

Coastal Quest in partnership with the California Department of Parks and Recreation (State Parks) commissioned this report to inform the “Planning Statewide Coastal Resiliency for California State Parks and Piloting in San Diego Coast District” project. There are some limitations in the methodologies used to collect the data for this Visitation Study. As a result, some of the findings are significantly different from the on the ground visitation data results reported on by the California San Diego State Parks Coast District.

Below we highlight three key noted differences:

- To complete this analysis, the researchers utilized a virtual spatial analysis platform (StreetLight Data Inc) to geographically assess total visits to the San Diego Coast District’s coastal park units. This geographic analysis was accomplished via the creation of spatial polygons in the virtual platform, within which the researchers could analyze and look at a subset of the virtual spatial analysis platform’s data related to that location. The geographic borders for these polygons differ from the boundaries used by the San Diego Coast District’s team for on the ground analysis, which leads to some differences in overall visitation recorded.
- The researchers for this visitation study used data on bikes, cars, and pedestrian visitation for the year 2021, and only car visitation data for the years 2018 to 2020, which may also account for some variability in the results.
- The visitation study supports some anomalous results, that differ from the State Parks teams on the ground experience with visitors. This includes a comparable number of visitors in the month of January to the months of June through August, which is not necessarily supported by the San Diego Coast District’s on the ground observations.

San Diego Coast District Coastal Parks Visitation Study

California State Parks

FINAL REPORT

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Christopher Monz, PhD and Jordan Nesbitt, MS

Recreation Ecology Lab

Department of Environment and Society

Utah State University

Prepared for Coastal Quest and California State Parks

Key Findings

- A mobile device-based visitor use estimation study for the San Diego Coast District (SDCD) Coastal Parks was conducted via the Streetlight platform. Results suggest that a mobile device-based approach appears to be a viable means of estimating visitation in the SDCD, based on the availability of the data in most locations and the “face validity” of the results. Future work should consider some on-site counting methods where feasible to allow for additional calibration and quality control.
- Average daily vehicle arrivals exhibited a general declining trend from 2018-2021 at Carlsbad State Beach and Moonlight State Beach. There was an increasing trend at South Carlsbad State Beach. Other locations were either relatively consistent or showed no clear trend or pattern. Similar trends were observed when visitation trends were summarized by annual arrivals.
- December appears to consistently be the lowest or one of the lowest months of visitation across all parks. Use tends to increase markedly in January and remains relatively consistent through the summer months at many parks.
- Peak hours of visitation vary considerably by park, but many locations exhibit a peak of use in late morning and another peak in late afternoon or early evening.
- Most visitors to all parks across all years are white (60-80% depending on park and year), but a wide range of ethnicities are also represented.
- Although SDCD parks attract visitors from a broad geographic area, the highest number of visitors tend to come from locations proximate to each park.
- Exceptionally hot days did not appear to result in dramatic changes in visitation as compared to similar days of normal seasonal temperature.

Introduction

Overview

The California coast is commonly viewed as one of the most scenic destinations in the world. Comprised of sandy beaches, rocky shores, cliffs, bluffs, estuaries, and lagoons, California's coast sustains an extraordinary biological diversity, possesses significant cultural resources, and offers outstanding recreational opportunities. California State Parks (State Parks; www.parks.ca.gov) manages nearly one quarter of the California Coastline in 128 coastal parks, providing coastal access and recreational opportunities to over 50 million people from all over the world.

State Parks' San Diego Coast District (SDCD), one of thirteen coastal districts in the State Park System, includes eleven coastal park units ranging from Carlsbad State Beach in the north to Border Field State Park along the United States-Mexico border. SDCD coastal parks contains some of California's most interesting and rare examples of natural and cultural heritage while providing visitors with a wide variety of recreational opportunities. The district manages three areas for camping and many day-use beaches, which include several popular surf spots and ample opportunity for sunbathing, jogging, swimming, hiking, birding, fishing, and photography.

