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MARK-RECAPTURE ABUNDANCE ESTIMATE OF CALIFORNIA COASTAL STOCK BOTTLENOSE DOLPHINS: NOVEMBER 2009 TO APRIL 2011

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

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ABSTRACT

The occurrence, distribution, group size and abundance of California coastal stock bottlenose dolphins (*Tursiops truncatus*) were assessed during a boat-based photo-identification study between November 2009 and April 2011 off San Diego, California. A total of 31 photographic surveys were completed and dolphin groups were encountered on 30 (97%) of them. A total of 115 dolphin groups were observed and 346 individuals photographically identified. All groups were sighted within approximately 1-2 km of shore. The mean group size was 8.2 (SE = 0.6) and the average number of dolphins and groups encountered per survey was 31.5 (SE = 4.2) and 3.9 (SE = 0.5), respectively. Low resighting rates (mean = 2.2; SE = 0.8) and an ever-increasing rate of discovery for previously unidentified dolphins were observed. Strikingly, 258 of the 346 identified dolphins during this study were not represented in the prior 1981-2005 photo-identification catalog for San Diego. Dolphins were considered "marked" if they had two or more dorsal fin nicks. Mark-recapture analysis using POPAN as well as closed models in RMark produced abundance estimates of 515 marked dolphins (95% CI = 470-564, SE = 24.0) and 453 marked dolphins (95% CI = 411-524, SE = 28.1), respectively. Differences in encounter rates, group size and number of groups encountered per survey during the 2009-2011 study were apparent when compared to earlier studies in the same area between 1984 and 2005.

INTRODUCTION

The common bottlenose dolphin (*Tursiops truncatus*) is the most frequently encountered cetacean in the nearshore waters of California and Baja California, Mexico. Two distinct ecotypes occur in these waters: a coastal form that is typically found within 1-2 km of shore (Carretta et al. 1998; Defran and Weller 1999; Bearzi 2005) and an offshore form that is distributed in deeper waters, typically greater than a few kilometers from shore (Defran and Weller 1999; Bearzi et al. 2009). Differentiation of these two ecotypes, which are managed as separate stocks by the National Marine Fisheries Service (Carretta et al. 2015), is supported by morphological (Walker 1981; Perrin et al. 2011), photographic (see Shane 1994) and genetic data (Lowther-Thieleking et al. 2014).

The size of the California coastal stock is small, previously estimated to contain about 500 individuals (Dudzik et al. 2006) that are distributed between Monterey, California and Ensenada, Baja Mexico (Defran et al. 1999; Hwang et al. 2014; Defran et al. 2015), with occasional sightings as far north as San Francisco, California[1]. Photo-identification research has been carried out on the coastal stock off California, and to a lesser extent off Northern Baja California, since the early 1980s. Areas off California and Baja California where photographic data have been collected include: (1) Ensenada, (2) San Diego, (3) Orange County, (4) Santa Monica Bay, (5) Santa Barbara, (6) Monterey Bay and (7) San Francisco Bay.

In general, photo-identification data have shown that California coastal dolphins display limited site fidelity to any portion of their distribution (Defran et al. 1999; Hwang et al. 2014). Instead, they routinely travel back-and-forth within their range, on some occasions in excess of 900 km,

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[1] Szczepaniak, I., W. Keener, M. Webber, J. Stern, D. Maldini, M. Cotter, R.H. Defran, M. Rice, G. Campbell, A. Debich, A. Lang, D. Kelly, A. Kesaris, M. Bearzi, K. Causey, and D. Weller. 2013. Bottlenose dolphins return to San Francisco Bay. Poster presented at the 20th Biennial Conference on the Biology of Marine Mammals, Dunedin, New Zealand December 9-13.

while at the same time typically staying very near shore (Defran et al. 1999; Hwang et al. 2014; Defran et al. 2015).

Records from the nineteenth century suggest that coastal bottlenose dolphins may have once occurred in Monterey Bay and San Francisco Bay (Dall 1873; True 1889; Orr 1963). More recent studies, however, considered the northern range boundary to be located off Los Angeles County up until the early 1980s (Norris and Prescott 1961; Dohl et al. 1981; Leatherwood and Reeves 1982). The 1982-83 El Niño Southern Oscillation (ENSO) dramatically impacted the coastal marine ecosystem off California and Baja. It was during this ENSO event that California coastal stock dolphins extended their northern range back to Monterey Bay (Wells et al. 1990). This northern range extension has persisted to the present day (Riggin and Maldini 2010; Maldini et al. 2010; Cotter et al. 2011) and now extends even further north to San Francisco Bay and most recently, Bodega Bay[1]. The southern boundary of the California coastal stock is less well known but photo-identification data demonstrate that it extends to at least Ensenada (Defran et al. 1999; Hwang et al. 2014; Defran et al. 2015) and for a few individuals, possibly San Quintín (Defran et al. 2015).

