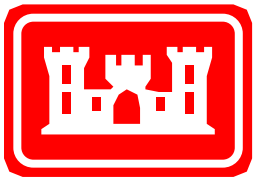
CALIFORNIA LEAST TERN FORAGING STUDY

MARINA DEL REY DREDGING PROJECT



U.S. Army Corps of Engineers

Los Angeles District,

Prepared by:

DUTRA GROUP

and

Keane Biological Consulting
Long Beach, California

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CALIFORNIA LEAST TERN FORAGING STUDY WITH RESPECT TO PROPOSED DREDGING LOCATIONS IN SOUTHERN CALIFORNIA

Prepared for:

THE DUTRA GROUP
1000 Point San Pedro Road
San Rafael, CA 94901
Contact: Andrew Hunt

and

U.S. Army Corps of Engineers, Los Angeles District (CESPL)
915 Wilshire Boulevard
Los Angeles, California 90017
Contact: Lawrence Smith

CESPL Contract No.: W912PL-10-P-0056

Prepared by:

Keane Biological Consulting
2892 N. Bellflower Blvd.
Suite 480
Long Beach CA 90815-1125
Contact: Kathleen Keane

May 17, 2013

EXECUTIVE SUMMARY

This report summarizes the methods and results of monitoring by Keane Biological Consulting (KBC) of the maintenance dredging conducted by The Dutra Group at Marina del Rey (MDR) in the spring and summer of 2012, under contract to the U.S. Army Corps of Engineers (Corps), Los Angeles District (Corps) under Contract Number W912PL-10-P-0056.

The dredging project at MDR began April 5, 2012 and terminated in mid-October 2012. It removed approximately 783,000 cubic yards of accumulated sand from the MDR entrance channel, improving navigational safety and providing material for deposition in other areas.

A nesting site for the endangered California least tern (CLT), the Venice Beach Nesting Site (VBNS) is present just north of the MDR entrance channel, and the terns are generally nesting there and foraging over nearby bodies of water, including open ocean, harbors, marinas and river mouths, from April through August. Thus, dredge monitoring included CLT foraging surveys to confirm the Corps' determination that dredging at MDR would have no effect on CLT foraging.

The chronology of CLT occurrence at the VBNS relates to potential numbers of CLT foraging at MDR. CLT numbers in 2012 at the VBNS fluctuated from approximately 100 in early May, to 50 in late May, and 120 the first week of June, and few CLT thereafter. Eggs from all nest attempts were depredated by American crows, which are numerous in the MDR area and depredated all CLT eggs at VBNS the previous three years and several prior years. Nesting site monitors also reported evidence of a lack of CLT prey in 2012. Thus, the results of foraging surveys reported herein may not reflect foraging behavior during successful CLT nesting.

Nevertheless, KBC designed the study reported herein to 1) document any observable effects of dredging and associated activities on CLT foraging behavior such as turbidity, and 2) to record CLT foraging behavior within the 12 areas where the dredge was operating and compare it with foraging behavior in comparison areas where no dredging was occurring.

Dredge monitoring two to three times weekly, three hours in the morning and two in the evening, began April 18. Only one turbidity incident was observed during 52 morning and 52 evening surveys, when the anchor of a dredge support boat generated a turbidity plume beyond the dredge area that dissipated quickly.

CLT foraging surveys, documenting foraging dives within the active dredge area, inactive dredge areas and comparison areas, were added May 2, following reports of CLT nest initiations, and terminated August 10, following departure of all CLT from the MDR area. A total of 1,066 CLT dives were recorded during all morning surveys, including 403 dives (44%) within the six comparison areas (four of these were in near-shore ocean habitat preferred by CLT, per previous foraging surveys) and 153 (14%) within dredge areas during dredging, generally within 100 feet of the dredge. Evening survey data were insufficient for analyses.

Foraging data were sufficient at only five dredge areas for comparison between dredge versus non-dredging periods. Of these, results were inconsistent: two supported more dives during dredging, two during non-dredging, and one had similar numbers of dives for the two periods, although because of unsuccessful nesting, CLT numbers in the MDR area varied between each comparison. Surveys at only one of the five areas were conducted during periods of similar CLT activity, and this area supported 2.6 times more dives during dredging than non-dredging, although the sample size was small. This suggests that timing of CLT activity is a more important predictor of CLT foraging activity than the presence or absence of dredge activity.

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This report summarizes the methods and results of monitoring by Keane Biological Consulting (KBC) of the maintenance dredging conducted by The Dutra Group at Marina del Rey in the spring and summer of 2012, under contract to the U.S. Army Corps of Engineers, Los Angeles District (Corps) under Contract Number W912PL-10-P-0056.

The Corps conducts regular maintenance dredging at several locations along the California coast to ensure navigational access. One of these locations is the entrance channel for Marina del Rey (MDR) Harbor, just north of the Ballona Creek channel in Los Angeles County. The 2012 dredging project at MDR began April 5, 2012 and terminated in mid-October. The project removed approximately 783,000 cubic yards of accumulated sand from the MDR entrance channel, improving navigational safety and providing material to the Port of Long Beach for its Middle Harbor Redevelopment Project, to areas offshore of Dockweiler State Beach for beach replenishment, and to areas offshore and onshore at Redondo Beach for beach replenishment.

