If We Build It, Will They Come? An Evaluation of The Effects of Beach Nourishment Projects on Beach Attendance in Southern California

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Abstract

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Beach nourishment is a practice widely used in Southern California to protect coastal structures. A presumed co-benefit of beach nourishment is to maintain sand that supports beach recreation and tourism. I evaluate the relationship between sand added to coastlines by beach nourishment projects and beach attendance to determine whether beach nourishment draws more people to the coast. I find no evidence that beach nourishment results in higher visitation rates.

1. Introduction

Southern California is home to over 350 km of coastline, making beaches an important natural feature of the state (Raheem et al., 2009). The popularity of Southern California beaches suggests that overall attendance will continue to increase as population in the region increases (Dwight, Brinks, SharavanaKumar, & Semenza, 2007). Attendance is highest at Southern California beaches during the summer, "with 53% of visits occurring in June, July, and August" (Dwight et al., 2007). Coastal tourism and recreation in Southern California generates most of California's over $40 billion Ocean Economy (Dwight et al., 2007; Dwight, Catlin, & Fernandez, 2012).

Sandy beaches are dynamic systems created by a balance of marine and terrestrial processes. Offshore littoral cells circulate sediment between geographic boundaries along the coast. Longshore currents drag sediment along the coastline while waves deposit or erode sediment on sandy beaches depending on the wave energy, beach slope, and sediment type and size (Benedet, Finkl, Campbell, & Klein, 2004). On land, rivers carry eroded bedrock from upstream to be deposited onto beaches. Coastal bluffs erode as the result of wind friction and terrestrial water runoff (Benedet et al., 2004). This adds to the sediment budget of coastal systems.

However, sandy shorelines are vulnerable to coastal erosion. "Predictions of shoreline change with limited human intervention indicate that 31% to 67% of Southern California beaches may become completely eroded by 2100…" (Vitousek, Barnard, Limber, Erikson, & Cole, 2017). Due to an increase in coastal development—the result of a rising population—humans have indirectly altered the shape of beaches by cutting off sediment supplies (Pendleton, Mohn, Vaughn, King, & Zoulas, 2012). The interactions of terrestrial water sources—such as creeks and rivers—with the coastline is interrupted by coastal development. In Southern California, much of the sediment deposited onto the coastlines comes from fluvial transport of sediment supply from the Peninsular Range by San Juan Creek, San Mateo Creek, Santa Clara River, Santa Margarita River, Santa Ana River, and San Luis Rey River (Andrews & Antweiler, 2012; Inman & Jenkins, 1999; Warrick & Milliman, 2003). These rivers carry sediment to the littoral cells during winter precipitation events that are responsible for depositing sand onto many beaches in Southern California (Andrews & Antweiler, 2012; Inman & Jenkins, 1999; Warrick & Milliman, 2003). While dams offer developers the opportunity to build on land otherwise submerged by rivers and streams, they prevent eroded bedrock sediment from being carried to coastlines where they are deposited (Pendleton et al., 2012, p. 224).

Furthermore, development along coastal cliffs reduces the supply of sediment available to beaches. Seventy-three percent of the sediment deposited into the Oceanside littoral system is supplied by eroding cliffs (Caspers, 1961). Development on or around coastal cliffs changes the stabilizing forces of coastal sediment from bluffs and cliffs. Coastlines are dynamic systems and their sediments either build up or wash away according to the strength of accretionary and erosional forces. As a result of sediment sources being cut off from transport to littoral cells, the lack of sediment supply has decreased coastal accretion of sand to a point that erosion is wearing away beaches and decreasing beach width faster than coastal sediment can be replenished. This ultimately makes the coastal infrastructure more vulnerable to processes such as sea level rise and events such as intense storm surges. Options for managing coastal erosion include construction of hard structures, managed retreat of infrastructure, and coastal nourishment. Methods of human shoreline alteration—including armoring and beach nourishment—directly change the shape of the shorelines.

A common method of counteracting erosion and offsetting the effects of sea level rise in Southern California is through beach nourishment projects, the most accepted method of coastline restoration and management (Pendleton et al., 2012). During beach nourishment projects, sediment is added to the shoreline as a means to make sandy beaches wider. This method of coastal restoration involves dredging sediment from a source such as a river bed or offshore sediment-rich habitat and depositing it onto the beach (Pendleton et al., 2012). Wave action then incorporates the sediment into to the littoral cell that subsequently redistributes the sand to beaches.

Wide beaches are better able to protect the shoreline from waves made more intense by sea level rise and storms (Griggs & Kinsman, 2016). Long-term impacts of beach nourishment projects vary by beach and are dependent on sediment grain size across the shoreline and wave energy (Pendleton et al., 2012). As the population and amount of coastal development continues to increase along coastal California, beach nourishment serves as an option to supplement natural nourishment processes that have been disrupted by the development of coastal structures.
A beneficial side effect of widening beaches by nourishment to protect coastal structures is that wider beaches offer more space for coastal recreation. The concept of making beaches wider is consistent with a general preference for wide and sandy beaches (Marin, Palmisani, Ivaldi, Dursi, & Fabiano, 2009; Parsons, Chen, Hidrue, Standing, & Lilley, 2013; Pendleton et al., 2012). According to Griggs & Kinsman (2016), the "general expectation, realistic or not, by those in support of a typical beach nourishment project, is that the added sediment will not just increase the net volume of the shoreface but that this sediment will widen the visible, subaerial portion of the beach."