Coastal bottlenose dolphins off California are not listed as threatened or endangered under the Endangered Species Act or as depleted under the Marine Mammal Protection Act. The National Marine Fisheries Service (NMFS) is responsible for assessing the status of the population off the U.S. west coast; no conservation or management plans currently exist. Based on historic photographic mark-recapture studies of this population off San Diego, California, the abundance of this stock based on analyses of the marked portion of dolphins identified was apparently stable over multiple decades (Dudzik et al. 2006). Hansen (1990) estimated the coastal population abundance as 173-240 for the period of 1981-1983. Defran and Weller (1999) continued the work started by Hansen (1990) and estimated abundance to be 234-284 for the period of 1984-1989. More recently, Dudzik et al. (2006) estimated population size to be 323 (259-430) during the 2004-2005 period. Current estimates presented here suggest that the population may be increasing, as the minimum number of animals identified (n = 346) exceeds the population size estimates presented by Dudzik et al. (2006) over similar time periods. The population size is nevertheless comparatively small (approximately 500 individuals) and its extremely coastal distribution makes it vulnerable to a number of possible human-related threats. The objective of the present study was mark-recapture abundance estimation for California coastal stock bottlenose dolphins for the period of November 2009 to April 2011.

METHODS

Study Area - Photo-identification surveys took place in the same San Diego study area as has been used by San Diego State University and NOAA Fisheries Southwest Fisheries Science Center researchers since 1981 (see Defran and Weller 1999; Dudzik et al. 2006), consisting of a 32 km strip of coastline between Scripps Pier (32° 52’ N) and South Carlsbad (33° 08’ N) (Fig. 1).

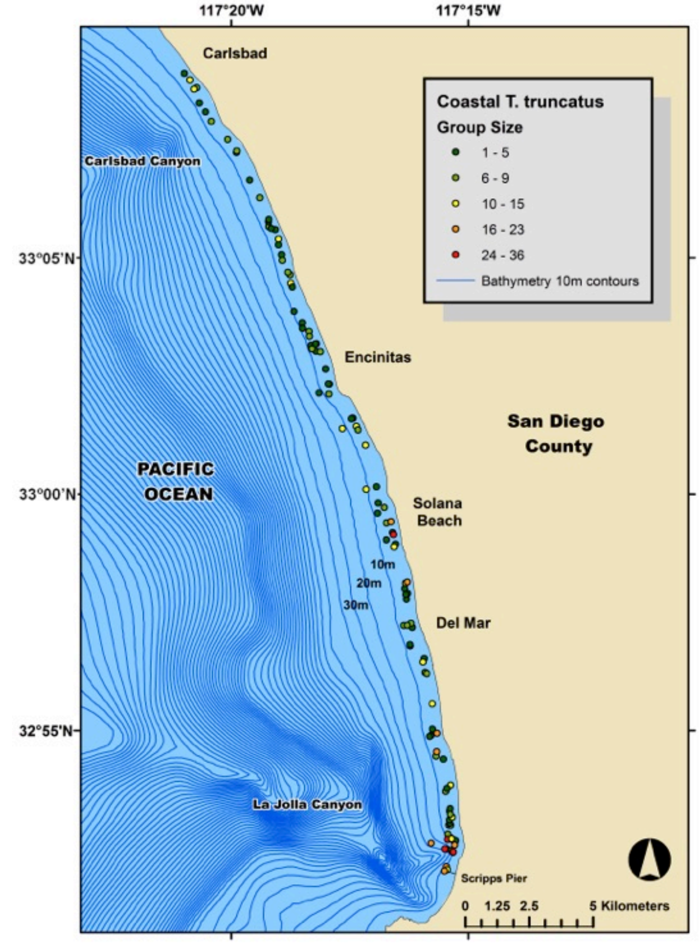

Figure 1. San Diego study area and 2009-2011 dolphin sighting locations.

Photographic Surveys - Survey, photo-identification and data collection methods followed those described by Defran and Weller (1999), Dudzik (1999) and Dudzik et al. (2006) with the exception that digital photography was used exclusively during the current study. Photographic surveys involved slow travel in a 6.7-meter outboard-powered rigid-hull inflatable boat (RHIB) moving parallel to the shoreline, 90-180 m offshore of the surf line. All surveys were conducted in Beaufort Scale ≤ 3 and under visibility conditions adequate for sighting and photographing dolphins. The research team consisted of a boat driver, data recorder and photographer(s). Systematic visual search of the area from the shore to 2 km offshore was maintained until a dolphin sighting was made. Upon initial sighting of a group, the survey vessel slowed to idle speed, and maneuvered to a vantage point approximately 50 m from the dolphins. From this position, observations of group location (as determined by GPS), time, behavior, and number of dolphins were recorded. The research vessel was then moved within approximately 30 m of the group and individuals were photographed with Canon digital SLR cameras equipped with 100-400-mm telephoto lenses. In all cases, attempts were made to photograph every dolphin in a group.

A group was defined as either a solitary individual or two or more dolphins observed in close spatial proximity and swimming in close association and generally coordinating their diving or direction of movement (see Defran and Weller 1999). Group size estimates were based on field observations and represented the product of a consensus among observers on the survey vessel. The term "calf" is used herein to refer to young of the year and defined by the observation of fetal folds.

Two survey types were conducted during the study: complete and partial. Complete surveys covered the entire study area. Partial surveys covered only a portion of the study area (due to mechanical failure or deteriorating weather) but encountered at least one dolphin group.

