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Short Note

New Record of California Coastal Bottlenose Dolphins (*Tursiops truncatus*) in Offshore Waters

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California coastal bottlenose dolphins (*Tursiops truncatus*) comprise a distinct ecotype that typically inhabits waters < 1 km from shore and about 10 to 30 m deep, often to the surf zone (Defran & Weller, 1999; Defran et al., 1999; Bearzi et al., 2009; Perrin et al., 2011). An offshore bottlenose dolphin ecotype is found in deeper waters of California, usually more than a few kilometers from shore to well beyond the continental shelf edge (Defran & Weller, 1999; Bearzi et al., 2009; Perrin et al., 2011; Lowther-Thieleking et al., 2014). The National Marine Fisheries Service (NMFS) manages these ecotypes as separate stocks (Carretta et al., 2017), differentiated by cranial morphology, diet, parasite load (Walker, 1981; Perrin et al., 2011), and genetics (Lowther-Thieleking et al., 2014). The two forms, however, cannot be reliably identified in the field based on external appearance (Walker, 1981; Leatherwood et al., 1982).

Coastal bottlenose dolphins were first sighted in Northern California's San Francisco Bay Area (SF Bay Area) in November 1983 in nearshore habitat consistent with that stock's ecological preferences. They arrived coincident with an El Niño warm water event that brought the coastal dolphins from the Southern California Bight north to at least Monterey Bay (Wells et al., 1990; Maldini et al., 2010; Riggin & Maldini, 2010; Defran et al., 2015). A more recent range expansion by coastal bottlenose dolphins, beginning *ca*. 2007, led to regular observations of small groups of this ecotype throughout the SF Bay Area, including four coastal counties: San Mateo, San Francisco, Marin, and Sonoma (Keener et al., 2023). The Marine Mammal Center (TMMC), a stranding response and research facility located in this area, established a dolphin identification catalog with data collected primarily through shore-based efforts using standard photographic comparison and archiving techniques (Defran et al., 1990; Würsig & Jefferson, 1990). The catalog contains 84 individual dolphins with at least two dorsal fin trailing edge marks (Keener et al., 2023).

Bottlenose dolphins are encountered infrequently offshore in the Gulf of the Farallones adjacent to the SF Bay Area (Figure 1A). NMFS shipboard stock assessment line-transect surveys in the California Current Ecosystem from 1991 to 2018, using 25x binoculars, did not detect any bottlenose dolphins in or near the Gulf of the Farallones (Becker et al., 2020). Dedicated cetacean counts along fixed cruise tracks from SF Bay and Southeast Farallon Island (SEFI), which lies 44 km west of San Francisco, from 1971 to 1979 recorded six species (Huber et al., 1982). A complementary effort of daily cetacean censuses from SEFI from 1973 to 1994 recorded 15 species (Pyle & Gilbert, 1996). Over this combined 24-y period, these efforts produced no bottlenose dolphin sightings. SEFI is the largest (0.39 km^2) of the Farallon Island group, a chain of rocky islets perched on a plateau near the continental shelf break in waters ranging from 47 to 60 m deep (Capitolo, 2009). The islands, a National Wildlife Refuge, are situated in a highly productive marine upwelling ecosystem and host major seabird and pinniped breeding colonies (White, 1995).

Two prior opportunistic sightings are known for the area: (1) on 21 November 1982, a single large

