska to feed. Proportionally, most of these whales appear to be from the non-listed Hawaii DPS. These rates are considered below in our proposed approach for evaluating impacts to the listed DPSs in ESA section 7 consultations within the WCR.

Humpback Abundance Estimates off the U.S. West Coast

Based on the best available information (described below), all of the whales from the Central America DPS appear to migrate to feed only off the west coast of the United States. Conversely, whales from the Mexico DPS migrate in varying proportions to the U.S. west coast, British Columbia, and various areas off Alaska.

Wade et al. (2016) estimated abundance within all sampled winter breeding and summer feeding areas in the North Pacific and estimated migration rates between these areas using a comprehensive photo-identification study of humpback whales in 2004-2006 during the "SPLASH" (Structure of Populations, Levels of Abundance and Status of Humpbacks) project. Subsequently, Wade (2017) reanalyzed the Wade et al. (2016) data because "the multistrata model analyses were not necessarily converging to the correct answer," as stated in Wade (2017). The revised results led to different estimates of abundance for both the breeding (winter) and feeding (summer) grounds and different estimates of the proportional representation of animals from the different breeding grounds foraging off areas of the U.S. west coast. We note that the SPLASH surveys were conducted around 15 years ago, which indicates that those abundance estimates are outdated; specifically, they are greater than 8 years old, which is not considered a reliable estimate of current abundance, as summarized in NMFS' Guidelines for Preparing Stock Assessment Reports (NMFS 2016). For the 2004-2006 humpback populations, the Wade (2017) revised abundance estimate for the Central America DPS is 783 (Coefficient of Variation (CV)=0.17) animals, and the revised abundance estimate for the Mexico DPS is 2,806 (CV=0.055) animals, using the Multistrata model (N_{multi}) (which uses both winter and summer data; Table 2 in Wade 2017). Estimates of 2004-2006 humpback whale abundance for summer foraging areas for CA/OR (not distinguished by DPS) were between 1,555-1,728 animals and abundance estimates for northern WA/SBC was between 352-412 animals, both using two different models (Table 1 in Wade 2017).

Because these abundance estimates were derived from the ~15 year old SPLASH project, we look to the best available science to estimate the current abundance of the two listed DPSs. Based on the most recent final (2019) Stock Assessment Report (SAR) (Carretta et al. 2020), abundance estimates from photographic mark-recapture surveys conducted off California and Oregon (1991-2014) represent the most precise estimates. Depending on the choice of mark-recapture model and the sampling period (2011-2014 Chao estimate), the 2019 SAR identified the best estimate of humpback whales foraging off CA/OR to be 2,374 (CV=0.03) whales. For the WA/SBC feeding group, Calambokidis et al. (2017) estimated 526 (CV=0.23) humpback whales based on 2013 and 2014 mark-recapture data. Because the CA/OR/WA humpback whale is still considered one stock under the MMPA, the combined estimate of the foraging (summer) population of humpbacks is 2,900 whales, with a growth rate of approximately 6-7% per year (Carretta et al. 2020).

Most recently, Calambokidis and Barlow (2020) presented a preliminary report on updated abundance estimates through 2018 for humpback whales off the U.S. west coast to the Pacific Scientific Review Group (PSRG). These estimates were peer-reviewed by the PSRG and have been subsequently published in a NOAA Technical Memorandum. Importantly, Calambokidis and Barlow (2020) provided an abundance estimate for the U.S. west coast stock (CA/OR/WA) of humpbacks (and the Eastern North Pacific stock of blue whales), which has been included in the draft 2021 SAR, with revised trend information and other metrics to assist managers in assessing risk of human-related activities to this stock. Capture-recapture models for humpback whales off CA/OR showed a dramatic increase in recent years, with a trend for the population starting in 1989 (~500 animals) through 2018 increasing an average 7.5% per year, with a higher

rate of increase in the late 2000s[1]. While multiple abundance estimates for humpbacks along the U.S. west coast were reported, the most recent (i.e., 2018) estimate of 4,973 whales (with a standard error of 239 and lower and upper 20th percentile values of 4,776 to 5,178 whales) was produced for CA/OR based on the Chao model using rolling 4-year periods for the last four most recent available years (2015-2018; Table 3 in Calambokidis and Barlow 2020). While the estimates of humpback whale abundance for WA/SBC were also presented (1,593 animals, standard error of 108) and showed increases, particularly in recent years and extending into the Salish Sea[2], the abundance estimate for the U.S. west coast only included CA/OR. There are two main reasons why the authors did not add the two estimates from both foraging areas. First, the WA/SBC estimate included a fairly large number of animals that would be outside U.S. waters, since some of the major areas of concentration were just north of the U.S. border. Animals outside of U.S. waters are generally not included in abundance estimates generated for SARs under the MMPA[3]. Secondly, there is some interchange between the CA/OR and the WA/SBC areas, which would mean that each individual estimate is to some degree including a portion of animals from the other area (J. Calambokidis, Cascadia Research Collective, personal communication, September 2020).

