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Short Note

Bryde's Whale (*Balaenoptera brydei/edeni*) Sightings in the Southern California Bight

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Given the paucity of confirmed sightings over the last 20 y, and its traditional, more tropical or low-latitude distribution, the Bryde's whale (*Balaenoptera brydei/edeni*)[1] has been excluded from recent National Marine Fisheries Service (NMFS) stock assessment reports of cetaceans occurring in the Southern California Bight (SCB) (Carretta et al., 2011). The last U.S. Pacific marine mammal stock assessment to include the Bryde's whale was in 2006 (Carretta et al., 2007). During the past five decades, only two confirmed sightings of Bryde's whales were documented off Southern California (Table 1). In January 1963, a Bryde's whale (originally misidentified as a fin whale) was seen near La Jolla, California (Nicklin, 1963; Morejohn & Rice, 1973) (Table 1). In October 1991, another Bryde's whale was sighted off Monterey Bay (Barlow, 1997). The latter sighting, along with five other possible sightings (labeled as sei [*B. borealis*] or Bryde's whales), occurred during extensive systematic ship/vessel and aerial surveys conducted in California waters between 1991 and 2008 (e.g., Carretta & Forney, 1993; Hamilton et al., 2009; Barlow et al., 2010) (Table 1).

The natural history of the Bryde's whale is not well known (Kato & Perrin, 2009), though it is the most common rorqual species in the eastern tropical Pacific (ETP) and the Gulf of California (located approximately 350 km south of San Diego) (e.g., Tershy et al., 1990; Tershy, 1992; Jackson et al., 2008; Barlow et al., 2009). Breeding and calving occur year-round, and short seasonal migrations occur in some areas (Jefferson et al., 2008). However, longer movements of Bryde's whales from the tropical Pacific (25° N) to the east coast of Japan (43° N) have also been documented by Japanese tagging in the western Pacific in the late 1980s (Kishiro, 1996).

Bryde's whales in California are believed to belong to the ETP stock for which there is no current population trend data and no biological basis for stock separation (Carretta et al., 2007). Goto et al. (2004) conducted a mitochondrial DNA control sequencing analysis using samples from Baja California (two from the west coast and 10 from within the Gulf of California) and compared those to samples from Hawaii and the western North Pacific. The haplotypes detected in the Hawaiian samples were shared with western North Pacific samples, but no haplotypes were shared between Baja California and the other localities. Although the sample size is small, and therefore the results must be considered preliminary, it suggests that whales from the latter locality belong to a separate population (Goto et al., 2004). The last estimated abundance of Bryde's whales in California, Oregon, and Washington coastal waters in 2006 was 12 individuals (CV = 2.0) (Barlow, 1997; Carretta et al., 2007). Bryde's whales are not listed as a Threatened or Endangered species under the U.S. Endangered Species Act and are not considered a strategic stock under the Marine Mammal Protection Act (Carretta et al., 2007; Jefferson et al., 2008). Kanda et al. (2007) suggested that there is evidence of limited gene flow between various subpopulations of Bryde's whales in the western North Pacific, South Pacific, and Indian Oceans, and that these subpopulations may need separate management actions. It is unknown if the ETP stock of Bryde's whale is genetically isolated from these other regions.

Recent passive acoustic monitoring data from 2000 through 2009 suggest that Bryde's whale

occurrence in the SCB has been increasing since 2003. Acoustic recordings of cetaceans were obtained either with an autonomous bottom-moored High-Frequency Acoustic Recording Package (HARP) or with a boat-based hydrophone (Hildebrand et al., 2010). This acoustic monitoring suggests that calls occur year-round, with peak call rates recorded between August and October (Kerosky et al., 2011). However, no Bryde's whale sightings have been matched to these calls. Bryde's whales are difficult to differentiate in the field from sei whales, and to a lesser extent from fin whales (*B. physalus*), given the subtle differences in external physical characteristics, including body shape and coloration (Cummings, 1985; Jefferson et al., 2008; Smultea et al., 2010). Confirmation of a Bryde's whale at sea typically requires a clear, close-up view of the species' characteristic, paired lateral longitudinal ridges, one on either side of the usual balaenopterid central longitudinal ridge, as well as its dorsal fin shape (Omura, 1966; Cummings, 1985; Jefferson et al., 2008). All other balaenopterids have only one prominent central rostrum ridge, although other rorqual whales can sometimes show much-reduced auxiliary rostrum ridges (T. A. Jefferson, pers. obs., 2011). Consequently, many historical sightings typically have not distinguished between Bryde's and sei whales (and sometimes fin whales) when the latter's distinctive white lower right jaw cannot be seen (Jefferson et al., 2008).

Between August 2006 and September 2010, we photo-documented five separate sightings of single Bryde's whales in SCB waters.

