

Commercial Whaling, Especially for Gray Whales, *Eschrichtius robustus*, and Humpback Whales, *Megaptera novaeangliae*, at California and Baja California Shore Stations in the 19th Century (1854–1899)

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Introduction

Whaling ranks along with some pelagic fisheries for marine fish as one of the world's most widespread and ancient forms of living resource exploitation. It was pursued at one time or another along nearly every human-inhabited coastline, including the west coast of North America. Eastern North Pacific whale populations were subject to hunting over various time periods, at various seasons, and at various points in their annual migratory cycles.

In a broad analysis of global whaling, Reeves and Smith (2006) identified no fewer than 25 different whaling "operations" that targeted baleen whales in the North Pacific, ranging from hunts by

aboriginal groups involving relatively primitive methods that began many hundreds or even thousands of years ago to the more recent factory ship activities using modern searching, killing, and processing methods. One of these operations (No. 47 in the Appendix of Reeves and Smith, 2006) was described as "American-style shore" whaling on the west coast of the United States that began in 1854 and targeted primarily gray whales, *Eschrichtius robustus*, and humpback whales, *Megaptera novaeangliae*.

The widely held view that the population of gray whales in the eastern North Pacific (often called the California population or stock) has essentially recovered from depletion by whaling was challenged by the suggestion from genetic analysis that there were close to 100,000 in the North Pacific during prewhaling times (Alter et al., 2007). If that estimate were reasonably accurate

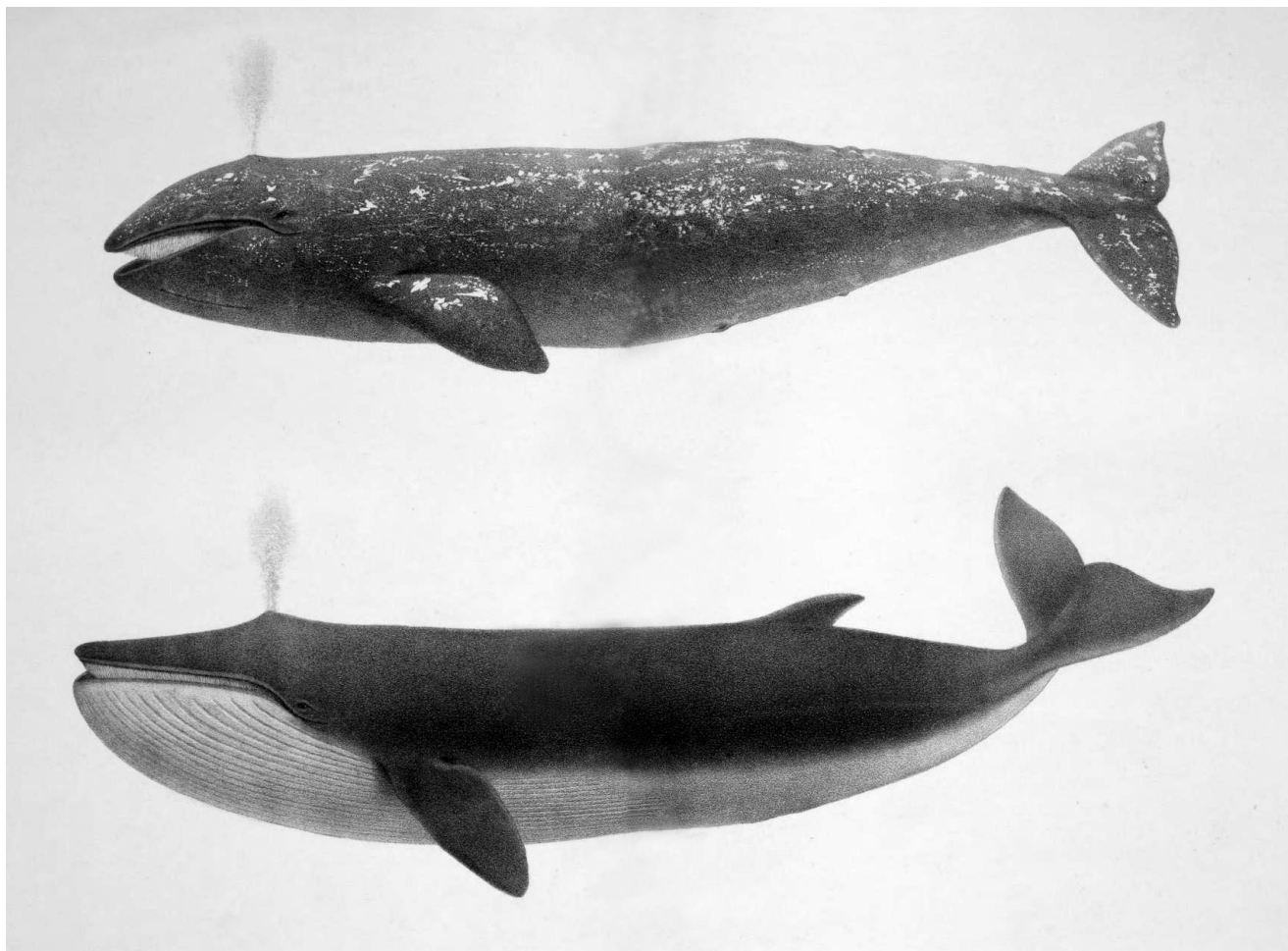
and applied to the period just before large-scale commercial exploitation of gray whales began in the 1840's, it would mean that the catch record used to model the eastern population (IWC, 1993; Butterworth et al., 2002, their Table 2) is far from complete. In fact, even without the DNA-based estimate by Alter et al. (2007), concerns have been voiced concerning the accuracy and completeness of the catch record. Wade (2002:85–86), for example, stated:

"An unresolved issue regarding the eastern North Pacific gray whale is that it has not been possible to reconcile the catch history from the 1800's with the recent time series of abundance data in a simple way. Several attempts have been made to project population models forwards from the 1800's assuming the population was at carrying capacity prior to the start of commercial whaling in 1846, but such projections cannot produce a trend that agrees with the recent abundance estimates, which indicate the population roughly doubled between 1967 and 1988 The catch history and current trend can only be reconciled through fairly dramatic assumptions, such as an increase in the carrying capacity from 1846–1988 of at least 2.5 times, an underestimation of the historic commercial catch from 1846–1900 of at least 60%, or annual aboriginal catch levels prior to 1846 of at least three times the level previously thought (Butterworth et al., 2002)."

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ABSTRACT—Shore whaling along North America's California and Baja California coasts during 1854–99 was ancillary to the offshore and alongshore American whale fishery, which had begun in the North Pacific in the early 1800's and was flourishing by the 1840's. From its inception at Monterey, Calif., in the mid 1850's, the shore fishery, involving open boats deployed from land to catch and tow whales for processing, eventually spread from Monterey south to San Diego and Baja California and north to Crescent City near the California–Oregon border. It had declined to a relict industry by the 1880's, although sporadic efforts continued into the early 20th century. The main target species were gray whales, *Eschrichtius robustus*, and humpback whales, *Megaptera novaeangliae*, with the valuable North

Pacific right whale, *Eubalaena japonica*, also pursued opportunistically. Catch data are grossly incomplete for most stations; no logbooks were kept for these operations as they were for high-seas whaling voyages. Even when good information is available on catch levels, usually as number of whales landed or quantity of oil produced, it is rarely broken down by species. Therefore, we devised methods for extrapolation, interpolation, pro rationing, correction, and informed judgment to produce time series of catches. The resulting estimates of landings from 1854 to 1899 are 3,150 (SE = 112) gray whales and 1,637 (SE = 62) humpback whales. The numbers landed should be multiplied by 1.2 to account for hunting loss (i.e. whales harpooned or shot but not recovered and processed).



A gray whale (top) and a fin whale drawn by Charles M. Scammon to illustrate his classic book on American whaling (Scammon, 1874). These depictions of body shape and markings are far superior to many later drawings by less experienced artists. They reflect Scammon's extensive first-hand knowledge of the animals he hunted.

Humpback whales in the eastern North Pacific have recovered strongly from depletion by commercial whaling in the 19th and 20th centuries (Calambokidis et al., 2008). In contrast to eastern gray whales, however, the catch history of humpback whales in the North Pacific has been given relatively little attention in the literature. Rice (1978:29) believed that the total population was only “on the order of 15,000 prior to 1905” although he gave no rationale for this conclusion. His tally of modern catches in the North Pacific, totaling 28,000 from 1905 to 1965, may be reasonably accurate, but Rice’s estimate of premodern humpback catch levels and abundance must be negatively biased

to a considerable degree as basin-wide abundance in the mid 2000’s was close to 20,000 and the population was still growing at about 5% per year (Calambokidis et al., 2008).

The main purpose of this paper is to review the history of commercial shore whaling along the coasts of California and Mexico and to estimate catches of gray and humpback whales by 19th century shore whaling. It represents a first attempt to create a complete time series of catches of both species by pre-modern commercial shore whalers in this part of their range.

The report of the 1990 Special Meeting of the IWC Scientific Committee on the Assessment of Gray Whales

recommended that further searches be carried out for “missing shore-based commercial catches” and that the values used to account for whales killed but unprocessed (“struck-and-lost”) be reconsidered (IWC, 1993:252). It acknowledged that the commercial component (at least) of the catch series used at the meeting to model the eastern North Pacific population (Butterworth et al., 1990, 2002, based mainly on Lankester and Beddington, 1986) was likely incomplete and needed careful reevaluation. In this paper, we attempt to update and improve the catch record for gray whales.

With regard to humpback whales, Rice (1978) acknowledged that the

effects of “old-style” ship-based whaling had not been assessed, noting only the slightly more than 200 ship-based humpback kills plotted in the North Pacific by Townsend (1935). In his estimate of pre-whaling abundance for this species, Rice essentially dismissed the 19th century ship-based catches, as well as the catches by 19th century shore whalers. He stated that although 17 stations along the California coast were active at various times between 1854 and 1900, they “depended on gray whales, and few if any humpbacks were killed.”

Here, we infer that substantial numbers of humpback whales were taken by the 19th century shore whalers in California and Baja California. A separate study of ship-based whaling for humpback whales in the eastern North Pacific during the 19th century is needed before further inferences can be made concerning the historical abundance of this species.

Materials and Methods

Data Sources and General Features of the Fishery

This study was guided and informed by two major reviews of 19th century shore-based whaling in California and Mexico—a master’s thesis (Nichols, 1983; supervised by D.A. Henderson) and a book chapter (Sayers, 1984). Despite the nearness of their publication dates, these two reviews seem to have been prepared independently. They are largely complementary, but not always consistent in regard to the data they contain. Both relied heavily on a handful of standard published sources, specifically Scammon (1874) and Henderson (1972, 1984), as well as Townsend (1886), Jordan (1887a, 1887b), Collins (1892), and Starks (1922). Although we consulted much of that work ourselves, we also assumed that the station-by-station reviews and analyses by Nichols and Sayers had incorporated most of it, particularly with respect to gray whales.

According to Sayers (1984), the more northern stations along the California coast were established mainly with humpback whales as targets, whereas the southern stations were established

mainly to take advantage of the predictable seasonal availability of gray whales. Many of the stations took a mix (often seasonally determined) of both species as well as right whales, *Eubalaena japonica*, whenever an opportunity became available. Blue whales, *Balaenoptera musculus*, and fin whales, *B. physalus*, were taken rarely, and sperm whales, *Physeter macrocephalus*, even less often (Starks, 1922; Bertão, 2006:100, 106).

The taking of both humpback whales and gray whales is a typical feature of shore whaling in the eastern North Pacific going back all the way to the prehistoric Makah (Huelsbeck, 1988). This mixture often causes uncertainty in allocating catches (including oil production values) between the two species. Adding to the uncertainty is the fact that gray whales may have been intentionally or mistakenly reported as humpbacks in some modern whaling statistics (Scheffer and Slipp, 1948:310).

Methods of Catch Estimation

Information on shore-based whaling in Mexico (Baja California) and California was compiled from the sources identified above. In addition to the descriptions of activities at each station (or group of geographically proximate stations), data were assembled systematically on years of operation, numbers of men and boats employed, numbers of whales secured or quantities of whale oil landed, and whenever possible, the species breakdown of the catch (see Appendix). It proved possible to construct nearly complete datasets for a few of the stations, but for most, numerous gaps exist. In fact, in some instances little is known beyond the years of operation, and even then it is sometimes impossible to be certain of years when the station was and was not fully manned and functioning.

Several methods of interpolation were developed to account for uncertain and missing landings. When landings were reported as numbers of whales, we assumed that those values were known without error. In some instances, different sources reported different numbers taken in a given season for that

particular station. For example, there were 48 instances when both Nichols (1983) and Sayers (1984) had data on the number of whales taken, and in 25 of these instances, the values were identical. Nichols’s values averaged approximately one whale (0.98, SE = 0.90) fewer than Sayers’s and ranged from 15 fewer to 18 more, but there appeared to be no systematic differences between the two sources.

We assumed in all cases that any difference was due to omission, i.e. the lower value was a result of incomplete information available to either Nichols or Sayers, and therefore used the larger value. When the only value reported was the quantity of whale oil landed, we estimated the number of whales by dividing reported barrels by average barrels of oil per whale from the data for that station in years when both numbers and oil were reported. Uncertainty associated with those estimated numbers of whales was approximated using the observed variance in the number of barrels per whale, following a Taylor’s series expansion (Seber, 1973). Whenever a species other than gray whales or humpback whales (e.g. right whales) were specified in the source, those individual whales or the corresponding quantities of oil were subtracted before estimation. Also, as explained later, it was assumed that, on average, the oil yield from gray whales and humpback whales was essentially the same and therefore we made no attempt to convert oil quantities to whales landed for the two species separately.

We assumed that whaling continued in years when there were no reported landings unless we had information indicating that operations had been suspended or interrupted. The landings in such years were assumed to have been similar to those reported in surrounding years. Two cases were considered. The first was when there were short gaps in the data or longer gaps but where the landings before and after a gap were similar. Here we interpolated the missing value as the average of landings for a period of time surrounding the gap.