Habitat models, also known as species distribution models (SDMs), have been recognized as valuable tools for estimating the density and distribution of cetaceans. They have also been used to provide updated abundance estimates, including minimum population size estimates. Recently, Becker et al. (2020) included data from the 2018 California Current Ecosystem Survey and combined it with previous line-transect surveys (1991-2018) to update population size estimates for U.S. west coast marine mammal stocks. Habitat models for a number of cetaceans (including humpback whales) were developed using previously established methods, incorporating recently developed techniques for deriving more comprehensive estimates of uncertainty in SDM predictions. In order to support agency requirements to calculate the potential biological removal level for these stocks in the SARs, the pooled average of the 2014 and 2018 model-predicted study area abundance estimates and associated variance estimates (including minimum abundance estimates (Nmin)) were also calculated. The most recent abundance estimate (i.e., 2018) for humpback whales was 4,784 animals (95 percent confidence interval of 2,658-8,609 animals; CV= 0.307). This generated an Nmin of 3,717 animals (Table 3 in Becker et al. 2020). While the overall abundance estimates generated from Becker et al. (2020) align rather well with Calambokidis and Barlow (2020), the line-transect estimate only reflects whale densities within the study area during summer and autumn, when surveys were conducted. Therefore, while the draft 2021 SAR considers (and compares) habitat models used to calculate abundance estimates, the mark-recapture estimate is considered the best because it:

---

[1] These estimates will further be evaluated and tested in the future with results from planned Bayesian models and an analysis of the 2018 sighting survey conducted by NMFS. A "SPLASH 2" program is also underway, with increased field efforts off southern Mexico and Central America as well as one or two workshops to update the databases and analyses.

[2] Photographs of humpback whales in the inland waters of Washington (Strait of Juan de Fuca, Haro Strait and Puget Sound) are currently being analyzed by Cascadia Research Collective to match individuals to the breeding ground photo identification catalogues. In the preliminary analysis to date, individuals from inland waters have been matched to Hawaii and Mexico but not to Central America. Until that analysis is complete, however, we will use the same proportions in inland waters as for the outer coast of Washington.

[3] Note that they may be included when estimates are based on mark-recapture for transboundary stocks such as humpback whales. The 2019 SARs included the abundance estimate for WA/SBC feeding group of humpback whales (n=526) and then this estimate was prorated for the time spent outside of U.S. waters (where data are available) to calculate the potential biological removal level (J. Carretta, NMFS-SWFSC, personal communication, December 2020).

1) has better precision, and 2) reflects an estimate of the overall population size, not just the animals that happen to be in the study area during line-transect surveys (J. Carretta, SWFSC, personal communication, January, 2021).
Therefore, we are relying on the Calambokidis and Barlow (2020) abundance estimate for the CA/OR/WA humpback whale stock: 4,973 (CV=0.048), with an Nmin of 4,776 animals. In addition, this abundance estimate has been included in the draft 2020 SAR for the CA/OR/WA stock (J. Carretta, SWFSC, personal communication, February 2021).
Based on the most recent information, particularly in the 15 years since the SPLASH project, humpback whales have increased annually at a rate of 6-7% off the U.S. west coast (Carretta et al. 2020), with preliminary estimates of humpbacks foraging off CA/OR increasing by 7.5% per year (Calambokidis and Barlow 2020). We assume that the abundance estimates for the Central America and Mexico DPS have both increased at this rate, although research is needed to verify this as these DPSs may be subjected to different threats, particularly on the wintering grounds but also while migrating north to and occupying different portions of their summer feeding grounds. In addition, they may have different internal rates of survival and reproduction. Because the Mexico DPS forages widely in the North Pacific, including areas off British Columbia and Alaska, we cannot estimate the total abundance of this DPS based on the recent minimum abundance estimate of the CA/OR/WA stock of humpbacks. Therefore, if we very conservatively assume that the total population estimated by Wade (2017), based on information from 2004-2006 (2,806 animals), has increased by 3 percent annually, the current total abundance estimate of the Mexico DPS would be 4,372 animals. With a 6 percent annual growth (which is reasonable for this threatened DPS) in the last 15 years, the current total abundance estimate of the Mexico DPS would be 6,725 animals. Similarly, and until we have more recent information regarding trends of the endangered Central America DPS, if we assume that the population estimated by Wade (2017) based on information from 2004-2006 (783 animals) has very conservatively increased by 3 percent annually in the last 15 years, the current abundance estimate of the Central America DPS would be 1,220 animals, while a 6 percent annual growth rate would yield an estimated 1,877 whales. With the most recent increasing trend of 7.5 percent/year presented in Calambokidis and Barlow (2020) and summarized in the 2020 draft SAR, we consider the 6 percent annual growth trend for both listed DPSs to be more probable than the 3 percent annual increase, and therefore, we estimate the abundance of the Central America DPS to be around 1,877 animals, with an estimated abundance of the Mexico DPS to be around 6,725 animals.