Because a nesting site for the California least tern (*Sternula antillarum browni*), listed as endangered by the federal and California Endangered Species Acts, is present just north of the MDR channel, dredge monitoring conducted by KBC included California least tern foraging surveys pursuant to requests by the U.S. Army Corps of Engineers, Los Angeles District (Corps) and the United States Fish and Wildlife Service (USFWS). Dredging activities near California least tern (CLT) nesting sites are generally limited to periods outside the nesting season (designated by the USFWS as beginning April 15 and ending September 15, although actual dates vary among sites and years) to avoid potential effects on CLT foraging. The Corps, however, determined that dredging at MDR would have no effect on CLT. Biological monitoring was proposed to confirm this determination.

The Venice Beach CLT nesting site (VBNS) occupies approximately 8 acres (3.3 hectares) north of MDR (Figure 1). CLT nesting has been documented at the VBNS since 1977 (Ryan and Vigallon 2010). From 1989 through 1995, VBNS contributed over 10 percent of CLT pairs breeding in California, and up to nearly 18% of statewide fledglings (Ryan and Vigallon 2012). However, the percentage of statewide pairs contributed by VBNS declined from nearly 10% in 1997 to zero in 2011, and productivity varied widely over that period (Ryan and Vigallon 2012).

The decline in nesting pairs and the recent variable productivity at VBNS is primarily due to depredation of CLT eggs by American crows (*Corvus brachyrhynchos*)(Ryan and Vigallon 2010 and 2012). Crows have been the primary predator at VBNS since 1990, and crows destroyed all eggs laid in 2002, 2004, 2005, 2009, 2010, and 2011 (Ryan and Vigallon 2010 and 2012). Predator management options at VBNS are limited due to the site's location on a public beach. However, crows were present during the 2006, 2007 and 2008 nesting seasons, yet the site produced up to 10%, 18% and 13%, respectively, of statewide fledglings (Ryan and Vigallon 2012). Ryan and Vigallon (2010) attributed these successes to the use of egg-baited traps beginning in 2006. They concluded that placement of traps prior to CLT nesting is essential to control crow predation, following delayed trap deployment and reduced trap numbers in 2008 that resulted in depredation of all eggs prior to June 16. Four more traps were added thereafter, and the site yielded up approximately 13% of statewide fledglings (Ryan and Vigallon 2010).

The predator management section of the Site Management Plan for the VBNS (Ryan and Vigallon 2010) specifies that: 1) Predator control should begin at least by mid-March; 2) At least ten traps should be used until volunteer monitors report reduced crow activity, 3) Traps should be operated for as much time as possible prior to nesting by terns and should be checked daily.

In 2012, the fourth consecutive year of no CLT productivity (Ryan and Vigallon 2012), KBC's monitors at MDR witnessed evidence that the Site Management Plan recommendations were not followed; this may have been the case during the previous three years as well. Ryan and Vigallon

(2012) attributed the lack of productivity during those years to crow predation and to low prey availability. In 2012, predator management began just prior to CLT arrival, fewer than ten traps were used, and trapping efforts were not continual. For example, Mr. Ryan reported that traps were closed for three or more days on several occasions (T. Ryan, pers. comm.).

The chronology of CLT occurrence at the VBNS, which relates to potential numbers of CLT foraging at MDR, is summarized in Ryan and Vigallon (2012) as follows: "There were approximately 100 least terns present in early May, decreasing to about 50 during the last two weeks of May, then rebounding to 120 the first week of June" and "The colony began to fail and numbers declined sharply beginning approximately June 12-14." All 14 documented nest attempts were destroyed by crows. Ryan and Vigallon (2012) reported that "crow activity at the colony was generally higher than in past years," with "a high of 21 crows counted during a single observation session."

Nevertheless, KBC designed the study reported herein to 1) document any observable effects of dredging and associated activities on CLT foraging behavior such as turbidity, and 2) to record CLT foraging behavior within areas where the dredge was operating and compare it with foraging behavior in comparison areas where no dredging was occurring.