To estimate the uncertainty associated with these interpolated values,

we treated the reported landings in the selected time period as a sample from a uniform distribution. Because some of the landings are known only with uncertainty (i.e. estimated from reports on oil production), we estimated the half width of the uniform distribution (w , Equation 1) for a selected time period using the second-order moment estimator (Benšić and Sabo, 2007)

$$w = (3(s^2 - \sigma^2))^{1/2}$$

where s is the standard deviation of the reported landings in the selected time period and σ^2 is the assumed constant variance about each year's landings that were reported in barrels of oil. We estimated σ^2 as the mean of the variances of the reported landings in the period. The variance of the interpolated landings value then becomes $w^2/3$.

The second case was when the average reported landings before and after a gap differed substantially. We constructed a hypothetical example to describe how we applied the above

uniform distribution approach to this case. Figure 1 shows the hypothetical data, with reported catches in years 1 and 2 (points labeled A), nine years with no catch reports, and reported catches in years 10, 11, and 12 (points labeled B). In this example, we assumed that catches for years 2 and 11 were reported in numbers of whales and those for years 1, 10, and 12 were reported in barrels of oil and converted to whales as described above. For these last three values, the estimation errors are depicted by the vertical bars of length one standard deviation above and below the individual points.

We interpolated the missing values (dots in Fig. 1) linearly from the average levels in the earlier and the later time periods (averages of the A and B points, denoted as X in Fig. 1). The vertical bars above and below the X's denote the width of the respective uniform distributions estimated ($2w$, Equation 1) from the landings in the two time periods. We estimated the uncertainty about the interpolated values as the variance of a uniform distribution from the lower

limit of the distribution of the A points to the upper limit of the distribution of the B points (represented by the horizontal dashed lines). The vertical bars above and below the interpolated points are then the standard deviations of the uniform distribution so formed. In the event that landings are available for only one year before or after the gap in reports, the uniform distribution has width equal to the difference between the two average values because no information on variability is available.

For stations with too few reported catches to allow this procedure, we projected the catch as the average catch per season at the seven well-reported stations. The variance of those projected catches was taken as the variance of a uniform distribution over the range of the catches per season using Equation 1. We estimated the numbers of gray whales and humpback whales separately based on the ratio of these two species in instances where the species identity of the whales taken was reported.

Results

The data on landings from 1854 to 1899, assembled from a variety of sources, include at a minimum whether an individual station operated in a given year, and at maximum the information on whales landed (rarely by species), barrels of oil, men employed, and boats involved (see Appendix). In addition to such information, the Appendix contains notes to clarify or augment aspects of the basic data. A pronounced feature of this material is the highly variable level of completeness across stations, with seven of the stations having substantially more data than the other ten.

Species Ratios

Scammon (1874:248–250) stated, “The whales generally taken by the shore parties are Humpbacks, and California Grays; but occasionally a Right Whale, a Finback, or a Sulphur-bottom (blue whale) is captured.” Too little data was available to us for reliable estimation of species proportions at most of the shore stations. That said, the data reviewed here support Scam-

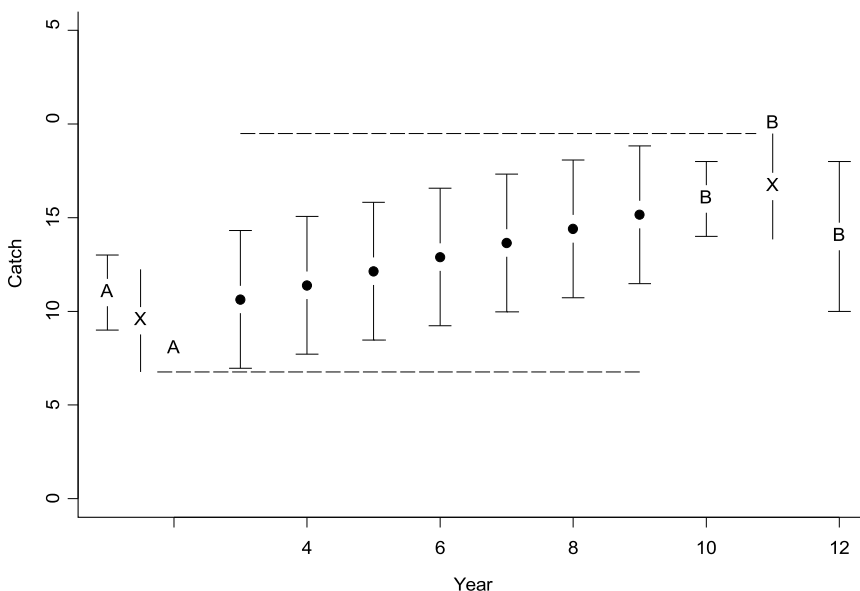


Figure 1.—Diagram illustrating the method used to estimate uncertainty of interpolated values for landings across years when there were gaps in reporting. The A and B points are the reported landings from two periods with data that surround a gap in time without data. The length of the vertical bars above and below the interpolated landings denote the uncertainty assigned to those landings, and are one standard deviation of a uniform distribution between the upper and lower dashed lines (see text for details).

mon's statement that catches of right, blue, and fin whales were very rare.

Right whales present a special problem because they were highly prized, and their capture always promised a windfall of oil and whalebone (baleen). Therefore, it is reasonable to assume that any seen, at any station, would have been chased and killed if possible. We further suspect that right whales were more likely to be reported because of the tendency for news of a right whale catch to reach print as a notable event, whereas it is much more likely that catches of the other species would have been reported simply as "whales" or their oil would have been added to the total produced, without comment.

Based in part on the statement by Sayers (1984) that southern stations were more oriented toward catching gray whales and northern stations toward humpback whales, and in part on other notations in the literature that give the same impression, and because of the limited number of species identifications in the catch statistics and other data, we stratified the whaling stations latitudinally into four geographic regions as indicated in the Appendix. We tallied the numbers of gray and humpback whales reported for the stations in each region (Table 1). This tally generally supports the suggestion by Sayers that the proportion of gray whales was lower in the two more northern strata, although the information available for the North stratum was extremely limited. The proportions shown in Table 1 were used to estimate the numbers of gray whales and humpback whales landed, by year.

Estimated Landings by Station and Region

In this section, the information on whaling effort and catch results is summarized for the four regions, starting from the southernmost stations and working northward (Fig. 2). In those instances where direct estimates of landings were possible from the available data, those estimates are reported here. Projected landings for other stations are then discussed in a separate (later) section.



Figure 2.—Principal place names mentioned in the text (prepared by Beth Josephson).

South

Baja California, Mexico

Sayers (1984) identified only three sites in Baja California where shore whaling was conducted. The most significant were at Punta Banda and Santo Tomas where San Diego-based whalers operated (though not continuously) from 1868 to 1885. According to Nichols (1983:164), another whaling

Table 1.—Numbers of gray whales and humpback whales reported for shore stations in four latitudinally defined regions, with the proportion gray (Pg), proportion humpback (Ph = 1-Pg), and standard error of the proportions (SEp).

Region	Gray	Humpback	Pg	Ph	SEp
South	70	4	0.95	0.05	0.026
S Central	36	1	0.97	0.03	0.027
N Central	45	37	0.55	0.45	0.055
North	0	1	0.0	1.0	0.0

concern had operated at Santo Tomas in 1864 and 1865.

Sayers (1984) appendix (p. 156) indicates a catch of 5 whales at Punta Banda/Santo Tomas in 1860 but without any details. This presumably is different from the on-shore tryworks set up in 1860–61 on the eastern shore of San Ignacio (Ballenas) Lagoon (La Freidera, or The Trypot or Tryworks; Henderson, 1972:100, 157). Although it is known that there was a shore station at Belcher Point, ca. 6–7 km (4 mi) north of the entrance of Magdalena Bay, there is little documentation concerning its operations (Webb, 2001).

Examination of a whaling voyage logbook from the late 1850's (*Saratoga*, 1856–60) revealed that at least one "shore party" was active in Magdalena Bay at that time (also see Henderson, 1972:100, 126–127; 1975; 1984:170). Our interpretation is that the activities of such groups, likely consisting of men who had deserted whaleships, are not subsumed as part of catches summarized by Sayers (1984) and Nichols (1983). On 18 January 1858 a trypot and three empty casks from the *Saratoga* were towed to shore where a group of

"Spaniards" had agreed to "take the oil from the carcasses, on halves." We interpret this to mean that the team on shore received whale carcasses after the blubber had been stripped for cooking aboard the vessel, and that for their efforts they were allowed to keep half of the oil produced from the flensed carcasses. This was called "carcassing" (Henderson, 1972:127). On 23 January 1858 the *Saratoga* logbook notes:

"The shore party of Spaniards came off and assisted us [in cutting in a gray whale taken the day before]. They try out the carcasses for us and two other ships on halves . . . They keep a sharp look out on shore with a telescope and when they see either of the three ships cutting, immediately put off in their boat, and when we have finished cutting, tow the carcass on shore to their works."

On 31 January, the logbook records that the *Saratoga* received 6 bbl of oil and "settled up" with the shore party,

as did the other two ships. The shore camp was dismantled on 19 February, and there is no further mention in the *Saratoga* logbook of oil received from the camp.

Considerable uncertainty surrounds the species composition of catches at the Baja California shore stations. Jordan (1887a:60) described Santo Tomas as a good site for taking sperm whales, and another source claimed that Punta Banda was seasonally variable, with gray whales taken between 10 December and 10 April and afterward humpbacks "further down the coast" (Sayers, 1984:150). A right whale was struck and lost at Punta Banda in February 1871 (Sayers, 1984:149). Gray and humpback whales were not reported separately in any of the Baja California data. Further, none of these stations appears to have lasted for long or to have accounted for large numbers of whales, < 20 whales and at most 700 bbl of oil, all told, in any single year (Sayers, 1984:156). The estimated landings of gray whales and humpback whales, combined, total 248 whales (SE = 21) over the 26 years that we know or presume shore stations operated in Baja California (Fig. 3). These were primarily gray whales (236, SE = 21), with only a few humpbacks (12, SE = 7).

San Diego, Calif.

Whaling in the San Diego area took place without any major interruption from 1858–59 through 1885–86, although there is an 8-year gap in the documentation (no local newspapers published) from 1860 to 1867 (Sayers, 1984; May, 2001). Various sites were used at different times to launch the boats and try out the oil—La Playa, Zuniga Point, Ballast Point, "Whaler's Bight" on North Island, and Point Loma. As many as four companies were operating at times during the 1860's (Sayers, 1984:146).

In the San Diego area, 19th century whaling may have involved humpbacks to some extent, but given the inshore localities of the stations, the period photographs and illustrations of the fishery (May, 2001), and the known present-day distribution and occurrence of the two species, the vast majority

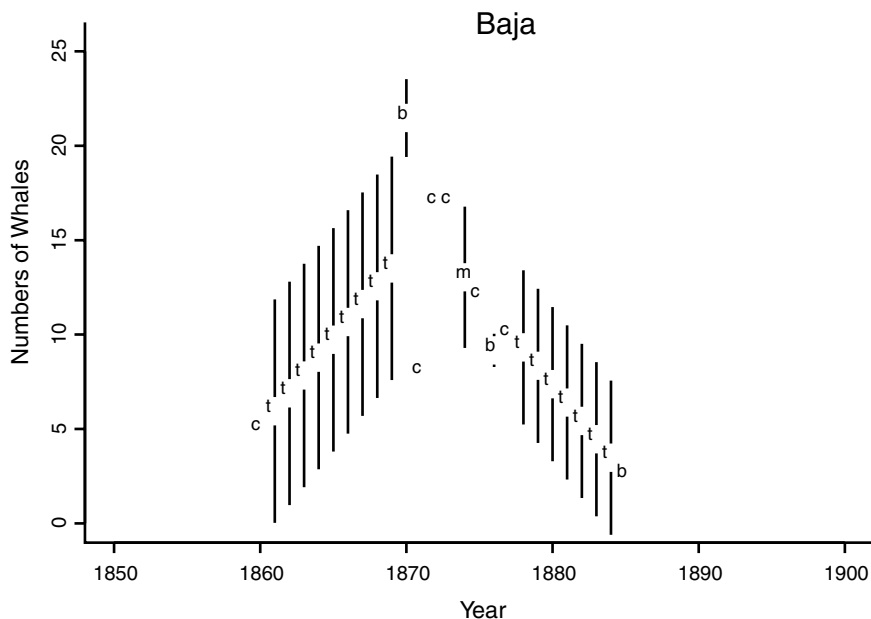


Figure 3.—Whales landed at Baja California shore stations, showing values reported as whales (c) or barrels of oil (b), and for years without data, interpolations—either the mean of adjacent data points (m) or, for multiyear gaps, linearly increasing or decreasing values (t) pegged to the means of data points before and after the gaps. Vertical bars denote one standard error of estimation above and below each year's data value or interpolated value (see text for details).

would have been gray whales, which is consistent with the regional proportions indicated in Table 1. A newspaper description from early January 1873 describes how the whaleboats were deployed from just inside the mouth of San Diego harbor to “lie in wait” in the kelp to intercept passing whales (May, 2001:11). At least one right whale was taken, accounting for fully half of the oil (150 out of 300 bbl) produced at the station in the 1885–86 season (Sayers, 1984:155). A 90 bbl whale reported as taken in the winter of 1868–69 (Nichols, 1983:99) also may have been a right whale.

Some fragmentary, and not always consistent, data are available on oil returns and numbers of whales landed. In 1871, at a time “when San Diego’s whale hunting industry was most successful,” the combined production by two companies working at three stations (Santo Tomas and Punta Banda in Mexico and Ballast Point in San Diego) amounted to 550 bbl of oil, “a record” (May, 2001). Yet a newspaper article in May 1873 reported that those same two companies working at the same three stations landed 24 whales producing 980 bbl of oil, described as “a very light catch for these two companies” (Sayers, 1984:146). It is difficult to reconcile such conflicting statements.

