Spatial distribution and abundance of baleen and sperm whales in the Peruvian sea: a historical review

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Abstract

Historical accounts of large whales in Peruvian waters existed before modern commercial whaling. Research on baleen and sperm (Physeter macrocephalus) whales was intense during whaling, thus producing essential knowledge on these species. The populations of large whales have declined considerably with whaling pressure since 1925 in Peruvian waters. After the whaling moratorium in 1985, research on these species decreased, and a considerable gap in knowledge exists until nowadays. This review aims to conduct a historical analysis of the spatial distribution and abundance of baleen and sperm whales in the waters of Peru. During whaling, sperm whale distribution and abundance received most of the research effort as this species was the most important target of the whaling fleet. Also, blue (Balaenoptera musculus) and Bryde’s whale (B. edeni brydei) were considered abundant in Peru. Changes in their distribution and abundance were evaluated mainly based on captures or climatic events. Following the cessation of whaling, sightings of these species were restricted to occasional surveys, limiting the assessment of possible current changes in their distribution and abundance, as well as the updating of existing information. Humpback whales (Megaptera novaeangliae) were considered overexploited at the beginning of commercial whaling. After the moratorium, this species population started to grow, expanding its distribution along the northern coast. Currently, the humpback whale is the most studied species due to the onset of whale-watching activities in 2009. This allowed us to update and increase the knowledge about its distribution and abundance in northern Peru. The findings of this study point at a need to considerably increase the research effort on large whales, particularly surveys to estimate population sizes of the species inhabiting the waters of Peru.

Keywords: Conservation, large whales, mysticetes, population recovery, Southeast Pacific, whaling.

Introduction

Whaling has been practiced since the Prehistoric era, mainly along the North Pacific Rim and adjacent Arctic regions (Savelle & Kishigami, 2013). Modern commercial whaling began in Norwegian waters with the use of the explosive harpoon in 1864 and the introduction of steam-powered factory ships in 1903 (Tønnessen & Johnsen, 1982). Whaling became more efficient because of the increased ship autonomy and capacity (Ruffle, 2002), leading to a rapid reduction of baleen (suborder: Mysticeti) and sperm (Physeter macrocephalus) (suborder: Odontoceti) whale populations (Clapham et al., 2002). With abundances declining in the Northern Hemisphere, whaling fleets from the United States (US), Canada, United Kingdom (UK), Norway, Germany, Russia, and Japan searched for whaling grounds away from their territorial waters, reaching the Southeast (SE) Pacific Ocean off the coasts of Chile, Peru, and Ecuador (Flores, 2010).

The first descriptions of whales in waters of Peru were made around 1599, often referring to the high abundance and the ease of encountering whales (Cobo, 1964). In 1960, early references of oil use from stranded whales in Peru were reported (Cobo,
whaling period (Baker & Clapham, 2004). Using this basis, it is possible to determine whether populations are recovering (Jackson et al., 2016).

Before modern commercial whaling, the distribution and abundance of large whales in Peru were mainly related to the Humboldt Current’s productivity and the abundant prey availability (Coker, 1908; Saetersdal et al., 1963). However, early reports do not detail with exactitude abundances in the area. At the onset of commercial whaling, since reporting was mandatory, data of the biological and ecological aspects of whales were made available by the whaling companies to the Peruvian scientific committee of the IWC and the South Pacific Permanent Commission (CPPS, Comisión Permanente del Pacífico Sur) (Saetersdal et al., 1963). Distribution information was limited to the whaling areas and correlated with sea surface temperature (SST) changes or prey availability (Townsend, 1935; Bini, 1951; Ramirez, 1990). Although there was a clear reduction in the abundance of the species, estimates were made for only one of the five target species for whaling (Valdivia et al., 1983). At present, despite recognizing the serious conservation problems of target whale species as their populations decline, their trends from the historical context have not been reviewed, and it is still necessary to recognize the aspects that remain to be investigated.

The objective of this review is to evaluate the historical trends of spatial distribution and abundance of baleen and sperm whales in Peruvian waters, considering their presence before, during, and after commercial whaling. It is expected to collect adequate information to identify gaps of knowledge that will aid conservation actions for the recovery of these species.

Materials and methods

Literature review

Literature focus on studies of large whales were collected from digital repositories including Google Scholar, Scopus, ScienceDirect, EBSCOhost, Wiley Online Library, SciELO, Redalyc, and the IWC library. Any type of information that had scientific validity was considered within the research, including cartographic maps or bulletins. The following keywords and combinations thereof were used in Spanish and English: "cetaceans", "large whales", "mysticetes", "whales", "Peru", "International Whaling Commission (IWC)", "Peruvian Sea Institute (IMARPE, Instituto del Mar del Perú)", "South Pacific Permanent Commission (CPPS)", "capture", "whaling", "whaling industry", "whaling operations", "spatial distribution", "abundance", "ecology", "management", "conservation"; as well as scientific and common names of whale species reported in the Peruvian sea: blue whale (Balaenoptera musculus), fin whale (B. physalus), Bryde’s whale (B. edeni brydei), sei whale (B. borealis), Antarctic minke whale (B. bonaerensis), humpback whale (Megaptera novaeangliae), Southern right whale (Eubalaena australis), and sperm whale (Physeter macrocephalus/P. catodon). Additionally, the IMARPE library and the journal “Boletín de Lima” were contacted to access old documents not available online. All relevant information before commercial whaling from 1844 to 2021 was compiled. The selection of the studies used in this review was carried out according to the following criteria: (1) studies reporting whales’ spatial distribution and/or abundance in Peru, (2) historical catch and/or sightings in Peru, and (3) studies...
on broad ecological aspects of baleen and sperm whales that could provide insights about past and/or current distribution and abundance trends.

**Catches and sightings during commercial whaling**

Catch and sighting statistics of baleen and sperm whales in the Peruvian sea from 1925 to 1985 were analyzed from the IWC (2013) report. Also, reports submitted by the Peruvian scientific committee, gathering information taken by whalers and observers aboard the Peruvian whaling companies located in Pisco, Ica (13°48' S, 76°14' W), Chancay, Lima (11°35' S, 77°16' W), and Paita, Piura (05°04' S, 81°08' W), established in 1951, 1954, and 1957 (Ramírez, 1989a), respectively, were reviewed. Additionally, the information available from IMARPE cruises around the Peruvian coast that reported the presence of large whales was revised.