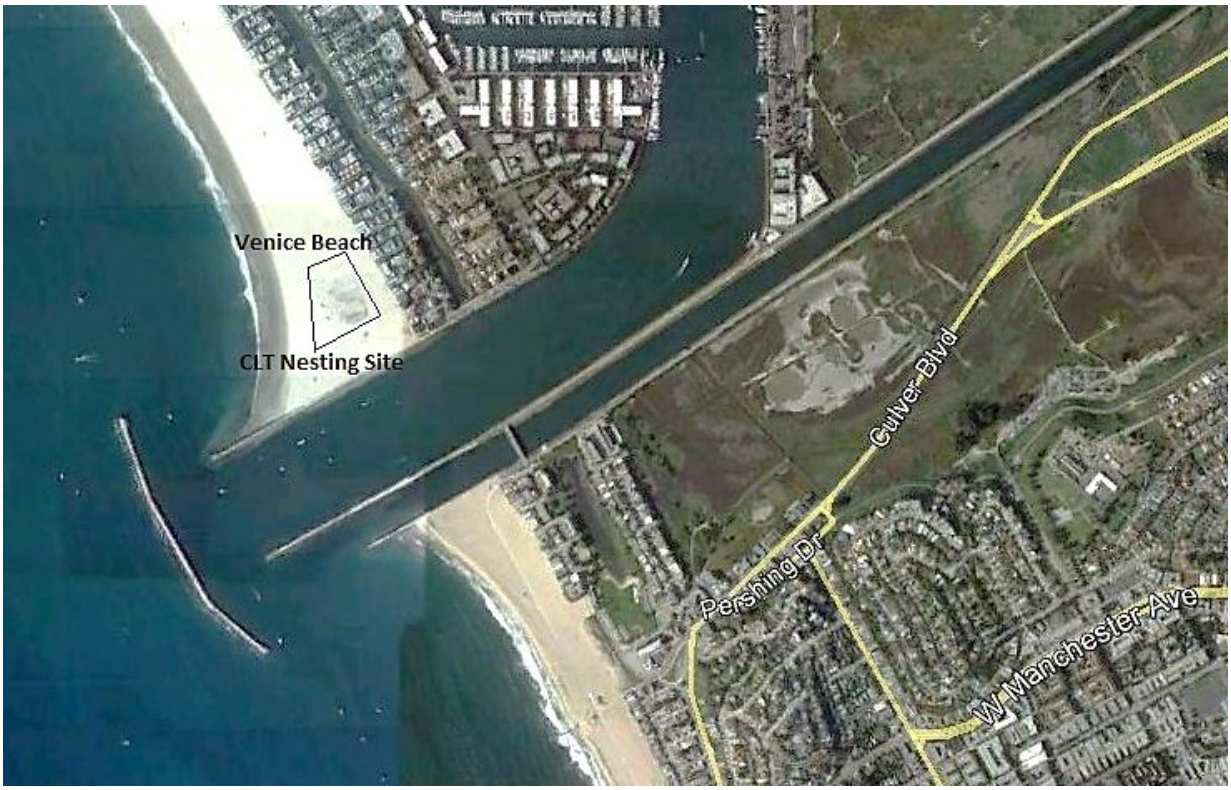

Figure 1. Location of Venice Beach CLT Nesting Site and Marina del Rey Entrance Channel

METHODS

Dredge Monitoring Methods

Initial monitoring of dredging activities and turbidity (visual evidence of turbidity beyond 100 feet of the dredge) within the boundaries of the dredge location (Figure 2) began on April 18, 2012 and continued twice weekly for five hours per day during two survey periods: morning (6 am to 9 am), and evening (5 pm - 7 pm)[1].

[1] These are times of day during which high levels of CLT foraging have been recorded during prior foraging surveys.

Figure 2. Location of Dredging Areas and Venice Beach California Least Tern Nesting Site (white numbers are Survey Station Vantage Points)

KBC biologists assigned to monitor this project had a minimum of three years of experience monitoring dredging activities at the Upper Newport Bay Ecosystem Restoration Project and/or other biological monitoring of construction activities associated with endangered species. Each monitor was assigned a map of the project area with numbered dredge locations and blank data sheets (Appendix A) to record, during each monitoring day, data including dredge and associated activity and its locations, times, types, equipment, the locations and extent of visible turbidity plumes, and numbers of CLT in the area.

Twice-weekly monitoring continued until May 1, when Tom Ryan, CLT biologist for the VBNS, reported the initiation of CLT breeding activities in the form of 75 CLT nest scrapes, which triggered the addition of CLT foraging surveys to the dredge monitoring.

During the week following the beginning of the CLT nesting season at VBNS, from May 2 through May 8, dredge monitoring occurred daily, during the morning and evening periods, and CLT foraging activity (see CLT Foraging Survey Methods below) was also recorded within the location where dredging was occurring.

From May 9 through August 10 (when no CLT were observed, triggering the cessation of monitoring) dredge monitoring and CLT foraging surveys were conducted three times weekly.

CLT Foraging Survey Methods

On April 15, KBC established survey station vantage points for each of the twelve dredge locations (1, 2, 3, 4, 5 6, 7 North, 7 South, 8 North, 8 South, 9 North, 9 South--Figure 2). These vantage points were used to monitor CLT activity with respect to dredging activities. An aerial photograph with the mapped dredge locations was used in the field, and landmarks such as street signs, trees, lights and benches along the jetties were marked on the photograph to denote vantage points and boundaries of dredge areas. Field data sheets used for dredge monitoring also included sections for entering CLT foraging data including CLT activity within 100 feet of the dredge, and turbidity plumes (Appendix A). An on-site meeting with all biological monitors was conducted April 16, during which survey methods, survey schedule and safety requirements for the work area (we did not work on or near the dredge or other project equipment) was discussed.

Following the reported initiation of CLT breeding activities at the VBNS, monitoring of dredging activities continued for six consecutive days during morning and evening surveys, with the addition of systematic CLT foraging surveys. Prior foraging surveys have been 20 minutes in length; this survey method was maintained to allow for comparisons, if appropriate, between data collected during this study and during previous surveys.

During each survey, we recorded the number of CLT foraging dives that hit the water within the boundaries of the dredge area. During a meeting with USFWS on June 7, 2012, USFWS biologists requested that CLT foraging dives only be considered valid when the dredge clamshell was operating. However, Kathy Keane of KBC argued that other dredging activities such as movement of scows, tugboats, the anchoring barge and other support vessels continued when the clamshell was stationary. She noted and that turbidity and disturbances to CLT foraging similar to operation of the clamshell may occur during these activities. Thus, KBC continued to count all CLT foraging dives, whether or not the clamshell was temporarily immobile.

Foraging surveys were conducted from the dredge monitoring location—a vantage point closest to the dredge—and included the entire specified dredge area. The 20-minute survey was followed by a 10-minute break when the biological monitor proceeded to one of the other 12 dredge areas (not adjacent to the current dredge area) to record foraging data where no dredging was occurring for later comparison with data collected at the same location during dredging.

Each subsequent half-hour consisted of a 20-minute survey and similar 10-minute break, alternating between the dredge location and the area where no dredging was occurring. Thus, each 3-hour morning monitoring period provided data for 6 foraging surveys, and the 10-minute break between allowed for statistical independence for each survey (our experience indicates that it is unlikely that the same CLT forage in one area for longer than a 10-minute period).