As indicated earlier, in some years the landings attributed to San Diego shore stations included oil or whales from outposts in Baja California. Also, in at least one year (1883–84) the whales processed at a shore station were actually taken by a whaling vessel, the *Sierra*, and towed to shore (Sayers, 1984:155). Nichols (1983:94) cites a report that the ship *Ocean* of New Haven spent the season of 1860–61 anchored inside San Diego Bay functioning as a floating land station, with whaleboats going outside the harbor to catch whales and then towing the whale carcasses to the ship for processing. According to Starbuck (1878:566–567) the *Ocean* sailed in August 1858 and sent home 64 bbl of sperm oil, 1,103 bbl of whale oil, and 1,652 lb of baleen before being sold in

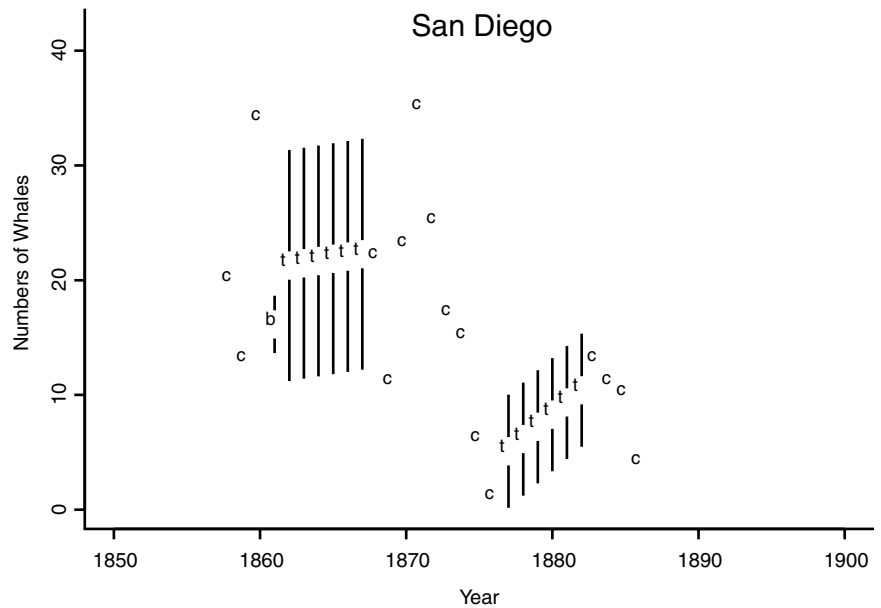


Figure 4.—Whales landed at San Diego, California, shore stations, showing values reported as whales (c) or barrels of oil (b), and for years without data, linearly interpolated values (t) pegged to the means of data points before and after the gaps. Vertical bars denote one standard error of estimation above and below each year’s data value or interpolated value (see text for details).

San Francisco for merchant service. The 500 bbl of whale oil obtained from 12 whales (presumably gray whales) in San Diego in April–May 1860 (Nichols, 1983:106) apparently was not included in Starbuck’s table of returns.

The estimated landings of gray and humpback whales, combined, total 453 whales (SE = 28) over the 29 years that the stations in San Diego are known to have operated (Fig. 4). Most were gray whales (431, SE = 29), with only 23 humpbacks (SE = 12).

Los Angeles, Calif.

Shore whaling in and near Los Angeles harbor began in 1860–61 and continued sporadically until the mid 1880’s, using two different sites (Deadman’s Island in San Pedro Bay, and Portuguese Bend) (Sayers, 1984:142–144; Bertão, 2006:151–157). All evidence indicates that the catch consisted mostly of gray whales (a right whale was taken in March 1861; Sayers, 1984:142). The estimated landings of gray and humpback whales, combined, total 398 whales (SE = 20) over the 26 years that the stations are known to have operated (Fig. 5).

Most were gray whales (378, SE = 21), with only 20 humpbacks (SE = 10).

Goleta (Santa Barbara), Calif.

At least three different companies operated a small shore station at Goleta between 1867–1880 but information on catches is extremely sparse (Sayers, 1984:141–142). Up to 450 bbl of oil was obtained in one winter season (Nichols, 1983:150). Apparently, nearly all of the whales taken at this site were gray whales. As recounted by Bertão (2006:189) regarding one of the companies: “The company hunted gray whales from December to April. The station’s location prevented a hunt for humpback whales, which kept outside the Channel Islands.” No direct estimates of landings were possible for this station.

Point Conception–Cojo Viejo, Calif.

This site was used for shore whaling initially for about 7 years, from 1879–80 to 1885–86. Both gray and humpback whales may have been taken regularly, but with a strong preponderance of gray whales according to the limited data available. A right whale was taken in

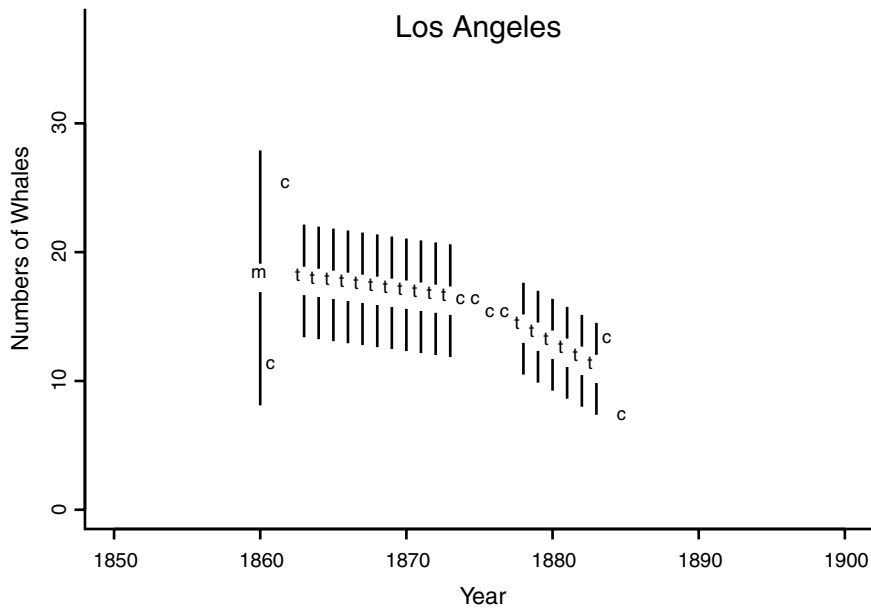


Figure 5.—Whales landed at Los Angeles, California, shore stations, showing values reported as whales (c), and for years without data, interpolations—either the mean of the adjacent data points (m) or, for multiyear gaps, linearly decreasing values pegged to the means of data points (t) before and after the gaps. Vertical bars denote one standard error of estimation above and below each year's data value or interpolated value (see text for details).

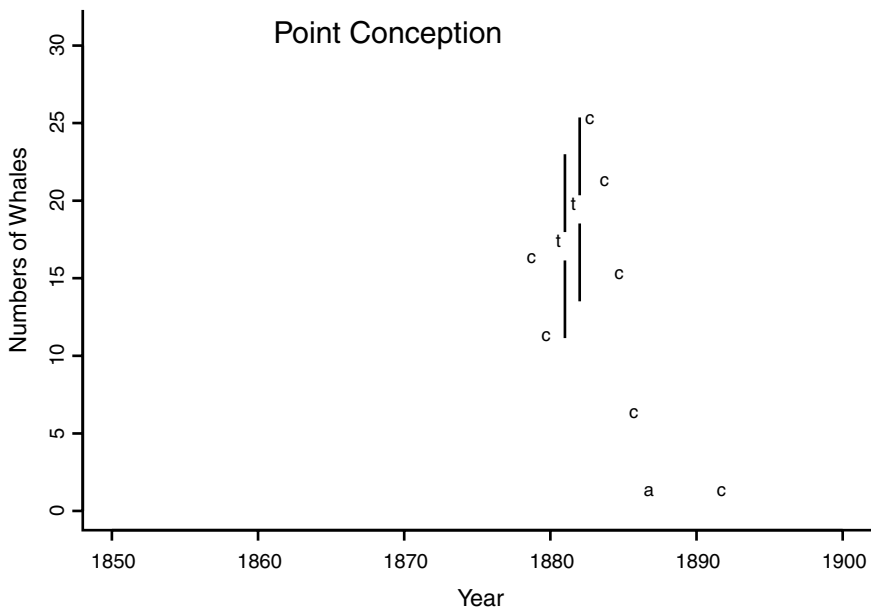


Figure 6.—Whales landed at the Point Conception shore station, showing values reported (c) or assumed (a) as whales, and for years without data, linearly interpolated values (t) pegged to the means of data points before and after the gap. Vertical bars denote one standard error of estimation above and below each year's data value or interpolated value (see text for details).

1884–85 (Townsend, 1886). Relatively good catch data are available. In the one season with detailed information (1879–80), 4 humpbacks were taken in October, followed by 5 grays in December, 10 grays in January, and 1 gray in February for a total of 16 grays (Jordan, 1887a). The humpbacks produced 148 bbl of oil, and the total for the station between April 1879 and February 1880 was 544 bbl, implying that the grays accounted for 396 bbl and thus about 25 bbl/whale. Townsend's (1886) reported totals for other years were 25 grays in 1883–84, 18 in 1884–85 (plus the right whale), and 11 in 1885–86. Although whaling at Point Conception apparently was suspended between 1885–86 and 1892, some kind of operation existed in at least November 1892 when a large whale was taken (Bertão, 2006:196–197). The estimated landings of gray and humpback whales, combined, total 132 whales (SE = 8) over the 14 years that the station is known to have operated (Fig. 6). Most were gray whales (126, SE = 7) and only a few were humpbacks (7, SE = 3).

South-Central

San Luis Obispo (Port Harford), Calif.

This station operated, apparently without interruption, from 1868–69 (possibly as early as 1867; Bertão, 2006:171) to 1887 (Nichols, 1983; Sayers, 1984). Both gray and humpback whales were taken although most of the catch consisted of the former, especially after the mid 1870's when summer whaling was abandoned (Bertão, 2006, p. 172). The reported total catch for three seasons was 9 in 1878–79, 11 in 1879–80, and 4 (all grays) in 1880–81 (Jordan, 1887a:60; Nichols, 1983:148). Catches were modest in the final years—6 grays in 1883–84, 4 grays in 1884–85, 3 grays in 1885–86, and 5 (species unspecified) in 1886–87 (Nichols, 1983:149). The estimated landings of gray and humpback whales, combined, total 96 whales (SE = 12) over the 20 years that the station is known to have operated (Fig. 7). However, according to Bertão (2006:173), 30 or more whales were taken in a single

year at this site, apparently during the 1860's and early 1870's. If this report is accurate, our estimate is probably negatively biased. In any event, most of the whales taken at this station were gray whales (92, SE = 12) and only a few were humpbacks (3, SE = 3).

San Simeon, Calif.

The operation at San Simeon is unique among the many whaling enterprises along the California coast in that it lasted without interruption for 27 years (1865–92) and records of the number of whales taken are almost complete, with only a few years missing in the 1880's (Nichols, 1983; Sayers, 1984:140, 154). Except for three right whales taken in 1884–85, the entire catch consisted of gray and humpback whales, and the ratio appears to have been at least three grays to one humpback (Nichols, 1983:136 reported that the station “depended almost entirely upon gray whales”). The total reported catch for 23 of the 27 years was 350 whales (not counting the 3 right whales; Nichols, 1983:135–141; Sayers, 1984:154).

In 1888 (actually 1888–89), 14 whales were taken (at least 7 of them between 1 January and 9 March and therefore were almost certainly gray whales; Nichols, 1983:137). Most of the catch at San Simeon consisted of gray whales migrating southward from December to February according to Townsend (1886), who further noted that the (smaller) catch during the northward migration (the “up season”) was skewed towards males since mothers with young calves migrated farther from shore and thus were less readily available. At least during the late 1860's and 1870's, some of the men and boats associated with the San Simeon station were based at Piedras Blancas Point (Bertão, 2006:169–170).

The estimated landings of gray and humpback whales, combined, total 441 whales (SE = 8) over the 30 years that the station is known to have operated (Fig. 8). Most were gray whales (428, SE = 14) and only a few were humpbacks (13, SE = 12). Although a small whaling operation existed at San Simeon from around 1894 to 1914, when the

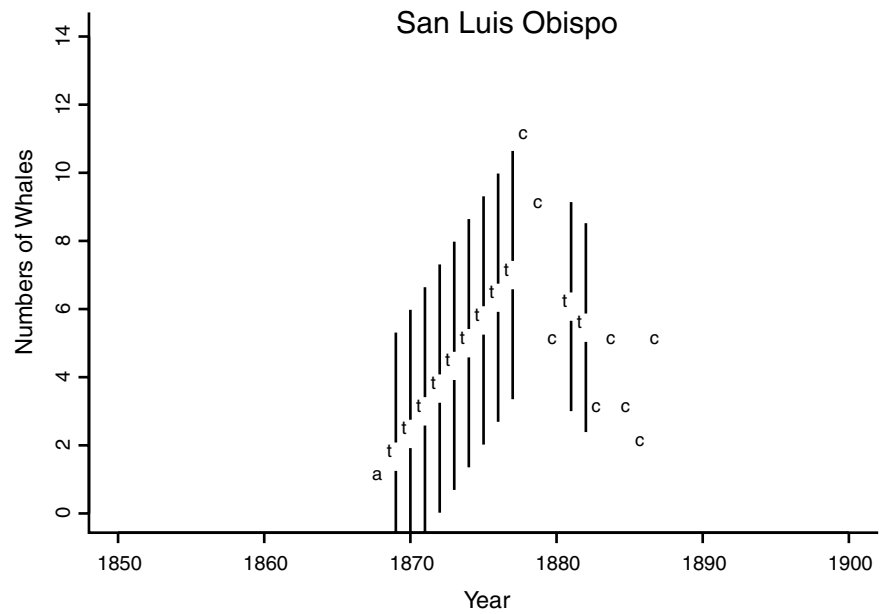


Figure 7.—Whales landed at the San Luis Obispo, California, shore station, showing values reported (c) or assumed (a) as whales, and for years without data, linearly interpolated values (t) pegged to the means of data points before and after the gaps. Vertical bars denote one standard error of estimation above and below each year's data value or interpolated value (see text for details).