Image Analysis - Only good quality photographs (in focus, entire fin out of the water, near perpendicular to the camera), of dolphins considered to be reliably identifiable over time (see Defran et al. 1999) were used in the analysis (Fig. 2). Differences in the number of notches an individual has can affect resightability and thereby contribute to heterogeneity in capture probabilities (Hammond 1986). The issue of heterogeneity, resulting from fin "distinctiveness", was minimized in the current study by limiting the analysis to "marked" dolphins that had more than one notch on the trailing edge of the dorsal fin (see Dudzik 1999). While dorsal fins with a single notch can, in some cases, be used to reliably identify individuals, it is also true that such fins are often ambiguous and can potentially introduce matching errors. Thus, only dolphins with two or more notches on their dorsal fins were used in the current study as was also the protocol used in past studies on the population (see Defran and Weller 1999; Dudzik 1999; Dudzik et al. 2006). This restriction effectively removed "unmarked" individuals from the individual identification data set.


Photo: D. Weller. NMFS Permit #: 774-1714 and 14097

Figure 2. Dorsal fin of a coastal bottlenose dolphin off San Diego County. The numerous nicks and notches on the trailing edge are used for individual identification. Barnacles (*Xenobalanus globicipitus*) is such as the one attached to the tip of this fin were ephemeral and not used for identification purposes.

Mark-Recapture Analysis – Both open and closed capture-recapture models were fitted using POPAN and the RMark interface to the program MARK. POPAN, a modified formulation of the Jolly-Seber open capture-recapture model, was used to develop estimates of super population size (N), apparent survival probability (φ), probability of capture during a given sampling period (ρ), and the probability of entry into the population between two given sampling periods (β). The super-population size in POPAN represents the total number of animals that ever are present in the study population. A series of POPAN models were developed to allow for fixed or time varying effects on the capture probabilities, apparent survival rates, and probability of entry. The best model was selected based on Akaike's Information Criterion (AICc), which provides a measure of model fit based on the trade-off between the goodness of fit of the model and the complexity (number of parameters) of the model.

Closed population capture-recapture models that allow for capture probabilities to vary with time and by individual (M_0, M_b, M_t, M_h, M_{th} - Chao et al., 1992; Otis et al., 1978) were also used to obtain closed population estimates. Closed models, where appropriate, assume that capture probabilities can change from one sampling period to the next (time variation), and that each member of the population has a unique capture probability due to sex, age, home range, etc., that is independent of all other members of the population.

Capture histories of each individual were partitioned for mark-recapture analysis by survey with each bimonthly survey representing one sampling occasion.

RESULTS AND DISCUSSION

Survey Effort and Encounter Rate - Between November 2009 and April 2011, a total of 31 photo-identification surveys were conducted, 115 dolphin groups encountered and 54 hours of direct observation recorded (see Appendix 1). Twenty-nine of the 31 surveys covered the entire study area (i.e. complete surveys), while two were partial surveys that covered only a portion of the study area due to mechanical failure or poor weather. Of the 29 complete surveys, dolphins were encountered on 28 (97%) of them and on both (100%) of the partial surveys. Thus, in total, dolphins were encountered on 30 (97%) surveys (28 complete and two partial). The 97% encounter rate for complete surveys is much higher than encounter rates reported for studies during 1984-1989 (79%), 1996-1998 (79%) and 2004-2005 (71%).

Group Size - Group sizes ranged from 1 to 36 dolphins with a mean group size of 8.2 (SE = 0.6) dolphins. Twenty-seven (23.4%) of 115 groups contained at least one calf and 55 calves were observed over the course of the study. The mean group size reported herein is notably smaller than that reported for 1984-1989 (mean = 19.8, SE = 1.5) and 1996-1998 (mean = 17.8, SE = 2.5), but only slightly smaller than that reported for 2004-2005 (9.1, SE = 1.5). The average number of dolphins encountered per survey during 2009-2011 (mean = 31.5, SE = 4.2) is higher than during 1984-1989 (mean = 26.8, SE = 2.5) and much higher than during 1996-1998 (mean = 21.1, SE = 5.9) and 2004-2005 (mean = 19.7, SE = 3.1). Of the 29 complete surveys on which dolphins were sighted, the mean number of groups encountered was 3.9 (SE = 0.5). On 11% (n = 3) of these surveys only one group was encountered, while two to five groups were seen on 72% (n = 20) of surveys and six to 11 groups were seen on 18% (n = 5) of surveys. Only one complete survey resulted in no sightings. In contrast, the same analysis for a 1984-1989 study

(Defran and Weller 1999) showed that 75% of the complete surveys encountered a single group. Thus, for the current study, mean group size was smaller than reported in the past, but the number of surveys that encountered multiple groups was higher.

Individual identification - A total of 7,387 digital images were taken during the study, and 346 dolphins were individually identified. This number of identifications is higher than that reported for a similar number of surveys (n = 27) in the same study area during 2004-2005 when 148 identifications were made (Dudzik et al. 2006)[2]. The rate of discovery for newly identified individuals is shown in Figure 3. This function shows a continuous increase in the number of "new" dolphin identifications throughout the study period. Figure 4 shows the "per-survey" proportion of new dolphins identified relative to the total cumulative number of dolphins identified.