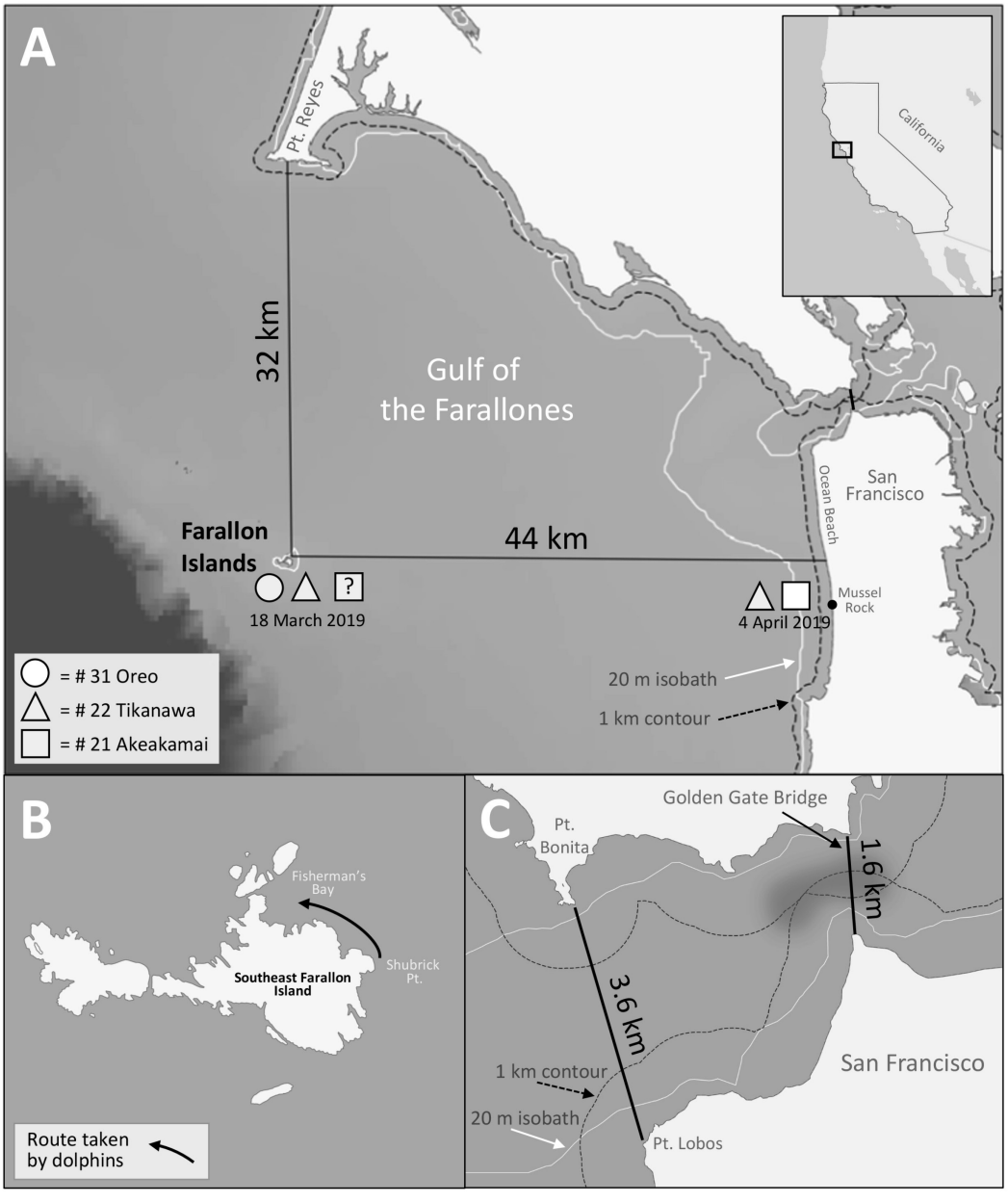

Figure 1. Maps of Northern California waters: (A) Gulf of the Farallones, with Southeast Farallon Island (SEFI) near the edge of the continental shelf (dark water shading) and coastal dolphin sighting locations and dates; (B) SEFI detail; and (C) Golden Gate strait detail with maximum and minimum crossing distances; dark water shading in narrows ranges in depth from approximately 80 to 110 m.

adult bottlenose dolphin was sighted from a whale-watching vessel traveling in a large mixed herd of Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), northern right whale dolphins (*Lissodelphis borealis*), and common dolphins (*Delphinus delphis*) in waters 270 to 300 m deep near the edge of the continental shelf southwest of the Farallon Islands (37° 40' N, 123° 06' W), approximately 53 km west of San Francisco (Wells et al., 1990); it was seen clearly by MAW as it approached the boat to bow ride briefly; and (2) on 15 October 1983, two bottlenose dolphins, possibly a mother–calf pair, were photographed by WK from a whale-watching vessel in the offshore waters of the Gulf of the Farallones between San Francisco and the Farallon Islands. In both instances, the bottlenose dolphins were presumed to be members of the offshore ecotype based on water depth and positions far from the mainland. Although habitats of the two eastern North Pacific ecotypes differ ecologically and generally do not overlap (Carretta et al., 1998), one study found a small percentage (< 5%) of photo-identified California coastal bottlenose dolphins in Santa Monica Bay occasionally ventured between 3 to 5 km offshore, with a few traveling up to 15 km (Bearzi et al., 2009; Perrin et al., 2011).