**Results and discussion**

The literature search yielded 118 documents from 1844 to 2021 (Fig. 1A). The most abundant sources of information were scientific reports submitted to the IWC and IMARPE by their respective scientific committees. This was followed by research articles, book chapters, scientific notes, conference proceedings, academic theses, literature reviews, and cartographic material. While most scientific reports (gray literature) were published from 1980 to 2002, research articles increased from 2006 onwards. The available material mainly describes sperm whales’ biology during the whaling period until the moratorium. Research documenting humpback whales’ ecology has become predominant recently (Fig. 1B).

During whaling, descriptions of the spatial distribution were considered only in reports since September 1976, with most studies occurring around Pisco, Chancay, and Paita, where whaling stations were located (Fig. 2) (Ramírez, 2001; Reyes, 2009). However, information on the current distribution of large whales is scarce and scattered (Pacheco et al., 2009).

Abundance data on large whales in Peru based on captures from 1925 to 1985 are available from the IWC and reports from whaling companies and other sources (Table 1). The evaluation of catch data was performed with caution, as sometimes the records do not agree because of differences in numbers presented by whalers (Cooke, 1983; Van Waerebeek et al., 1997). Since the correct inspection of catches and sightings did not occur until the introduction of the International Observer Program in 1971
Table 1. List of references reporting catches and/or sightings of large whales in Peru until the onset of the ban in 1985.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Years</th>
<th>Species</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Humpback</td>
</tr>
<tr>
<td>IWC (2013)</td>
<td>1925-1983</td>
<td>X</td>
</tr>
<tr>
<td>Other sources</td>
<td></td>
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<tr>
<td>Clarke (1980)</td>
<td>1936-1975</td>
<td>X</td>
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<tr>
<td>Garret (1980)</td>
<td>1936-1954</td>
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<tr>
<td>Mejía &amp; Poma (1966)</td>
<td>1966</td>
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<td>Ramírez (1985)</td>
<td>1983</td>
<td>X</td>
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<tr>
<td>Ramírez (1988d)</td>
<td>1974-1978</td>
<td>X</td>
</tr>
<tr>
<td>Ramírez (1989a)</td>
<td>1951-1985</td>
<td>X</td>
</tr>
<tr>
<td>Ramírez (2007a)</td>
<td>1968-1985</td>
<td>X</td>
</tr>
<tr>
<td>Saetersdal et al. (1963)</td>
<td>1947-1961</td>
<td></td>
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<tr>
<td>Valdivia et al. (1981a)</td>
<td>1968-1978</td>
<td></td>
</tr>
<tr>
<td>Valdivia et al. (1981b)</td>
<td>1980</td>
<td></td>
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<tr>
<td>Van Waerebeek et al. (1997)</td>
<td>1983</td>
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</tbody>
</table>

Table 2. Summary of catches and sightings of large whales in Peru from 1925 to 1985. Sources: IWC records and information from whaling expeditions provided by whaling companies (WC) and research cruises (RC) (see Table 1).

<table>
<thead>
<tr>
<th>Reports</th>
<th>Sperm</th>
<th>Bryde</th>
<th>Blue</th>
<th>Sei</th>
<th>Fin</th>
<th>Humpback</th>
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<td></td>
<td></td>
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<tr>
<td>IWC</td>
<td>71849</td>
<td>3589</td>
<td>930</td>
<td>2974</td>
<td>1952</td>
<td>835</td>
<td>82129</td>
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<tr>
<td>WC</td>
<td>75502</td>
<td>3759</td>
<td>938</td>
<td>2978</td>
<td>1985</td>
<td>906</td>
<td>86068</td>
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<tr>
<td>Sightings between 1975 and 1985 from WC and RC</td>
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<tr>
<td></td>
<td>22038</td>
<td>6284</td>
<td>5221</td>
<td>49</td>
<td>24</td>
<td>493</td>
<td>34109</td>
</tr>
<tr>
<td>Total catches and sightings between 1925 to 1985</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IWC</td>
<td>93887</td>
<td>9873</td>
<td>6151</td>
<td>3023</td>
<td>1976</td>
<td>1328</td>
<td>116238</td>
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<tr>
<td>WC</td>
<td>97540</td>
<td>10043</td>
<td>6159</td>
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<td>2009</td>
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<td>170</td>
<td>8</td>
<td>4</td>
<td>33</td>
<td>71</td>
<td>3939</td>
</tr>
</tbody>
</table>

(Clapham & Ivashchenko, 2016), real exploitation numbers were altered on several occasions (Clapham et al., 2007). Arguably, this happened to obtain benefits from catch quotas or to avoid bans. In this study, catches and sightings of large whales differ by ca. 4,000 individuals between the information provided by the IWC and data from whaling companies and research cruises (Table 2). Despite this difference, a decline in abundance toward the whaling ban in 1985 was evident in both catches and sightings (Figs 3-4).

As time progressed, after the whaling season, the implementation of more sophisticated and accurate methods allowed a more precise recording of sightings, and robust estimates of spatial distribution and abundance. Despite the differences between methods, the analysis of the results allows the identification of broad changes in the distribution and relative abundance of the species.

The following information sections for each species are presented: historical data collected and analyzed about spatial distribution...
Figure 2. Maps showing the main locations where large whales have been reported in Peruvian waters (A) during and (B) after commercial whaling. Elaborated based on the locations described in this study.

Figure 3. Temporal variation of the catches of baleen and sperm whales reported in Peru. Elaborated from the IWC reports from 1925 to 1983 (A) and (B), and from the information of the whaling expeditions provided by the whaling companies and research cruises (see Table 1) (C and D).
and abundance as well as an assessment of changes observed before the 1985 whaling moratorium, continuing with information after that date, and updates to 2021.

Sperm whale (*P. macrocephalus*)

Early descriptions of the presence of sperm whales in Peru were given under the name *Catodon macrocephalus* (Tschudi, 1844a, b). This odontocete was considered the only large whale easy to recognize because of its physical appearance (*i.e.* massive nasal complex) and oblique blow (Bini, 1951). Early distribution descriptions indicated a northern range limit at 12° S in central Peru extending toward the south (Gunther, 1936; Clarke, 1962). First sighting locations included Chala Morro, Arequipa (15°52’ S, 74°14’ W) and San Juan de Marcona, Ica (15°22’ S, 75°12’ W) (Fig. 2A) (Schweigger, 1964). Later, sperm whales were recorded offshore of Pisco and northern locations, including Lobos de Afuera Island, Lambayeque (06°56’ S, 80°42’ W), Cabo Blanco (04°14’ S, 83°25’ W), Sechura Bay (05°34’ S, 81°02’ W), Piata (05°01’ S, 81°07’ W) in Piura, and Tumbes (03°30’ S, 83°45’ W) (Fig. 2A) (Coker, 1908; Mejía & Poma, 1966).