Study Purpose

In early 2021, State Parks in partnership with the non-profit Coastal Quest (www.coastal-quest.org), started the process of completing local and regional sea level rise vulnerability assessments and adaptation planning for coastal parks in the SDCD. An important component of this project is outreach and engagement specifically targeted at SDCD park visitors, which will provide information on visitor values, park areas of importance, and preferences related to sea level rise adaptation strategies. This community strategic outreach and engagement process will be informed by this analysis of visitation and demographic data, with the goal of helping State Parks identify their primary SDCD park users and to assist with targeted outreach and engagement efforts.

Several research questions were developed to guide this visitation study. These questions were developed by State Parks district and headquarters staff, in collaboration with Coastal Quest.

1. What is the estimated daily, monthly, peak season, and annual visitation at each park?
2. What are the peak visitation times?
3. What is the number of daily parking lot car arrivals?
4. How many visitors are using park beaches and campgrounds?
5. What are the most used specific locations (i.e., entry points, trails) for each park unit?
6. Where are SDCD park visitors coming from?
7. What are the demographics of SDCD park visitors?
8. What are the transportation modes of arrival to SDCD park units?
9. Do exceptionally hot days influence visitation levels in select parks?

Visitation Study Approaches

Fundamental to park management is an understanding of the basic dynamics of visitor use: the numbers of visitors, where they enter and exit, and the long-term trends of visitation (English & Bowker, 2018). Park managers are often tasked with estimating visitation and various techniques have been developed, such as trailhead registration and observation-based counting methods (Watson et al., 2000). Automated trail and vehicle counting technology is another option for estimating visitation that has been available since the 1960's and the wide application of these approaches continues in many parks today (English & Bowker, 2018). Automated counters are commonplace since they are relatively inexpensive and easy to use and maintain (Watson et al., 2000) but efforts to improve use estimation methods are ongoing as several challenges with the existing methods remain. For example, it is particularly difficult to assess use in parks that have multiple and/or informal access points (Ziesler & Pettebone, 2018). An emerging approach for use estimation in parks and public lands uses mobile device data sources and associated analysis techniques.

With the extensive mobile cellular device use among the public for navigation, travel and communication, vast amounts of location-based data are produced. Available data and associated analysis can yield information on recreation behaviors and a range of demographic attributes. Numerous applications for these data have been demonstrated including analysis of travel demand for transportation services (e.g., Çolak et al., 2015), origin-destination analysis (e.g., Alexander et al., 2015), land use classification (Pei et al., 2014) and to understand tourist characteristics and movements (Raun & Ahas 2016). In parks and natural areas, several studies have been recently conducted that have demonstrated the utility of mobile device data-based approaches, including a comprehensive, multi-year use assessment study in urban-proximate parks in California (Monz et al., 2019); a demographic analysis and a spatial analysis of visitor use distribution in the same study area (Monz et al., 2021; Creany et al, 2022); and a comprehensive analysis of statewide travel and inter-park travel patterns in Colorado (Baird et al., 2022).

Streetlight Data and Insight Platform

This project builds on the research conducted by the Recreation Ecology Lab at Utah State University and other professionals (e.g., Monz et al., 2019; Monz et al., 2021; Creany et al., 2022) and employs Streetlight Data analytic tools and the Streetlight Insight Platform. Streetlight Data, Inc., (Streetlight) is a transportation and urban planning company located in San Francisco, CA, USA. Streetlight provides access to mobile device data primarily to produce transportation-planning analytics via Streetlight InSight, an online platform that allows custom data processing (Streetlight Data, 2022). Streetlight obtains mobile device data from two types of locational sources, navigation-GPS data, and Location-Based Services (LBS) data. Streetlight processes the mobile device data via a proprietary algorithm to produce various mobility

metrics, a process that includes several quality assurance and data cleaning steps to eliminate erroneous data and enhance spatial accuracy. Various calibration and scaling approaches are also available in the analysis process to correct for variations in the mobile device data stream compared to actual activity. It is important to note that to maintain individual privacy, all Streetlight InSight outputs are aggregated and cannot be directly examined to track the behavior, home locations or demographic information of any one individual.