Following the six-day survey period, morning and evening surveys continued three times weekly until August 10, when a lack of CLT observations indicated that CLT had departed the area.

In addition to foraging surveys at comparison dredge locations, KBC conducted surveys at six areas outside the dredge locations. The selected areas supported the highest levels of foraging during the most recent previous surveys (Atwood and Minsky 1983). They included four near-shore areas north and south of the MDR entrance—C1, C2, C3 and C6; Figure 3), and two areas within MDR beyond the dredge locations (C4 and C5—Figure 3), where CLT foraging was recorded during surveys at a potential entrance channel to adjacent wetlands (Keane 2001). Surveys were conducted using the same methods described above, 20 minutes per survey, with the intervening 10 minutes used for travel time between survey areas.

Comparison area surveys were conducted three times weekly, on the same days as dredge monitoring, to allow for statistical comparisons (same weather patterns, same times of day) with surveys within dredge areas. These surveys only occurred during the 6 am - 9 am period.

CLT Foraging Survey Data Analyses

CLT dives during evening surveys were infrequent (a total of 13 dives over 46 surveys) and thus were not used in subsequent analyses.

Figure 3. Locations of Comparison Areas for CLT Foraging Surveys

RESULTS AND DISCUSSION

KBC monitored dredging activity during morning and evening surveys for 52 dates, and conducted CLT foraging surveys on 47 of those dates, following the initiation of CLT breeding activities at the VBNS. Surveys were initiated on April 18 and continued beyond the discontinuance of CLT breeding activities at the VBNS in mid-June, as long as observations of CLT within the MDR survey areas continued. Surveys were terminated on August 10, following a lack of CLT sightings (aside from one transit flight) for four consecutive survey dates.

Following completion of dredge monitoring and foraging studies, data and analysis of 752 twenty-minute surveys, including surveys within the dredge areas and within comparison areas, was conducted. Results are summarized below.

Results of Dredge Monitoring

A total of 104 dredge monitoring surveys (52 morning and 52 evening surveys) for 20 minutes each were recorded over the entire survey period. The only turbidity incident observed during those 2,080 minutes of surveys occurred on May 21 at 6:15 pm. It extended beyond dredge area (Figure 4), but dissipated quickly. It was generated by the dredge support boat that moves and places the dredge anchors and likely occurred due to dragging of the anchor. No turbidity plumes 100 feet beyond the dredge were observed during the remaining 52 morning and 52 evening surveys. Appendix B summarizes dredge activity and CLT activity on each of the survey dates.

Figure 4. Turbidity Plume Generated by Dredge Support Vessel, 6:15 pm May 21, 2012

A rust plume from an unknown source was observed July 6, and a CLT was observed diving toward the plume (Figure 5). On May 2, a fuel spill was reported within the upper channels of the marina; it was not associated with the dredging project and was apparently contained; we observed no subsequent oil sheen in our dredge monitoring areas.

Figure 5. Rust Plume, with CLT dive toward plume, July 6, 2012

Results of CLT Foraging Surveys

CLT foraging activity at MDR was sporadic, related to CLT occurrence at the VBNS. Nests were initiated in early May and early June, but all eggs were depredated by crows soon after initiation. High numbers of crows were often observed at or near the nesting site (Figure 6).

Figure 6. Flock of American Crows over the Venice Beach Nesting Site (see fence)

Peaks of foraging activity in late May and early June (Figure 7) are likely related to peaks in CLT numbers (after the early May peak), as reported by Ryan and Vigallon (2012): "Team biologists estimated about 120-140 individuals attended the colony at its peak on June 5." Subsequent peaks in foraging activity on June 20 and July 11 (Figure 7) are likely due to arrival in the MDR area of CLT dispersing from other nesting sites. Even after CLT abandoned the VBNS, low numbers of CLT continued to forage on most dredge monitoring dates through early August (Figure 7).

A total of 1,066 CLT foraging dives were recorded during all morning surveys. Of these, 403 dives (44%) were recorded within the six comparison areas, higher than expected (for 6 [or 33.3%] of the total 18 areas surveyed, the expected percentage would be 33%). Area C3, the near-shore ocean survey area closest to the VBNS (Figure 3 and Table 1), supported the most dives for any of the 18 areas surveyed. These results are consistent with other foraging surveys (Atwood and Minsky 1983, Keane 2011), documenting the highest level of CLT foraging in the near-shore ocean.

A total of 153 CLT foraging dives were recorded within dredge areas during dredging (Table 1), generally within 100 feet of the dredge. Of the 153 dives, 64 occurred while the dredge was inactive but while other dredging activities were occurring, such as arrival and departure of scows, and anchor placement for the dredge (Table 1).