Section 30001 of the California Coastal Act (CCA) establishes that the protection of California's "natural and scenic resources" including the "ecological balance of the coastal zone" is the responsibility of the state government, and the government's interest to "protect its deterioration and destruction" by requiring that development be "essential to the economic and social well-being of the people of this state" ("California Coastal Act," 1976). Beach nourishment projects fulfill this responsibility in that widening sandy beaches along the coastline contributes to the livelihoods and well-being of the Southern California residents and tourists who utilize them. Nourishment is also arguably consistent with the Act's sections 30211, 30221, and 30251, which require that development not interfere with the public's access, recreational enjoyment, and visual enjoyment of the ocean and coastal zone.

Here, I test whether distribution of beach attendees changes as coastal geography is modified by beach nourishment projects. Specifically, I look at the relationship between the volume of sand added to the coastline from beach nourishment projects and beach attendance. I hypothesize that increasing beach width through nourishment projects draws more individuals to the beach. To test this hypothesis, I compare beach attendance during years beaches were nourished to years beaches were not nourished for each city in a t-test. Ultimately, I ask the question: Does sand move people?

2. Methods

I collected data for beaches and cities located in coastal Southern California, specifically between Point Conception and the California border with Mexico. Beaches were selected if they met the following two criteria:

1. Beaches were nourished between 1964 and 2015 according to the Beach Nourishment Database; and
2. Beaches are located in cities that are United States Lifesaving Association (USLA) certified, such that annual beach attendance data are available.

I gathered beach nourishment data made available through the Beach Nourishment Database created by a collaboration between the American Shore and Beach Preservation Association (ASBPA) and Aptim (web: http://beachnourishment.wcu.edu/oneState?state=CA). The Beach Nourishment Database is a collection of beach nourishment data from the Program for the Study of Developed Shorelines at Western Carolina University, SANDAG, and the Florida Department of Environmental Protection. From this database, I extracted information on beach nourishment projects, including the location of beach nourishment projects, the year a project occurred, and the volume of sand added to each beach of interest.

Annual beach attendance data were collected from the USLA statistics page (Appendix A). Only USLA certified cities were included in this analysis. Not all cities included in this analysis reported beach attendance for every year, so there are gaps in the data for annual beach attendance.

To align beach nourishment data with beach attendance data, I conducted my analysis at the city level. For cities that maintain more than one nourished beach, I combined the beaches as shown in Table 1.

Table 1. Beaches in analysis categorized by city.

County	City	Beaches
Santa Barbara	Santa Barbara	East Beach, San Buenaventura
Ventura	Port Hueneme	Silver Strand Beach, Hueneme Beach Park
Los Angeles	Los Angeles	Cabrillo Beach
Los Angeles	Long Beach	Long Beach
Orange	Seal Beach	Seal Beach
Orange	Huntington Beach	Surfside/Sunset Beach, Huntington Beach
Orange	Newport Beach	Santa Ana River County Beach, Newport Beach, Corona del Mar State Beach
Orange	San Clemente	San Onofre State Beach
San Diego	Oceanside	Oceanside City Beach
San Diego	Encinitas	Moonlight Beach
San Diego	Solana Beach	Fletcher Cove
San Diego	Del Mar	Del Mar, Torrey Pines
San Diego	Coronado	North Island Oceanside Beach, Gator Beach
San Diego	Imperial Beach	Silver Strand State Beach Park, Delta Beach, Imperial Beach, Tijuana National Estuary

I used two metrics of beach attendance:

1. The log of total attendance to normalize data across beaches (referred to here as attendance; Figure 1); and
2. The log of total attendance divided by the population of the county (referred to here as per-capita attendance; Figure 2).

I gathered county population data from the Bureau of Economic Analysis under the United States Department of Commerce (Appendix B).

I tested for a relationship between beach nourishment projects and changes in beach attendance. I plotted beach attendance by year and city against nourishment events (Figures 1 and 2). I looked for changes in attendance by conducting t-tests for each city to test for a significant difference in beach attendance and per-capita attendance between years beaches were nourished and years beaches were not nourished. Finally, I tested for a correlation between the volume of sand added to beaches by beach nourishment projects and beach attendance as well as per-capita attendance.

3. Results

While the populations of Southern California counties continue to increase over time, per-capita attendance decreases (Figure 1). This is consistent across all cities in this analysis independent of frequency of beach nourishments.

After Bonferroni correction, I found a significant difference in attendance for years beaches were nourished and years beaches were not nourished for the city of Long Beach, with a p-value less than 0.003 (Table 2). Despite this finding, there was no consistent detectable increase or decrease in attendance in relation to the timing of beach nourishments (Figure 2).