Although British and US whalers arrived at the Peruvian coast in 1790, sperm whale hunting in the SE Pacific probably started earlier in 1761 (Townsend, 1935). By 1835, the port of Paita was used by whalers to supply their ships with water and food for sperm whale hunting (Clarke & Paliza, 2008). However, at the beginning of commercial whaling in 1925, sperm whale catches in Peru decreased because whalers targeted humpback, blue, and fin whales (Fig. 2) (Clarke, 1962). During World War II (1941-1943), British factory ships increased sperm whale captures in Peru1, and their maximum catches occurred during 1936-1938 (2,021, 3,776, and 700 individuals), 1941-1943 (1,913, 3,342, and 3,299 individuals), 1947-1948 (2,887, and 2497 individuals), 1951 (6,317 individuals), and 1954 (3,182 individuals) (Clarke, 1980). The highest catch was obtained in 1951 (Fig. 3D) because the capture effort increased due to the beginning of whaling operations at the coastal station at Pisco (Ramírez, 1989a). After 1954, factory ships were discontinued, and whaling was exclusive to the coastal stations fleet (Saetersdal et al., 1963; Arriaga, 1981).

Whaling operations from Peruvian coastal stations were dedicated to hunting sperm whales due to their high abundance and the high economic value of ambergris and spermaceti oil (Kostritsky, 1952; Majluf & Reyes, 1989). Their products satisfied the needs of the market at the time, and the storage capacity was limited to capture other baleen whales (Clarke, 1962; Arriaga, 1981). Whaling from coastal stations declined in 1961, and sperm whale populations were considered overexploited (Figs 3B and 3D) (Saetersdal et al., 1963). Differences in sex ratio and size reflected the dynamics of whaling and sperm whale abundance (Ramírez, 1989a, 2001). At the beginning of sperm whale hunting, large males over 12 m in length were targeted, but as these individuals were depleted, whalers targeted smaller individuals, usually below the minimum hunting length of 10.7 m (Ramírez, 2001). Since males are larger than females, the latter accounted for most of the catch recorded after 1956 (Saetersdal et al., 1963; Ramírez, 1989b). From 1959 to 1962, the lack of males induced a decline in the pregnancy rate (Clarke et al., 1980). Although the absence of males was arguably attributed to the migration to Antarctic waters (Jonsgård, 1960), the effect on the population recruitment was negative (Ramírez, 1989a; Reyes, 1992).

The reduction in the sperm whale stock led to the closure of the Pisco and Chancay whaling stations in 1964, leaving only the station in Paita operational (Arriaga, 1981; Ramírez, 1989a). The catch effort moved toward baleen whales such as sei, fin, and Bryde’s whales (Fig. 3) (Grimwood, 1968; Valdivia et al., 1981a). Analysis of Catch Per Unit Effort (CPUE) from 1958 to 1976 confirmed the reduction in sperm whale abundance (Saetersdal et al., 1963; Mejía, 1964; Arriaga, 1981). Given the scarcity of males, the temporal comparison of CPUE in the year when males were abundant was erroneous because it overestimated a population that only considered females (Saetersdal et al., 1963). However, pregnancy rates between 1975 and 1977 decreased because of the lack of males, allowing CPUE comparisons to confirm the decrease in catches, despite the increase in hunting effort (Clarke et al., 1980; Ramírez, 1989a). Although sightings increased around 1981, the CPUE continued to decline (Ramírez, 1989b).

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1Whaling by factory ships, operating at sea or anchored, was known as “pelagic whaling”, although it was not described whether the hunting area was coastal or oceanic (CPPS, 1955).
The analysis of individual weights also showed a decline in the yield number of individuals per boat/day, from 87 tons in 1957 to 31 tons in 1981 (Ramírez, 1989b). This evidence of over-hunting was presented to the IWC in 1980 (Clarke et al., 2002), and a sperm whale ban was established in the SE Pacific in 1982, and Peru abided (IWC, 1982). Later that year, the specimen catch and sightings continued to decline, probably due to the 1982/1983 El Niño event (Figs 3B and D, 4B) (Ramírez & Urquizo, 1985).

Variation in sex/size classes of sperm whales could be attributed to the arrival of individuals from the Northern Hemisphere (Clarke, 1962), but the presence of mixed populations in Peru remains unknown (Ramírez, 2001). This species was reported at a mean SST of 20.3°C (range = 16 to 24.4°C) (Clarke, 1962), but with spatial segregation depending on sex and maturity stage. Adult males were distributed in SST ranging from 15 to 17°C, while juveniles were present at 16 to 18°C. Females were found from 17°C to warmer SST near the coast (Clarke, 1962). During El Niño 1982/1983 sperm whales moved 600 km southwards of the hunting area off Paita because temperatures reached 31°C (Ramírez & Urquizo, 1985; Ramírez, 1990). Sperm whale captures occurred mostly between 18° to 08° S and 82° to 85° W, during summer, fall, and spring (Ramírez, 1989b, 2001). Movements between Pisco and Paita recorded by identified tagged whales suggested a seasonal migration between central and northern Peru (Clarke, 1962; Ramírez, 1988a). Thus, aggregations were found in winter, between June and August off Pisco; and in summer, between January and March off Paita (Fig. 2A) (Saetersdal et al., 1963; Ramírez & Urquizo, 1985). SST above 17°C, suitable for birth, allowed the presence of adult females, juveniles, and calves in these zones (Ramírez, 2001; Reyes, 2009).

Identification tagging studies also confirmed that the northward migration began in June (Mejía, 1964; Mejía & Poma, 1966), and the southward migration started in September, which agrees with the high captures of sperm whales (no sex/size class difference) in December in Antarctic waters (Arriaga, 1981). However, stomach content analysis of individuals that migrated to northern Peru during summer showed beaks of squid species such as Gonatus antarcticus and Mensynchoteuthis hamiltoni, distributed south of 40° S. This indicates that sperm whales would also migrate from the subantarctic and Antarctic regions during these months (Clarke et al., 1976), since their preferred prey in waters off Peru was the Humboldt giant squid (Dosidicus gigas) (Clarke et al., 1988).