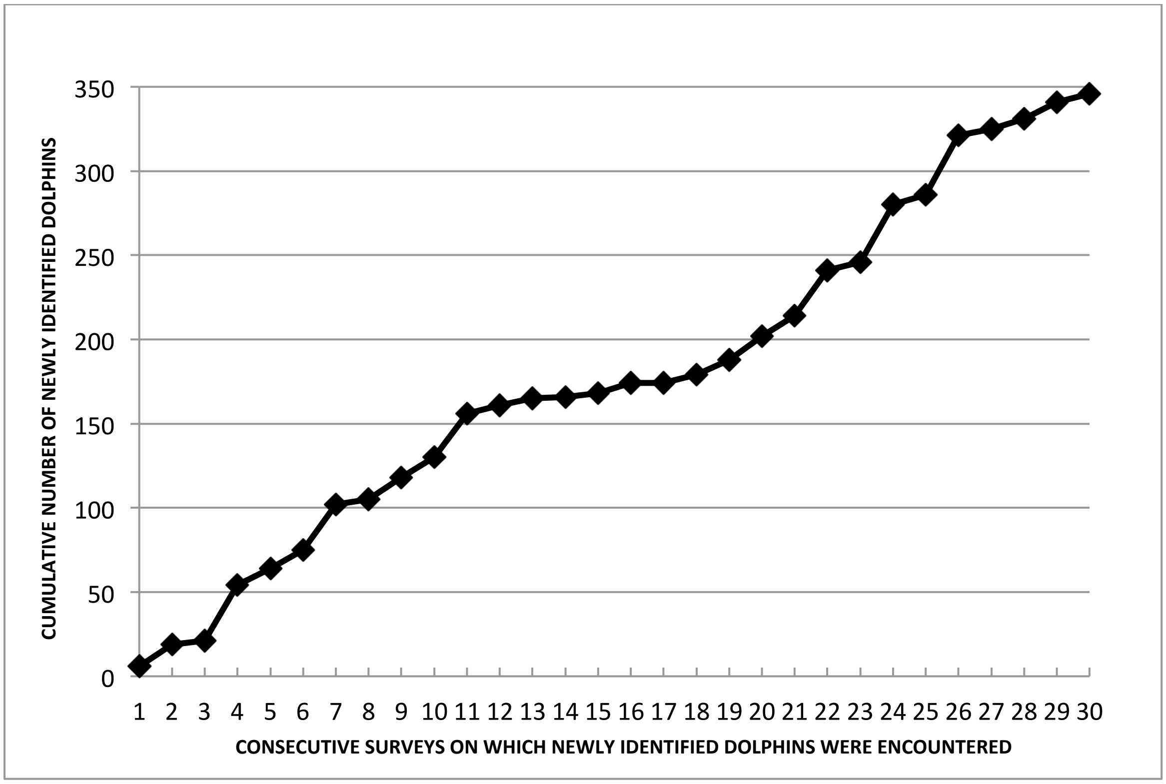

Figure 3. Rate of discovery for individuals identified in 2009-2011.

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[2] The catalog of 164 dolphins used in analyses by Dudzik et al. 2006 has subsequently been refined to include only 148 photo-identified dolphins.

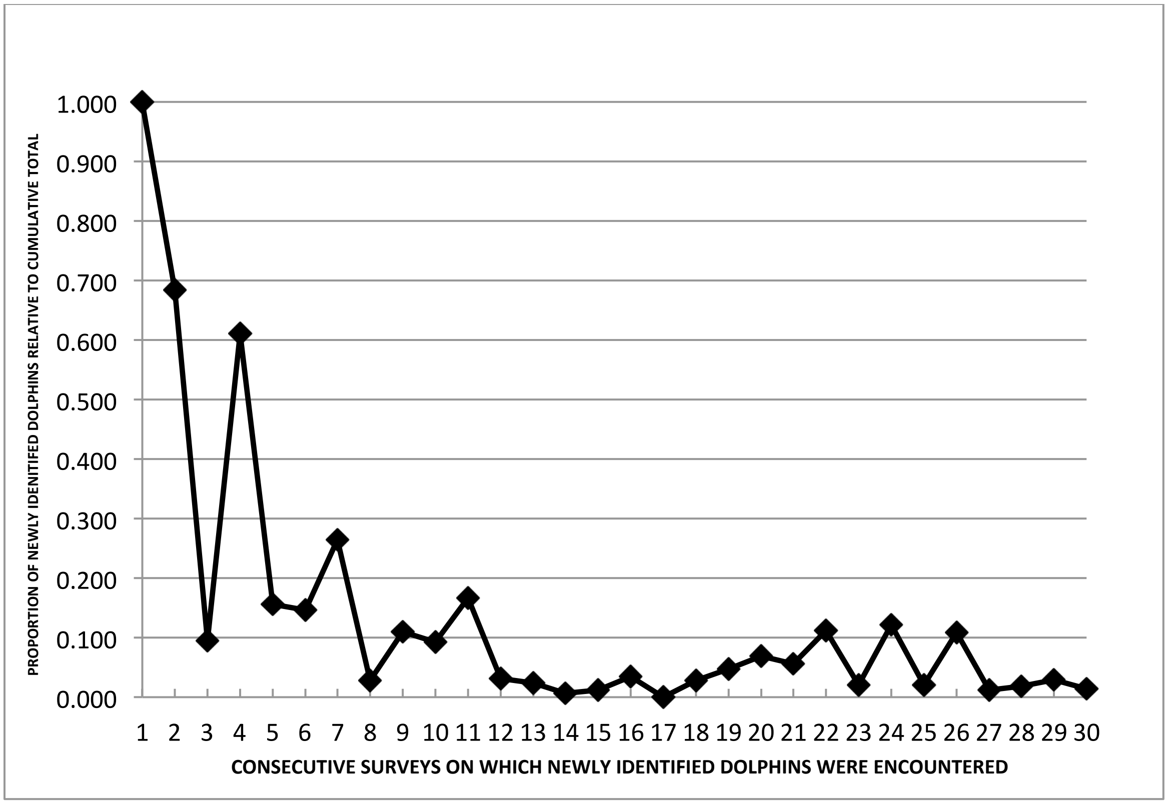

Figure 4. Proportion of new individuals identified per survey in 2009-11.