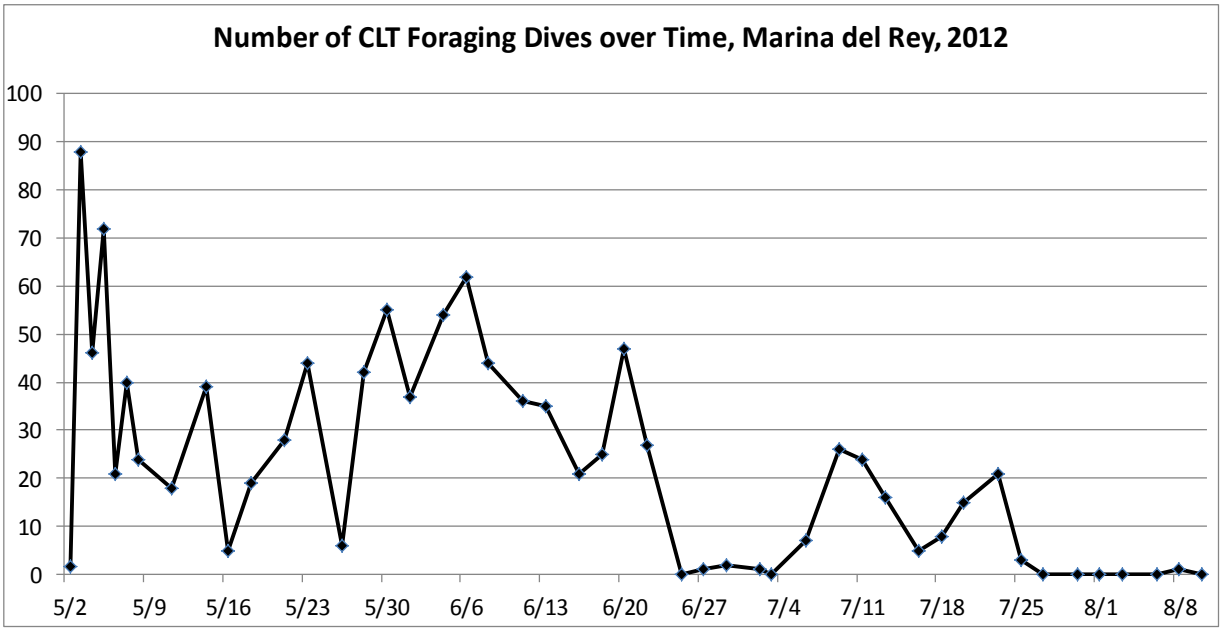

Figure 7. Total CLT foraging dives over time at all survey stations including comparison stations, reflecting fluctuations in CLT numbers in MDR area during the 2012 breeding season

TOTAL DIVES, ALL SURVEYS:			
Dredge Area[a]	**No Dredge**	**Dredge Present, Active or Not**	**Dredge Present and Active**
1	112.3	20	8
2	0	0	0
3	0	2	0
4	0	10	10
5	54	13	10
6	124	0	0
7S	37	21.33	13.3
7N	30	8	7
8S	0	0	0
8N	95	79	41
9S	39	0	0
9N	19	0	0
C1	23	n/a	n/a
C2	24	n/a	n/a
C3	231	n/a	n/a
C4	11	n/a	n/a
C5	3	n/a	n/a
C6	111	n/a	n/a
TOTALS	**913.3**	**153.33**	**89.3**
# SURVEYS	**143**	**47**	**47**
TOTAL DIVES ALL SURVEYS:			**1066.63**
TOTAL DIVES, C1-C6		**403**	
% OF TOTAL DIVES, C1-C6 (of non-dredge surveys)		**44.13%**	
a: see Figures 2 & 3			

Table 1. Summary of CLT Foraging Dives, all Surveys

Data for mean foraging dives were sufficient at only five dredge survey areas (1, 5, 7S, 7N and 8N—Table 2) for comparison between dredge versus non-dredge periods (Table 2). At other areas, dredging occurred prior to CLT arrival or following departure, or only occurred on two to three dates (Table 2). The dredge moved frequently throughout the dredge area during the survey period, sometimes remaining in one area for one or two survey days then returning to finish dredging in an area it had been previously. Thus, it was difficult to schedule comparison surveys of dredge areas when the dredge was not present.

Dredge Area[a]	MEAN DIVES[b] DREDGE PRESENT	# OF SURVEYS	MEAN DIVES[b] DREDGE NOT PRESENT	# OF SURVEYS	COMPARISON COMMENT	TIMING OF SURVEYS WITH RESPECT TO COMPARISON (see Figure 3)
1	0.56	12	1.50	25	2.7 more dives when dredge not present	Dredge in Area 1 when few CLT in area (end of July); no-dredge surveys during CLT presence early May, early June, early July.
2	no dredge	0	no survey	2	no comparison possible	Dredge not in Area 2 during our surveys
3	0.33	2	no survey	0	no comparison possible	Dredge in Area 3 twice during our surveys
4	1.11	3	no survey	0	no comparison possible	Dredge in area 4 only 3 dates; no non-dredge surveys
5	0.48	9	2.00	9	4 times more dives when dredge not present	Dredge in Area 5 end of June & July, when few CLT in area
6	0.00	1	3.76	11	no comparison possible	Dredge in Area 6 on only one date, in August, when few CLT in area
7S	1.02	7	1.03	12	similar dives per survey for dredge and no dredge	Dredge in 7S during high CLT activity in early May; no-dredge surveys during low CLT activity end of July
7N	0.89	3	0.77	13	slightly more dives when dredge present than not	Dredge at 7N only three times, mid-May; no dredge surveys late July
8S	0.00	2	no survey	0	no comparison possible	Dredge not in 8S during our surveys
8N	3.76	7	1.44	22	2.6 more dives when dredge present	Dredge in 8N mid-June; no-dredge surveys May 21, early June, all of July
9S	no dredge	0	4.33	3	no comparison possible	Dredge not in 9S during our surveys
9N	no dredge	0	2.11	3	no comparison possible	Dredge not in 9N during our surveys
***Average mean dives*; Total Surveys**	***0.91***	**46**	***2.12***	**100**		

a: see Figure 1

b: number of dives per 20-minute survey (3 surveys/day)

Table 2. Mean CLT Foraging Dives during Dredge and No-Dredge Surveys

The following comparisons were possible, although survey timing likely affected results, as discussed below and in Table 2 and shown in Figure 7:

- For Area 1, 2.7 times more dives were recorded during no-dredge surveys than during dredging, although the dredge was present during periods of low CLT foraging while no-dredge surveys occurred during high CLT foraging activity.
- For Area 5, 4 times more dives were recorded during no-dredge surveys, although the dredge was present during periods of low CLT foraging activity, while no-dredge surveys occurred during high CLT activity.