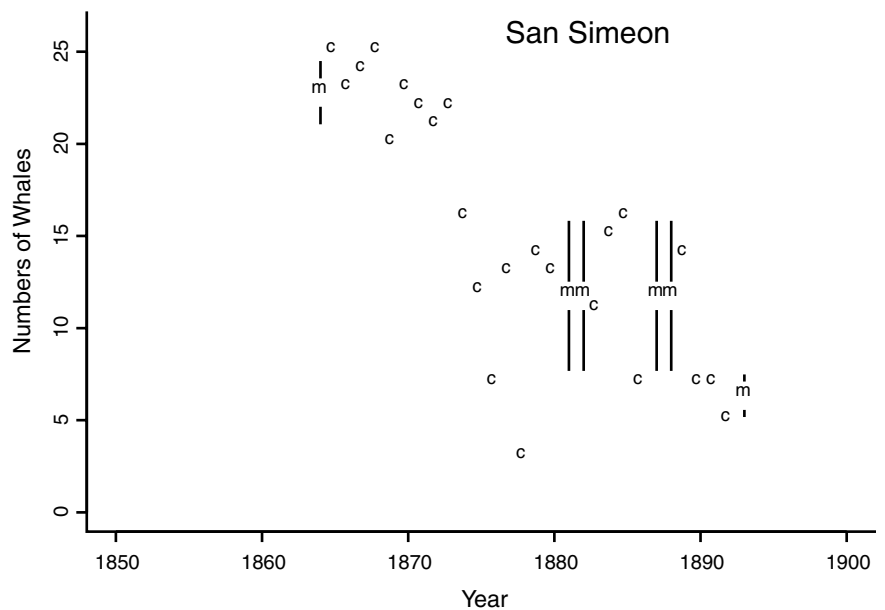
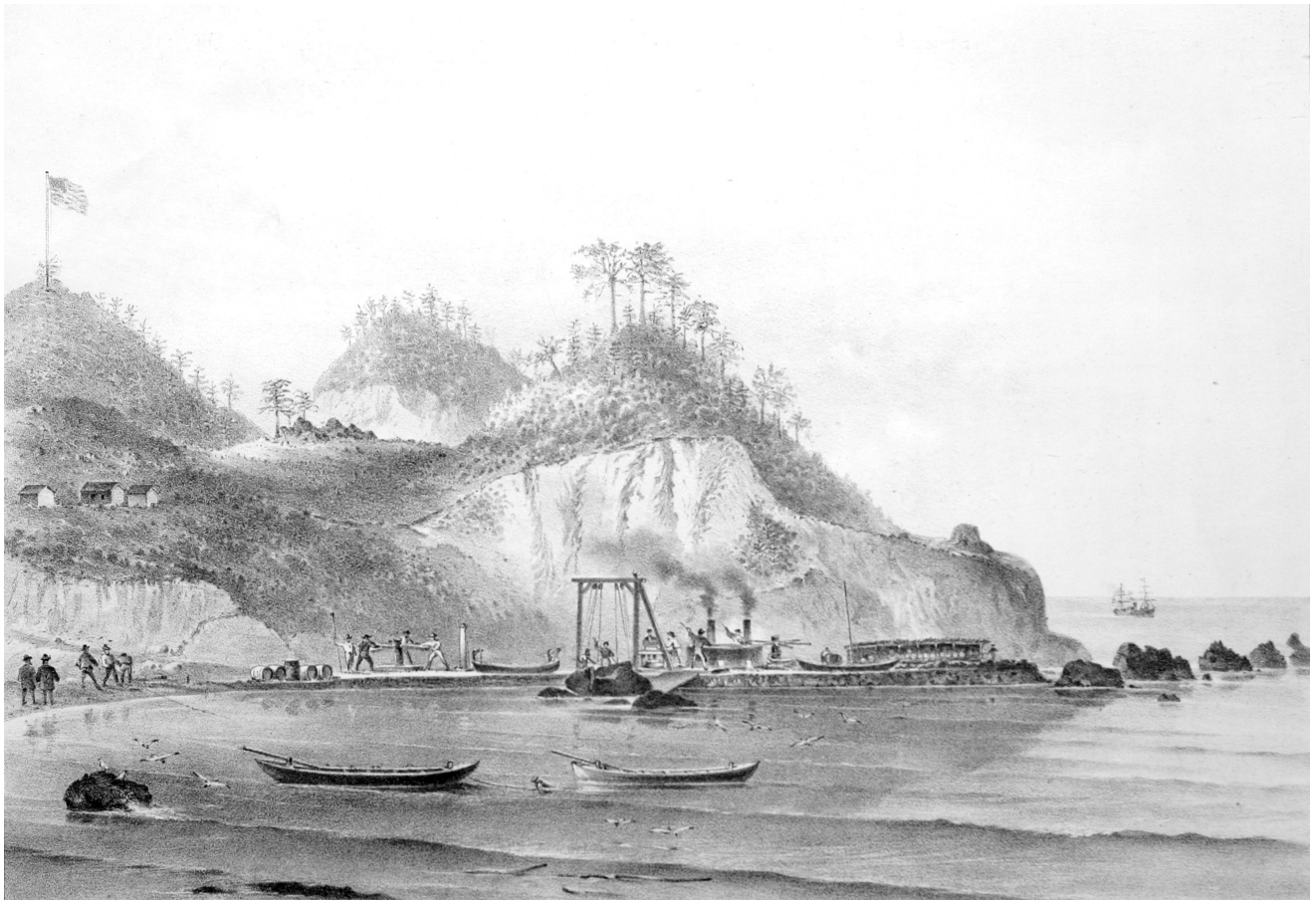


Figure 8.—Whales landed at the San Simeon, California, shore station, showing values reported as whales (c), and for years without data, interpolated values from the mean of adjacent data points (m). Vertical bars denote one standard error of estimation above and below each year's data value or interpolated value (see text for details).

last whale was taken there using 19th century open-boat methods (Bertão, 2006:169), we have not included that period in our estimate.



Lithograph of a whaling station at Carmel Bay drawn by Charles M. Scammon (Scammon, 1874: plate XXVII).

North-Central

Monterey Bay Area, Calif.

We describe the operations at several sites under this heading, including Point Sur, Carmel (Point Lobos), Monterey, and Santa Cruz (Soquel Point, Point Año Nuevo, and Davenport Landing).

Point Sur The operation here, some 30 km south of Monterey, lasted for only two seasons and may have been, in effect, an outpost of the Carmel operation (below). The total reported catch consisted of 1 gray whale and 1 blue whale in 1877–78; 3 grays, 1 humpback, and 1 right in 1878–79 (Nichols, 1983:153; Sayers, 1984:154; Bertão, 2006:104). These reports of landings appear to be complete.

Carmel This station was established at Point Lobos in 1862 and operated

until 1884 (Nichols, 1983:121–122). Despite such a long (and presumably continuous) period of operation, however, catch data are very sparse. The catch in 1879–80, the only year for which statistics are available, consisted of 3 humpbacks, 3 grays, and 1 fin whale, together producing a total of 200 bbl of oil (Nichols, 1983:123). Given the seasonal nature of the whaling—October to March—it can be inferred that migrating gray whales were the main targets of the 2–4 whaleboats and 17-man contingent at Carmel (Scammon, 1874:250; Nichols, 1983:121, 125). No direct estimates of total landings were possible from the available data.

Monterey This was the site of the first commercial shore whaling operation on the west coast of North America. The operation was probably

initiated in 1854 and persisted (at least in relict form) into the early 20th century (Sayers, 1984:134). Initially the focus was on humpback whaling rather than gray whaling although both species were taken (Bertão, 2006). Watkins (1925) indicated that the Portuguese Whaling Company produced about 800 bbl of “humpback oil” annually in three years, 1856–58, but another (newspaper) source stated that 24 “whales of all kinds” were taken by that company in Monterey Bay between April 1854 and November 1855 (Nichols, 1983:65). The specified catch in 1854, from newspaper sources (Sayers, 1984:153), consisted of 9 humpbacks, 5 grays, and 4 killer whales, *Orcinus orca*. In the late 1850’s, with the introduction of bombs and harpoon guns, the emphasis apparently shifted more toward gray whales (Nich-

ols, 1983:66).¹ Newspapers referred specifically to a gray whale struck but lost in December 1870 (Bertão, 2006: 22), 1 taken in March 1872 (Bertão, 2006:92–93), and 2 taken in January 1880 (Bertão, 2006:62). There were years (e.g. 1869) when large shoals of sardines in Monterey Bay attracted numerous humpback whales, leading to exceptionally large catches of them (Bertão, 2006:78–79). Catches of right whales were reported in 1856, 1859, 1873, and 1879–80 (Sayers, 1984:153; Nichols, 1983:75).

In the late 1850's and early 1860's at least three and possibly four different companies operated out of Monterey, each with a complement of at least two whaleboats and 12 crew members (Nichols, 1983:69–70; Sayers, 1984:133). Although whaling in Monterey had become unprofitable by the late 1880's and in fact may have been suspended for at least a few years (Nichols, 1983:70–71; Bertão, 2006:84–85), a new company was established in about 1895, which lasted for 2–3 years (Nichols, 1983:71). Another operation (2 boats, 17 Azorean whalers) that began in early 1896 and continued into the spring of 1898 (3 seasons) took “several dozen” whales per year (Lydon, 2001; also see Berwick, 1900; Bertão, 2006:86–90). Although most of the catch is said to have consisted of humpbacks, the seasonality and avowed dependence on the near-shore migration (e.g. Lydon, 2001:26) implies that grays also figured to some extent in the catch even in these late years. The equipment was transferred to Point Lobos in Carmel in the summer of 1898, and a joint Azorean–Japanese operation continued whaling there for two more seasons—winter 1898–99 and 1899–1900 (Lydon, 2001).

Catch data are fragmentary, with information only on number of whales secured for 4 years, only on oil returns

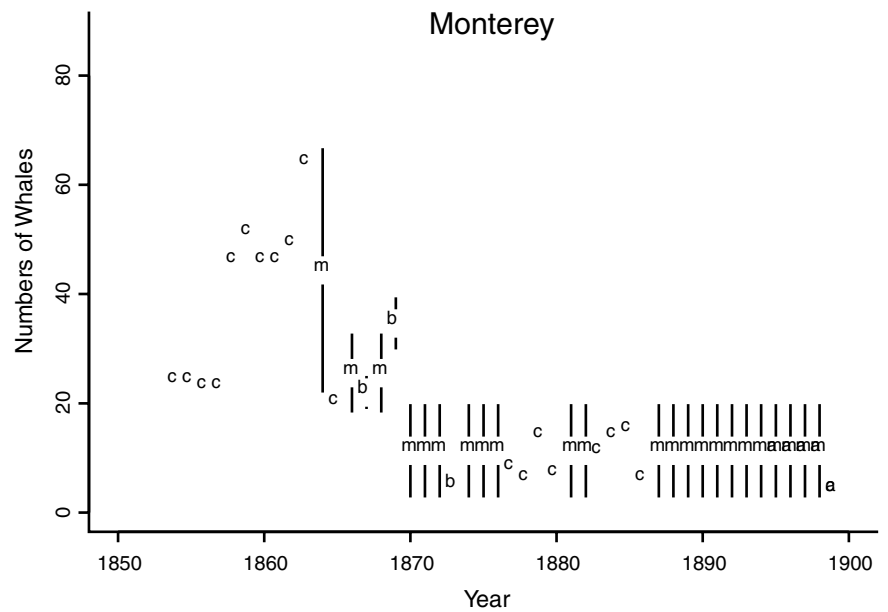


Figure 9.—Whales landed at Monterey, California, shore stations, showing values reported as whales (c) or barrels of oil (b), and for years without data, interpolated values from the mean of adjacent data points (m). Vertical bars denote one standard error of estimation above and below each year's data value or interpolated value (see text for details).

for 8 years (not counting 1873 when 175 bbl was obtained, apparently all or mostly from a large right whale), and on both whales and oil for 5 years (Nichols, 1983:75; Sayers, 1984:153). The estimated landings of gray and humpback whales, combined, total 884 whales (SE = 46) over the 46 years that the stations in and around Monterey are known to have operated (Fig. 9). Although slightly more than half of these were gray whales (477, SE = 55), substantial numbers of humpbacks were also taken (407, SE = 53). It is important to note a typographical error in the literature suggesting a much higher catch in Monterey from 1855 to 1857.²

Santa Cruz There were three known or likely sites of shore whaling in the general vicinity of Santa Cruz along the northwestern portion of Monterey

Bay—Soquel Point, Año Nuevo Point, and Davenport Landing. Fishermen in the area killed a right whale in November 1860, and between then and 1873 at least four whale carcasses were salvaged at sea and taken to shore for processing (Bertão, 2006:180). A whaling operation started at Soquel Point in October 1865 and was abandoned in March 1866 (Bertão, 2006:182–183). The same company then tried setting up an operation on Año Nuevo Point, probably later in the 1860's (Bertão, 2006:184). Finally, a station was established at Davenport Landing that continued to operate, but only in desultory fashion, into the mid 1870's (Bertão, 2006:185–186). No direct estimates of the total landings at these sites near Santa Cruz were possible.

It is relevant to note that a modern shore station operated at Moss Landing, approximately halfway between Monterey and Santa Cruz, for 5 years (1919–1922, 1924) (Clapham et al., 1997). Although whaling was attempted year-round, most catches were between April and November and consisted

¹Although Cooper (1871) claimed that mainly gray whales were being taken at Monterey when he visited there in August–September 1861, and Henderson (1972:27) judged him to be a reliable source, we are skeptical, given the season and the fact that humpback whales were otherwise known to be the main species hunted there in the summer months.

²Bancroft (1884–1890, Vol. 7:83, note 7) claimed that 24,000 bbl of oil was obtained at Monterey in the three years beginning in 1855. As indicated by Henderson (1972:211, note 376, citing Starks, 1922:18), this is “patently a misprint and inflation of the correct amount of twenty-four hundred barrels.”

almost entirely (94%) of humpbacks. Only 6 gray whales (all but 1 in January), 1 right whale (April), 2 blue whales (July), and 38 fin whales (most in summer months) were taken.

San Francisco Bay Area, Calif.

We have combined the operations at Pigeon Point and Half Moon Bay under this heading. Because the information available was very limited, no direct estimates of total landings at these stations were possible.

Pigeon Point A station was established here, north of Santa Cruz, in 1862, and it operated intermittently for more than 30 years (Nichols, 1983:126–128; Bertão, 2006:138–146). Whaling apparently ceased for several years beginning in 1879 but then resumed and continued until 1895. There is little information on the size or composition of catches although both humpbacks and gray whales were taken. Oil production amounted to 1,000 bbl in 1877–78 and 561 in 1878–79 (Sayers, 1984:153).

Some time prior to 1872, a visitor to the station reported that 12 humpbacks and no grays had been taken that season until the time of his visit, and that the previous year only 2 humpbacks had been taken and “the rest” had been grays (Nichols 1983:128). Curiously, Jordan (1887a) claimed that 12 “sulphurbottoms” (blue whales) were taken at Pigeon Point in the late 1870’s. This would have made it an exceptional site since there is no suggestion of more than an occasional blue whale being taken at any other California shore station during the 19th century. As noted by Nichols (1983:129), the fact that Jordan mentions the sulphurbottoms as passing the point headed north in April and south in the autumn suggests that he confused them with gray whales.