On 18 March 2019, a group of three bottlenose dolphins was sighted by Point Blue Conservation Science staff stationed on SEFI as part of their ongoing daily cetacean censusing program. From 1500 to 1735 h, the dolphins were observed intermittently and photographed (by ACS) using a Canon digital SLR with a 300-mm telephoto lens as they traveled northwest approximately 25 to 100 m off the island's steep granite shore from near Shubrick Point to Fisherman's Bay (37° 42' N, 123° 00' W; Figure 1B). Water depth in that area varies from 7 to 10 m. The dolphins were seen leaving Fisherman's Bay on a northerly course and then making a brief return to that bay at 1735 h before finally departing. Conditions were mild with a cloudy overcast, similar to weather at the island during the preceding 7 d.

We visually compared digital images of the dolphins sighted at SEFI to TMMC's photo-identification catalog of California coastal bottlenose dolphins (Figure 2). Despite the relative softness of the SEFI images due to distance (150 to 200 m) and subdued ambient light, based on two or more dorsal fin trailing edge marks (notches) and their relative distances from the fin tip, matches were made to two individuals: TMMC #31 ("Oreo") and TMMC #22 ("Tikanawa"). The third dolphin could not be positively matched to any known individual because of low image quality. However, it showed some similarity in fin shape, including a truncated tip, to TMMC #21 ("Akeakamai").

The two matched individuals, Oreo and Tikanawa, were first photo-identified on the coast of Monterey Bay in 2006 and later recorded multiple times nearshore on the coast of the SF Bay Area (Table 1). Based on long-term coastal bottlenose dolphin research, including biopsy sampling conducted in Monterey Bay, Oreo has been verified as an adult female and Tikanawa as an adult male (Cotter et al., 2012; unpub. Okeanis data). Out of ten sightings in the SF Bay Area (2010 to 2020), Tikanawa was photographed with Akeakamai nine times, often surfacing in synchrony (unpub. TMMC data). Adult male bottlenose dolphins can form stable partnerships (Connor et al., 2000), which may enable them to have larger ranges than solitary males (Owen et al., 2002). Based on Tikanawa and Akeakamai's well-documented long-term relationship and the third dolphin's fin shape, there is a moderate probability that the third dolphin sighted at SEFI was Akeakamai.

After the occurrence at SEFI on 18 March 2019, Oreo was not sighted again. Tikanawa, accompanied by Akeakamai, was sighted 2 wks later on 4 April 2019, back in normal inshore coastal habitat near Mussel Rock in Daly City, in a group of eight animals, all of which were previously photo-identified coastal bottlenose dolphins. Tikanawa and Akeakamai were sighted again on 17 September 2020 at Ocean Beach, San Francisco.

The unique sighting event we report at SEFI constitutes the first record of California coastal bottlenose dolphins in Northern California offshore waters. It is also the first record of the species at SEFI, adding to the island's rich cetacean diversity (Pyle & Gilbert, 1996). These two known coastal bottlenose dolphins established a new offshore distance record for their ecotype in the eastern North Pacific, more than doubling the 15 km reported by Bearzi et al. (2009) in the Southern California Bight. The closest mainland location to SEFI is the southern tip of the Point Reyes peninsula, a distance of 32 km. The location of Tikanawa's subsequent resighting on 4 April 2019 near Mussel Rock is 44 km from SEFI (Figure 1A). Depending on their route from the mainland across the Gulf of the Farallones, the dolphins traveled a straight-line minimum of between 32 to 44 km, crossing outer Gulf waters 55 to 84 m deep to reach SEFI. While not establishing a new habitat depth record for the ecotype (approximately 200 m along the Santa Monica Bay escarpment; Bearzi et al., 2009), the dolphins negotiated water far exceeding their presumed preferred depth of about 10 to 30 m (Bearzi et al., 2009; Perrin et al., 2011). The continental shelf widens in the Gulf of the Farallones, and areas of suitable shallow habitat extend farther offshore than elsewhere in the coastal dolphins' range. For