Analysis Process

All analyses were performed on geo-features (polygons and geofences) that were provided by State Parks staff to the research team. For each analysis we used the Zone Activity Analysis (ZAA) tool available through the Streetlight Insight platform. The ZAA tool is used to derive information about the volume of trips that start in, pass through, or end in a specific zone or polygon (Streetlight Data, 2022). Output from the ZAA tool also provides metrics for visitors' home ZIP codes, demographics (derived from U.S. Census Bureau Data), length of trip, volume of trips, and time of day for trips. This analysis allows for an estimate visitation to the park units and a determination of some demographic characteristics of the visitor population. Where appropriate, we also used the Streetlight Pedestrian tool, which is a recently developed procedure for estimating both bicycle and pedestrian use. This procedure is independent of vehicle use estimation and is based on device behavior which is markedly different among these modes. All analyses completed for this visitation study are subject to the limitations of the associated data sources and analytic capabilities available through Streetlight, Inc. For a more complete discussion of analysis details and limitations, we refer the reader to the Streetlight methodology paper (Streetlight Data, 2022) and the discussions in Monz et al., (2019), Creany et al. (2022) and Baird et al. (2022).

Question 1: What is the estimated daily, monthly, peak season, and annual visitation at each park?

Methods

To derive daily visitation data for each park unit, we used the ZAA tool using vehicle arrivals for the twelve whole-park polygons. To get the most accurate estimate, we used average annual daily traffic (AADT) single factor calibration tool to adjust the Streetlight Index into a single factor calibration Index (an estimate of total use; Streetlight, 2021). Following the technique used by Monz et al. (2019) and suggested by Streetlight, ten calibration zones were placed on roads proximate to the park entrances, but not on major highways. The calibration factors for each zone were averaged and applied to all polygons. Polygons were not examined for pass through use since we were only interested in arrivals—meaning trips ending in those zones.

The ZAA was performed on twelve whole-park polygons to understand visitation throughout the 2018-2021 time period. To gauge the volume of visitation, we only used the data returned

for trips that *ended* in the park polygons, excluding trips that started in the polygons and pass-through activity. InSight calculates an *average daily volume* – meaning it is an average across all days of the week and all days of the year that have been selected for the analysis. To estimate total yearly vehicle arrivals to the park units we took the *average daily volume* and multiplied it by the days in the year.

For seasonal visitation we examined Memorial Day through Labor Day each year as our “peak-season” based and the dates outside of that range as our “off-season”. The same methodology was used for this analysis as mentioned above, except the average daily volume only includes the dates selected for each season.

Results and Discussion

Across all twelve full park polygons, sufficient data were available to determine average daily (Figure 1), yearly (Table 1), peak season (Figure 2) and monthly park visitation (Table 2).