Stomach content analysis (between 1958 and 1962) indicated that sperm whales in the Peruvian sea fed almost exclusively on Humboldt giant squid, consuming up to 8.69 million tons per year (Clarke et al., 1988, 1993). Industrial fishery fleets for giant squid from Japan, Korea, and China began to operate in 1989, which probably hampered sperm whales from finding their preferred prey and recovery from commercial whaling (Clarke et al., 2002). The few sightings of sperm whales during IMARPE cruises between March and May 1998 and their absence during the “Ballenas Libres” expeditions off northern Peru and Ecuador in 2001 were suggested to be caused by the scarcity of giant squid (Sánchez et al., 1998; Clarke et al., 2002). Also, it was hypothesized that SE Pacific sperm whales migrated to the Northern Hemisphere seeking prey (Clarke et al., 2002), although they could have also moved southwards to Chile. Nonetheless, their absence is still explained by whaling overexploitation.

Further stomach samples (between 1959 and 1961) and feces analysis (during 1985, 1987, 1988, 1989, and 1991) detected other cephalopod species; Histiotethys boylei, Ancistrocheirus lesueurii, and Octopoteuthis deletron, with fish and crustacean remains (Clarke et al., 1976; Smith & Whitehead, 2000). These findings indicate that sperm whales do not rely exclusively on Humboldt giant squid (Clarke & Paliza, 2001), and fishing of this squid arguably does not affect sperm whales’ abundance (Smith & Whitehead, 2000; García-Godos, 2006). Although further research is still needed, the high correlation between sperm whale relative abundance and CPUE of Humboldt giant squid in Peru suggests a predator and prey relationship (García-Godos, 2006).

Between 1995 and 2002, 38 sightings of 133 individuals were obtained in 21 surveys covering neritic and oceanic waters of Peru with a maximum-calculated sighting rate of 0.324 sightings/100 nm (García-Godos, 2006). These relatively high numbers of sightings suggested a natural population increment (García-Godos, 2006). However, it is worth mentioning that the spatial sampling effort conducted by García-Godos (2006) covered a larger area than previous expeditions (i.e., Sánchez et al., 1998; Sánchez & Arias-Schreiber, 1998; Clarke et al., 2002), hindering comparisons with previous data.

Sightings from IMARPE cruises between 1995 and 2002 corroborated that sperm whales were distributed in waters with SST of 20.23 ± 3.31°C (range = 16.02 to 29.1°C) (García-Godos, 2006). In contrast to the observations during El Niño 1982/1983 (Ramírez & Urquizo, 1985), sightings of sperm whales increased during El Niño 1997/1998 (García-Godos, 2006), although the increase has not been discussed, it may also be due to the advancement and improvement of research techniques. Additionally, although there were records along the Peruvian coast, a significant concentration occurred mainly in the north, from 7° S to the border with Ecuador (03°23′ S), and in the south, from 16° S to the border with Chile (18°21′ S) (Fig. 2B), which were former whaling grounds (García-Godos, 2006).

During two cruises in the summer and spring of 2003, 13 sightings composed of 63 individuals were recorded (García-Godos & Santillán, 2004). Sperm whales were sighted in southern oceanic waters mainly at temperatures above 20°C during summer. This increase in sightings indicated the presence of sperm whales off Peru and may provide some insights about their potential recovery. However, anthropogenic activities are further threatening this species. From 58 large whale strandings recorded from 1997 to 2017, 14% (n = 8) were sperm whales (Bachmann et al. 2018), entangled with fishing gear or showing evidence of collisions with vessels (Pizarro-Neyra, 2010; García-Godos et al., 2013).

In Peru, research on sperm whales after whaling is limited (e.g. García-Godos & Santillán, 2004; García-Godos, 2006; García-Godos et al., 2013; Pizarro-Neyra, 2017). The most recent reports are encouraging, but it is necessary to increase the research effort, mainly in oceanic waters, and clarify their current situation, considering the previous abundance before and during the commercial whaling period (Saetersdal et al., 1963).

**Humpback whale (M. novaengliae)**

This species was initially described in Peru as *Megaptera nodosa*
Based on the information above, it is possible that the catch of these 495 specimens occurred elsewhere.

After that, humpback whale catches did not exceed 250 individuals per year (Fig. 5A). In 1961, an increment in catches was motivated by an unsuccessful attempt to introduce whale meat for human consumption (Ramírez, 1988b). Between 1963 and 1966, 118 individuals were captured to complete the quota offered to the market, not covered by sperm whales, the main target of whalers at the time (Ramírez, 1988c).

A ban on humpback whales in the Southern Hemisphere began in 1964, but hunting in Peru continued until 1968 (Majluf & Reyes, 1989). Later, from 1975 onwards, only sightings were recorded which remained stable (Fig. 5B). The decline in sightings in 1980 was attributed to the decrease in whaling time effort due to the hunt seasons established by the IWC for other species (Ramírez, 1988c). Without continuous surveys throughout the year, humpback whale sightings were occasionally recorded, and not as frequently as in previous years. Sightings near northern Peru continued to decline, probably because of the shift in the distribution caused by El Niño 1982/1983 environmental anomalies (Ramírez & Urquizo, 1985). Between 1983 and 1985, sightings during the breeding season increased again with the return to normal thermal conditions (Ramírez, 1990). Observations Per Unit Effort (OPUE) values of humpback whales progressively increased (Ramírez, 1988c), and although surveys did not continue after 1985, it is possible that their abundance continued increasing due to the population recovery observed today (Van Waerebeek et al., 1996; Félix et al., 2021).

As mentioned previously, humpback whales were observed between July and November (Townsend, 1935). Further information extended their presence from May to December, with catches peaking from September to November, and occasional catches in January and February (Ramírez, 1988c, 1990). This species showed a preference for a mean SST of 19°C (range = 15.2°C to 24.2°C) (Ramírez & Franco, 1982; Valdivia et al., 1983; Sánchez et al., 1998). The El Niño 1982/1983 seemed to be responsible for their distribution around the central and south coast off Peru, where the usually cold waters of the Humboldt Current became warm (Ramírez & Urquizo, 1985). After their breeding season, they migrate back to their feeding grounds in Antarctic waters (Gambell, 1987, Acededo et al., 2017a).