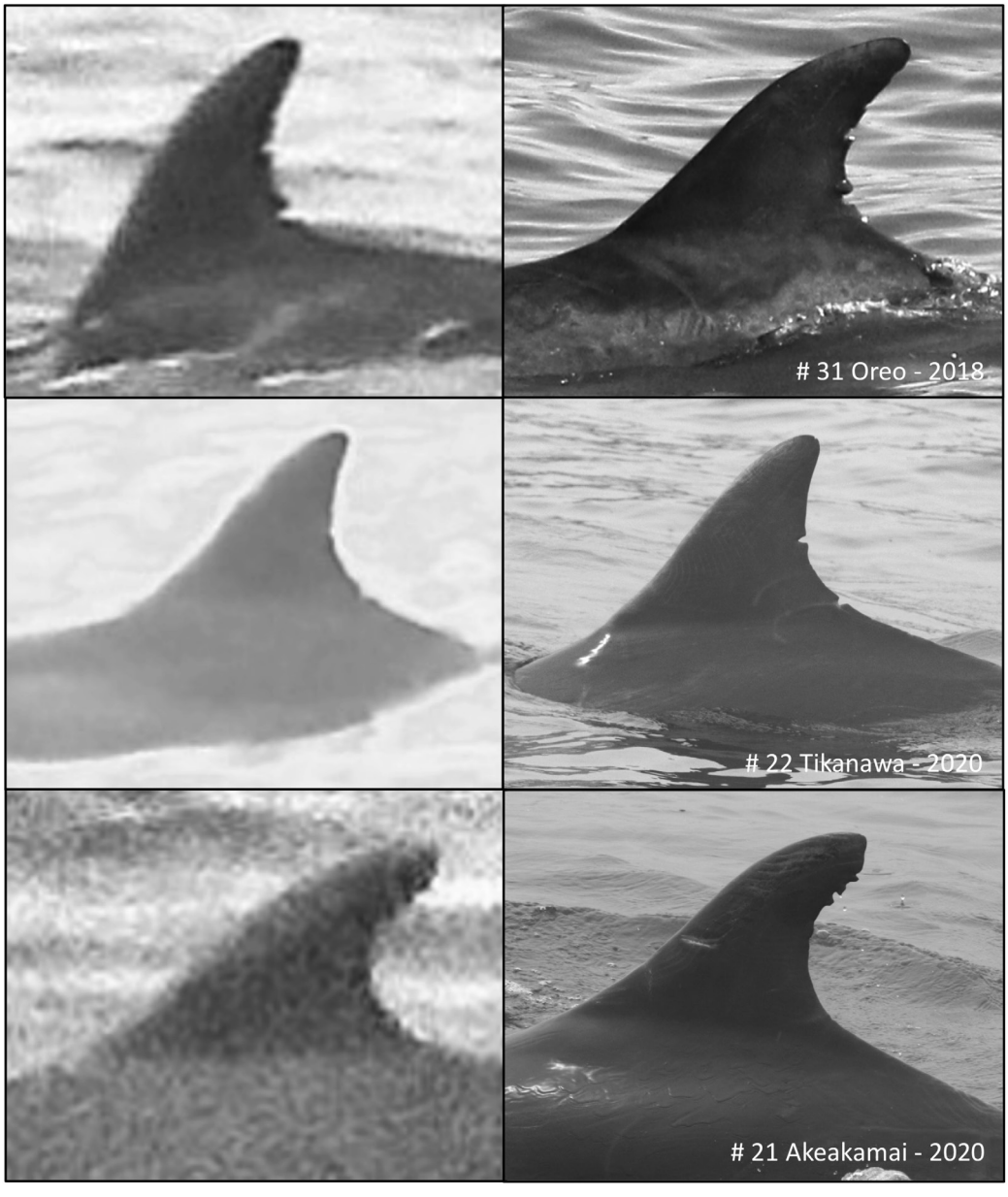

Figure 2. Comparison dorsal fin images for three bottlenose dolphins (*Tursiops truncatus*) photographed at SEFI on 18 March 2019 (left column), and TMMC catalog images with ID #, name, and year recorded (right column) (Photos taken at SEFI by A. C. Spears. *Catalog images:* ID #31 by W. Keener and ID #22 and #21 by I. Szczepaniak. Authorized by NOAA Permit #20386.)