Mixing Proportions of Humpback DPSs found off the U.S. West Coast

In this section, we consider how to reconcile the DPS-specific information from Wade (2017) with the most recent stock specific information on humpback whale abundance from Calambokidis and Barlow (2020). Wade et al. (2016) summarized the distribution and relative abundance of humpback whale breeding populations, including the two ESA-listed DPSs that forage off the U.S. west coast (but also SBC). Subsequent review of the models used to generate those estimates from the SPLASH data produced new estimates of the abundance and distribution of humpback whale DPSs in both summer feeding areas and winter mating and calving areas (Wade 2017). The models described in Wade et al. (2016) reflect the strong fidelity individual whales show to specific winter and summer areas. Wade et al. (2016) and Wade (2017) describe estimated movement probabilities (also referred to as migration rates) of the Mexico DPS and the Central America DPS between winter breeding grounds and summer feeding areas and categorize the summer feeding areas into regional strata (CA/OR and WA/SBC).

Table 3 in Wade (2017) (and included in Appendix A for reference) summarizes movement probabilities of humpback whales to and from their summer and winter areas. Table 3a depicts the probability of a humpback whale moving from each winter area to each summer area, while Table 3b depicts the probability of a humpback whale moving from each summer area to each winter area. We considered the information summarized in both tables (below), although we consider the probability of a humpback whale foraging off the U.S. west coast moving to its breeding/winter area off Mexico and Central America (Table 3b) to be most informative, particularly when assessing the risk an action occurring in the summer feeding areas poses to either DPS. Movement probabilities depicted in Table 3b help inform us of the mixing proportions of the two listed DPSs foraging off the U.S. west coast, particularly off the CA/OR stratum where only the two listed DPSs forage there (and therefore summing the proportions of the two DPSs equate to 100 percent of the animals expected in that area).

In the discussion that follows, we use the values from Tables 3a and 3b in an assessment of the potential abundance of each DPS off the U.S. West Coast and the proportions of each DPS that could be expected to forage in different areas off the U.S. West Coast. The assessment of the potential abundance of each DPS is important to the overall context of the effect that activities off the U.S. West Coast could have on the survival and recovery of these DPSs. The assessment of the mixing proportions off CA/OR and WA/SBC is important to evaluating the specific impacts of an activity on animals exposed to the action. Another way to look at the use of Table 3b in the discussion that follows is to consider how many individuals in the set of animals exposed to some action originate from one DPS or the other. For example, if the mixing proportions in a particular area are 30 percent Mexico and 70 percent Central America, then in a given group of 10 animals within that area, three would likely originate from the Mexico DPS and seven would likely originate from the Central America DPS.

According to Wade (2017), the Mexico DPS primarily migrates to foraging areas in the Gulf of Alaska and the Aleutian Islands/Bering Sea (approximately 68 percent of the DPS), with approximately 32 percent foraging off CA/OR and WA/SBC (Table 3a in Wade 2017). Within the CA/OR strata, the proportion of the humpback whales feeding there in the summer months and moving back to the winter breeding area off Mexico is 32.7 percent. For the SBC/WA strata, the proportion of the humpback whales feeding there in the summer months and moving back to Mexico would be 27.9 percent (Table 3b in Wade 2017).

According to Wade (2017), the majority (approximately 93 percent) of the Central America DPS uses the CA/OR strata, with approximately 7 percent of the DPS using the WA/SBC strata (Table 3a in Wade 2017). Within the CA/OR strata, the proportion of the humpback whales feeding there in the summer months moving back to the winter breeding area off Central America is 67.2 percent. For the SBC/WA strata, the proportion of the humpback whales feeding there in the summer months and returning to the Central America wintering area would be 8.7 percent (Table 3b in Wade 2017). Thus, the majority of the Central America DPS forages off CA/OR, with a small proportion foraging off WA/SBC.