Figure 1. Average Daily Vehicle Arrivals

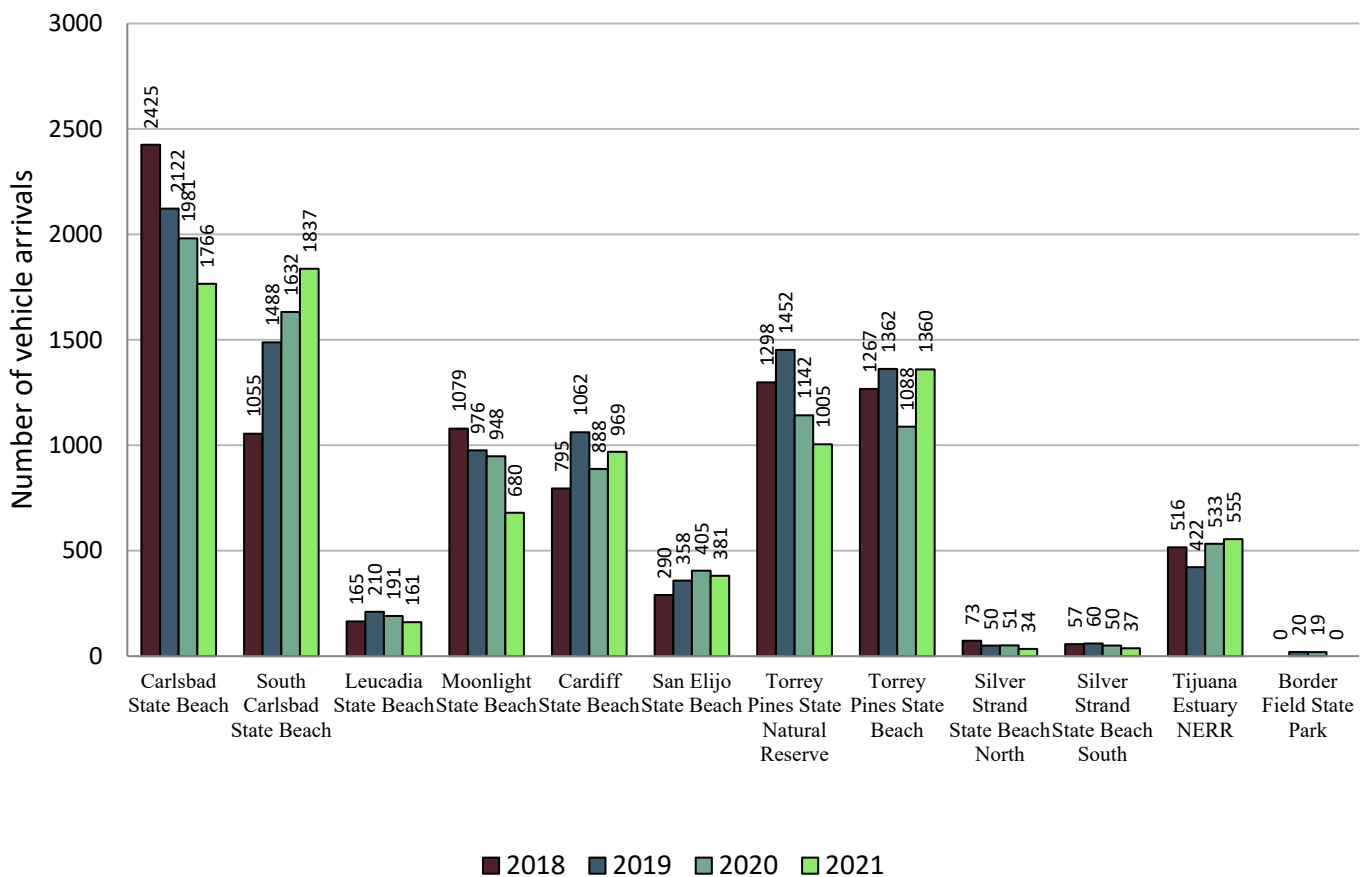
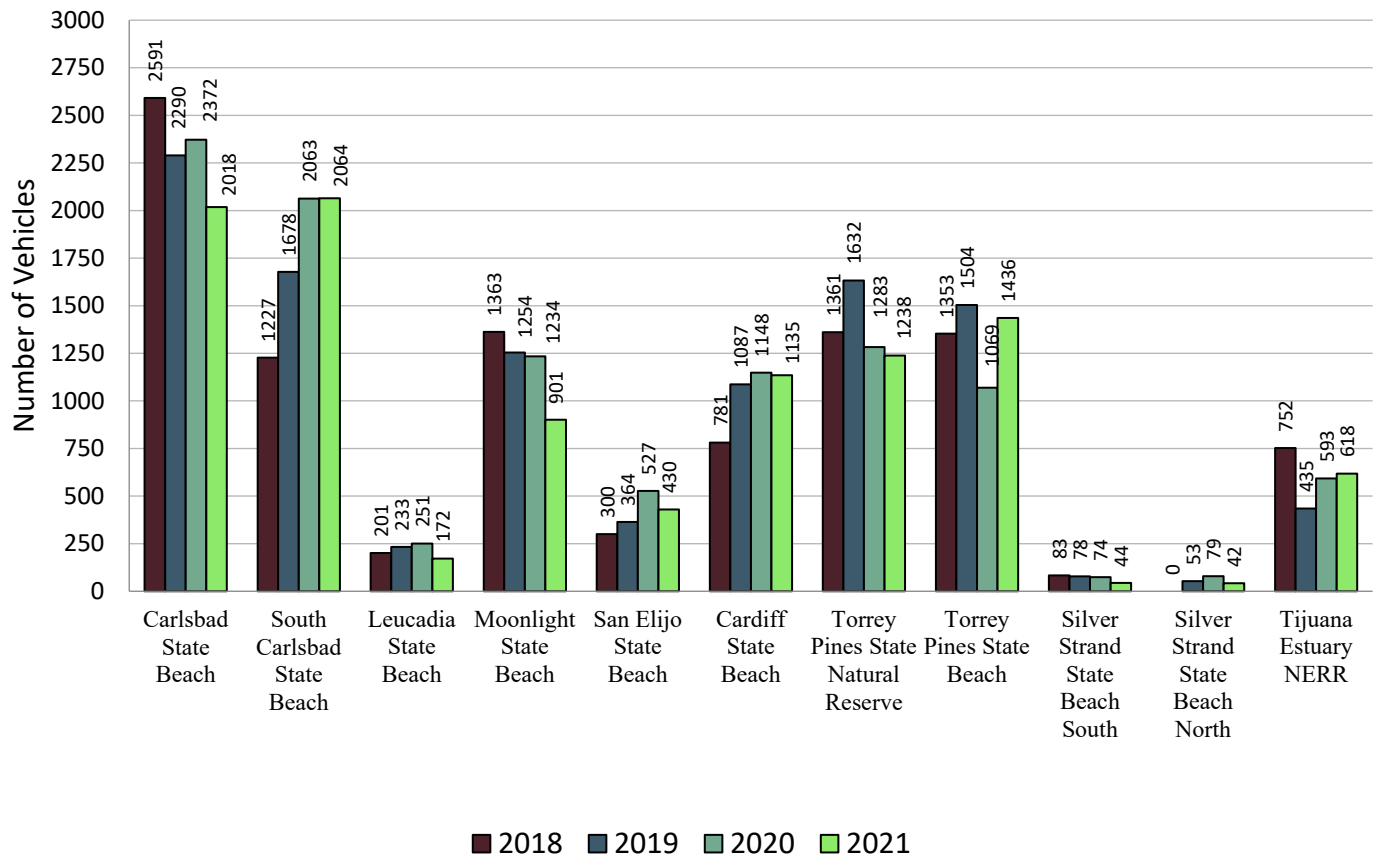