Sightings occurred over bottom depths ranging up to 5,000 m and approximately 75 to 120 km from the mainland Southern California coast (Figure 1). One sighting occurred in October 2008 and another in September 2010 during 33,880 km of aerial surveys conducted from a fixed-wing Partenavia P68-C or P68-OBS aircraft (Smultea et al., 2009, 2011). The remaining three sightings occurred during extensive small-vessel surveys that included offshore waters west of

Table 1. Documented sighting information for Bryde's whales (*Balaenoptera brydei/edeni*) off central and southern California, including the Southern California Bight (SCB), 1963-2010

Date	Species	Location	Lat./ long.*	Group size	Total body length (m)	Total obs. time (min)	Water depth (m)	Species confirmation source	Reference
8 Jan 63	Bryde's whale	1 km from La Jolla shore, San Diego, CA	32.47/ -118.44	1	13.7 m	180		Still photographs and motion pictures	Morejohn & Rice, 1973
5 Oct 91	Bryde's whale	Monterey Bay, CA	36.1162/ -125.1496	2	13 m	20		Naked eye; photographs	J. Barlow, pers. comm.
17 Aug 06	Bryde's whale		32.9/ -119.1815	1	Adult	42		Digital photographs from a rigid-hulled inflatable boat (RHIB)	Cascadia, Sighting Number N1-9
18 Aug 06	Bryde's whale		32.7515/ -118.9345	1	Adult	6		Digital photographs from RHIB	Cascadia, Sighting Number N1-5
19 Oct 08	Bryde's whale	120.7 km NE of SCI	33.1184/ -118.3312	1		5	5,000 m	Digital aerial photographs	Smultea et al., 2009; SES Daily Sighting Number 6
24 Sept 10	Bryde's whale		32.9278/ -118.9063	1		5	5,000 m	Digital aerial photographs	Smultea et al., 2011; SES Daily Sighting Number 5
25 Sept 10	Bryde's whale		32.8549/ -119.0826	1		25		Digital photographs from RHIB	Cascadia, Sighting Number PHY-1

*In WGS 84

San Clemente Island: two in June 2006 and one in September 2010. Photographs were taken with a Canon 20D digital camera and a Canon 100-400 mm zoom lens or a 70-200 mm zoom lens with a 1.4x converter. All of our sightings required close examination of photographs to confirm species identification and were reviewed by at least three species experts.

Recent calls and sightings of Bryde's whales in Southern California waters may represent a range expansion related to increasing periods or areas of warmer water temperatures, including the summer/fall El Niño Southern Oscillation (ENSO) events; the offshore poleward-flowing Davidson Current period from late fall to late winter (November to January) inshore of the California Current; and climate change (Kerosky et al., 2011). Southern California occasionally experiences seasonal El Niño oceanographic events that typically increase sea-surface water temperatures from fall through winter (National Oceanic & Atmospheric Administration [NOAA], 2011). Since 1990, warmer El Niño water temperatures have occurred in Southern California during 14 of the past 21 y (NOAA, 2011). Our sightings do not appear to be directly correlated with ENSO events, though recent increased sightings and calls in the SCB may be indirectly related through effects on prey distribution.

Data reported herein indicate that Bryde's whales occur off southern California more often than previously reported. This may be a recent phenomenon related to warming of ocean temperatures associated with oceanographic events such as ENSO and climate change that influence the availability and distribution of prey (Learmonth et al., 2006; Kerosky et al., 2011). Salvadeo et al. (2011) determined that interannual variability of Bryde's whale occurrence in the southwestern Gulf of California was highly correlated with the ENSO and its likely impact on prey availability. Our sightings, along with Bryde's whale calls, suggest that the species' use of the SCB is increasing. This is likely a result of interrelated factors, including climate change/global warming, short-term water temperature changes such