Based on the most recent information in the 2019 SAR (Carretta et al. 2020) and in Calambokidis and Barlow (2020), it is clear that there have been changes in the abundance and/or distribution of humpback whale DPSs over the last 10-15 years since the data gathered during the SPLASH project was re-analyzed by Wade (2017). While we do not have an analysis that provides a specific estimate of the current DPS abundances and distributions, we used the available information to consider several scenarios and generated the most plausible estimate of

the current abundance and distribution of the two listed DPSs. From these estimates, we can weigh the potential impact of activities on ESA-listed humpback whales off the U.S. west coast in the face of some uncertainty until definitive information on the current status of ESA-listed DPSs become available.

Because we do not have current movement probabilities for humpbacks originating from Central America and Mexico (the two ESA-listed DPSs that forage off the U.S. west coast), we will first consider the revised Wade (2017) proportions. We know that previously published abundance estimates for the Mexico DPS and the Central America DPS based on the SPLASH surveys are outdated. More recent abundance estimates published in the 2019 SAR (Carretta et al. 2020) do not include data collected during subsequent years (through 2018) off the U.S. west coast. Therefore, the 2019 SAR estimate should be considered *minimum* estimates. We know that humpback whales off the U.S. west coast generally have increased between 6-7 percent annually over the last 30+ years (Carretta et al 2020) or, more recently, 7.5 percent annually (Calambokidis and Barlow 2020), although we do not know whether these increases are applicable to all three DPSs feeding off our coast. If we conservatively estimate that the endangered Central America DPS has increased 6 percent annually over 15 years, the current abundance estimate would be around 1,876 animals found off the U.S. west coast. Similarly, if we assumed that the threatened Mexico DPS has conservatively increased at 6 percent annually, the current estimate for the entire DPS would be around 6,725 animals, with some portion of that total found off the U.S. west coast.

The most recent minimum abundance estimate contained in Calambokidis and Barlow (2020) for CA/OR humpbacks is 4,776 animals. Based on the Wade (2017) calculations of proportions off of CA/OR, 67 percent of these animals (or 3,200 animals) are from the Central America DPS (which would indicate a 10 percent annual growth rate for this DPS) and 33 percent (or 1,576 animals) are from the Mexico DPS (which would indicate that less than a quarter of the Mexico DPS forages off CA/OR, assuming a 6 percent annual growth rate (1,576/6,725)). Because it is not likely that the endangered Central America DPS has increased at a rate greater than the estimated growth rate for the stock (7.5% annually), we assume that the mixing proportions in summer feeding areas off CA/OR estimated by Wade (2017) are outdated.

Therefore, to consider what proportions of these DPSs are off of the U.S. west coast, we considered the combination of the most recent abundance estimates with reasonable assumptions of population growth rates since 2004-2006 to derive proportional estimates for the current populations of humpback whales off the coasts of CA, OR, and WA. Since we know that all of the Central America DPS forages off the U.S. west coast, we assume that, with a 6 percent annual growth rate, approximately 1,877 (39 percent of the 4,776 minimum abundance estimate; Calambokidis and Barlow 2020) feeding off the U.S west coast originate from Central America (endangered DPS)[4]. Based on available information, almost all of that DPS (93 percent per Wade (2017; Table 3a)) forages off CA/OR (a maximum estimate of ~1,746 animals (93% of 1,877)). Given this calculation, and the fact that Mexico DPS humpbacks forage off CA/OR (and no other DPSs forage there other than the Central America DPS), approximately 61 percent of humpbacks

[4] Note that if we assumed that the Central America DPS had increased annually at a 3 percent growth rate, we could assume that out of all humpbacks foraging off CA/OR, only 26 percent comprise the Central America DPS, which is less conservative in assessing risk to this endangered DPS.

foraging off CA/OR (or 2,913 animals of the 4,776 minimum abundance estimate) would originate from Mexico (threatened DPS).

For WA/SBC, we do not have an estimate of the abundance of humpbacks that may be foraging north of CA/OR and only within U.S. waters, only that they represent a small proportion of the minimum abundance estimate for the CA/OR/WA stock (as defined under the MMPA), with most of the humpbacks feeding north of the U.S. border (J. Calambokidis, Cascadia Research Collective, personal communication, September, 2020). However, without available current mixing rates or Washington specific abundance information, we apply the Wade (2017) movement probabilities of humpbacks feeding off WA/SBC to breeding areas off Central America and Mexico. This means we assume that around 28 percent of whales feeding off WA/SBC originate from the Mexico DPS, and approximately 9 percent[5] originate from the Central America DPS (Table 3b in Wade (2017)). The majority of the humpback whales (63 percent) feeding in this area would originate from the non-listed Hawaii DPS.