After commercial whaling, only opportunistic sightings were recorded from 1985 onwards. IMARPE cruise data suggested that aggregations occurred from ~5° S to the border with Ecuador (Fig. 2B) (Bello et al., 1998; Sánchez & Arias-Schreiber, 1998; Flórez-González et al., 2007). Beginning in 2009, studies from whale-watching platforms in northern Peru increased research on this species with better navigation equipment and prepared researchers (Pacheco et al., 2009, 2011). Sightings of numerous mother and calf pairs confirmed the functionality and extension of the breeding area of the stock G toward the Peruvian northern coast (García-Godos et al., 2008, 2009; Pacheco et al., 2009, 2011; Santillán, 2011; Guidino et al., 2014).

Records are available between May and June at Lobos de Tierra Island (06°25.96′ S, 80°52.27′ W) (García-Godos et al., 2008). Also, along the coast between Cabo Blanco and Los Órganos (04°10′ S, 08°8.27′ W) and Sechura Bay (Fig. 2B), during winter/spring from July to November (Pacheco et al., 2009; Santillán, 2011; Guidino et al., 2014).
et al., 2014). The peak abundance occurs between September and October, toward the end of the breeding season (Pacheco et al., 2009; Santillán, 2011; Guidino et al., 2014). During the breeding season, 3,115 humpback whales were sighted in 1,426 different groups between 2010 and 2019, with a total observation effort of 1,056.6 h (Pacheco et al., 2021). Sightings occur at a mean SST value of 21.5°C (range= 18.5 to 23°C) (Guidino et al., 2014; Pacheco et al., 2021).

Pacheco et al. (2009) recorded the movement directions of humpback whales in Los Órganos (Fig. 2B), and found that whales moved in either northeast or southeast direction, but some individuals did not show a consistent movement direction, suggesting constant displacement within the area. Additionally, there is a segregated distribution in respect to depth and distance from shore, depending on age and group size (Pacheco et al., 2011, 2021; Santillán, 2011; Guidino et al., 2014). Groups with calves are found close to shore (2 to 50 km) in shallow waters (Pacheco et al., 2021). Adults and/or subadults, either in pairs or solitary, are distributed in areas from 20 to 50 m in depth, and groups made up of three to more individuals can be found over the continental shelf break (200-m depth) (Guidino et al., 2014; Pacheco et al., 2021). Either groups or solitary individuals can be located at a distance ranging from 20 km offshore to the continental shelf break (Santillán, 2011; Guidino, et al. 2014). As the season progresses, humpback whales move away from the coast, possibly taking migration routes to return to their feeding grounds (Pacheco, 2019).

Humpback whales in the SE Pacific are experiencing population recovery after the moratorium. The species has expanded into (or returned to) breeding (Pacheco et al., 2009, 2021) and feeding grounds (Acevedo et al., 2013; Huckle-Gaete et al., 2013), where they were rarely sighted or captured in the past. The daily rate of successful sightings during whale-watching tours in northern Peru suggests this species is abundant during the breeding season (Pacheco et al., 2011). This coincides with solid evidence of recovery from population estimates, made with photo-identification recapture data and mathematical models for population size estimation (Félix et al., 2011; 2021). Félix et al. (2011) calculated a population size of ca. 6,500 individuals, and recently Félix et al. (2021) estimated ca. 11,784 individuals with a 5.07% annual rate of increase. However, humpback whales’ preference for coastal habitats and their tendency to concentrate in defined areas expose them to entanglements with fishing gear, vessel collision, and unregulated whale-watching (Flórez-González et al., 2007; García-Godos et al., 2013; García-Cegarra et al., 2019; Villagra et al., 2021). It is important to improve the management of the species in Peru (and elsewhere) and to reinforce the protection measures to reduce the threats to the population recovery.

**Blue whale (B. musculus)**

Blue whales were reported in Peru before commercial whaling as the ‘best recognized’ and ‘largest of all’ because of their lengths of up to 33 m (Bini, 1951; Yochem & Leatherwood, 1985). Blue whales were not considered abundant in Peruvian waters due to the intensive whaling in Antarctic waters since 1904 (Clarke, 1962; Schweiger, 1964; Williams et al., 2011). Between 1925 and 1927, 509 individuals were captured, a number higher than the

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*a Authors’ observation: considering the records of previous years, this high number of blue whale sightings raises doubts about its accuracy.*
remained unknown until 1997, when a stranded individual was reported at Don Martin Island, Lima (11°02’ S, 77°39’ W) (Fig. 2B) (Reyes, 1992; Arias-Schreiber, 1996; Van Waerebeek et al., 1997). This record constituted the southern limit in Peru, however blue whales are distributed further south in Chile (Cooke, 2018b). Blue whales have shown a preference for a mean SST value of 22.9°C (range = 16.6 to 28.2°C) (Ramírez, 1983). During IMARPE cruises in 1998, 30 individuals were recorded at an SST ranging from 18 to 24°C (Sánchez et al., 1998; Sánchez & Arias-Schreiber, 1998).

Early descriptions of Schweigger (1964) indicated that blue whales migrated from feeding grounds in Antarctic waters to breed in tropical waters in northern Peru from June to late October. Observations from 1976 to 1983 suggested a modification in timing; sightings were more frequent from November to May, peaking in February, with scarce sightings from June to September (Donovan, 1984). Donovan (1984) proposed changes in the timing of sightings because individuals from the northern Pacific would be entering Peruvian waters. Blue whales could stay year-round in Peruvian waters because of the high availability of small euphausiids (Ballón et al., 2011), their preferred prey (Reyes, 1992).

Currently, two blue whale subspecies are recognized to occur in Peru: Antarctic (or true) (B. m. intermedia) and pygmy (B. m. brevicauda) (Donovan, 1984; Kato et al., 1995; Williams et al., 2011). Antarctic blue whales were considered the most abundant in the SE Pacific (Branch et al., 2007), but a decline to < 1% of their original abundance led the species to concentrate in cold polar regions where krill is abundant (Branch et al., 2004, 2007). Pygmy blue whales are found during the austral summer in Antarctica and migrate northward for breeding during winter, reaching the Equator in the SE Pacific (Branch et al., 2007; Pastene et al., 2020). Recently, the possibility of a new subspecies called "Chilean blue whale" has been proposed, whose population would be resident off Chile and Peru (Cooke, 2018b).