- For Area 7S, mean dive values were similar for dredge (1.02) and no-dredge (1.03), although dredge surveys were conducted in early May when CLT foraging activity was high, and no-dredge surveys occurred when CLT foraging activity was low.
- For Area 7N, mean foraging dives when the dredge was present were slightly higher (0.89) than when it was not (0.77), although no-dredge surveys occurred when CLT foraging activity was low while the three dredge surveys occurred during high foraging activity.
- For Area 8N, 2.6 times more dives were counted during dredging than during no-dredge surveys. Both dredge and no-dredge surveys were conducted when CLT numbers were high (Figure 3). This is the only comparison that seems valid in light of the fact that dredge and no-dredge surveys occurred during periods of similar CLT foraging activity in the MDR area.

CONCLUSION

The results of the CLT foraging study summarized in this report cannot be considered conclusive regarding CLT foraging behavior with respect to dredging, since, because of unsuccessful nesting at the VBNS, it was not possible to collect CLT foraging data during the hatching, fledging and post-fledging stages of nesting. Previous CLT foraging studies have shown a shift in CLT foraging locations to predominantly near-shore ocean pre-hatching to river mouths (ERC 1989) and harbor areas bordered by riprap (Keane 2003) post-hatching. No foraging studies have been conducted at VBNS since 1981 (Atwood and Minsky 1983), although the study recorded an increase within MDR from zero CLT foraging observations in May (pre-hatching) to 20 in June and July (post-hatching).

Ryan and Vigallon (2012) surmised that "while the proximate cause of colony failure was egg predation by crows, the ultimate cause may have been low food resources." They posit that because of low prey availability, CLT were spending more time away from the nesting site looking for food and therefore not present to defend the nesting site from crows (Ryan and Vigallon 2012). In an email dated May 21, Mr. Ryan reported "terns are present in the early morning hours, but move offshore to forage mid-morning with few, if any, adults attending the colony. The crows then move in and remove any eggs laid the night before" (T. Ryan, pers. comm.).

If CLT prey were in fact insufficient near the VBNS in 2012, results of the CLT foraging study reported herein may be further compromised by unusual foraging patterns related to insufficient CLT prey in the vicinity of the VBNS. However, Ryan and Vigallon (2012) reported observations of fish exchanges and courtship flights between adults in mid-April, and Ryan (pers. comm.) reported 75 nest scrapes (beginnings of nests) on May 1, new nest scrapes from May 18 to 23, and new nesting attempts in early June, suggesting that CLT were finding sufficient prey to initiate nesting. In addition, although CLT were no longer nesting by mid-June, KBC's foraging surveys continued to record CLT diving for prey in the MDR area through early August. Finally, KBC monitors observed CLT within the VBNS in 2012 and within other nesting sites during previous years when crows were present and noted that CLT, particularly in low numbers, often appeared unable to deter crows. Thus, we conclude that crow depredation was likely the primary reason for CLT reproductive failure in 2012, although no comparison data are available on CLT foraging behavior at MDR during years of good productivity.

However, the fact that this study recorded 153 CLT foraging dives (14% of total dives including those in comparison areas) in dredge areas when the dredge and/or tugboats, survey boats and support vessels were present and active suggests that dredging has little to no effect on CLT foraging behavior. Turbidity plumes beyond 100 feet were observed on only one occasion, although a CLT was observed diving toward the turbidity plume (Figure 5). Finally, the dredge and its support vessels occupy a relatively miniscule area of potential CLT foraging habitat in the vicinity of the VBNS, including ocean, Ballona Creek, MDR, Venice Canals and the channels and lagoons of Ballona Wetlands.

The only other study on CLT foraging during dredging was during 2002 to 2005 near the CLT nesting site at Alameda Point in the San Francisco Bay area (TetraTech 2006). The purpose of the study was to determine whether the Oakland Harbor Deepening project and associated berth development, and the Middle Harbor Habitat Enhancement project had any effect on CLT foraging and chick provisioning. CLT were observed diving on prey in Middle Harbor Habitat Enhancement Area during active sediment deposition activities, but the study's authors concluded that "no conclusory test of an immediate effect of the deposition on tern foraging behavior was possible" (TetraTech 2006).

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Ryan, T. 2012. Personal communication in the form of an email regarding California least tern activity and predator management at the Venice Beach nesting site in 2012. Emails dated May 1 ("The traps were in from April 16-26, removed from April 26-May 1"); May 9 ("I closed the traps after they had been open and baited from May 2 to 8"); May 18 ("May 15, all of the eggs had been predated and there were no new nests"); May 21 ("terns are present in the early morning hours, but move offshore to forage mid-morning with few, if any, adults attending the colony. The crows then move in and remove any eggs laid the night before"); and May 24 ("We are going to close the traps tomorrow [May 25] and re-open them again on Tuesday next week [May 29]").

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APPENDIX A.