The estimated subset of unmarked dolphins (n = 274) consisted of 124 single notch individuals, 95 dolphins with only distinctive scarring (e.g., tooth rakes) or dorsal fin shape but no dorsal notches, and 55 calves without any identifiable markings or notches. When this subset of 274 unmarked dolphins was added to the subset of 346 marked individuals used in the mark-recapture analysis (total of 620), it can be crudely estimated that 56% of the population was marked. This said, it is important to recognize the limitations and difficulties associated with attempting to estimate the number of unmarked dolphins in the population (see Hansen and Defran 1990). These challenges are especially apparent when considering the unknown contribution that repeated sightings of the same unrecognizable dolphins have on estimates of the proportion of unmarked dolphins.

Sighting frequencies for the 346 dolphins identified ranged between 1 and 8 (mean = 2.2; SE = 0.8) and 143 (41.3%) individuals were sighted only once (Table 1). The rate of discovery curve (Fig. 3) and sighting frequency distribution (Table 1) both suggest that dolphins do not exhibit long-term site fidelity to the San Diego study area.

Table 1. Number of sightings for dolphins identified in 2009-2011

Number of Sightings	Number of Individuals	Percentage
1	143	41.3%
2	92	26.6%
3	56	16.2%
4	27	7.8%
5	17	4.9%
6	5	1.4%
7	4	1.2%
8	2	0.6%

The lack of site fidelity observed here has also been reported during previous studies off San Diego (Weller 1991; Defran and Weller 1999; Dudzik 1999; Dudzik et al. 2006) and suggests that the coastal stock is panmictic. Further support for this assumption comes from surveys conducted in different geographic locations along the California and Baja coastlines (Defran et al. 1999; Hwang et al. 2014; Defran et al. 2015).

Photo-identification Comparisons – Dolphins photo-identified off San Diego during 2009-2011, 2004-2005 and 1981-1999 studies were compared to determine inter-period overlap/match rates. Results from these comparisons include: (1) of 346 dolphins identified off San Diego during 2009-2011, 63 (18%) were also sighted off San Diego during 2004-2005, (2) of 346 dolphins identified in San Diego during 2009-2011, 47 (14%) were also sighted off San Diego during 1981-1999, and (3) of 346 dolphins identified off San Diego during 2009-2011, 88 (25%) were also sighted off San Diego during 1981-2005 (this includes 22 dolphins seen in both the 1981-1999 and 2004-2005 study periods). It is noteworthy that 75% (n = 258) of the dolphins photo-identified off San Diego during 2009-2011 were "new", previously uncataloged, individuals. This finding is suggestive of a "pulse" of new animals into the study area during 2009-2011, especially during surveys 1-11 and 22-26 (Figs. 3 and 4).

Abundance - The number of marked individuals (those with two or more dorsal fin notches) was estimated using both open and closed mark-recapture models. Based on AICc scores, the POPAN model with constant capture probability, time-varying apparent survival probability, and constant probability of entry into the population ($\rho_{.}\,\varphi_{\mathbf{t}}\,\beta_{.}$) was selected as the best model fit; among the closed models, the full likelihood closed model M_{th} (time and heterogeneity) was selected as having the best model fit. The best POPAN ($\rho_{.}\,\varphi_{\mathbf{t}}\,\beta_{.}$) model produced an estimate of 515 (95% CI = 470 – 564, SE = 24.0, CV = 0.05), while the best closed model (M_{th}) produced an estimate of 453 (95% CI = 411 – 524, SE = 28.1, CV = 0.06). These estimates are slightly higher than previous closed model (M_{th}) estimates for the same population: 1987/1989 = 354 (95% CI = 330-390, SE = 15.0); 1996-1998 = 356 (95% CI = 306-437, SE = 32.6); 2004-2005 = 323 (95% CI = 259 – 430, SE = 42.5) (Table 2). The best POPAN model produced a survival estimate for marked dolphins of 0.97 (SE= 0.005; LCI= 0.96 - UCI = 0.98).

Table 2. Abundance estimates for the "marked" segment of the California coastal stock of bottlenose dolphins from 1986 - 2011.

Time Period	N (95% CI)	Minimum number of marked individuals	Model	Source
1984-1986	289 (230-398)	160	M_{th}	Dudzik 1999
1987-1989	354 (330-390)	284	M_{th}	Dudzik 1999
1996-1998	356 (306-437)	225	M_{th}	Dudzik 1999
2004-2005	323 (259-430)	164	M_{th}	Dudzik et al. 2006
2009-2011	453 (411-524)	346	M_{th}	This Report
2009-2011	515 (470-564)	346	POPAN $\rho_{.}\varphi_{t}\beta_{.}$	This Report

The different parameterizations of the POPAN and closed mark-recapture population estimators preclude direct goodness of fit comparisons via AICc scores and therefore the results of both models are presented here. The present population estimate represents only those individuals in the population that have sufficient marks to be reliably identified over time.