Considering the population decline, it is likely that the Chilean subspecies has faced the same fate due to overexploitation during commercial whaling (Van Waerebeek et al., 1997; Williams et al., 2011). In Peru, blue whales were already considered scarce (Donovan, 1984; Van Waerebeek et al., 1997), and since the presence of subspecies was unclear, it would be wrong to assign their current population status. Recent sightings of this species on the northern and southern coast (e.g. Pacheco et al., 2019; Testino et al., 2019) (Fig. 2B) indicate that this species is still observed in Peru. Research should be conducted to correctly identify subspecies to better characterize their distribution and abundance.

### Table 3. Population estimates of Bryde’s whale stock in Peru.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>14,687</td>
<td>Valdivia et al. (1981a)</td>
</tr>
<tr>
<td>1968</td>
<td>17,388</td>
<td>Ramirez (2007a)</td>
</tr>
<tr>
<td>1973</td>
<td>13,703</td>
<td>Valdivia et al. (1981a)</td>
</tr>
<tr>
<td>1978</td>
<td>12,409</td>
<td>Valdivia et al. (1981a)</td>
</tr>
<tr>
<td>1980</td>
<td>11,651</td>
<td>Valdivia et al. (1981b)</td>
</tr>
<tr>
<td>1981</td>
<td>11,370</td>
<td>Valdivia et al. (1982)</td>
</tr>
<tr>
<td>1982</td>
<td>10,281</td>
<td>Ramirez (1985)</td>
</tr>
<tr>
<td>1983</td>
<td>9,725 to 10,177</td>
<td>Ramirez (1985)</td>
</tr>
<tr>
<td>1983</td>
<td>12,776</td>
<td>Ramirez (1985)</td>
</tr>
<tr>
<td>1985</td>
<td>11,325</td>
<td>Ramirez (2007a)</td>
</tr>
</tbody>
</table>

Before commercial whaling, sei whales occurred in the Peruvian sea but without further details on their distribution or abundance (Gunther, 1936; Bini, 1951). Catch numbers were not high, and the species was not considered abundant (Ramírez, 1988d). From 1925 to 1966, 107 individuals were captured in Peru (Fig. 7A) (Clarke, 1962). The speed and elusiveness of sei whales did not make them a preferred species for whalers (Español-Jiménez et al., 2019). However, catches increased after 1964, with 664 and 784 individuals caught in 1968 and 1969, respectively, after the decline of sperm whales (Grimwood, 1968; Arriaga, 1981; Valdivia et al., 1981a). Despite the relatively high catches from 1968 to 1972, Valdivia et al. (1981a) estimated negative CPUE trend, suggesting depletion and scarcity in Peru.

Catch data of sei and Bryde’s whales were pooled together because of the difficulties distinguishing them at sea (Clarke, 1962), making it challenging to extract species-specific information. In August 1972, Dr. Nishiwaki (a Japanese expert) could identify and separate both species (Clarke, 1980; Ramírez, 1988d). However, it was impossible to estimate the proportion of captures of each species in previous years (Valdivia et al., 1981a). The correct identification indicated that more Bryde’s whales were hunted than sei whales, so their catches decreased drastically since 1976 (Valdivia et al., 1981a,b). A ban was established for sei whales in June 1978 due to a notorious population decline (Ramírez, 1988d). Sightings after the ban did not exceed ten individuals, and no sei whales were recorded after 1981 (Fig. 7B).
Sei whales inhabit deep and oceanic waters (Acevedo et al., 2017b). In Peru, the main whaling areas were located off Piata, between 3° and 8° S, approximately 200 nm off Lambayeque, Piura, and Tumbes (Fig. 2A) (Arriaga, 1981; Ramírez, 1988d; Arias-Schreiber, 1996). Whalers have observed this species feeding on euphausiids occasionally (Ramírez, 1985). Sei whales migrate from Antarctica to Peru during winter/spring from August to October, searching for SST below 20.8°C (Ramírez, 1988d; Reyes, 1992); it is not well understood whether this migration is related to their breeding season.

After the moratorium, no further research has been conducted on sei whales in the Peruvian sea. Their current distribution and abundance remain largely unknown throughout the Southern Hemisphere (Prietó et al., 2012; Español-Jiménez et al., 2019). IMARPE cruises during the 1990s report either "Balaenoptera sp." and/or "Balaenoptera borealis/edeni" (i.e. Márquez & Arias-Schreiber, 2001; Sánchez & Arias-Schreiber, 1998). Thus, the problem of combining both species during sightings persists even after the whaling period. Hamilton et al. (2009) highlighted the absence of sei whales throughout the SE Pacific from 1986 to 2005, and the closest information to Peruvian waters of this species comes from Chile (Acevedo et al., 2017b; Häussermann et al., 2017). Further research is required to reveal the status of this species in Peru.

Bryde's whale (B. edeni brydei)

Whalers provided early reports of Bryde's whales in the SE Pacific from Gorgona Island, Colombia, and Isla de la Plata, Ecuador, in 1914 (Clarke & Aguayo, 1965). However, because they were constantly mistaken for sei whales, the first confirmed record after analysis of baleen’s keratin occurred in Iquique, northern Chile (Clarke, 1962; Clarke & Aguayo, 1965). The proximity of these locations suggested that their distribution included Peru (Clarke, 1980). In August 1972, proper identification was made to separate the catch from sei whales (Clarke, 1980; Clarke et al., 1980; Ramírez, 1988d), but it is possible that their exploitation began in 1968 because reports pooled specimens under the "sei+Bryde" label without further details to differentiate the species (Valdivia et al., 1981a). After the differentiation, Bryde's whales dominated the catch, positioning them as the second most exploited species and the last large whale captured in Peru (Reyes, 1992). However, catches of this species did not exceed 500 individuals per year (Fig. 8A).