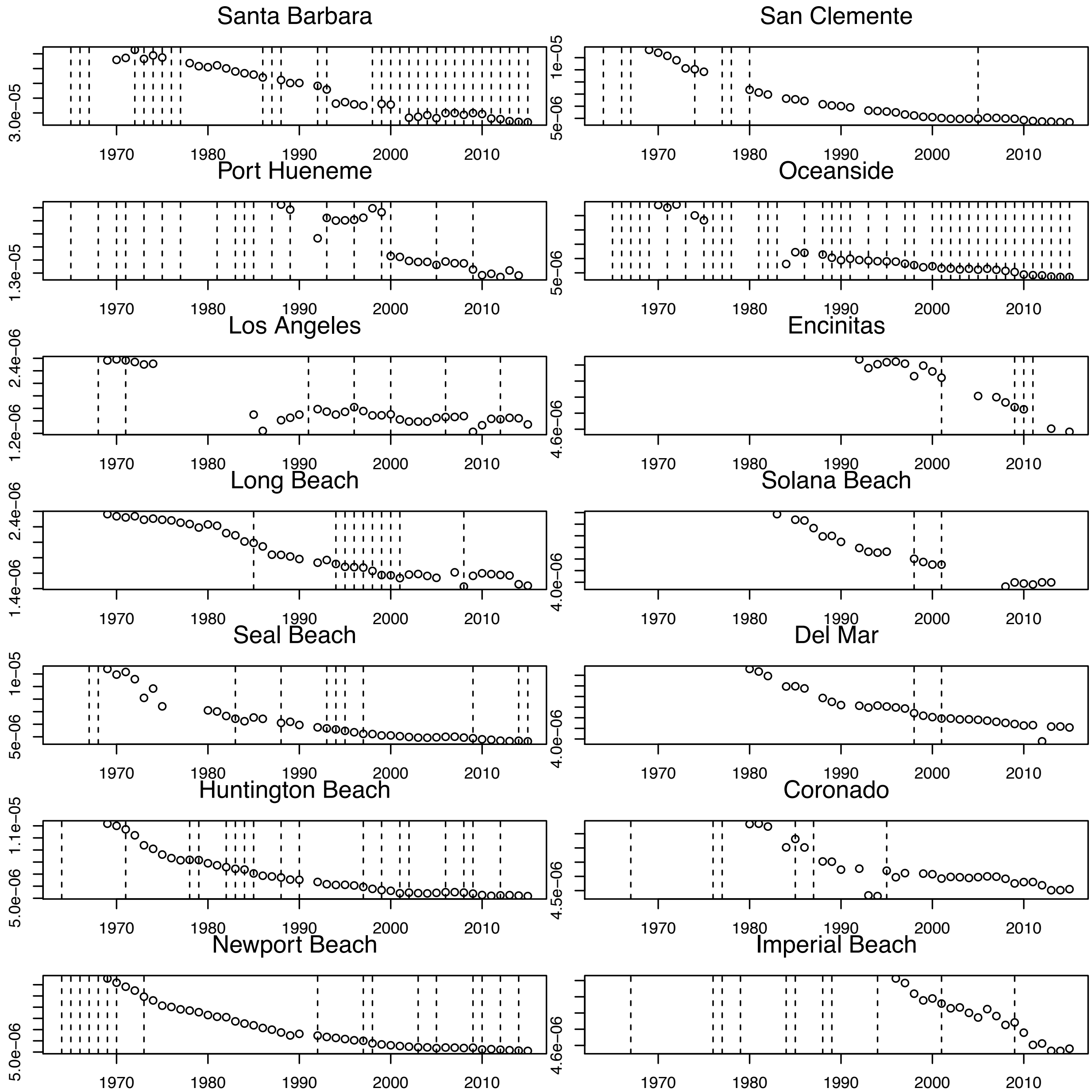

Figure 1. Attendance proportion for each city between 1964 and 2015. The vertical dotted lines represent years of nourishment projects.