Table 1. Yearly Vehicle Arrivals 2018-2021

	2018	2019	2020	2021
Carlsbad State Beach	885,125	774,530	723,065	644,590
South Carlsbad State Beach	385,075	543,120	595,680	670,505
Leucadia State Beach	60,255	76,650	69,715	58,765
Moonlight State Beach	393,835	356,240	346,020	248,200
Cardiff State Beach	290,175	387,630	324,120	353,685
San Elijo State Beach	105,850	130,670	147,825	139,065
Torrey Pines State Natural Reserve	473,770	529,980	416,830	366,825
Torrey Pines State Beach	462,455	497,130	397,120	496,400
Silver Strand State Beach North	26,645	18,250	18,615	12,410
Silver Strand State Beach South	20,805	21,900	18,250	13,505
Tijuana Estuary NERR	188,340	154,030	194,545	202,575
Border Field State Park	NA	7,300	6,935	NA

Park Unit	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Carlsbad State Beach	2213	1861	1921	2086	2021	2222	1975	1807	1771	1601	1203	1028
South Carlsbad State Beach	2097	1897	1795	1936	1992	2045	2054	1948	1960	1595	1968	1441
Torrey Pines State Beach	1733	1387	1309	1208	1366	1462	1454	1299	1271	1300	1827	1431
Torrey Pines State Natural Reserve	1079	1000	969	1015	1129	1209	1245	1175	1098	995	708	604
Cardiff State Beach	943	937	969	1036	1096	1195	1103	1036	1058	1020	742	688
Moonlight State Beach	730	581	639	719	653	903	927	835	647	493	617	496
Tijuana Estuary NERR	696	601	687	588	497	632	639	541	518	443	604	456
San Elijo State Beach	515	462	346	377	355	430	440	406	394	394	365	247
Leucadia State Beach	228	196	144	171	161	167	183	158	181	NA	NA	NA