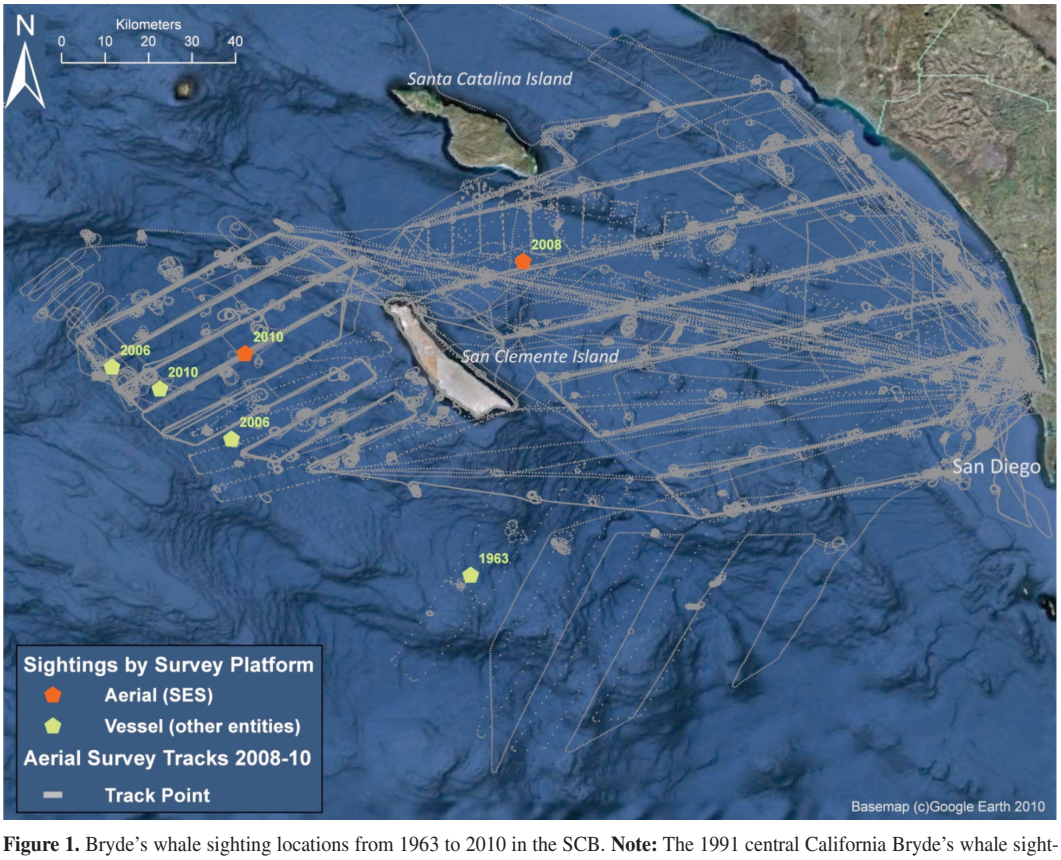

Figure 1. Bryde's whale sighting locations from 1963 to 2010 in the SCB. **Note:** The 1991 central California Bryde's whale sighting is excluded from this map due to distance from the other sightings depicted here. **Also note:** Survey tracks only represent aerial survey effort. They do not represent vessel effort, although vessel sightings are depicted herein.

Figure 2. (Top) Bryde's whale seen on 19 October 2008, showing head in right dorso-lateral view with central longitudinal ridge on the rostrum and the well-marked, smaller lateral ridges on each side (diagnostic character of species); the darker longitudinal stripes represent the shallow grooves on either side of the ridges. (Photographed by Lori Mazzuca under NMFS Permit 14451) (Bottom) Bryde's whale seen on 24 September 2010; dorsal view of full body, showing prominent dorsal fin and the well-defined central longitudinal ridge on rostrum flanked by an auxiliary ridge on each side. (Photographed by Bernd Würsig under NMFS Permit 15369)

as El Niño and La Niña, changes in prey distribution/abundance, increased abundance of the ETP stock with concomitant range expansion, and/or an artifact of increased sighting effort off California (Baker & Madon, 2007). Our limited sightings point to offshore use of the SCB, consistent with the speculation of Kerosky et al. (2011), that SCB Bryde's whales may initially travel north offshore then return south closer to the shore. It is our hope that the reporting of our sightings herein will lead to (1) a better understanding of this species' occurrence in the SCB, (2) consistent inclusion of the Bryde's whale in environmental impact analyses and stock assessment reports in southern California, and (3) increased efforts to photo-document and/or genetically sample future potential sightings to ascertain species and stock affinities. Data provide additional support for our suggestion that Bryde's whales be added to the Pacific SARs, and that further research effort should be expended into investigating this phenomenon. For instance, Bryde's whales are often seen on ETP dolphin assessment cruises, and there may be sufficient data to conduct a preliminary trends assessment to see if there is evidence of a population increase for this stock.[2]

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Endnotes

[1] The International Whaling Commission continues to use the name *B. edeni* for all Bryde's whales. Although it is widely recognized that there are probably two species involved, the affinities of the type specimens have not yet been resolved, and the use of *B. edeni* for all Bryde's whales is therefore a pragmatic approach (Jefferson et al., 2008).

[2] After acceptance of this note, we learned of an additional sighting of two Bryde's whales approximately 6 km west of San Clemente Island, California (32.51 282/-118.33 743) on 1 October 2009 confirmed by photograph during a NMFS/SWFSC aerial survey (W. Perryman, NMFS/SWFSC, unpub. data, 3 February 2012). The whales were estimated to be 10.4 and 12.9 m long, respectively.

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