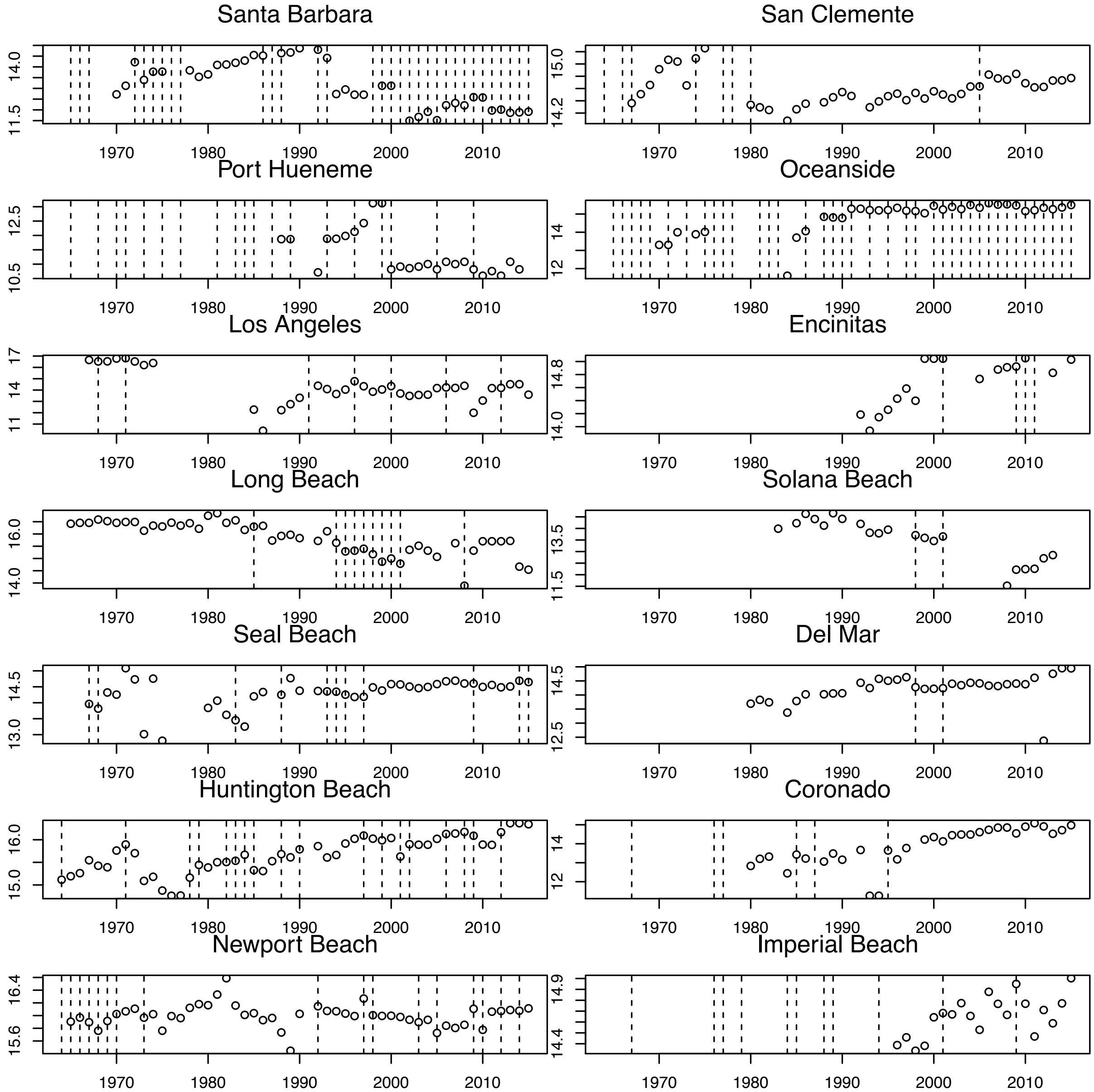

Figure 2. Attendance for each city between 1964 and 2015. The vertical dotted lines represent years of beach nourishment.

Table 2. Statistical results of t-test.

	Attendance		Per-Capita Attendance	
City	**t-statistic**	**p-value**	**t-statistic**	**p-value**
Santa Barbara	-2.856	0.007	-3.387	0.002
Port Hueneme	1.019	0.334	1.284	0.227
Los Angeles	1.865	0.098	0.453	0.669
Long Beach	-3.495	0.002	-3.809	0.001
Seal Beach	-0.564	0.578	-2.384	0.0224
Huntington Beach	0.863	0.393	-0.542	0.592
Newport Beach	-0.852	0.400	-0.243	0.811
San Clemente	0.116	0.915	0.785	0.507
Oceanside	2.273	0.049	-2.104	0.062
Encinitas	NA	NA	NA	NA
Solana Beach	0.701	0.492	-1.190	0.256
Del Mar	0.359	0.722	-1.509	0.187
Coronado	-1.628	0.129	1.020	0.481
Imperial Beach	1.281	0.392	0.448	0.703

Figure 3 shows the relationship between the volume of sand added to beaches from nourishment projects and the corresponding attendance. There is no detectable relationship between volume of sand added to beaches and beach attendance. Despite significant correlations for Los Angeles and Oceanside after Bonferroni correction, p-value less than 0.003, the correlation coefficients range from -1 to 1—varying around 0—suggesting that an increase in volume of sand added to the Southern California coastline by beach nourishment does not result in a large increase or decrease in beach attendance.