Although we considered (and rejected) several other scenarios of abundance estimates and movement probabilities for the two listed DPSs foraging off the U.S. west coast, we feel the scenario described above is the most plausible, given current available data.

In conclusion, we consider any humpback whales migrating or foraging off the coast of California and Oregon to be ESA-listed whales that originate either from Mexico or Central America. We will consider humpback whales migrating or foraging off the coast or in inland waters of Washington to primarily originate from the listed Mexico or non-listed Hawaii DPSs, with a smaller proportion being Central America humpback whales. Further, based on available information, the proportions of these populations in different areas of the coast may not strictly match the estimates calculated by Wade (2017) and may also vary between sub-regions (e.g. southern and northern portions of CA/OR and the inland waters and outer coast of WA/SBC).

ESA Section 7 Consultations

ESA assessments of human activities, such as section 7 consultations, should be conducted using the best available scientific and commercial information and approaches. For future section 7 consultations, NMFS-WCR will apply a proportional impact approach based on the available information described above. Currently, this information suggests that, for actions occurring off the coast of California and Oregon, up to 39 percent of the humpback whales that could be affected by a proposed action would be members of the endangered Central America DPS and up to 61 percent would be members of the threatened Mexico DPS. For example, for an action proposed or occurring off California estimated to kill 10 humpback whales, we would conservatively assume that 39 percent (or 4) of those animals affected might originate from the endangered Central America DPS, which we believe consists of around 1,877 animals, assuming a 6 percent annual growth rate. We would assess that same activity and associated mortality on the assumption that 61 percent (or 6) of those humpback whales may originate from the Mexico DPS. This DPS includes the animals off the west coast (estimated in this memo as a minimum of 2,913 whales). Since likely over half of the animals from this DPS migrate to feed in other areas of the Pacific, the DPS' total abundance is greater than 2,913 animals. As described above, based

[5] Here, 9 percent represents the proportion of animals seen on the foraging grounds that move to Central America (Table 3b in Wade (2017)) versus the percentage of the total population originating from the breeding ground (~7 percent (Table 3a in Wade (2017)).

on an assumed 6 percent annual growth rate, we estimate the minimum abundance estimate for the total Mexico DPS to be around 6,725 animals.

Alternatively, we recognize that changes in abundance (as described earlier) may not translate into changes in the proportion of DPSs migrating to various feeding areas, since feeding ground destinations are thought to be maternally-directed. Therefore, for activities conducted in specific areas off the coasts of California and Oregon (e.g., southern California), NMFS-WCR could consider the more detailed summary of humpback whale migrations along the U.S. west coast in Calambokidis et al (2017). Their research shows that the proportion of humpback whales migrating to different winter breeding areas changes with latitude, not just between the two recognized feeding areas (e.g., CA/OR and WA/SBC), but also within them. This is an alternative approach that may provide a more conservative assessment of the level of risk a localized proposed action poses to both individual animals within the action area and the effects to the DPSs from which those animals originate. Using the results of Calambokidis et al (2017), given the movement of the two listed DPSs from the U.S. west coast to their breeding/wintering areas, we could further sub-divide the CA/OR region to two sub-regions: South CA and North CA/OR, with a dividing line in the Gulf of the Farallones area. As described, while clear differences are shown to exist in winter migratory destinations among feeding areas, subtler differences also exist within feeding areas (Figure 5 in Calambokidis et al. 2017, and included in Appendix B for reference). For instance, the proportion of humpback whales foraging off the U.S. west coast and subsequently migrating to Central America follow a gradient through the feeding area, with whales feeding off southern California much more likely to travel to Central America versus those foraging farther north up the U.S. west coast. From Figure 5 (specifically the blue bars representing the percentage of unique individuals in different feeding areas known to match each wintering area), it appears that approximately 60 percent of the Central America DPS forages south of the Gulf of the Farallones, with a smaller proportion of the population feeding north of this area and decreasing in numbers through northern California and Oregon. The Mexico DPS is much more complex with respect to the proportion of animals foraging off the U.S. west coast, showing variation throughout the area. Given the more "predictable" movement of the Central America DPS off California and Oregon, using the results of Calambokidis et al. (2017), we may be able to qualitatively analyze the risk of the effects of proposed actions (particularly relatively localized actions) to this DPS.