The estimates of abundance presented here are based on the number of marked individuals identified (n = 346) during the study but do not account for the proportion of unmarked dolphins in the population. Previous photo-identification studies off San Diego estimated that approximately 65% of all dolphins observed had distinctively marked dorsal fins (Defran and Weller 1999). Here, it was estimated that approximately 56% of all dolphins observed were marked. Therefore, if 44% of all dolphins are unmarked, then the adjusted population size could be closer to 600. As mentioned earlier, however, the limitations and difficulties associated with attempting to estimate the number of unmarked dolphins in the population presents significant challenges, especially with respect to over representation of unmarked individuals as a result of repeated sightings of the same individuals.

Variability in the probability that a dolphin will visit the San Diego study area compromises the assumption of equal catchability and may introduce a negative bias in the population estimate. However, the panmictic nature of the coastal stock (as discussed above) helps counter this negative bias and provides support for the assumption that sampling off San Diego alone will likely result in an abundance estimate representative of the entire population. The weighted average abundance estimate of 206 (CV=0.12) from tandem aerial surveys along the California coast in 1999-2000 provided a short-term "snapshot" of coastal bottlenose dolphin abundance in U.S. waters during that period (Carretta et al. 1998), while corresponding photographic mark-recapture estimates of abundance for marked portion of dolphins (i.e. uncorrected for the portion of the population that was unmarked) from 1996-1998 and 2004-2005 ranged from 356 (306-437) and 323 (259-430), respectively (Table 2) . The longer-term photo-based mark-recapture estimate reported here, which spans nearly 18 months, is more likely to be more inclusive of the stock as a whole given the regular movements of individuals along the U.S. and Northern Baja coastlines.

CONCLUSIONS

Findings from the present study of coastal bottlenose dolphins off San Diego, California differ somewhat from previous studies in the same area. While differences in encounter rates, group size and number of groups encountered per survey vary between the 2009-2011, 2004-2005 and 1984-1989 and 1996-1999 studies; it is difficult to determine if these differences simply represent inter-annual variation and/or survey effort and study duration. Perhaps most important from a management perspective, however, is that the estimate of abundance for the stock appears to have increased since it was last assessed in 2004-2005. The apparent increase of abundance may reflect the high number (n = 258) of marked dolphins identified that had not been previously identified between 1981-2005.

Despite the possible increase in abundance, the size of this bottlenose dolphin stock is comparatively small and in combination with its coastal distribution places it at risk from a variety of potential human-related threats. Interactions with coastal fisheries are a potential source of mortality or injury to dolphins. Coastal set gillnet and lobster trap fisheries occur within the range of California coastal bottlenose dolphins, with documented entanglements of bottlenose dolphins in each gear type (Carretta et al. 2014). Contaminant levels, including residues from DDT and PCBs, documented in stranded bottlenose dolphins off southern California are among the highest reported for any cetacean (Shaul et al. 2015). Long-term exposure to pollutants may lead to reproductive impairment, population reduction and immune suppression. Morbillivirus, an infectious disease implicated as the cause for several mass die-offs of coastal bottlenose dolphins along the US Atlantic and Gulf coasts, is known to occur in marine mammals off the coast of California and is therefore also of concern. Therefore, it is recommended that ongoing monitoring of this stock be conducted to aid in its continued management.

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Appendix 1. Summary information for photo-identification surveys conducted during 2009-2011

Survey Date	Group Number	Group Start	Group End	Observation (min)	Latitude	Longitude	Complete (C) or Partial (P)	Field Estimate	Calf Estimate
2-Nov-09	2	11:01	11:45	44	32 59.594 N	117 16.916 W	C	5	0
2-Nov-09	3	12:29	13:41	72	33 03.095 N	117 18.315 W	C	6	0
30-Nov-09	3	10:16	10:36	20	32 52.742 N	117 15.380 W	C	6	3
30-Nov-09	4	10:38	10:53	17	32 52.809 N	117 15.432 W	C	7	2
30-Nov-09	5	10:59	11:14	15	32 53.716 N	117 15.475 W	C	6	0
30-Nov-09	6	11:21	12:00	39	32 54.896 N	117 15.787 W	C	9	0
7-Jan-10	2	10:32	11:18	46	32 59.392 N	117 16.722 W	C	6	1
25-Jan-10	1	9:43	10:51	68	32 53.000 N	117 15.409 W	C	18	1
25-Jan-10	2	11:10	12:08	58	32 57.999 N	117 16.340 W	C	5	1
25-Jan-10	3	12:15	13:16	61	33 01.387 N	117 17.654 W	C	10	0
19-Feb-10	2	9:45	10:31	46	32 52.494 N	117 15.460 W	C	6	0
19-Feb-10	3	12:05	13:08	63	33 08.757 N	117 20.875 W	C	12	3
24-Feb-10	5	11:12	12:22	70	32 59.716 N	117 16.770 W	C	9	1
24-Feb-10	7	13:26	14:30	64	33 07.500 N	117 20.077 W	C	9	0
12-Mar-10	1	9:37	10:28	51	32 52.997 N	117 15.369 W	C	8	0
12-Mar-10	2	10:43	11:11	28	32 54.459 N	117 15.677 W	C	9	0
12-Mar-10	3	11:16	11:24	8	32 54.877 N	117 15.814 W	C	3	0
12-Mar-10	4	11:37	11:58	21	32 56.228 N	117 15.910 W	C	8	0
12-Mar-10	5	12:09	12:36	27	32 57.224 N	117 16.363 W	C	7	0
12-Mar-10	6	14:00	14:56	56	33 08.272 N	117 20.679 W	C	4	0
29-Mar-10	3	10:00	10:42	42	32 56.207 N	117 15.877 W	C	7	0
29-Mar-10	3a	10:42	10:52	10	32 57.898 N	117 16.278 W	C	3	0
29-Mar-10	4	11:25	11:44	19	33 03.023 N	117 18.218 W	C	2	0
29-Mar-10	5	11:50	12:22	32	33 03.145 N	117 18.320 W	C	5	0
23-Apr-10	2	9:55	10:37	42	32 54.552 N	117 15.664 W	C	21	3
23-Apr-10	3	10:48	11:05	17	32 56.791 N	117 16.225 W	C	4	0
23-Apr-10	4	11:59	12:15	16	33 03.622 N	117 18.502 W	C	3	0