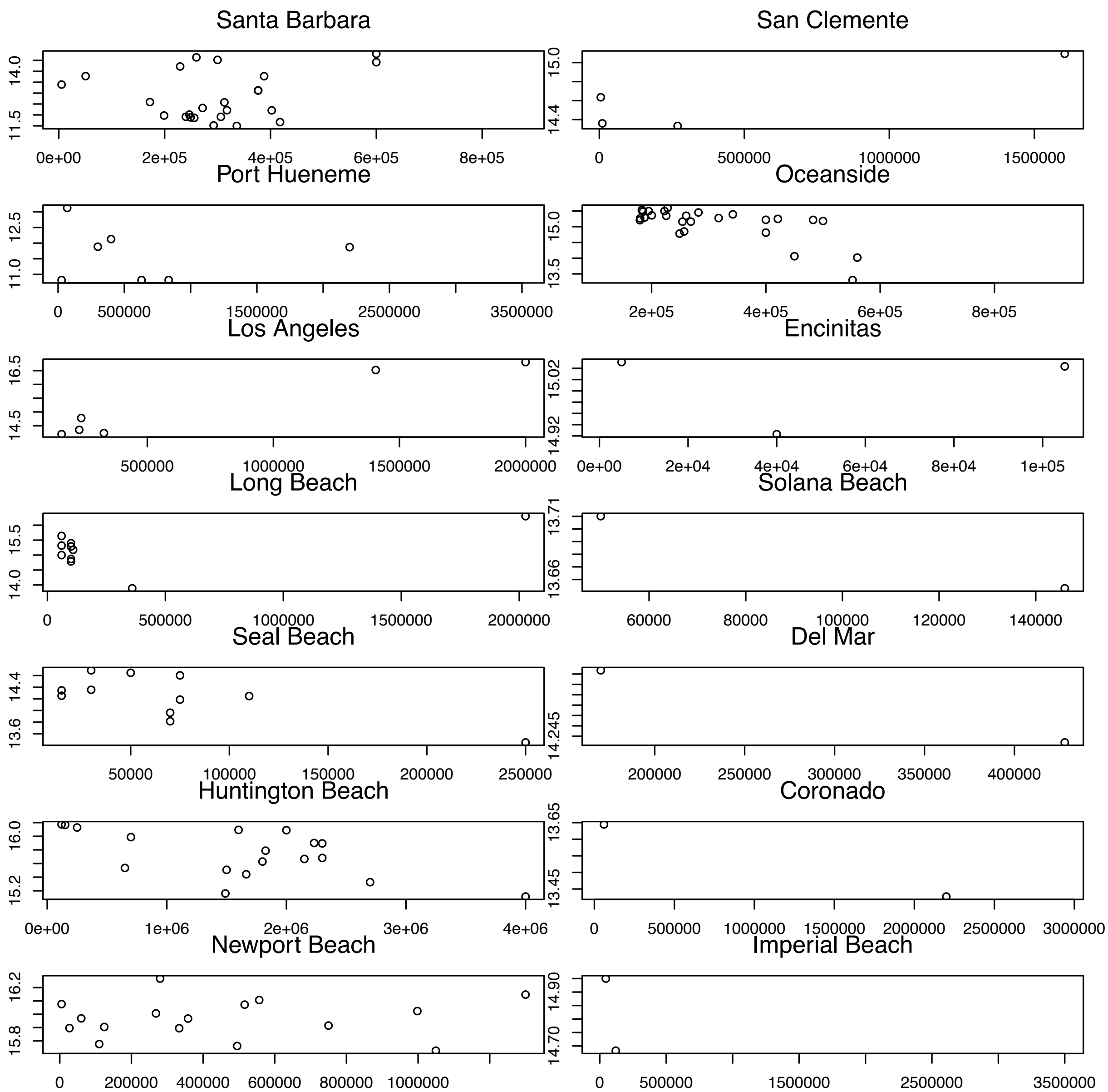

Figure 3. The x-axis is the volume of sand (in cubic yards) added to the city's beaches in cubic yards. The y-axis is the attendance.

Table 5. Statistical results of correlation test.

	Attendance		Per-Capita Attendance	
City	Correlation Coefficient	p-value	Correlation Coefficient	p-value
Santa Barbara	0.200735	0.347	-0.1674235	0.4342
Port Hueneme	-0.08570103	0.855	0.2446258	0.597
Los Angeles	0.969249	0.001404	0.9817297	0.002956
Long Beach	0.5360453	0.1102	0.7385576	0.0147
Seal Beach	-0.7148507	0.01342	0.6292787	0.0694
Huntington Beach	-0.5971823	0.008876	0.3968308	0.1148
Newport Beach	0.06161685	0.8207	0.3664828	0.2413
San Clemente	0.8733735	0.1266	0.8928994	0.2973
Oceanside	-0.6942447	5.896e-05	0.7267084	1.766e-05
Encinitas	0.1177738	0.9248	0.9577195	0.1858
Solana Beach	NA	NA	NA	NA
Del Mar	NA	NA	NA	NA
Coronado	NA	NA	NA	NA
Imperial Beach	NA	NA	NA	NA

4. Discussion

I found no evidence of an effect of nourishment projects on beach attendance; conversely, I found evidence of a striking decline in per-capita beachgoing despite ongoing nourishment across cities and counties. These results strongly suggest that if jurisdictions choose to nourish beaches with the goal of attracting a greater number of beachgoers, they are manifestly failing to meet that goal.