If the same action was proposed off Washington (including inland waters) and an estimated 10 humpbacks would be adversely affected, we would assume about 9 percent (or 1) of the humpback whales occurring off of Washington would be from the endangered Central America DPS and about 30 percent (or 3) would be from the threatened Mexico DPS. Having no other updated estimates of abundance or proportion specific to the areas off Washington, we are defaulting to using the Wade (2017; Table 3b) movement probabilities at this time. As noted in footnote #2, photos from humpback whales in inland waters are currently being analyzed. Until we have updated information on the proportions of humpbacks from the Central America and Mexico DPSs specific to inland waters, we will apply the WA estimates in Table 1 for both coastal and inland waters. Generally, these estimates comport with our current understanding of the distribution of these populations off our coast. Over time, as population status or environmental conditions change, or further population survey analysis, genetic analysis, or photo identification work occurs, these proportions may change.

For consultations on activities that span the entire U.S. west coast, the assessment would need to take into consideration available information on the distribution and intensity of the activities across the coast and make bridging assumptions, as needed, about shifts in proportion presence along the coast to describe the proportional impacts of an action on the listed humpback whales.

As a result, biological opinions should include an analysis of the effects of the proposed action on the endangered Central America DPS and the threatened Mexico DPS, as those are the two DPSs on the U.S. west coast that remain listed under the ESA. The proportional assignments discussed above can be used as a proxy for determining the likelihood that a proposed activity (e.g., fishing) may affect this listed entity. For example, a fishery conducted off of a large portion of California may "take" humpback whales, but without knowing the DPS origin of individual animals, a section 7 biologist would conclude that the chances of fishery interactions with a listed entity would be 100 percent, with any given animal having a 39 percent chance of being from Central America DPS and a 61 percent chance of originating from the Mexico DPS (Table 1). As noted above and summarized in considerably more detail in Calambokidis et al. (2017), the Central America DPS is found in higher proportions off southern California (south of the Gulf of the Farallones) (Figure 5, and included in Appendix B). A similar scenario (e.g., fishing activity) occurring off the coast of Washington is likely to be more complicated, with potentially a nearly 40 percent chance of a fishery interacting with a listed entity (28 percent Mexico and 9 percent Central America) (Table 1); however, this is a *very* conservative estimate since we know that humpbacks from at least the Mexico DPS may be found in greater proportions foraging north of the U.S. – Canada border.

Table 1. Current estimates of abundance and relative proportions of the Central America DPS (endangered), Mexico DPS (threatened) and Hawaii DPS (non-listed) found off the U.S. west coast.

Action Area	Probability that a humpback would be from Central America DPS (N_{min} = - 1,877 (6 percent growth))	Probability that a humpback would be from Mexico DPS (N_{min}= 6,725 (6 percent growth))	Probability that a humpback would be from Hawaii (non-listed) DPS
CA/OR*	39%	61%	0%
WA**	9%	28%	63%

*Probabilities are based on the assumption that both the listed DPSs have increased 6 percent per year (which provides a conservative estimate that 4 out of 10 humpbacks could represent the Central America DPS), and given that the Nmin of the CA/OR/WA humpback stock (under the MMPA) is 4,776 animals (Calambokidis and Barlow 2020). Note that an action proposed south of the Gulf of the Farallones is more likely to interact with a humpback from the Central America DPS verses a Mexico DPS (Calambokidis et al. 2017).

**Source: Wade (2017; Table 3b). Note that the majority of humpbacks that may be found off WA likely are moving north of the U.S. border and feeding primarily off SBC. In addition, we are currently applying the same proportions of the two listed DPSs to both coastal and inland waters of WA until further analysis is completed.

Assigning humpback whale takes that occur off the U.S. west coast

Similarly, these proportions may be used for determinations of the likelihood that individual animals that have been taken from one DPS or another (in cases where the animal is not identified in a photo catalog). Instances of these types of takes may include vessel strikes or fishery interactions. Using the logic outlined above, if a humpback whale is "taken" off the U.S. west coast where two or more DPSs mix on the foraging grounds and origin of the animal is unknown, NMFS could preliminarily assign it according to the likely proportion of the known DPSs that forage or migrate in the area, conservatively taking into account the certainty (or uncertainty) associated with the estimated proportion. For example, off the coast of Washington, NMFS could consider a 40% chance that a humpback whale struck by a vessel to be from either the listed Mexico or Central America DPS. Complicating matters is that entangled whales are documented to continue swimming over large distances and long periods of time following the

initial interaction. For example, a humpback whale might in fact be entangled off Oregon or Washington (or even in Alaska or outside of the United States), but is reported as entangled in California, and therefore, the origin of the entangled whale may incorrectly be "assigned" to a particular DPS (listed or not listed). Similarly, we often do not know the origin of a humpback that is found dead or injured as a result of a ship strike/entanglement, nor where the strike/entanglement occurred.