7-May-10	2	9:48	9:52	4	32 52.652 N	117 15.279 W	C	2	0
7-May-10	3	10:06	10:13	7	32 54.397 N	117 15.524 W	C	3	0
7-May-10	4	10:21	10:43	22	32 55.030 N	117 15.755 W	C	3	0
7-May-10	5	10:58	11:09	11	32 57.780 N	117 16.306 W	C	3	0
7-May-10	6	11:48	12:20	32	33 03.438 N	117 18.360 W	C	9	0
7-May-10	7	12:33	13:24	51	33 04.942 N	117 18.922 W	C	9	0
14-May-10	1	9:39	10:14	35	32 52.697 N	117 15.326 W	C	9	0
14-May-10	2	11:17	11:34	17	33 01.606 N	117 17.444 W	C	5	0
14-May-10	3	11:49	12:06	17	33 04.401 N	117 18.721 W	C	4	0
14-May-10	4	12:10	12:43	33	33 05.392 N	117 19.003 W	C	14	3
4-Jun-10	2	10:04	10:49	45	32 53.295 N	117 15.394 W	C	7	0
23-Jul-10	1	9:59	10:21	22	33 02.327 N	117 17.933 W	C	5	0
30-Jul-10	1	9:06	9:29	23	32 52.671 N	117 15.265 W	C	3	0
30-Jul-10	2	10:18	10:25	7	33 01.603 N	117 17.433 W	C	2	0
13-Aug-10	1	9:52	10:16	24	33 03.863 N	117 18.678 W	C	3	0
13-Aug-10	2	10:28	10:43	21	33 05.657 N	117 19.211 W	C	6	2
20-Aug-10	None	None	None	-	No dolphins	-	C	-	-
14-Sep-10	1	9:28	10:02	34	32 53.351 N	117 15.381 W	C	2	0
14-Sep-10	2	10:13	10:46	33	32 57.181 N	117 16.180 W	C	3	0
14-Sep-10	3	10:56	12:02	66	32 58.940 N	117 16.535 W	C	5	0
14-Sep-10	4	12:16	12:36	20	33 04.638 N	117 18.764 W	C	7	0
14-Sep-10	5	12:37	13:01	24	33 05.590 N	117 19.069 W	C	3	0
30-Sep-10	1	9:35	9:40	5	32 53.040 N	117 15.387 W	C	2	0
14-Oct-10	1	9:18	9:26	8	32 52.468 N	117 15.360 W	C	4	0
14-Oct-10	2	9:33	9:33	1	32 53.108 N	117 15.395 W	C	3	0
14-Oct-10	3	9:50	10:28	38	32 53.166 N	117 15.337 W	C	10	0
21-Oct-10	1	9:39	9:57	18	32 56.527 N	117 15.931 W	C	3	0
21-Oct-10	2	10:20	10:44	24	32 59.187 N	117 16.595 W	C	1	0
21-Oct-10	3	11:38	11:47	9	33 05.272 N	117 19.005 W	C	3	0
21-Oct-10	4	11:48	12:19	31	33 05.065 N	117 18.939 W	C	5	0