BIOLOGICAL MONITORING DATA SHEET FOR MARINA DEL REY DREDGING PROJECT

KEANE BIOLOGICAL CONSULTING
LEAST TERN FORAGING & DREDGE MONITORING
Marina del Rey 2012

DATE:	TIME BEGIN:	TIME END:	OBSERVER:
WIND:	CLOUD COVER:	TIDE:	VISIBILITY:

CALIFORNIA LEAST TERN FORAGING DATA

Survey station[1]	Time Period[2]	TOTAL Dives[3]	TOTAL Transits[4]	FORAGING ACTIVITY COUNTS (use hatch marks)	
				DIVES	TRANSITS
	0600 - 0620				
	0630 - 0650				
	0700 - 0720				
	0730 - 0750				
	0800 - 0820				
	0830 - 0850				
	1700 - 1720				
	1730 - 1750				
	1800 - 1820				
	1830 - 1850				

1 See maps of dredge locations & comparison stations. **DON'T FORGET THE "C" IF IT'S A COMPARISON STATION!**
2 Survey periods are 20 min on, 10 min off for walking/driving between stations.
3 Total CLT foraging dives (number of plunges into water to capture prey. DO NOT count aborted dives.
4 Only count transit flights that do not morph into foraging flights and only transit flights headed away from the observer.

DREDGE MONITORING DATA

Dredge Location (number of dredge area):		Location of Dredge WITHIN dredge area:
Description of Dredge & Related Activities (record times of observations):		
Location(s) of turbidity plume(s):		
Did you observe turbidity beyond 100 ft?		If so, where and when? (Remember to report it!!):
Other Comments, and Marine Mammals observed:		

Birds Observed (AOU code):										

!! BE SURE TO SCAN AND EMAIL YOUR DATA SHEET TO KATHY & TO LARRY SMITH W PHOTOS !!

APPENDIX B.

SUMMARY OF DREDGING ACTIVITIES DURING BIOLOGICAL MONITORING FOR MARINA DEL REY DREDGING PROJECT

DATE	AM or PM[1]	DREDGE LOCATION	NOTES ON DREDGE ACTIVITIES	NOTES ON CLT ACTIVITY
18-Apr	AM	3	scow change 0650, clamshell starts 0720 then moves south	CLT heard over VBNS 0600; foraging in 7S
	PM	2	dredge contiously operating near breakwater	none
20-Apr	AM	3	Dredge began in southern portion of 3 and then moved to	CLT observed foraging in Area 6, Area 7N, Area 8N, Area 8S, and
	PM	3	dredge moves toward 7S; BRPE foraging near dredge	no CLT at 1700 but heard over VBNS at 1900
23-Apr	AM	3	dredge in western portion of Area 3	at least 6 CLT by Coast Guard/Sheriff's office
	PM	3	scow change 1810	none
25-Apr	AM	7S	dredge moves within 7S; scow change 0850	36 CLT foraging over areas 6 and 7N
	PM	7S	filling Scow 6; high winds	none
30-Apr	AM	4	dredge in Area 4, not Area 7 as reported; scow change 0730	CLT over beach west of nesting site then foraging at 7N and 8N
	PM	4	dredge moves within Area 4; several crows near nest site	none
2-May	AM	7S	dredge in 4 then moved to 7S at 0640	none; local sport fishing outfit reports sm. anchovies in area
	PM	7S	dredge operating entire period	none
3-May	AM	7S	dredge inactive0800 to 0843	3 foraging dives in dredge area
	PM	7S	dredge inactive 1700 - 1717	none
4-May	AM	7S	dredge starts up 0615, stops briefly to move NW in 7S 0820	10 CLT foraging dives in dredge area
	PM	7S	dredge operating entire period	none
5-May	AM	7S	dredge resumes activity at 0840 after maintenance	none
	PM	7S	dredge inactive except when moving north 1830	none
6-May	AM	7S	scow change 0735	none
	PM	7S	dredge inactive entire survey period	none
7-May	AM	7S	scow change 0620	none
	PM	7S	dredge operating entire period	none
8-May	AM	7S	dredge halted briefly 0715 to remove debris from clamshell	8 CLT dives in dredge area
	PM	7S	dredge operating entire period	none
11-May	AM	4	scow change 0820; dredge operating remainder of shift	none in dredge area; 15-20 CLT in 9S, courtship with 2"+ fish
	PM	4 and 5	dredge operating entire period	none
14-May	AM	4	clamshell active entire period following shift change 0620	10 CLT foraging dives in dredge area; CLT foraging between scow
	PM	5-Apr	dredge operating entire period	none
16-May	AM	7N	scow change 0706	one CLT foraging dive in dredge area
	PM	7N	dredge inactive 1800-1840	none
18-May	AM	7N	dredge operating entire period	six CLT dives in dredge area; bait concentration in Area 6 with
	PM	7N	dredge operating entire period	none
21-May	AM	7N	dredge inactive 0600-0620 and 0700-0720	one CLT dive in dredge area; many dives in Area 6
	PM	7N	dredge operating except when moving within 7N. turbidity	none
23-May	AM	1	dredge halted 0805-0815	none
	PM	1	dredge operating entire period	none
26-May	AM	8S	dredge halted for scow change 0700-0742	none but CLT foraging in 8N
	PM	8S	dredge inactive entire period	none
28-May	AM	8S	dredge repair to 0844	none but good numbers of CLT around nesting site
	PM	8S	dredge operating except when moving within 8S	four CLT transit flights over dredge area
30-May	AM	8N to 4	dredge moves from 8N to 4 at 0615	12 CLT dives in dredge area; 8 AMCR in nesting area
	PM	5	dredge inactive 1700 - 1840 when scow arrives and is placed	none