As a result, for entangled or ship-struck humpback whales off the U.S. west coast (where the location of the initial entanglement/strike is unknown) will use the following guidance: Initially, NMFS-WCR will assume that there is a high probability that those humpback whales originate from one of the two listed DPSs. Because past experience suggests that most ship strikes or entanglements in general occur near the reported location, NMFS-WCR should use their best judgment and apply either the 39 percent (Central America DPS) and 61 percent (Mexico DPS) proportional values described above for reports off CA/OR or use the more location-specific approach described above using the Calambokidis (2017) information. Similarly, for reported ship strikes or entanglements off WA, NMFS-WCR should initially (and/or until more recent information is available) use the 9 percent and 28 percent proportional values described above to determine whether a humpback whale is likely from the Central America or Mexico DPS. In addition, available information, such as genetic or photo ID information gathered from the event, or other event-specific information, such as gear identification or details on where a strike or entanglement actually occurred, could be used to make a final positive identification or pro-ration to the affected DPS. We anticipate that such findings may be used in negligible impact determinations under section 101(a)(5)(E) of the MMPA and ESA section 7 consultations (including the Environmental Baseline section).

Important additional questions

Beyond the need to continue photo identification data collection and the refinement of genetic assignments of DPS origin (e.g. via nuclear genetic differentiation), there are other research questions that may aid in assignment of affected or potentially affected humpback whales to a specific DPS.

Questions for further discussion along with initial implementation of this approach:

- What (if anything) do the shifts in haplotype frequency along the Oregon and California coast mean about the proportional presence of Mexico and Central America DPS whales?

Questions for future, further refinement of the approach:

- Characterization of the foraging areas by importance to the DPSs may be based on how many individuals from specific DPSs were seen multiple times and in multiple years. In other words, do any of the DPSs exhibit a proportionately larger site fidelity to the U.S. west coast year after year, or differential fidelity to certain areas?
- Given the distance they must migrate to their breeding grounds, do humpback whales from either the Mexico DPS or the Central America DPS have longer residency times when foraging off the U.S. west coast? Satellite telemetry data, if they exist, might be important here.
- Can we further refine the proportional assignment of animals foraging off the coast and inland waters of Washington to the three DPSs and estimate the abundance of humpbacks foraging there?

References

Becker, E.A., K.A. Forney, D.L. Miller, P.C. Fiedler, J. Barlow and J.E. Moore. 2020. Habitat-based density estimates for cetaceans in the California Current Ecosystem based on 1991-2018 survey data. NOAA Technical Memorandum NMFS-SWFSC-638.

Calambokidis, J., J. Barlow, K. Flynn, E. Dobson, and G.H. Steiger. 2017. Update on abundance, trends, and migrations of humpback whales along the US West Coast. International Whaling Commission Paper SC/A17/NP/13. 17 p.

Calambokidis, J. and J. Barlow. 2020. Updated abundance estimates for blue and humpback whales along the U.S. west coast using data through 2018, U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-634.

Carretta, J.W., K.A. Forney, E.M. Olson, D.W. Weller, A.R. Lang, J. Baker, M.M. Muto, B. Hanson, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, J.E. Moore, D. Lynch, L. Carswell, and R.L. Brownell. 2020. U.S. Pacific Marine Mammal Stock Assessments: 2019. NOAA- TM-NMFS-SWFSC-629.

Martien, K.K., Hancock-Hanser, B.L., Lauf, M., Taylor, B.L., Archer, F.I., Urbán, J., Steel, D., Baker, C.S., & Calambokidis. J. (2020). Progress report on genetic assignment of humpback whales from the California-Oregon feeding aggregation to the mainland Mexico and Central America wintering grounds. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-635. https://swfsc-publications.fisheries.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-635.pdf

NOAA. 2016. Guidelines for Preparing Stock Assessment Reports Pursuant to Section 117 of the Marine Mammal Protection Act.

Wade, P.R., T.J. Quinn, J. Barlow, C.S. Baker, A.M. Burden, J. Calambokidis, P.J. Clapham, E.A. Falcone, J.K.B. Ford, C.M. Gabriele, D.K. Mattila, L. Rojas-Bracho, J.M. Straley, B. Taylor, J. Urban, D. Weller, B.H. Witteveen and M. Yamaguchi. 2016. Estimates of abundance and migratory destination for north Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA21 presented to the International Whaling Commission Scientific Committee.

Wade, P. R. 2017. Estimates of abundance and migratory destination for North Pacific humpback whales in both summer feeding areas and winter mating and calving areas – revision of estimates in SC/66b/IA21. International Whaling Commission. SC/A17/NP/11. 10 pp.

Appendix A

Table 3 (from Wade 2017). Movement probabilities for the multi-strata model.

a. Probability of moving from each winter area (on left) to each summer areas (as columns).