Across all cities, there is a consistent decrease in per capita beach attendance. According to Dwight et al. (2007), “[California] beaches are very popular destinations for millions of people, and the overall attendance levels are predicted to increase as the population in the region continues to grow rapidly.” This same prediction was addressed in the Land Use and Local Coastal Plans for Santa Barbara and Oceanside. However, it is evident from Figure 1 that while the Southern California population is increasing, beach attendance is decreasing. Despite efforts to continue to widen beaches through nourishment, the additional sand space is not compelling additional beach attendance.

In Long Beach, attendance and per-capita attendance were significantly different between years beaches were nourished and years beaches were not nourished. The Land Use Plan (LUP) for Long Beach illustrates an interest in developing the waterfront areas of the city—including the Downtown Shoreline area—to encourage use of the area to grow local tourism.

Per-capita attendance in Santa Barbara was significantly different between years beaches were nourished and years beaches were not nourished. Unlike Long Beach, Santa Barbara's Local Coastal Plan, emphasis is placed on developing policy focused on the "retention of the shoreline area for the general public…and the preservation and improvement of the shoreline for full, balanced public use…" (The City of Santa Barbara, 2004, p. 35). Of the publicly-owned recreation areas in the coastal zone, East Beach—one of the nourished beaches in Santa Barbara for which data were collected for this research—has the highest areal acreage compared with other recreation areas in the city of Santa Barbara, including other beaches and parks (The City of Santa Barbara, 2004). This would suggest that more sand added to the area would result in an increase in beach attendance. While there was a significant difference in beach attendance during years Santa Barbara beaches were nourished, there was no significant correlation between volume of sand added to the beach by nourishment and attendance.

Oceanside's beaches are the most frequently nourished in this analysis (Figures 1 and 2). While neither attendance nor per-capita attendance for Oceanside were significantly different between years beaches were nourished and not nourished, the correlation between Oceanside's attendance, as well as the per-capita attendance, and volume of sand added to beaches during nourishment is significant (Table 2). In Oceanside's initial LUP, guidelines within the city's

LCP application from 1985, beach usage was in decline at the time of the document's publication as a result of high erosion along the city's coastline (The City of Oceanside, 1985). An objective of Oceanside's LUP was to find funding to improve city beaches and "encourage a program of periodic replenishment of the beach or interim stabilization of the shoreline by artificial means" (The City of Oceanside, 1985, p. 9). It is clear in Figure 2 that beach attendance increased following Oceanside's adoption of LCP status in 1986. Furthermore, the city of Oceanside implemented overall objectives of maximizing enjoyment of the coastal zone and recreation areas in the LUP through erosion-prevention measures including beach nourishment (The City of Oceanside, 1985, p. 8).

This analysis does not account for the natural erosion and sedimentation processes which could also contribute to the sediment budget. This could explain why there is not a strong positive or negative correlation between volume of sand added to beaches and beach attendance. I did not test if beach attendance was higher during years beaches were nourished than during years beaches were not nourished.

The majority of Southern California beachgoers are residents (Oh, Draper, & Dixon, 2010; Prati, Albanesi, Pietrantoni, & Airoldi, 2016). "Although the beaches of Southern California are popular tourist destinations, it is interesting to note the majority of beach visitors are local residents. One study conducted at Santa Monica Beach…reported 88% of summer beach visitors are California residents, and 78% are with their families" (Dwight et al., 2007, p. 856). Tourists and residents likely use beaches differently (Oh et al., 2010). While "…tourists were more interested in visiting beach destinations with moderate commercial development,… residents were more likely to oppose high levels of commercial development along the beach" (Oh et al., 2010). Additionally, research suggests that residents prefer beach destinations with less development and fewer management interventions than tourists (Oh et al., 2010, p. 249). Nourishment is a costly process to combat coastal erosion, and "…beach nourishment projects are only economic for major tourist destinations" (Klein & Osleeb, 2010). Also "…the decision to invest in beach nourishment projects is more likely in counties that are year-round tourism destinations…" (Klein & Osleeb, 2010).

4. Conclusion

Why do we nourish? While beach nourishment projects may not be sufficient to increase beach attendance, they offer a means of stabilizing the coastline. According to the results of the simulations from Vitousek at el. (2017), "…current rates of beach nourishment may be insufficient to keep pace with potential long-term erosion." However, regularly widening beaches through nourishment projects promotes the continued existence of sandy shoreline. Furthermore, beach nourishment serves as a means to protect the high-value coastal structures threatened by coastal squeeze. Housing prices along the California coast have increased as a result of high demand and high regulation (Kahn, Vaughn, & Zasloff, 2010, p. 278).

The research in this paper suggests that adding sand to beaches by nourishment projects does not have a strong impact on beach attendance. In fact, despite an increase in the frequency of beach nourishment projects in some cities, per capita beach attendance is decreasing. Clearly, other unspecified factors determine beach attendance in the coastal cities studied here.

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Appendix A

Beach attendance by year and city.