Half Moon Bay Whaling operations here, about 35 km south of San Francisco, began in 1860 or 1861 and continued at least intermittently until 1882 (Nichols, 1983:117; Sayers, 1984:131; Bertão, 2006:147–149). There is little information on catches or scale of effort (e.g. number of boats, crew members). The author of a book on place names of San Mateo county placed the site of the

Table 2.—Estimated numbers of gray and humpback whales landed (Whales) at seven stations between 1854 and 1899, with standard error (SE (W)), showing the total number of seasons of whaling (Years), the average number of whales per season for each station (WPY), standard errors (SE (WPY)).

	Baja	Los Angeles	Monterey	Pt. Conception	San Diego	San Luis Obispo	San Simeon
Years	26	26	46	14	29	20	30
Whales	247.5	398	884.1	132.5	453.3	94.5	441.1
SE(W)	21.23	19.61	45.85	8.38	27.56	11.76	8.4
WPY	9.5	15.3	19.2	9.5	15.6	4.7	14.7
SE (WPY)	0.82	0.75	1	0.6	0.95	0.59	0.28

shore station at Whaleman’s Harbor just outside the northern end of Half Moon Bay and quoted the 1862 Coast Pilot as indicating that about 1,000 bbl of “humpback oil” had been secured at this station in autumn 1861 (Brown, 1975; cited in Bertão, 2006:138).

North

North Coast Counties, Calif.

Shore whaling was prosecuted from three or four sites in northern California—Bolinias Bay, Humboldt Bay, Trinidad Bay, and Crescent City—but very little information is available on any of them. No direct estimates of total landings at these stations were possible.

Bolinias Bay This site, just northwest of San Francisco, may have hosted a whaling operation that consisted of a fleet of small vessels taking whales, flensing the blubber alongside, and delivering it to shore cookers every few days (Nichols, 1983:110–111; Sayers, 1984:131). This station is thought to have been active in 1857, although Bertão (2006:120–122) was skeptical that it ever got beyond planning stages. In any event, he believed that its principal intended targets were sperm whales rather than gray or humpback whales.

Humboldt Bay A steam tug whaled in Humboldt Bay in 1855, and the whales, apparently all or mostly humpbacks, were towed to Humboldt Point for processing (Sayers, 1984:131; Bertão, 2006:110–113).

Trinidad Bay A summer humpback whaling operation existed here in 1861. This may have represented relocation by the company that had whaled at Crescent City several years earlier (Bertão, 2006; see the following paragraph).

Crescent City This fourth site was some 30 km south of the Oregon border (Nichols, 1983:85–86; Sayers,

1984:127, 131; Bertão, 2006:113–119). Two stations were active there in the mid 1850’s (1854–57 at least). Judging by the few newspaper and other reports referring to whaling in this area, it was primarily a summer activity (May–September) and therefore likely took more humpbacks than gray whales.

Again, it is relevant to note that a modern shore station operated at Trinidad in 1920 and 1922–1926 (Clapham et al., 1997). The whaling season generally began in April and ended in November, with most catches made during May–September. Catch composition was similar to that at Moss Landing (see above)—84% humpbacks, 12% fin whales, and only 1 blue whale and 1 gray whale (no right whales reported). The lone gray whale was a male taken in July while feeding “almost on the rocks” near Crescent City along with four other gray whales (Howell and Huey, 1930).

Projected Landings by Station

We were able to estimate numbers of whales landed for seven shore stations. Some of the substantial uncertainty surrounding the estimates for those stations has been addressed by interpolation. Addressing the even greater uncertainty surrounding the landings from the remaining stations, however, is more difficult. One approach is to make projections on the assumption that those stations had productivity levels similar to the levels of the seven with direct estimates, ranging from 4.7 to 19.2 gray and humpback whales, combined, per year (Table 2). Assuming the landings for the other stations were in this range, projected landings for them would be the number of years operating multiplied by the average of estimated annual landings for the seven relatively well-reported stations, 12.6 (SE = 2.2). The uncertainty of such projections is

Table 3.—Estimated and projected gray and humpback whale landings at California shore stations from 1854 to 1899. Shown are numbers of station-years where estimates of landings were possible (Est. Years), estimated gray whales (Est GW) and humpback whales (Est HB) with their standard errors (Est GW SE, Est HB SE), numbers of station-years where landings were projected (Proj Years), and numbers of estimated and projected gray and humpback whales (GW, HB) and their standard errors (GW SE, HB SE).

Year	Est. Years	Est GW	Est GW SE	Est HB	Est HB SE	Proj. Years	GW	GW SE	HB	HB SE
1854	1	13	1.3	11	1.3	1	13	1.3	23	5.0
1855	1	13	1.3	11	1.3	2	13	1.3	36	9.8
1856	1	13	1.3	10	1.3	2	20	5.0	29	5.5
1857	1	13	1.3	10	1.3	3	26	9.8	34	6.8
1858	2	44	2.6	22	2.6	3	58	10.1	46	7.2
1859	2	40	2.8	24	2.8	3	54	10.1	48	7.3
1860	4	79	9.8	24	3.0	3	93	13.8	48	7.3
1861	4	57	6.6	23	2.7	6	84	20.6	71	13.7
1862	4	77	11.4	25	3.1	5	105	22.6	60	10.9
1863	4	80	12.4	31	3.8	5	107	23.1	67	11.1
1864	5	92	17.3	23	10.5	5	120	26.1	59	14.8
1865	5	82	11.9	12	1.9	5	109	22.9	48	10.6
1866	5	84	12.6	15	3.9	5	111	23.2	50	11.1
1867	5	84	12.1	13	2.4	6	123	22.9	49	10.7
1868	6	88	8.3	15	3.9	6	128	21.2	51	11.1
1869	6	79	8.5	18	3.2	6	119	21.3	55	10.9
1870	6	89	7.7	9	4.3	6	128	21.0	45	11.3
1871	6	87	7.4	9	4.3	6	127	20.9	45	11.3
1872	6	85	7.4	9	4.3	6	125	20.9	45	11.3
1873	6	76	5.7	6	1.6	6	115	20.3	42	10.6
1874	6	68	7.0	8	4.1	6	108	20.7	44	11.2
1875	6	56	6.0	7	4.0	6	95	20.4	44	11.2
1876	6	43	6.0	7	4.0	6	83	20.4	43	11.2
1877	6	52	6.0	6	1.1	7	99	25.1	48	12.6
1878	6	45	7.0	5	1.0	7	92	25.4	47	12.6
1879	7	73	7.1	9	1.6	7	119	25.4	51	12.6
1880	7	59	7.0	6	1.3	6	98	20.7	42	10.5
1881	7	66	11.3	8	4.1	5	94	22.5	43	11.2
1882	7	67	11.3	8	4.2	5	95	22.5	44	11.2
1883	7	70	5.4	8	1.6	4	91	15.6	38	8.6
1884	7	73	4.2	9	1.6	4	94	15.2	39	8.6
1885	7	59	1.3	9	1.3	2	66	5.1	27	5.6
1886	5	22	0.5	3	0.5	2	28	4.9	22	5.4
1887	4	23	6.2	6	3.9	2	30	7.9	24	6.7
1888	2	18	6.2	5	3.9	2	25	7.9	24	6.7
1889	2	20	4.8	5	3.9	2	27	6.8	24	6.7
1890	2	13	4.7	5	3.9	1	20	6.8	11	4.5
1891	2	13	4.7	5	3.9	1	20	6.8	11	4.5
1892	3	12	4.7	5	3.9	1	19	6.8	11	4.5
1893	2	12	4.9	5	3.9	1	19	6.9	11	4.5
1894	1	6	4.7	5	3.9	1	13	6.8	11	4.5
1895	1	6	4.7	5	3.9	1	13	6.8	11	4.5
1896	1	6	4.7	5	3.9	0	6	4.7	5	3.9
1897	1	6	4.7	5	3.9	0	6	4.7	5	3.9
1898	1	6	4.7	5	3.9	0	6	4.7	5	3.9
1899	1	2	0.2	2	0.2	0	2	0.2	2	0.2

estimated from the variance of a uniform distribution of half width estimated by Equation 1. The estimated range of that uniform distribution from Equation 1 is slightly wider than the range of whales per year, 4.2 to 21.1 whales per year, and the standard error of a uniform distribution of that width is 4.9 whales per year.

Total Landings

The estimated and projected total landings were combined, by region, then prorated to species using the ratios in Table 1, and then summed across regions (Table 3). The temporal distributions of the annual estimated and projected gray and humpback landings were similar

(Fig. 10 and Fig. 11), although the total from 1854–99 for gray whales (3,150, SE = 112) was nearly double that for humpback whales (1,637, SE = 62).

Discussion and Conclusions

Oil Marketing and Yield

Most of the oil secured by the shore stations was shipped to San Francisco, although some also was used locally for lighthouses and lamps (May, 2001; Fox, 2001). In the early years of shore whaling, when there was a premium for machine lubricant and lighting fuel, humpback oil commanded a higher price than gray whale oil, whereas in later years, when the use of whale oil

shifted to rope making and leather working, the lighter oil obtained from gray whales sold more readily in local markets (Bertão, 2006:51).

According to Fox (2001), the range of yields reported for gray whales at California shore stations was 25–45 bbl (1 barrel = 31.5 U.S. gal or 26.28 Imp gal). Sayers (1984:123), citing Scammon (1874), gave the range in yield for gray whales as 25–35 bbl, with “exceptional animals” giving 60 bbl or more. Data from shore stations and the *Ocean* (anchored in San Diego Bay) in 1860 indicate that 1,150 bbl of oil was obtained from 32 whales (Nichols, 1983:105–106), most or all of which probably were gray whales,

for an average yield of 36 bbl. A large humpback whale in the North Pacific would yield about 40 bbl (Scammon, 1874). Although humpbacks, like gray whales, could produce as much as 60 or even 70 bbl, the average yield was

probably not greatly different between the two species (Mitchell and Reeves, 1983).

In our study, the meager shore-station data on yield were not sufficiently detailed to allow us to distinguish gray

whales from humpbacks. We had sufficient data (minimum of 5 observations) for only three sites to calculate meaningful averages of bbl/whale: Baja California, 31.86 (SE = 3.06, $n = 5$), San Diego, 37.88 (SE = 5.53, $n = 10$), and Monterey, 36.39, SE = 5.01, $n = 11$. These combined data, together with five more observations spread across various other sites, gave an average of 38.01 (SE = 2.67, $n = 31$).

Both Scammon (1874:250–251, but see below; also see Henderson, 1972:138) and Henderson (1984:180) used 35 bbl/whale to convert oil quantities to estimates of gray whales landed in both shore- and ship-based whaling. For his part, Scammon (1874:250–251) concluded that the aggregate quantity of oil produced by “the several shore parties, since their first establishment,” was “not less than 95,600 barrels.” He guessed that 75,600 bbl came from gray whales and 20,000 from humpback whales, fin whales, and blue whales. Without stating his method, Scammon converted these numbers to “not less than 2,160 California Grays, and eight hundred Humpbacks and other whalebone whales.” This equates to 35 bbl/whale for grays and 25 bbl/whale for the other species. It is possible that 35 bbl/whale is too high for humpbacks; indeed, several studies of humpback whaling (mainly on humpback calving/breeding grounds) produced average yields of about 25 bbl/whale (Mitchell and Reeves, 1983; Best, 1987; Reeves and Smith, 2002).

Given the artisanal character of the various shore whaling operations, their efficiency in making oil from killed whales was highly variable. Sayers (1984) pointed out (following both Scammon (1874) and Rice and Wolman (1971)) that gray whales taken during the “going down” season (December–February) were “fat, well nourished, and rendered a fine quality of oil,” whereas those taken during the “going up” season (February–April) could have lost up to a third of their body mass while fasting and, in the case of adult females, nursing their calves. Jordan (1887a:60) stated that a southbound whale could be expected to yield 35 bbl, a northbound

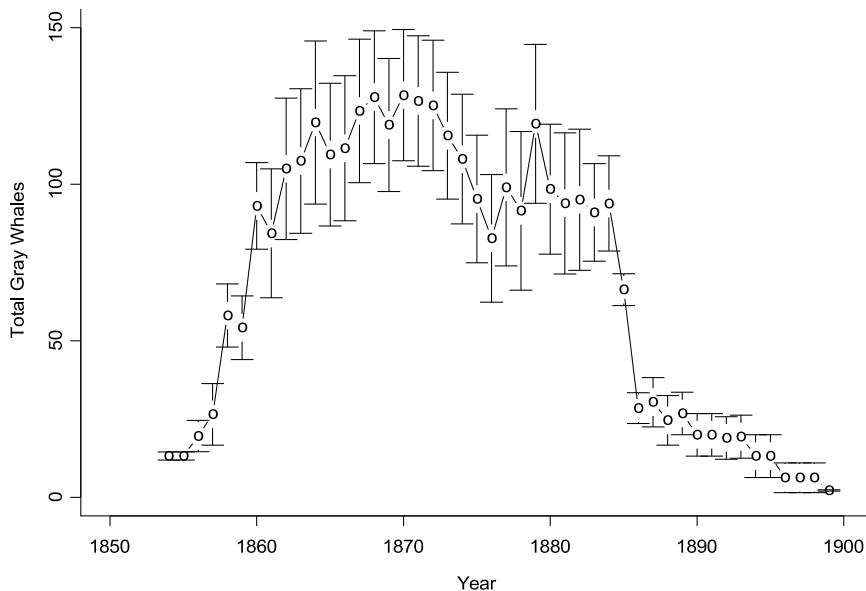


Figure 10.—Estimated and projected number of gray whales landed at California shore stations from 1854 to 1899, with vertical bars indicating plus and minus one standard error.