Area moving to						
Area moving from	Kamchatka	Aleutian Islands/Bering Sea	Gulf of Alaska	SE Alaska/ Northern BC	Southern BC/WA	OR/CA
Asia	0.054	0.946	0.000	0.000	0.000	0.000
Hawaii	0.000	0.711	0.120	0.152	0.016	0.000
Mexico	0.000	0.552	0.111	0.020	0.033	0.284
Central America	0.000	0.000	0.000	0.000	0.074	0.926

b. Probability of moving from each summer area (on left) to each winter area (as columns).

Area moving to:				
Area moving from:	**Asia**	**Hawaii**	**Mexico**	**Central America**
Kamchatka	1.000	0.000	0.000	0.000
Aleutian Islands/Bering Sea	0.021	0.868	0.110	0.000
Gulf of Alaska	0.004	0.872	0.120	0.000
SE Alaska/Northern BC	0.000	0.635	0.279	0.087
Southern BC/WA	0.000	0.635	0.279	0.087
OR/CA	0.000	0.000	0.327	0.672

Appendix B

Figure 5 from Calambokidis et al. 2017.

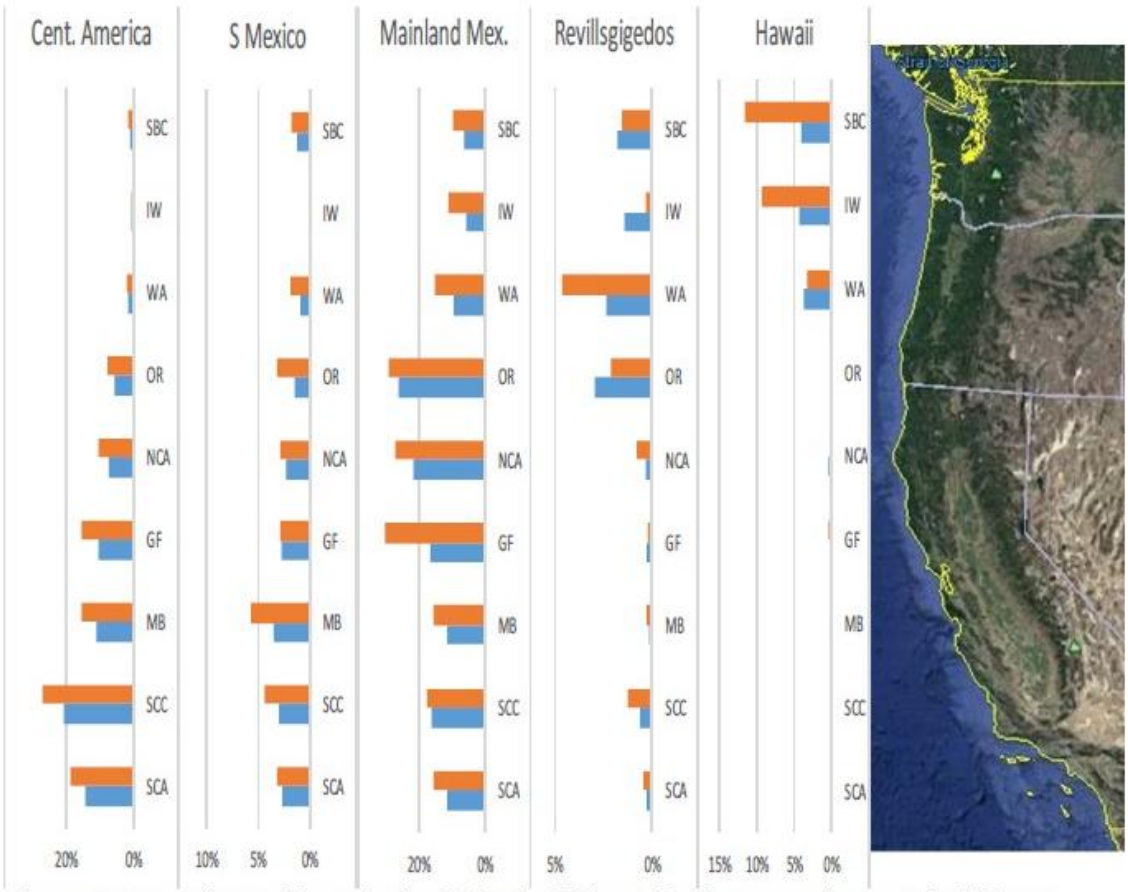

Figure 5. Proportions of humpback whales in different feeding areas that match different wintering areas. Blue bars show percent of unique individuals and red show percent of encounters in each area known to match each wintering area.