Year	Santa Barbara	Port Hueneme	Los Angeles	Long Beach	Seal Beach	Huntington Beach	Newport Beach
1964	NA	NA	NA	NA	NA	3669310	NA
1965	NA	NA	NA	13500000	NA	3964693	8074250
1966	NA	NA	NA	14000000	NA	4241320	8614556
1967	NA	NA	17121134	14000000	1157900	5648859	8000000
1968	NA	NA	15000000	16000000	1000000	5000000	7000000
1969	NA	NA	15158503	15000000	1658600	4832678	8160000
1970	335000	NA	19400000	14000000	1551130	7000000	9100000
1971	500000	NA	20000000	14500000	3550000	8000000	9500000
1972	1500000	NA	15000000	14500000	2500000	6600000	9900000
1973	655300	NA	10897785	10150000	449250	3575518	8600000
1974	960000	NA	13109230	12500000	2562500	3916318	9087050
1975	963565	NA	NA	12063240	365513	2887829	7000000
1976	NA	NA	NA	14100000	NA	2573993	8814200
1977	NA	NA	NA	12500000	NA	2586448	8541150
1978	1023750	NA	NA	13800000	NA	3840310	10036000
1979	756000	NA	NA	11000000	NA	5089392	10640000
1980	848504	NA	NA	18727200	1023375	4810839	10462500
1981	1316500	NA	NA	20731000	1283674	5405483	12371500
1982	1343100	NA	NA	14000000	822337	5431109	16000000
1983	1456000	NA	NA	15500000	694908	5581809	10407850
1984	1614000	NA	NA	10500000	569856	6369911	8980400
1985	2082000	NA	214581	12000000	1468428	4531204	9225500
1986	2030000	NA	33229	12400000	1681991	4446671	8269700
1987	NA	NA	NA	6800000	NA	5532623	8556250
1988	2280000	143000	204319	8200000	1542470	6463862	6810900
1989	2350000	143000	346239	8600000	2600000	6021235	5108900
1990	2868300	NA	608089	7500000	1752300	7194184	9130610
1991	NA	NA	NA	NA	NA	NA	NA
1992	2680000	45000	1760674	6700000	1740000	7717455	10296800
1993	1825000	145000	1310135	9935527	1716333	6001187	9559100
1994	340000	145000	850000	6200000	1700000	6338954	9512500
1995	420000	160000	1253972	4360000	1550000	8177646	9170950
1996	330000	185000	2622639	4493600	1442000	9085387	8820060
1997	330000	250000	1680152	4864000	1450333	9754311	11614400

1998	NA	500000	1040788	3892000	1948000	9106723	8941000
1999	500000	500000	1264367	2866000	1764560	8777201	8838850
2000	500000	50000	1708568	3263000	2157333	9231086	8864443
2001	NA	55000	888490	2643000	2136830	6132008	8694375
2002	98219	52000	721291	4655000	1996042	8050182	8320300
2003	117154	55000	779655	5500000	1899333	7959820	8005157
2004	148921	60000	800150	4500000	1973600	7958466	8309790
2005	100660	50000	1430291	3500000	2157643	9069730	6758342
2006	201881	65000	1518410	NA	2357451	10103404	7579488
2007	223540	60000	1453248	6100000	2400000	10204627	7315536
2008	200552	65000	1751609	1075000	2200000	10569438	7681651
2009	293586	50000	162343	4500001	2200000	9709925	9885521
2010	289613	40000	476415	6600000	1975000	7986932	7102152
2011	158254	47000	1425192	6600000	2100000	7936526	9446850
2012	165123	40000	1458474	6600000	1950000	10497969	9549900
2013	142325	65000	2008071	6700000	2000000	12815307	9703500
2014	145172	50000	2014511	2342357	2400000	12815307	9587070
2015	149527	NA	801345	2072747	2300000	12530294	9954345

Year	San Clemente	Oceanside	Encinitas	Solana Beach	Del Mar	Coronado	Imperial Beach
1964	NA	NA	NA	NA	NA	NA	NA
1965	NA	NA	NA	NA	NA	NA	NA
1966	NA	NA	NA	NA	NA	NA	NA
1967	1725291	NA	NA	NA	NA	NA	NA
1968	2000000	NA	NA	NA	NA	NA	NA
1969	2320560	NA	NA	NA	NA	NA	NA
1970	3000000	600000	NA	NA	NA	NA	NA
1971	3500000	600000	NA	NA	NA	NA	NA
1972	3400000	1200000	NA	NA	NA	NA	NA
1973	2305300	NA	NA	NA	NA	NA	NA
1974	3583000	1074500	NA	NA	NA	NA	NA
1975	4226590	1225630	NA	NA	NA	NA	NA
1976	NA	NA	NA	NA	NA	NA	NA
1977	NA	NA	NA	NA	NA	NA	NA
1978	NA	NA	NA	NA	NA	NA	NA
1979	NA	NA	NA	NA	NA	NA	NA
1980	1679500	NA	NA	NA	884020	373800	NA
1981	1613400	NA	NA	NA	1013441	543900	NA
1982	1544350	NA	NA	NA	927501	609950	NA