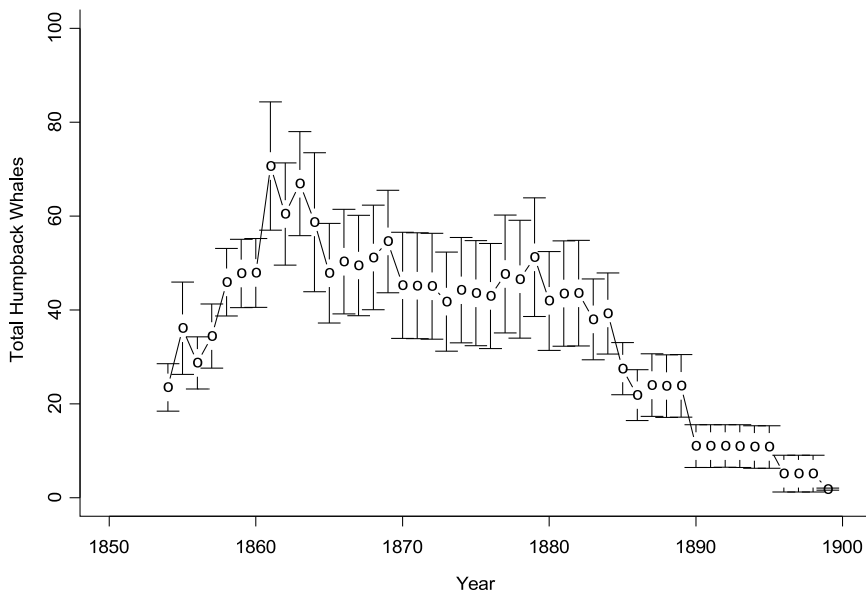
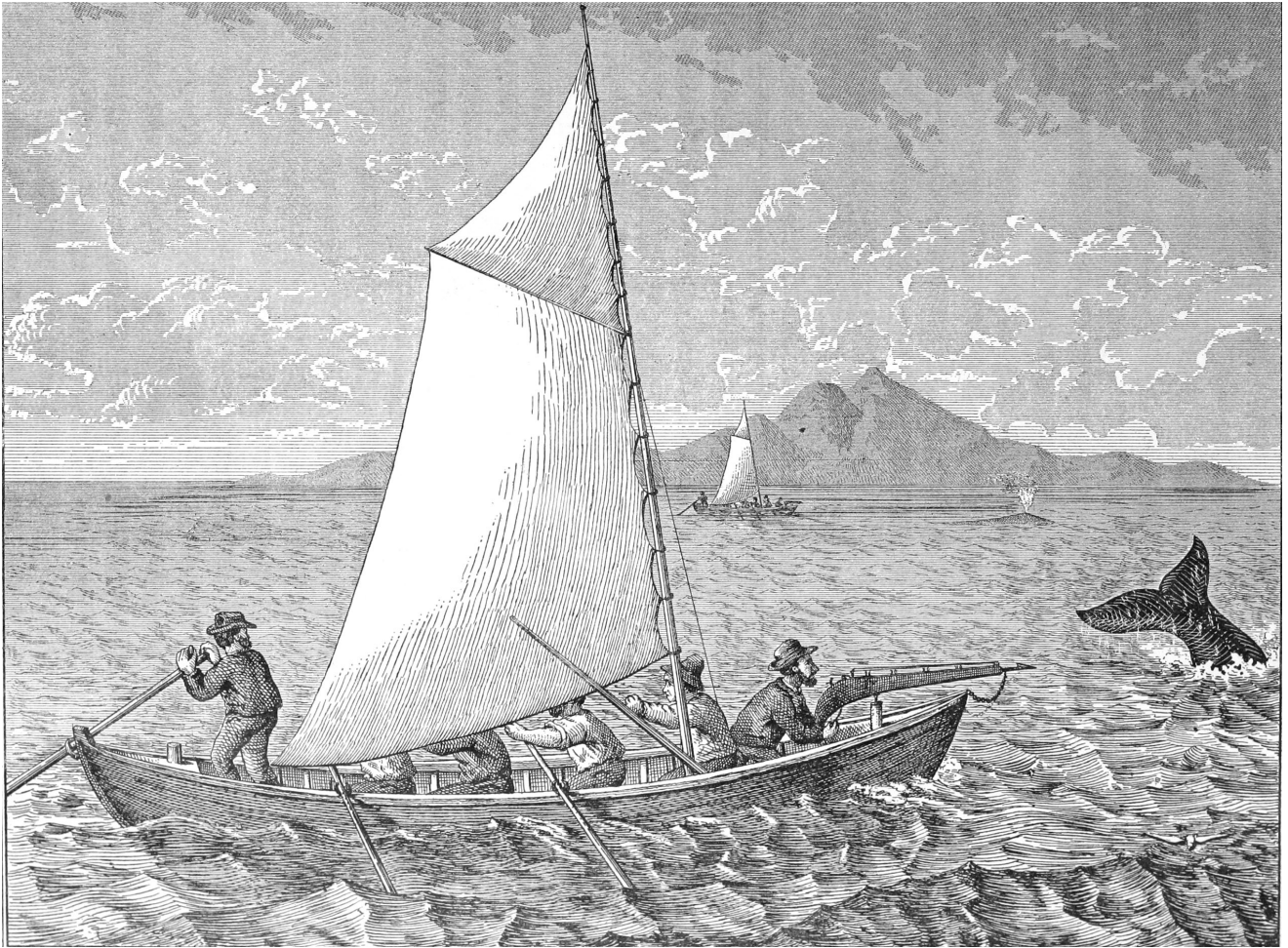


Figure 11.—Estimated and projected number of humpback whales landed at California shore stations from 1854 to 1899, with vertical bars indicating plus and minus one standard error.



Lithograph of a whaleboat with Greener's gun mounted, drawn by Charles M. Scammon (Scammon, 1874:249).

whale 25 bbl. He also claimed that during the southbound migration “the larger cows come nearest to shore and first” while on the northbound migration “the cows and calves are farthest out, the bulls and dry cows near shore.” The yields of humpbacks undoubtedly varied seasonally as well although the seasonal signal is perhaps less clear for them, at least off California, than it is for gray whales.

In addition to the variability from seasonal changes in body condition, the towing distance and circumstances could affect processing efficiency. For example, “Sharks, which like to gorge themselves on the whale’s carcass, were one of the shore whaler’s main concerns . . .” (Bertão, 2006:48). Also, whales that

sank and were only processed after several days on the bottom could be “in such a state of advanced decay that the oil was not worth much” (Bertão, 2006:49). All of the factors that reduced processing efficiency would have reduced the oil returns, possibly leading to underestimation of the numbers of whales landed.

Finally, in a study of shore whaling in New York (on Long Island), Reeves and Mitchell (1986:208) concluded that there had been a tendency for newspapers and other sources “to report the yields of unusually large whales more regularly than those of small or medium-sized whales.” Also, they found that “in many instances the yield reported is only the whalers’ optimistic estimate, made prior

to trying out.” This is consistent with the observation by Henderson (1972: 139) that the oil amounts estimated by ship-based whalers and reported from the whaling grounds in Baja California often turned out to be higher than the amounts reported upon their arrival at home port. One or both of these factors likely influenced at least some of the data on California shore whaling, with the net effect of an upward bias in estimates of average yield and thus a negative bias in the derived estimates of whales landed.

Hunting Loss

Hunting loss was a significant feature of California shore whaling. At least four factors would have contributed to

the variability in loss rates at the different shore stations and at different times in their histories of operation: heaviness of the sea, storminess of the weather, depth of the water, and experience of the crews (Bertão, 2006:50). Sinking was a “major problem” for the shore whalers and they “developed special procedures to cope” with it (Bertão, 2006:48). Sinking was exacerbated by the widespread use of explosive projectiles even though some of the weapons (e.g. Greener’s harpoon gun and Pierce’s harpoon-bomb-lance gun) were supposed to make the whale “fast” to the boat after being struck (Nichols, 1983:9–16; Bockstoce, 1986:73). Other bomb-lances, in contrast, were used simply to make a quick kill and did not involve tethering the quarry.

At least three different types of explosive weapons were used at the San Simeon land station in 1880—English-made swivel guns, Greener’s exploding-head harpoon guns, and Norwegian-made bomb guns—with varying levels of success (Nichols, 1983:139). A right whale attacked off San Simeon in April 1880 was struck with 25 bomb-lances plus harpoons, but it was still not secured (Nichols, 1983:141). In the late 1850’s the whalers in San Diego using Greener gun/bomb-lance techniques reportedly landed only 5 of 12 (presumably gray) whales killed (Nichols, 1983:105; Sayers, 1984:144), which implies a loss rate factor (multiplier applied to secured catch) of 2.4. The implements used there were “of marginal quality” and “two thirds of the whales wounded were lost due to the harpoon’s failure to explode” (Nichols, 1983:109, citing the diary of a judge who visited the station at Ballard Point in 1860).

At Monterey in the early 1850’s, the bomb-lances available “were defective and proved useless” and therefore only hand harpoons and lances were used (Sayers, 1984:132). Nonetheless, 6 whales killed at Monterey between April and September 1854 were lost (the secured catch over that period consisted of 9 humpbacks, 5 grays, and 4 killers) (Nichols, 1983:72). The next year, 18 whales were secured and 6 were killed but lost (5 humpbacks and

1 gray) (Sayers, 1984:153). The Greener harpoon gun did not come into regular use at Monterey until 1865 (Bertão, 2006:76).

In San Diego in the 1860’s, it was claimed that 2 out of 3 whales struck with bomb-lances were lost due to the failure of the bombs to explode (Hayes, 1929). At Pigeon Point in one season, apparently 1869, 10 of the 22 whales killed were lost (Bertão, 2006:49); those secured were all humpbacks but it is uncertain whether any (or even all) of those that were lost were grays (Nichols, 1983:128). In any event, according to Starks (1922:10), the loss rate that year at Pigeon Point was “much greater . . . than usual.” This latter comment reinforces our concern that the anecdotal information on loss rates should not be assumed to be representative of the fishery overall or even of particular stations or time periods.

Two factors would have mitigated hunting loss. First, at Point Conception (Cojo Viejo), for example, all but one of 16 gray whales secured in the 1879–80 seasons bore wounds attributed to previous strikes by bomb-lances (Jordan, 1887a). This demonstrates that struck whales did not necessarily die, even when struck by these potentially lethal weapons. Therefore, struck-but-lost whales were not certain to die of their wounds. Second, eventual salvage of whales that were killed but lost may have been the norm at some stations. For example, in Monterey in 1900, it was generally expected that sunken whales would float to the surface on the third day after being killed, and then be towed ashore for processing (Berwick, 1900).

Another factor can be viewed as a “hidden” addition to hunting loss. Scammon (1874:251) included in his calculation of shore-based gray whale catches not only an allowance for struck-but-lost whales, but also “one eighth [of the killed number, including both secured and struck-but-lost] for unborn young.” This presumably would apply mainly to hunts during the southbound migration when many cows were carrying near-term fetuses. However, calves several months old and accompanying their mothers on the northbound migra-

tion also would have been vulnerable, if orphaned, because of their continued social if not also physiological dependence on their mothers.

Our conclusion from examining all available data is that no more reliable quantitative calculation of hunting loss is possible beyond that based on the informed opinion of Scammon (1874) and Henderson (1984) that one whale was killed and lost for every five processed. Therefore, we propose that landings should be multiplied by a loss rate factor of 1.2 to estimate total removals, but emphasize that that procedure is probably negatively biased because it fails to account for fetal mortality and at least some orphaning of calves leading to their death.

Landings of Gray Whales and Humpback Whales

Our estimates of landings of gray and humpback whales are highest in the 1860’s and 1870’s and decline abruptly beginning in the 1880’s, with a less rapid but continuing decline to the end of the century (Fig. 12). The cause of the decline is not certain although it has generally been assumed that, at least in the case of gray whales, it was related to the cumulatively depleting effect of removals by the shore fishery in California and the ship-based fishery in the gray whale breeding lagoons of Baja California. Scammon (1874:251), for example, concluded, “This peculiar branch of whaling [California shore whaling] is rapidly dying out, owing to the scarcity of the animals which now visit the coast; and even these have become exceedingly difficult to approach.”

It is also possible that economic or other factors played a role in the decline in catches, as suggested by Davis et al. (1997) for other species in a more general analysis of 19th century whaling. The price of whale oil spiked in the mid 1860’s and then began a fairly steady but slow decline before leveling off in the mid 1880’s at values very close to what had prevailed in the early 1850’s at the start of the California shore fishery (Fig. 12). There is no clear signal, however, in the trend in oil prices that would help explain the declines in gray and hump-

back catches from the 1880's to the end of the century.

Our estimates of landings of gray whales and humpback whales, both by species and combined, can be compared to previous estimates for the entire period (1854–1899) and for the earlier period of 1854–1874, and in one case by year. The earliest estimates were by Scammon (1874:250–251; see above), who estimated landings of 2,160 gray whales and 800 humpback (and other baleen) whales from 1854 to 1874 (see Grant, 1969:XXIX). For that same early period, our estimates were somewhat lower for gray whales (1,889) and higher for humpback whales (996).

The latter is not directly comparable to Scammon's estimate as we tried to exclude the other species that were taken occasionally (blue, fin, and right whales) whereas he lumped them with humpbacks. For gray and humpback whales combined, Scammon's and our estimated totals differ by only 2.5%, a remarkable and probably coincidental similarity given that the two approaches were independent and used mostly different information. It should be noted that Scammon (1874:251) considered his estimates to be negatively biased to a considerable extent, whereas Henderson is said to have thought they were "a little high" (personal commun. to Nichols, 1983:46).