Being the last species targeted by whalers, more efforts were made to evaluate its population (Valdivia et al., 1983). Population size estimates were made for Peru using CPUE values (Table 3). The values presented by Valdivia et al. (1981a, b, 1982) and Ramírez (1985, 1989a, 2007a) showed an apparently stable stock throughout time unaffected by the hunting effort. Valdivia et al. (1982) revised the estimations and suggested that there was no observable trend in decline or increments in CPUE because the DeLury method (1947) was not performed correctly. The effort series of this method included catcher days worked (CDW) (1973-1980) and catcher-searching hours worked (CSW) (1977-1981). Other parameters were a natural mortality value of 0.07 and a recruitment age of 10 years. However, recruitment age was considered the time of first sexual maturity, implying an excess over natural mortality (Cooke, 1983). For this reason, Cooke (1983) performed a CPUE analysis using three different effort series: gross catcher days worked (1968-1980), estimated searching hours (1969-1980), and recorded searching hours (1977-1981). The re-estimation used natural mortality of 0.07 and a recruitment age of ten and five years. A population of 4,008 individuals for 1980; Ramírez, 1989a, 2007a) showed an apparently stable stock throughout time unaffected by the hunting effort. Valdivia et al. (1983) performed a CPUE analysis using three different effort series: gross catcher days worked (1968-1980), estimated searching hours (1969-1980), and recorded searching hours (1977-1981). The re-estimation used natural mortality of 0.07 and a recruitment age of ten and five years. A population of 4,008 individuals for 1980 was estimated using the DeLury method, with a decrease of 1,135 individuals in 1983. Consequently, Cooke (1983) concluded that the Bryde’s whale population in Peru was substantially depleted, and there was an overestimation in previous studies.

Since 1980, the IWC has regulated whaling and established catch quotas and whaling seasons of six months, from October to March (Ramírez, 2007a). After the sperm whale ban in 1982, whalers targeted Bryde’s whales (Ramírez, 1989a), but because the catch quotas were low, the catches decreased, and sightings increased (Fig. 8) (Valdivia et al., 1982; Ramírez, 1989a). The abundance of this species peaked in November, December, and January from 1980 to 1985. In 1981/1982, the IWC established a whaling season from November to March, and the whaling quota was obtained just one and a half months earlier. In 1983, the quota was gathered in only two and a half months. For this reason, it was thought that Bryde’s whales were abundant (Ramírez, 1985; Ramírez & Urquizo, 1985). Size and sex ratio evaluations corroborate the high abundance because although males decreased slightly since 1974, the groups considered as “recruits”, “adults”, and “elders” were stable (Valdivia et al., 1981a).

Sightings decreased in 1982/1983, probably due to El Niño event
(Ramírez, 1989c, 1990; Ramírez & Urquizo, 1985). Because the decline from 1983 to 1985, the minimum catch size moved from 10.7 to 12.2 m to improve whale protection (Ramírez, 2007a, b).

During whaling, Bryde's whales were sighted mainly in northern Peru, from Chimbote, Ancash to Zorritos, Tumbes (03°38' S, 81°57' W) (Fig. 2A), where mating was observed (Ramírez, 1988a). From 03°30' S to 08° S, Bryde's whales were found at a mean SST of 23°C (range = 18.8 to 25.3°C) (Valdivia et al., 1981b; Ramírez, 1989a, d). Two “forms” of Bryde's whales were proposed, the “northern” and “southern” forms, spatially separated around 7° S in Chiclayo, Lambayeque (Fig. 2A). Later, the descriptions of neritic and oceanic forms presented in other countries were adopted (Valdivia et al., 1981a). The oceanic form was distributed during spring and summer off Piura (Fig. 2A), at temperatures up to 20°C, especially of 22 to 25°C (range = 18.8 to 25.3°C), and 200 nm or more from the coast, although they enter up to 8 nm with the oceanic water’s movement toward the east (Valdivia et al., 1981b; Ramírez, 1992, 2007). It was questioned whether these individuals corresponded to a new subspecies (Ramírez, 1988b).

According to catch data, Bryde's whales were considered abundant and present in Peru almost all-year round (Valdivia et al., 1984; Arias-Schreiber, 1996), but no current information supports this notion. Occasional sightings have been reported during IMARPE cruises from 10° S to 04° S (i.e. Bello et al., 1998; Sánchez & Arias-Schreiber, 1998; Márquez & Arias-Schreiber, 2001). In 2012 and 2013, two individuals were reported off Piura; and in 2016, 16 individuals were present during 12 sightings (Fig. 2B) (Castro et al., 2017; Pacheco et al., 2019). Sightings of singles were the most frequent, although two mother-calf pairs were observed milling (Castro et al., 2017). Also, two stranded individuals were reported in 2015 off Lambayeque (Fig. 2B) (Bachmann, 2018). These reports are evidence that they would be becoming more frequent in northern Peru (Castro et al., 2017).

Increased research effort will provide new reports and updated information on Bryde's whales abundance and distribution.

Fin whale (B. physalus)

Early reports placed this species under the scientific name Physeter macrocephalus, and it was reported to occur around Lobos de Tierra Island, Piura (Fig. 2A) (Tschudi, 1844a; Reyes, 2009). Fin whales swarm faster than whaling ships, making their capture difficult (Gunther, 1936; Clarke, 1962; Majluf & Reyes, 1989). From 1925 to 1927, 605 individuals were captured in Peru (Fig. 9A), suggesting an important abundance (Harmer, 1928). After that, whaling was sporadic with low annual catches, suggesting a population decline (Ramírez & Urquizo, 1985, Ramírez, 1988b).

Approximately 1,985 fin whales were captured from 1925 to 1985. The maximum catch occurred between 1965 and 1967 because whaling was directed to this species and other baleen whales due to the lack of sperm whales (Valdivia et al., 1981a). Most of the individuals captured were shorter than the established minimum capture length of 16.8 m. There was no commitment to comply with this regulation due to the need to supply whaling operators’ oil and meal offered to the market (Ramírez, 1988b).

Between 1968 and 1977, fin whales were hunted in occasional encounters that searched for other whale species (Ramírez, 1988b). Finally, in 1976, fin whales were protected by the IWC, although two individuals were captured in Peru in 1977 (Valdivia et al., 1983; Majluf & Reyes, 1989; Reyes, 2009).

Fin whales were sighted and captured mainly off Piura (Fig. 2A) (Ramírez, 1988b), where they fed on euphausiids (Reyes, 1992; Arias-Schreiber, 1996). This species was seen in early winter, from August to November (Harmer, 1928; Van Waerebeek & Engblom, 2007). However, other authors reported that the species could stay year-round, being more frequent in summer and spring, from September to April, at a mean SST of 21.7°C (Ramírez & Urquizo, 1985; Ramírez, 1988b; Reyes, 1992). Similarly, Kostritsky (1952) indicated that fin whale presence corresponded to warm seasons. But after 1977, sightings did not exceed ten individuals per year (Fig. 9B) (Ramírez & Urquizo, 1985), and there are no reports from 1982 until the end of whaling.