1983	NA	NA	NA	1190440	NA	NA	NA
1984	1296600	110100	NA	NA	643861	253400	NA
1985	1562700	892400	NA	1508906	971230	678191	NA
1986	1711600	1277800	NA	2257411	1230108	551481	NA
1987	NA	NA	NA	1803676	NA	NA	NA
1988	1751400	2804655	NA	1358807	1233723	470950	NA
1989	1900000	2705950	NA	2322115	1270627	718610	NA
1990	2068100	2623000	NA	1820909	1278261	518900	NA
1991	1940300	4371028	NA	NA	NA	NA	NA
1992	NA	4371028	1447850	1463683	1858051	865525	NA
1993	1614350	4051920	1130000	998203	1540182	77660	NA
1994	1776147	4000899	1391000	974150	2138892	77660	NA
1995	1935600	4066350	1560000	1140165	1996512	842900	NA
1996	2016390	4588035	1849000	NA	2073975	528187	1772000
1997	1812395	3915997	2159000	NA	2263859	956657	1903000
1998	2039126	3829065	1790935	900000	1586088	NA	1682500
1999	1862400	3414815	3414129	800000	1494000	1501139	1760500
2000	2095650	5133218	3414129	700000	1502101	1711300	2288500
2001	1987200	4183430	3414129	850000	1531881	1363975	2379800
2002	1865800	4836445	NA	NA	1795890	1887500	2350630
2003	2006047	4297085	NA	NA	1703982	1956000	2606220
2004	2263543	5365880	NA	NA	1856655	1957500	2316200
2005	2270042	4623341	2502345	NA	1818000	2218000	2039800
2006	2750000	5925270	NA	NA	1678722	2510500	2892400
2007	2584700	5493314	2891026	NA	1652742	2811000	2589800
2008	2533060	5577115	2992331	101075	1765300	2826500	2339900
2009	2781900	5260178	3027050	202275	1805500	2075500	3109900
2010	2388800	3835213	3440422	207300	1763255	2965000	2592600
2011	2232600	4012800	NA	210500	2216969	3550000	1918700
2012	2250200	4620000	NA	330800	236722	3002000	2447700
2013	2495500	4261226	2748951	380053	2559384	2034000	2166000
2014	2502800	4684700	0	NA	3115939	2460000	2601000
2015	2597500	5363000	3367770	NA	3099747	3189000	3278000

Appendix B

Population by year and county.

	Los Angeles	Orange	San Diego	Santa Barbara	Ventura
1969	6989910	1376796	1340989	261991	369811
1970	7042756	1432621	1365976	265291	381174
1971	7103651	1484217	1391925	269930	395691
1972	7056632	1536789	1433126	276957	408523
1973	7040446	1607146	1499594	277414	419461
1974	7085800	1669064	1540667	278431	433885
1975	7116806	1725693	1616907	282626	448918
1976	7211683	1772685	1642781	286075	460485
1977	7251637	1812147	1715527	290381	478695
1978	7351757	1853136	1775410	295397	494086
1979	7401021	1891962	1827602	295423	512189
1980	7506544	1948067	1875620	300191	532827
1981	7608796	2004806	1927018	305588	546389
1982	7767422	2045925	1972354	313073	562142
1983	7920955	2088886	2018133	322294	575586
1984	8041685	2123362	2066419	329133	588790
1985	8182906	2171930	2126090	338569	602819
1986	8393640	2228895	2196834	345651	615422
1987	8553844	2281486	2275309	352021	632062
1988	8667680	2333101	2364284	355810	650851
1989	8793710	2383920	2444380	365695	664692
1990	8878157	2418986	2512365	370565	670117
1991	8948125	2452691	2553122	374910	675706
1992	9055424	2497014	2593126	378003	684143
1993	9100159	2532639	2599776	380064	689943
1994	9096608	2566599	2614685	384226	698509
1995	9089015	2603678	2623697	384582	703486
1996	9127042	2643996	2651549	386108	710215
1997	9206538	2709277	2692600	391290	721107
1998	9313589	2773187	2736720	394738	730779

1999	9437290	2815933	2789593	396906	743357
2000	9538191	2854513	2827366	399990	756506
2001	9626034	2885457	2869672	403164	766689
2002	9705913	2908245	2900355	405178	779489
2003	9767145	2929376	2914702	406810	788070
2004	9793263	2941711	2930007	407284	793994
2005	9786373	2940055	2938375	408079	794197
2006	9737955	2932261	2947289	408085	798183
2007	9700359	2931629	2975742	411243	800027
2008	9735147	2957593	3022116	415859	806353
2009	9787400	2987177	3061203	420356	815130
2010	9825473	3017647	3104346	424396	825320
2011	9888476	3053884	3140692	425998	830707
2012	9953555	3084935	3181513	430638	834519
2013	10015436	3112576	3218419	435800	839498
2014	10066615	3134438	3258856	440553	844078
2015	10112255	3156573	3290245	443815	847719
2016	10137915	3172532	3317749	446170	849738