Considering the entire period, our estimate of total landings of 4,787 gray whales and humpback whales, combined, can be compared directly to the estimate by Nichols (1983). His estimation methods were not explained in detail, but his "best estimate" was "based on probable unrecorded captures according to recorded station success and number of years of operation for which no records are available" (p. 40; his Table 2, p. 39–40, and his Table 3, p. 42–43). Starting from reported landings totaling "at least" 1,308 whales of all species, combined [our total from Nichols (1983) was 1,281], he estimated total landings as 3,637 whales, substantially lower than our total of 4,787 gray and humpback whales, combined. Considering only the earlier period (1854–1874), however, the estimate of landings by

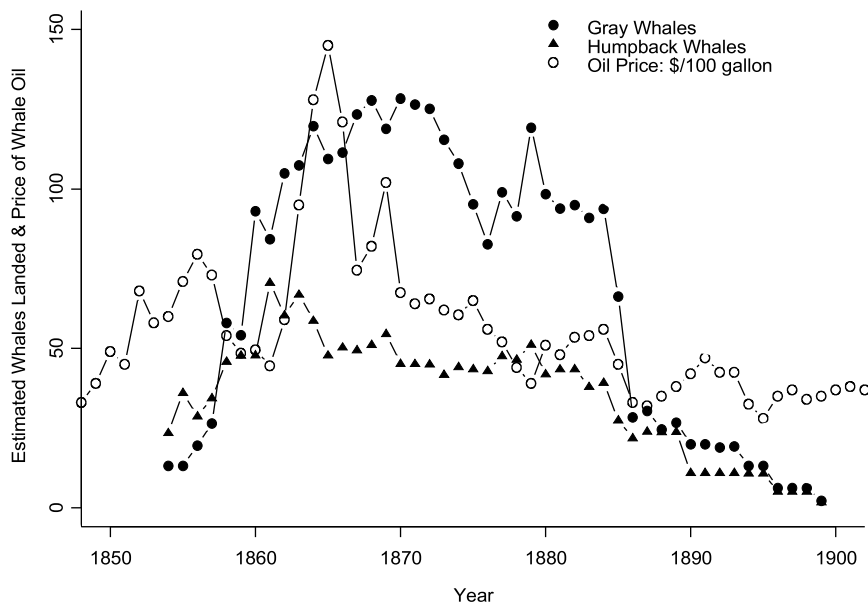


Figure 12.—Gray (solid circles) and humpback (triangles) whales landed by California shore stations from 1854 to 1899, with the price of whale oil (open circles; data from Davis et al., 1997).

Nichols was more similar to ours (2,550 vs. 2,885 whales, respectively), and as he indicated (p. 45), "a bit lower" than the 2,960 of Scammon (1874).

At about the same time as Nichols (1983) was completing his study, additional work was reported by Henderson (1984) and Sayers (1984). Henderson (1972:163) had judged Scammon's estimate of the gray whale catch by shore whalers to be "essentially correct," and in his 1984 book chapter, which has generally been regarded as a comprehensive reconstruction of the catch history of the eastern Pacific gray whale population, he used Scammon's value of 2,160 for the shore whaling component from 1854–1874. Similarly, Sayers (1984) presented a summary of landings (her Appendix, p. 153–156, which we used, along with Nichols (1983), as a key data source) but, unlike Nichols, Sayers made no attempt to estimate total landings through interpolation.

It is interesting to note that although the book chapter by Sayers (1984) was in the same volume as Henderson's 1984 chapter (and was cross-referenced in it), Sayers's compilation seems not to have been used in Henderson's catch estimation (his Table 1, p. 169). Moreover,

Henderson did not cite Nichols (1983) as a source even though Nichols's work (completed in January 1983) had been carried out under Henderson's supervision in the Geography Department, California State University at Northridge. The relationships among these sources remain obscure, and thus we were not able to reconcile differences or pursue further comparisons of them.

Our estimates can also be compared on a year-by-year basis to Reilly (1981), who provided annual estimates of the numbers of gray whales killed (that is, landed plus an adjustment for animals struck but lost). He based his estimates on the kill estimates in Henderson (1972) for three time periods, allocating them to years within those periods based on Henderson's notes. Reilly assumed, for example, that 200 whales were killed annually from 1859 to 1867 (his Table 44). His study was completed before those of Nichols (1983) and Sayers (1984), when there was very little published documentation available on gray whale catches between 1874 and 1912. For those years, he therefore had to rely on the scattered literature available at the time to make admittedly crude estimates (his Table 45).

We derived estimates of landings from Reilly's estimates of kills of gray whales for the entire period 1854–1899 by dividing them by his assumed loss rate factor (1.2). These estimated landings totaled 2,831, only roughly 10% lower than our total of 3,150 gray whales landed. Although the totals are similar, this may be largely coincidental as Reilly's temporal distribution of landings was very different from ours, with substantially higher levels in the earlier time period and lower levels after 1870 (Fig. 13).

Reilly's (1981) estimates of removals were designed for use in modeling the temporal history of the eastern gray whale population (Reilly, 1981; Cooke, 1986) and have been used in the development of other time series for the same purpose, mainly within the context of the Scientific Committee of the International Whaling Commission (Lankester and Beddington, 1986; Butterworth et al., 1990, 2002; IWC, 1993). The published information on those other time series generally does not distinguish catches by the shore fishery from those by other fisheries (e.g. ship-based, aboriginal/subsistence), so direct comparisons with our estimates are not possible.

In addition to the uncertainty reflected in the standard errors of our total estimated landings of gray and humpback whales (CV = 3.5% and 3.8%, respectively), several large sources of uncertainty probably exist but remain unmeasured. Our estimation procedures do not take into account the uncertainty of whether the reports of landings, when and where available, are themselves complete. There are suggestions in the literature (see above) that for some stations at some times, landings records are incomplete.

Although the incompleteness of the available data for many years for the seven best-reported stations has been addressed in the interpolation model, that model itself assumes temporal continuity in the activities and landings at these stations. The projection model for other stations assumes consistency within the geographic regions, in terms of both the scale of effort and production and the species composition of catches. It further assumes that the lack of reports for a given station is not related to that station's scale of whaling operations. Finally, the estimates of the proportions of gray and humpback whales in

the catches are founded on grossly incomplete reporting, and there is reason to suspect that the reports themselves were biased by local interest in recording mainly the larger, more valuable whales taken.

Our effort to address and quantify the many uncertainties that apply to the catch data for 19th century California and Baja California shore whaling has been only partially successful. The estimation methods, especially the projected catches for poorly documented stations, in the present paper may be near the limits of plausibility, considering the meager records of shore whaling operations. Further progress in reducing and measuring uncertainty will depend on work by local historians. The material reviewed here should provide guidance on geographic sites, time periods, and topics that deserve particular attention. In some instances, it would be useful to have more information simply to confirm that active whaling was or was not taking place in certain years. In other instances, more needs to be known about the species hunted. In this regard, consideration should be given to the use of bone material that may be available for excavation and salvage at whale processing localities. Such material might be useful not only as a way of identifying species composition of catches, but also for assessing the relative age structure of catches.

In spite of their limitations, we consider our estimates and projections of gray whale landings by 19th century California and Baja California shore whaling to be more reliable than previous estimates. Our estimates are based on all presently available station-by-station data, and we have used well-defined methods that allow the inclusion of estimates of uncertainty. Previous estimates of landings are generally less directly and clearly derived from reported landings, and none include estimates of uncertainty. Further, explicit information has not been provided on how various types of bias were treated in previous estimations.

Thus, the estimates of gray whale landings in the present paper (appro-

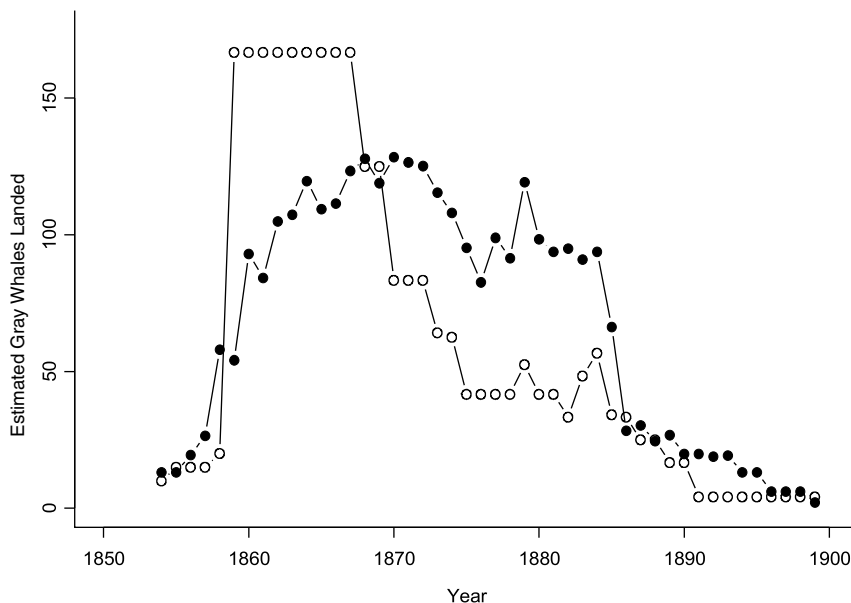


Figure 13.—Gray whales landed at California shore stations between 1854 and 1899 from our analyses (filled circles) and Reilly's (1981) analysis (open circles), showing a marked difference in temporal pattern.

proportionately adjusted to account for hunting loss) offer an alternative to Reilly's and other previous catch series (see earlier) for use in population modeling. Further modeling of the eastern North Pacific gray whale population, and initial modeling of the eastern North Pacific humpback whale population, must await reconstruction or re-evaluation of catches by ship-based whalers. In a study parallel to the present one, we are pursuing this for gray whales (Reeves et al., 2010). To our knowledge, no similar work has begun on humpback whales.

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Appendix

Year, region (see text), station, source(s) of information, number of whales landed (all species, L) according to source (N, S, or O), barrels (Bbls) of oil reported, gray whales (GW), right whales (RW), and humpback whales (HB) landed, number of boats active at the station that year, number of crew members employed at the station that year, and comments.

Coded fields:

Sources: S = Sayers (1984), N = Nichols (1983), B = Bertão (2006), O = another source.

Year	Region	Station	Source(s)	LN	LS	LO	Bbls	GW	RW	HB	Boats	Men	Comments
1854	North	Crescent City	S		1					1	2		Harpooned and lost'; 1 company; mainly humps
1855	North	Crescent City	S, N										
1856	North	Crescent City	S, N	3	3								Probably humps; 2 companies
1857	North	Crescent City	S, N										
1858	North	Crescent City	N										Nichols (1983) gave no basis for assuming activity here 1858–1889; only in his table, without explanation
1859	North	Crescent City	N										
1860	North	Crescent City	N										
1861	North	Crescent City	N										
1862	North	Crescent City	N										
1863	North	Crescent City	N										
1864	North	Crescent City	N										
1865	North	Crescent City	N										
1866	North	Crescent City	N										
1867	North	Crescent City	N										
1868	North	Crescent City	N										
1869	North	Crescent City	N										
1870	North	Crescent City	N										
1871	North	Crescent City	N										
1872	North	Crescent City	N										
1873	North	Crescent City	N										
1874	North	Crescent City	N										
1875	North	Crescent City	N										
1876	North	Crescent City	N										
1877	North	Crescent City	N										
1878	North	Crescent City	N										
1879	North	Crescent City	N										
1880	North	Crescent City	N										
1881	North	Crescent City	N										
1882	North	Crescent City	N										
1883	North	Crescent City	N										
1884	North	Crescent City	N										
1885	North	Crescent City	N										
1886	North	Crescent City	N										
1887	North	Crescent City	N										
1888	North	Crescent City	N										
1889	North	Crescent City	N										
1855	North	Humboldt Bay	S										Steam tug, mostly humps
1861	North	Trinidad	B										Humpbacking
1861	North C.	Half Moon	S, N										Active 1861–78; 1,000 bbl HB oil produced autumn 1861 (Bertao, 2006:138)
1862	North C.	Half Moon	S, N										
1863	North C.	Half Moon	S, N										
1864	North C.	Half Moon	S, N										
1865	North C.	Half Moon	S, N										
1866	North C.	Half Moon	S, N										
1867	North C.	Half Moon	S, N										
1868	North C.	Half Moon	S, N										

continued

Appendix (continued)

Year	Region	Station	Source(s)	LN	LS	LO	Bbls	GW	RW	HB	Boats	Men	Comments
1869	North C.	Half Moon	S, N										
1870	North C.	Half Moon	S, N										
1871	North C.	Half Moon	S, N, B										
1872	North C.	Half Moon	S, N										1 fin whale
1873	North C.	Half Moon	S, N										
1874	North C.	Half Moon	S, N										See Scammon (1874)
1875	North C.	Half Moon	S, N										
1876	North C.	Half Moon	S, N										
1877	North C.	Half Moon	S, N										
1878	North C.	Half Moon	S, N										
1879	North C.	Half Moon	S, N										
1880	North C.	Half Moon	S, N, B										
1881	North C.	Half Moon	B										
1882	North C.	Half Moon	B										
1857	North C.	Bolinas Bay	S, N, B										Species and time period unclear; several boats this year
1862	North C.	Pigeon Point	S, N										Both grays and humps
1863	North C.	Pigeon Point	S, N										
1864	North C.	Pigeon Point	S, N										
1865	North C.	Pigeon Point	S, N										
1866	North C.	Pigeon Point	S, N										Intermittent operations; years uncertain
1867	North C.	Pigeon Point	S, N										
1868	North C.	Pigeon Point	S, N										
1869	North C.	Pigeon Point	S, N										
1870	North C.	Pigeon Point	S, N										
1871	North C.	Pigeon Point	S, N										
1872	North C.	Pigeon Point	S, N										In one previous season, 12 humps (no grays) taken until time of a visit; yr before only 2 humps, 'the rest' grays
1873	North C.	Pigeon Point	S, N										
1874	North C.	Pigeon Point	S, N										
1875	North C.	Pigeon Point	S, N										
1876	North C.	Pigeon Point	S, N										
1877	North C.	Pigeon Point	S, N	29			1,000						
1878	North C.	Pigeon Point	S, N	16			564						
1879	North C.	Pigeon Point	S, N										
1880	North C.	Pigeon Point	S, N										
1881	North C.	Pigeon Point	S, N										
1882	North C.	Pigeon Point	S, N										
1883	North C.	Pigeon Point	S, N										
1884	North C.	Pigeon Point	S, N										
1885	North C.	Pigeon Point	S, N										
1886	North C.	Pigeon Point	S, N										
1887	North C.	Pigeon Point	S, N										
1888	North C.	Pigeon Point	S, N										
1889	North C.	Pigeon Point	S, N										
1890	North C.	Pigeon Point	S, N										
1891	North C.	Pigeon Point	S, N										
1892	North C.	Pigeon Point	S, N										
1893	North C.	Pigeon Point	S, N										
1894	North C.	Pigeon Point	S, N										
1895	North C.	Pigeon Point	S, N										
1856	North C.	Santa Cruz	S, N										
1857	North C.	Santa Cruz	S, N										
1858	North C.	Santa Cruz	S, N										
1859	North C.	Santa Cruz	S, N										
1860	North C.	Santa Cruz	S, N						1				
1861	North C.	Santa Cruz	S, N										Reportedly active 1858-1884 (Nichols, 1983:42-43)
1862	North C.	Santa Cruz	S, N										
1863	North C.	Santa Cruz	S, N										
1864	North C.	Santa Cruz	S, N										
1865	North C.	Santa Cruz	S, N										
1866	North C.	Santa Cruz	S, N										
1867	North C.	Santa Cruz	S, N										
1868	North C.	Santa Cruz	S, N										
1869	North C.	Santa Cruz	S, N										

continued

Appendix (continued)