Table 1. Sighting histories for three bottlenose dolphins (*Tursiops truncatus*) in Monterey Bay and the San Francisco Bay Area (2006 to 2020). Text in gray denotes history of a dolphin not positively identified at Southeast Farallon Island: Akeakamai, a long-term partner of Tikanawa.

TMMC ID#	Name	Sex	Monterey Bay		SF Bay Area	
			Years	# sightings	Years	# sightings
31	Oreo	F	2006, 2007, 2008, 2009, 2010, 2011, 2014	53	2013, 2014, 2017, 2019	8
22	Tikanawa	M	2006, 2007, 2008, 2009, 2010, 2011	35	2010, 2011, 2014, 2015, 2016, 2019, 2020	10
21	Akeakamai	M	2006, 2007, 2008, 2009, 2010, 2011	42	2011, 2014, 2015, 2016, 2019, 2020	9

Sources: Oreo and Akeakamai (Keener et al., 2023); Tikanawa in Monterey Bay (unpub. Okeanis data) and in SF Bay Area (unpub. TMMC data).

example, using a mid-range habitat depth, the 20 m isobath reaches a maximum of 11 km from shore as it trends southwesterly toward SEFI (Figure 1A).

Since their arrival in the SF Bay Area, coastal bottlenose dolphins have navigated the Golden Gate strait, a potential barrier to their movement. The strait connects the Gulf of the Farallones with SF Bay and is 4.5 km long, 3.2 km wide at the western (ocean) end, and 1.6 km wide at the eastern (bay) end (U.S. Coast Pilot, 2022). It is one of the deepest estuarine outlet channels in the world, up to 110 m deep near the narrows of the strait beneath the Golden Gate Bridge (Barnard et al., 2006). Data from our local study of coastal bottlenose dolphin movements from 2007 to 2018 indicate that of 84 photo-identified animals, more than half (n = 49; 58%) crossed the Golden Gate strait at least once (Keener et al., 2023). However, with one exception, it is not known where the dolphins made the transits. The shortest distance is 1.6 km over deep (100 m) water; a longer route near the entrance of the strait is 3.6 km over shallower (43 m) water (Figure 1C). The only documented crossing of the bay by coastal bottlenose dolphins occurred on 15 April 2015 when two photo-identified individuals were observed from the Golden Gate Bridge swimming directly from north to south across the strait near its narrowest, deepest point. The 1.6 km transit to Fort Point, San Francisco, was completed in 10 min when the dolphins joined a group of four or five of their conspecifics. Whichever route they took, the dolphins' experience crossing the strait may have behaviorally prepared some of them to travel more extensively into the Gulf of the Farallones. Before their excursion to SEFI, Oreo was recorded only south of the strait, while Tikanawa was recorded north and south (unpub. TMMC data).

Our results confirm that the California coastal bottlenose dolphin is a highly mobile and flexible top marine predator (Defran et al., 1999; Hwang et al., 2014) that continues to explore novel habitat (Keener et al., 2023). Therefore, care should be taken when assigning bottlenose dolphins in the eastern North Pacific to ecotype based solely on their observed location in offshore continental shelf waters vs nearshore waters. This point is reinforced by observations of coastal/inshore ecotype bottlenose dolphins in deep or offshore waters in the Southern California Bight (Bearzi et al., 2009), in the Mediterranean Sea (Gnone et al., 2011; Genov et al., 2022), and the Gulf of Guayaquil, Ecuador (Jiménez & Alava, 2014). We recommend photo-identification and genetic studies to better understand the differentiation between coastal and offshore bottlenose dolphin forms in California.

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