Figure 2. Average Daily Vehicle Arrivals (Memorial Day-Labor Day)



Average Daily Visitation

For average daily vehicle arrivals (Figure 1) across the time period (2018-2021), some locations such as Carlsbad State Beach and Moonlight State Beach exhibited declining trends, while others showed no clear trend. South Carlsbad was a notable exception with 2021 arrivals being highest observed during the study period.

It is important to note that Border Field State Park consistently returned very little data, which is likely due to the closed/restricted access status of this location due to various managerial factors.

Average Monthly Visitation

Monthly averages (Table 2) show more detail with June and July often exhibiting the highest visitation and December often being the lowest. Notable is the increase in visitation in January which is generally comparable to peak season levels at most park locations.

Average Peak Season Visitation

Peak season use is generally higher for most but not all locations. For example, Carlsbad State Beach average use was approximately 12.3% higher in 2021 for peak season versus the average across all times of year, while Leucadia State Beach was not remarkably different.

Average Annual Visitation

Yearly vehicle arrivals (Table 1) mirror the same trends but are represented as total yearly counts as previously described.

Question 2: What are the average hourly vehicle arrivals for each calendar year?

Methods

Hourly vehicle arrivals to the park were also derived using the ZAA tool. Instead of selecting all times of day, we chose hourly bins to get an *average arrival* for each hour of the day across all days of the year. Again, these were the average vehicle trips ending in these zones per hour, averaged across all days of the year.

Results and Discussion

Average hourly arrival patterns (Figures 3-11) across all areas show a general pattern of increasing arrivals through the morning hours with a peak of early arrivals occurring approximately at the noon to 1 PM timeframe. Notable is an afternoon peak, which occurs in many parks in urban-proximate areas, often in the 4 to 5 PM hour. Some locations, such as Cardiff State Beach, have strong evening peak arrivals that exceed the noontime maxima (Figure 3). Three beaches, the two Silver Strand beaches and Border Field State Park, returned insufficient data on an hourly basis and are not included in this analysis.