Year	Region	Station	Source(s)	LN	LS	LO	Bbls	GW	RW	HB	Boats	Men	Comments
1870	North C.	Santa Cruz	S, N										
1871	North C.	Santa Cruz	N										
1872	North C.	Santa Cruz	N										
1873	North C.	Santa Cruz	N										
1874	North C.	Santa Cruz	N										
1875	North C.	Santa Cruz	N										
1876	North C.	Santa Cruz	N										
1877	North C.	Santa Cruz	N										
1878	North C.	Santa Cruz	N										
1879	North C.	Santa Cruz	N										
1880	North C.	Santa Cruz	N										
1881	North C.	Santa Cruz	N										
1882	North C.	Santa Cruz	N										
1883	North C.	Santa Cruz	N										
1884	North C.	Santa Cruz	N										
1854	North C.	Monterey	S, N	24	18			4		9	2	12	Apr 54–Nov 55: 24 whales; 6 more (5 hump, 1 gray) killed but lost (Sayers, 1984)
1855	North C.	Monterey	S, N	23	24		300					17	
1856	North C.	Monterey	S, N	23			800		1				HB oil; Sayers (1984) says 509bbl
1857	North C.	Monterey	S, N	23	23		800				6	36	HB oil; Sayers (1984) says 1,016 bbl
1858	North C.	Monterey	S, N	46			800				8	48	HB oil; Sayers (1984) says 1,500 bbl; 2 companies; from 1858 'focus' changed from humps to grays (Nichols, 1983:66)
1859	North C.	Monterey	S, N	51			1,800		1		8	48	600 bbl gray oil; third company active
1860	North C.	Monterey	S, N	46			1,600				8	48	1,200–2,000 bbl
1861	North C.	Monterey	S, N	46			1,600				8	48	
1862	North C.	Monterey	S, N	49			3,400				8	48	3,400 is from 2 companies; Sayers (1984) says 2,500 bbl, mostly HB
1863	North C.	Monterey	S, N	49	64		1,930						One company stopped this yr or next
1864	North C.	Monterey	S, N										Oil and bone worth \$31,000
1865	North C.	Monterey	S, N	20			679						Oil from 2 Monterey stations (now consolidated) and 1 Carmel
1866	North C.	Monterey	S, N										
1867	North C.	Monterey	S, N				800					52	Declining; oil from Monterey and Carmel combined
1868	North C.	Monterey	S, N										
1869	North C.	Monterey	S, N				1,260						Oil from Monterey and Carmel combined
1870	North C.	Monterey	S, N										
1871	North C.	Monterey	S, N					1					
1872	North C.	Monterey	S, N										
1873	North C.	Monterey	S, N				175		1				Also 1 500 lb bone
1874	North C.	Monterey	S, N									23	
1875	North C.	Monterey	S, N										
1876	North C.	Monterey	S, N										
1877	North C.	Monterey	S, N	4	8	8	500				3	23	Nichols (1983): 4 year; Sayers (1984) 8 season; the company also had 'four guns of each kind'
1878	North C.	Monterey	S, N	6				3	1	1	3	23	3 gray + 1 hump = 185 bbl
1879	North C.	Monterey	S, N	9		14		7	1	6	3	23	
1880	North C.	Monterey	S, N	7									4 fin whales
1881	North C.	Monterey	S, N										
1882	North C.	Monterey	S, N										
1883	North C.	Monterey	S, N	5	11			11					
1884	North C.	Monterey	S, N	14	12					17			17 in 2 yr
1885	North C.	Monterey	S, N	15	5			12					bleak for getting grays
1886	North C.	Monterey	S, N	6									
1887	North C.	Monterey	S, N										
1888	North C.	Monterey	S, N										
1889	North C.	Monterey	S, N										
1890	North C.	Monterey	S, N										
1891	North C.	Monterey	S, N										
1892	North C.	Monterey	S, N										
1893	North C.	Monterey	S, N										
1894	North C.	Monterey	S, N										
1895	North C.	Monterey	S, N								2		new company; several dozen whales, mainly humps
1896	North C.	Monterey	S, N								2		new company; several dozen whales, mainly humps
1897	North C.	Monterey	S, N										several dozen whales, mainly humps

continued

Appendix (continued)

Year	Region	Station	Source(s)	LN	LS	LO	Bbls	GW	RW	HB	Boats	Men	Comments
1898	North C.	Monterey	S, N										shifted to Carmel
1899	North C.	Monterey	S, N	4								16	possibly 2 different companies active
1861	North C.	Carmel	S, N										
1862	North C.	Carmel	S, N									17	
1863	North C.	Carmel	S, N										
1864	North C.	Carmel	S, N										
1865	North C.	Carmel	S, N										
1866	North C.	Carmel	S, N										
1867	North C.	Carmel	S, N										
1868	North C.	Carmel	S, N										
1869	North C.	Carmel	S, N										
1870	North C.	Carmel	S, N										
1871	North C.	Carmel	S, N										
1872	North C.	Carmel	S, N										
1873	North C.	Carmel	S, N										
1874	North C.	Carmel	S, N								4		
1875	North C.	Carmel	S, N										
1876	North C.	Carmel	S, N									3	
1877	North C.	Carmel	S, N									2	
1878	North C.	Carmel	S, N										
1879	North C.	Carmel	S, N	7	7		200	3	0	3		17	
1880	North C.	Carmel	S, N									2	
1881	North C.	Carmel	S, N										
1882	North C.	Carmel	S, N										
1883	North C.	Carmel	S, N										
1884	North C.	Carmel	S, N										
1877	North C.	Point Sur	S, N	1	2			1					
1878	North C.	Point Sur	S, N	3	5			3	1	1			
1879	North C.	Point Sur	S, N	3									
1864	South C.	San Simeon	N										
1865	South C.	San Simeon	S, N	25	25							15	10 to 20 men, approx at 15
1866	South C.	San Simeon	S, N	23	23								
1867	South C.	San Simeon	S, N	24	24								
1868	South C.	San Simeon	S, N	25	25								
1869	South C.	San Simeon	S, N	20	20								
1870	South C.	San Simeon	S, N	23	23								
1871	South C.	San Simeon	S, N	22	22								
1872	South C.	San Simeon	S, N	21	21								
1873	South C.	San Simeon	S, N	22	22								
1874	South C.	San Simeon	S, N	16	16								
1875	South C.	San Simeon	S, N	12	12								
1876	South C.	San Simeon	S, N	7	7								
1877	South C.	San Simeon	S, N	13	13								
1878	South C.	San Simeon	S, N	3	3							5	
1879	South C.	San Simeon	S, N	14	14		500						
1880	South C.	San Simeon	S, N	13	13		450	12		1	4		13 taken by 21 Feb; total 17 through Apr (Nichols, 1983:141)
1881	South C.	San Simeon	S, N										
1882	South C.	San Simeon	S, N										
1883	South C.	San Simeon	S, N	5	11								
1884	South C.	San Simeon	S, N	15	15				3				
1885	South C.	San Simeon	S, N	16	14								
1886	South C.	San Simeon	S, N	7									
1887	South C.	San Simeon	S, N										
1888	South C.	San Simeon	S, N								9	21	
1889	South C.	San Simeon	S, N	14	5			7					
1890	South C.	San Simeon	S, N	7	7								
1891	South C.	San Simeon	S, N	7	7								
1892	South C.	San Simeon	S, N	5	5								
1893	South C.	San Simeon	S										
1868	South C.	San Luis Obispo	S, N								3	21	Up to 30 whales in single yr (Bertao, 2006:173) in late 60's/early 70's
1869	South C.	San Luis Obispo	S, N										
1870	South C.	San Luis Obispo	S, N										

continued

Appendix (continued)

Year	Region	Station	Source(s)	LN	LS	LO	Bbls	GW	RW	HB	Boats	Men	Comments
1871	South C.	San Luis Obispo	S, N										
1872	South C.	San Luis Obispo	S, N										
1873	South C.	San Luis Obispo	S, N										
1874	South C.	San Luis Obispo	S, N										
1875	South C.	San Luis Obispo	S, N										
1876	South C.	San Luis Obispo	S, N										
1877	South C.	San Luis Obispo	S, N										
1878	South C.	San Luis Obispo	S, N	11	11								All grays and humps, mostly grays
1879	South C.	San Luis Obispo	S, N	9	9								All grays and humps, mostly grays
1880	South C.	San Luis Obispo	S, N	4	5			4			3	21	
1881	South C.	San Luis Obispo	S, N										
1882	South C.	San Luis Obispo	S, N										
1883	South C.	San Luis Obispo	S, N	3				6					
1884	South C.	San Luis Obispo	S, N	5				4					
1885	South C.	San Luis Obispo	S, N	3				3					1 blue whale
1886	South C.	San Luis Obispo	S, N	2									
1887	South C.	San Luis Obispo	S, N	5								20	
1879	South	Point Conception	S, N	9			554	16		4	4	20	148 bbl from 4 humps; of 4 boats only 2 used per season
1880	South	Point Conception	S, N	11									
1881	South	Point Conception	S, N										
1882	South	Point Conception	S, N										
1883	South	Point Conception	S, N	12				25					
1884	South	Point Conception	S, N	22				18	1				
1885	South	Point Conception	S, N	15				11					
1886	South	Point Conception	S, N	6									
1887	South	Point Conception	N										
1892	South	Point Conception	B			1							Bertao, 2006:196
1867	South	Goleta	S									6	Small station; mainly grays; max. 1-season return: 450 bbl (Nichols, 1983:150)
1868	South	Goleta	S										
1869	South	Goleta	S										
1870	South	Goleta	S, N										
1871	South	Goleta	S, N										
1872	South	Goleta	S, N										
1873	South	Goleta	S, N										
1874	South	Goleta	S, N										
1875	South	Goleta	S, N										
1876	South	Goleta	S, N										
1877	South	Goleta	S, N										
1878	South	Goleta	S, N										
1879	South	Goleta	S										
1880	South	Goleta	S										
1860	South	Los Angeles	N										
1861	South	Los Angeles	S, N	12					1				LA includes Portuguese Bend and San Pedro Bay; right whale Mar 1861 (Sayers, 1984:142)
1862	South	Los Angeles	S, N	13	25								Nichols (1983) says >600 bbl from 25 whales in 1862 clearly referring to 12 + 13 for 1861–62; also, 6 in 6 days in Mar 1862, produced >200 bbl
1863	South	Los Angeles	S, N										Almost entire catch was grays
1864	South	Los Angeles	S, N										2 stations active for 3 yr 1864–66
1865	South	Los Angeles	S, N										
1866	South	Los Angeles	S, N										
1867	South	Los Angeles	S, N										
1868	South	Los Angeles	S, N										
1869	South	Los Angeles	S, N										
1870	South	Los Angeles	S, N										
1871	South	Los Angeles	S, N										
1872	South	Los Angeles	S, N										
1873	South	Los Angeles	S, N										
1874	South	Los Angeles	S, N	16			722						Total oil over 3 yr 1874–76: 2,166 bbl (Nichols, 1983:145)
1875	South	Los Angeles	S, N	16			722						
1876	South	Los Angeles	S, N	15			722						
1877	South	Los Angeles	S, N	15									

continued

Appendix (continued)

Year	Region	Station	Source(s)	LN	LS	LO	Bbls	GW	RW	HB	Boats	Men	Comments
1878	South	Los Angeles	S, N										
1879	South	Los Angeles	S, N										
1880	South	Los Angeles	S, N										
1881	South	Los Angeles	S, N										
1882	South	Los Angeles	S, N										
1883	South	Los Angeles	S, N										
1884	South	Los Angeles	S, N	6	13								
1885	South	Los Angeles	S	7									
1858	South	San Diego	S, N	5	20		775						
1859	South	San Diego	S, N	13			900						
1860	South	San Diego	S, N	34									By this yr 2, possibly 3 companies active
1861	South	San Diego	S, N				650						
1862	South	San Diego	S, N										
1863	South	San Diego	S, N										
1864	South	San Diego	S, N										
1865	South	San Diego	S, N										
1866	South	San Diego	S, N										
1867	South	San Diego	S, N										
1868	South	San Diego	S, N		22							32	One yielded 90 bbl so possibly a right; by this yr at least 2, probably 3 or 4 stations active, 32 or more men. One station stopped
1869	South	San Diego	S, N										Company that stopped in 1869 resumed operations
1870	South	San Diego	S, N	10	23		695						Includes returns from 2 Baja stations
1871	South	San Diego	S, N	35	21		1,750						
1872	South	San Diego	S, N	25	7		280						
1873	South	San Diego	S, N	10	17		645						
1874	South	San Diego	S, N	15			400						
1875	South	San Diego	S, N	6									
1876	South	San Diego	S, N		1		60						
1877	South	San Diego	S, N										
1878	South	San Diego	S, N										
1879	South	San Diego	S, N										
1880	South	San Diego	S, N										
1881	South	San Diego	S, N										
1882	South	San Diego	S, N										
1883	South	San Diego	S, N	2	13								13 whales taken by Sierra, towed to shore for processing
1884	South	San Diego	S, N	6	11		273						
1885	South	San Diego	S, N	8	10		300		1				Calif. half the oil was from the right
1886	South	San Diego	S, N	4									
1860	South	Baja	N		5								
1861	South	Baja	N										
1864	South	Baja	N										
1865	South	Baja	N										
1868	South	Baja	S										
1869	South	Baja	S										
1870	South	Baja	S				684						
1871	South	Baja	S		8		240				2	19	Punta Banda, a right struck/lost (Sayers, 1984:149); San Diego returns included those from 2 Baja stations so this may be duplicative
1872	South	Baja	S		17		700						
1873	South	Baja	S		17		400						
1874	South	Baja	S										
1875	South	Baja	S		12		432						
1876	South	Baja	S				292						
1877	South	Baja	S		10		286						
1878	South	Baja	S										
1879	South	Baja	S										
1880	South	Baja	S										
1881	South	Baja	S										
1882	South	Baja	S										
1883	South	Baja	S										
1884	South	Baja	S										
1885	South	Baja	S				80						