In March and May 1998, nine fin whales were recorded during two sightings on an IMARPE cruise at SST between 18 and 21°C, but no specific locations were provided (Sánchez et al., 1998).

On 03 March 2007, a group of 11 fin whales was sighted off Callao (12°09’ S, 77°23’ W) (Fig. 2B) (Van Waerebeek & Engblom, 2007). It was questioned whether these individuals corresponded to a new subspecies (B. physalus quoyi) from the Southern Hemisphere because morphological characteristics, such as nasal bone configuration and size, did not match the description of B. physalus. To date, this aspect has not been reviewed because of

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**Table 4.** Records of Southern right whale (*E. australis*) in Peru until 2021. Adapted from Van Waerebeek et al. (2008).

<table>
<thead>
<tr>
<th>Date</th>
<th>Position</th>
<th>Location</th>
<th>Composition</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 November 1987</td>
<td>17°38’ S, 71°20’ W</td>
<td>Ilo, Moquegua</td>
<td>2 individuals</td>
<td>Before going south, they stayed for about three days</td>
<td>Van Waerebeek et al. (1992)</td>
</tr>
<tr>
<td>07 September 1996</td>
<td>16°13’ S, 73°42’ W</td>
<td>Atico, Arequipa</td>
<td>Mother-calf pair</td>
<td>They remained in the same area until 12 November 1996</td>
<td>Van Waerebeek et al. (1992)</td>
</tr>
<tr>
<td>December 1996</td>
<td>16°26’ S, 73°08’ W</td>
<td>La Planchada, Arequipa</td>
<td>Mother-calf pair</td>
<td>Possible re-sighting of pair no. 2, due to the proximity of location</td>
<td>Van Waerebeek et al. (1998)</td>
</tr>
<tr>
<td>26 August 2003</td>
<td>15°08’ S, 78°21’ W</td>
<td>Bahia San Fernando, Ica</td>
<td>Mother-calf pair</td>
<td>Apparently left the bay at the end of September</td>
<td>Santillán et al. (2004)</td>
</tr>
<tr>
<td>30 July 2003</td>
<td>12°29’ S, 76°48’ W</td>
<td>Pucusana, Lima</td>
<td>Mother-calf pair</td>
<td>Moved north and then west</td>
<td>Van Waerebeek et al. (2008)</td>
</tr>
<tr>
<td>August 2005</td>
<td>04° S, 80°58’ W</td>
<td>Punta Sal, Tumbes</td>
<td>2 individuals</td>
<td>Possible sighting, close to humpback whales</td>
<td>Van Waerebeek et al. (2008)</td>
</tr>
<tr>
<td>06 January 2006</td>
<td>18°17’ S, 70°27’ W</td>
<td>Los Palos, Tacna</td>
<td>1 individual</td>
<td>Stranding</td>
<td>Pizarro-Neyra (2010)</td>
</tr>
<tr>
<td>05 April 2007</td>
<td>12°24’ S, 77°10’ W</td>
<td>San Bartolo, Lima</td>
<td>1 individual</td>
<td>Sighting from a seismic vessel</td>
<td>Van Waerebeek et al. (2008)</td>
</tr>
<tr>
<td>20 August 2012</td>
<td>12°10’ S, 77°02’ W</td>
<td>Chorrillos, Lima</td>
<td>Mother-calf pair</td>
<td>Stayed approximately 3h</td>
<td>Orihuela &amp; Cortegana-Arias (2013)</td>
</tr>
</tbody>
</table>
Antarctic minke whale (B. bonaerensis)

There was no evidence of Antarctic minke whales in Peru until 27 September 1991, when a juvenile male was recorded entangled near the Pucusana artisanal fishing port, Lima (12°30' S) (Fig. 2B). Subsequently, a juvenile female was recorded on 30 October 1991, near the same port (Arias-Schreiber, 1996). The last report was of an entangled juvenile observed on 01 June 2002 in Morín port, La Libertad (08°24' S, 78°54' W) (Fig. 2B) (García-Godos et al., 2013). Since minke whales were not targeted during whaling, no further information on this species is available, either in terms of distribution or abundance. Also, no current reports are available; thus, the status of this species in Peru remains unknown (Van Waerebeek & Reyes, 1994).

Conclusions and outlook

Scientific data collected during whaling produced important information about the distribution and/or abundance of baleen and sperm whales in Peru. Most studies have focused on the sperm whales during the whaling era because they were the main target species. After the moratorium, reports on almost all whale species regarding their spatial distribution and abundance (e.g. Arias-Schreiber, 1996; Reyes, 1992, 2009) were limited by scarce and outdated information. The occasional reports of Bryde’s, fin, and blue whales on the northern Peruvian coast after whaling suggests that the research coverage is insufficient. Similarly, the lack and seasonality of the surveys could underestimate the presence and frequency with which large whales could inhabit the Peruvian sea.

This review shows that overexploitation led to drastic changes in the abundance of baleen and sperm whales off Peru. The scarcity of reports for certain species could not only imply that populations have not yet recovered, but also that the effort in evaluating the population recovery of the species is limited. Currently, whale-watching on humpback whales on the north coast has increased and updated the information available on this species, supporting the estimation of the abundance of the SE Pacific stock. It is expected that the continuity of these activities will allow the extension of studies to other species, such as the Bryde’s whale, which has occasionally been observed during the humpback whale breeding season. Also, abundance estimation models should be conducted from the data collected in research cruises by IMARPE.

After whaling, studies and even reports of large whales have been extremely scarce, so the description of their distribution has not shown significant changes. New studies must evaluate the distribution in relation to changes in physico-chemical parameters and the presence of climate events such as El Niño-
Southern Oscillation. Every reporting opportunity should be taken to evaluate whales’ movements, so it would be appropriate to support community education projects that help locals report species along the Peruvian coast. Stranding reports could be considered an indirect proxy for the location of these cetaceans, and necropsies can provide information on their interaction with other species, fishing activity, or the possible presence of pathogens.

Finally, although large whales were considered abundant in the Peruvian sea, it remains complex to adequately define the “initial” local status of each species. The description of whales’ historical distribution and abundance allow us to reasonably assume that due to whaling and current threats, not all populations have fully recovered locally. Moreover, even though commercial whaling carried out in Peru, by foreign nations and its own, contributed to the decrease of the large whale populations, it allowed the collection of information that is still valid today. However, it is still necessary to implement at least seasonal visual surveys on the Peruvian coast to understand the current trends of large whales and to complement and/or update existing information.

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