DATE	AM or PM[1]	DREDGE LOCATION	NOTES ON DREDGE ACTIVITIES	NOTES ON CLT ACTIVITY
1-Jun	AM	5	dredge inactive 0620-0643; scow leaves 0820	none; CLT activity over nesting site, and foraging in adjacent
	PM	5	dredge inactive 1700 - 1735 when scow arrives and is placed	none; and only 5 or 6 CLT at nesting site
4-Jun	AM	5	dredge idle 0745 - 0803	3 CLT dives in dredge area
	PM	8S	dredge operating entire period	none
6-Jun	AM	8N	dredge repositioning to 7S at 0730	31 CLT dives in dredge area
	PM	1	dredge inactive 1805 - 1820	none
8-Jun	AM	1	scow change 0700 - 0720	none but 25 CLT dives in 7S
	PM	1	dredge inactive after new scow 1755 - 1900	none
11-Jun	AM	3	dredge inactive entire shift 0600 - 0900	none
	PM	3	dredge inactive during entire period 1700 - 1900	none
13-Jun	AM	3	dredge inactive 0600 - 0700	3 CLT dives; successful Caspian tern dives off dredge bow;
	PM	3	dredge inactive during entire period 1700 - 1900	none
16-Jun	AM	8N	dredge and scow moe 150 ft west 0800	none
	PM	8N	dredge operating during entire shift 1700 - 1900	none
18-Jun	AM	8N	dredge inactive 0810 - end of shift 0850	8 CLT foraging dives; including dives within 50' of active dredge
	PM	8N	dredge inactive entire shift 1700 - 1900	none
20-Jun	AM	8N	scow change 0600 then dredge moves west	19 CLT foraging dives
	PM	8N	no monitoring	no monitoring
22-Jun	AM	8N	dredge inactive entire shift 0600 - 0850	2 CLT foraging dives; CLT courtship flights
	PM	8N	dredge inactive entire shift 1700 - 1900	none
25-Jun	AM	8N	dredge inactive entire shift 0600 - 0850	none
	PM	9N	dredge operating entire shift 0600 - 0850	none
27-Jun	AM	4	dredge inactive 0705 - 0715 and 0800 - 0850	none
	PM	4	dredge operating entire period	none
29-Jun	AM	5	dredge operating entire shift 0600 - 0850	none
	PM	5	dredge inactive entire shift 1700 - 1900	none
2-Jul	AM	5	dredge inactive 0600 - 0800	none
	PM	5	dredge active except after scow removal 1845 - 1900	none
3-Jul	AM	5	dredge inactive 06000 - 0635	none
	PM	5	dredge operating entire period	none
6-Jul	AM	6 to 5	dredge inactive 0720 - 0850; 75' rust plume in dredge area	5 CLT dives in dredge area
	PM	6-May	dredge operating entire period	none
9-Jul	AM	5	dredge inactive 0630 - 0720	3 CLT foraging dives; high CLT activity on beach
	PM	5	dredge operating entire period	none in dredge area but 8 CLT dives in 8N after 1830
11-Jul	AM	5	dredge operating entire period	one CLT dive in dredge area
	PM	4	dredge operating entire period	none in dredge area but 6 CLT dives in 9N
13-Jul	AM	5	dredge inactive 0800 - 0850, dredge moving to Area 4	one CLT foraging dive; several CLT on beach
	PM	1	no monitoring	no monitoring
16-Jul	AM	1	dredge inactive 0630 - 0850	none; CLT active in 7N and 8N
	PM	1	dredge inactive until 1813	6 CLT dives in dredge area
18-Jul	AM	1	dredge inactive 0630 - 0800	6 CLT foraging dives in dredge area
	PM	1	dredge inactive during scow change & move 1715 - 1830	6 CLT foraging dives in dredge area; 5 dives in 7S
20-Jul	AM	1	dredge inactive while moving south 0745 - 0800	6 CLT foraging dives in dredge area
	PM	2	dredge operating except 1800 - 1920 scow change	none

DATE	AM or PM[1]	DREDGE LOCATION	NOTES ON DREDGE ACTIVITIES	NOTES ON CLT ACTIVITY
23-Jul	AM	1	dredge inactive 0715 - 820 during scow change & move	6 CLT foraging dives in dredge area
	PM	1	dredge operating except 1730 - 1735	1 CLT dive in dredge area; 20 dives in 7S
25-Jul	AM	1	dredge operating entire period	none; CLT foraging in 7S
	PM	1	dredge inactive 1705 - 1817 during move west	none
27-Jul	AM	1	dredge inactive during scow change 0600 - 0842	none
	PM	1	no monitoring	no monitoring
30-Jul	AM	1	dredge inactive entire period	none
	PM	1	dredge operating entire period	none
1-Aug	AM	1	dredge inactive entire period	none
	PM	1	dredge inactive 1718 - 1815	
3-Aug	AM	1	dredge operating entire period	none
	PM	9N	dredge operating entire period	none
6-Aug	AM	1	dredge operating entire period	none
	PM	1	dredge inactive 1715 - 1800, scow change	none
8-Aug	AM	1	dredge inactive 0615 - 0730	one CLT foraging dive in dredge area
	PM	1	dredge operating entire period	none
10-Aug	AM	6	dredge inactive 0800 - 0850	none
	PM	6	dredge inactive 1730 - 1808 during clamshell repair	none

[1] AM = 6 am - 9 am; PM = 5 pm - 7 pm