21-Oct-10	5	12:23	12:53	30	33 04.458 N	117 18.747 W	C	10	3
11-Nov-10	1	9:07	10:24	77	32 52.121 N	117 15.462 W	P	23	2
11-Nov-10	2	10:33	11:48	75	32 52.580 N	117 15.283 W	P	20	0
11-Nov-10	3	11:57	12:13	16	32 53.225 N	117 15.377 W	P	9	0
11-Nov-10	4	12:29	12:51	22	32 55.565 N	117 15.758 W	P	12	0
16-Nov-10	1	9:49	10:24	35	32 53.846 N	117 15.371 W	C	10	0
16-Nov-10	2	10:52	11:49	57	32 59.144 N	117 16.576 W	C	27	3
16-Nov-10	3	12:50	13:12	22	33 08.593 N	117 20.734 W	C	9	0
30-Nov-10	1	10:15	11:33	78	32 58.117 N	117 16.323 W	C	12	0
30-Nov-10	2	11:53	12:55	62	32 59.417 N	117 16.628 W	C	23	3
30-Nov-10	3	13:02	13:32	30	33 01.034 N	117 17.166 W	C	12	1
30-Nov-10	4	14:21	14:37	16	33 07.882 N	117 20.422 W	C	8	0
17-Dec-10	1	9:11	10:15	64	32 52.699 N	117 15.436 W	C	36	2
17-Dec-10	2	11:13	11:21	8	33 04.375 N	117 18.714 W	C	4	0
20-Jan-11	1	9:23	9:59	36	32 52.424 N	117 15.324 W	C	13	0
20-Jan-11	2	10:02	10:28	26	32 52.617 N	117 15.784 W	C	17	0
20-Jan-11	3	10:48	11:05	17	32 56.448 N	117 15.957 W	C	12	0
20-Jan-11	4	11:17	11:29	12	32 57.876 N	117 16.316 W	C	2	0
20-Jan-11	5	11:33	11:46	13	32 56.816 N	117 16.228 W	C	3	0
20-Jan-11	7	12:09	12:27	18	33 00.155 N	117 16.937 W	C	5	1
20-Jan-11	8	12:37	13:00	23	33 02.115 N	117 17.941 W	C	7	1
20-Jan-11	9	13:04	13:32	28	33 03.338 N	117 18.354 W	C	9	3
20-Jan-11	10	13:48	14:06	18	33 06.639 N	117 19.615 W	C	5	0
20-Jan-11	11	14:15	14:32	17	33 07.225 N	117 19.891 W	C	4	1
20-Jan-11	13	14:44	15:01	17	33 08.083 N	117 20.547 W	C	5	0
27-Jan-10	1	9:33	10:36	63	32 52.497 N	117 15.493 W	C	30	3
27-Jan-10	6	12:01	12:20	19	33 03.073 N	117 18.299 W	C	7	0
27-Jan-10	7	12:37	12:51	14	33 05.764 N	117 19.218 W	C	2	0
27-Jan-10	8	12:57	13:17	20	33 06.267 N	117 19.401 W	C	9	0
15-Feb-11	1	9:24	9:26	2	32 52.057 N	117 15.443 W	C	15	0

15-Feb-11	2	9:29	9:51	22	32 52.030 N	117 15.503 W	C	20	0
15-Feb-11	3	10:01	10:16	15	32 52.700 N	117 15.351 W	C	9	0
15-Feb-11	6	10:48	11:01	13	32 57.269 N	117 16.205 W	C	8	0
15-Feb-11	7	11:20	11:46	26	33 00.100 N	117 17.151 W	C	10	0
15-Feb-11	8	11:56	12:00	4	33 01.595 N	117 17.464 W	C	3	0
15-Feb-11	9	12:09	12:27	18	33 03.180 N	117 18.204 W	C	18	2
15-Feb-11	10	12:48	12:53	5	33 04.689 N	117 18.809 W	C	6	0
15-Feb-11	11	13:14	13:24	10	33 08.566 N	117 20.789 W	C	10	0
22-Feb-11	1	9:41	10:01	20	32 54.942 N	117 15.658 W	C	17	2
22-Feb-11	2	10:29	11:20	51	32 58.140 N	117 16.286 W	C	20	0
16-Mar-11	1	12:19	13:04	45	32 52.710 N	117 15.351 W	C	15	1
16-Mar-11	2	13:30	13:58	28	32 57.225 N	117 16.289 W	C	8	2
16-Mar-11	3	14:13	14:20	7	32 59.034 N	117 16.725 W	C	2	0
16-Mar-11	4	14:24	14:40	16	32 59.813 N	117 16.901 W	C	3	0
16-Mar-11	5	15:12	15:35	23	33 03.508 N	117 18.497 W	C	4	0
23-Mar-11	1	9:53	11:12	79	32 52.431 N	117 15.313 W	C	26	0
23-Mar-11	2	11:29	11:34	5	32 53.776 N	117 15.452 W	C	5	0
23-Mar-11	3	12:01	12:39	38	32 58.887 N	117 16.563 W	C	10	0
23-Mar-11	4	13:12	13:27	15	33 03.011 N	117 18.120 W	C	9	0
19-Apr-11	1	10:00	10:27	27	33 01.433 N	117 17.363 W	C	12	0
19-Apr-11	2	10:37	10:48	11	33 01.357 N	117 17.327 W	C	6	3
19-Apr-11	3	10:56	11:21	25	33 02.330 N	117 17.950 W	C	2	0
19-Apr-11	4	11:26	11:42	16	33 02.142 N	117 18.150 W	C	2	0
19-Apr-11	5	11:54	12:01	7	33 02.645 N	117 18.010 W	C	4	0
19-Apr-11	6	12:06	12:42	36	33 03.177 N	117 18.224 W	C	5	0
19-Apr-11	7	13:03	13:17	14	33 05.616 N	117 19.160 W	C	2	0
19-Apr-11	8	13:19	13:38	19	33 05.806 N	117 19.210 W	C	3	0
19-Apr-11	9	13:47	13:57	10	33 07.257 N	117 19.885 W	C	8	2
19-Apr-11	10	14:11	14:16	5	33 08.895 N	117 20.992 W	C	2	0