Figure 3. Average Hourly Vehicle Arrivals to Cardiff State Beach

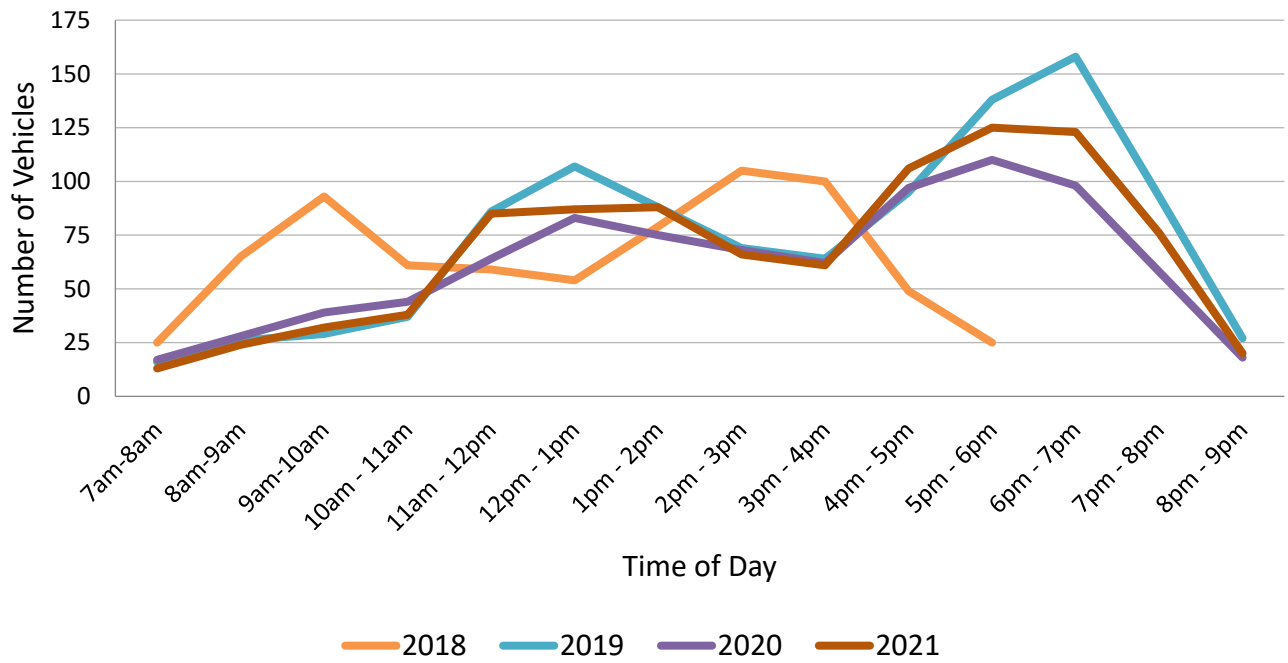


Figure 4. Hourly Arrivals to Leucadia State Beach

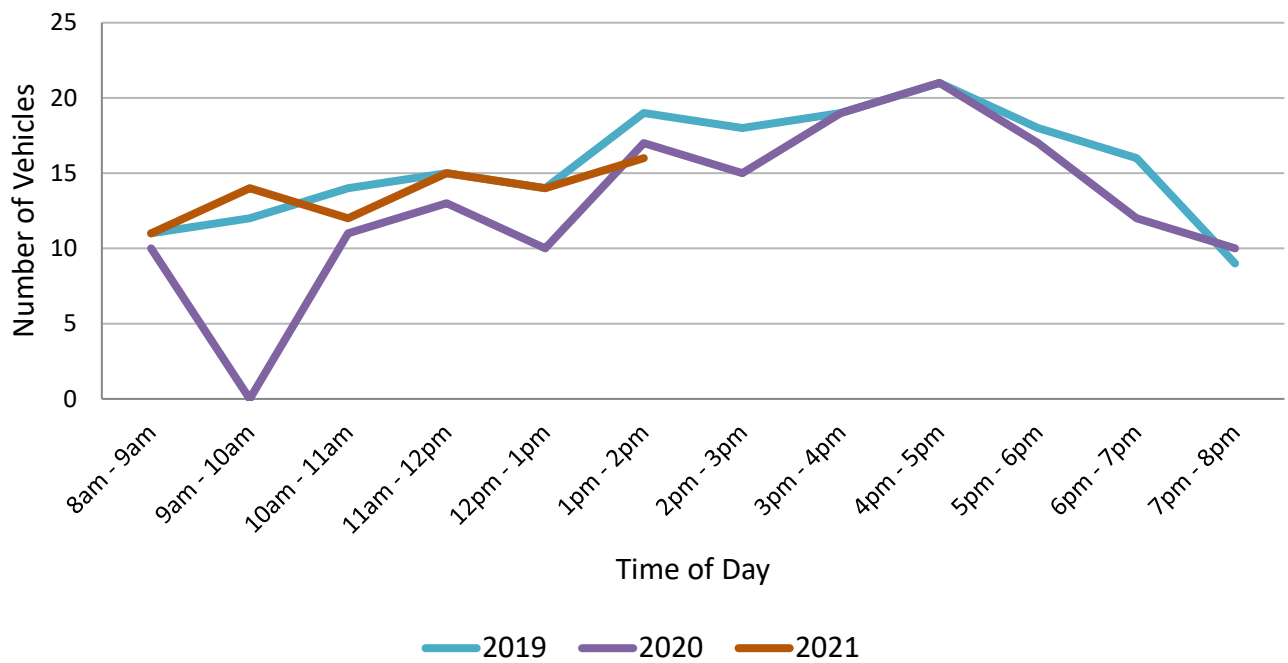


Figure 5. Hourly Vehicle Arrivals to Moonlight State Beach

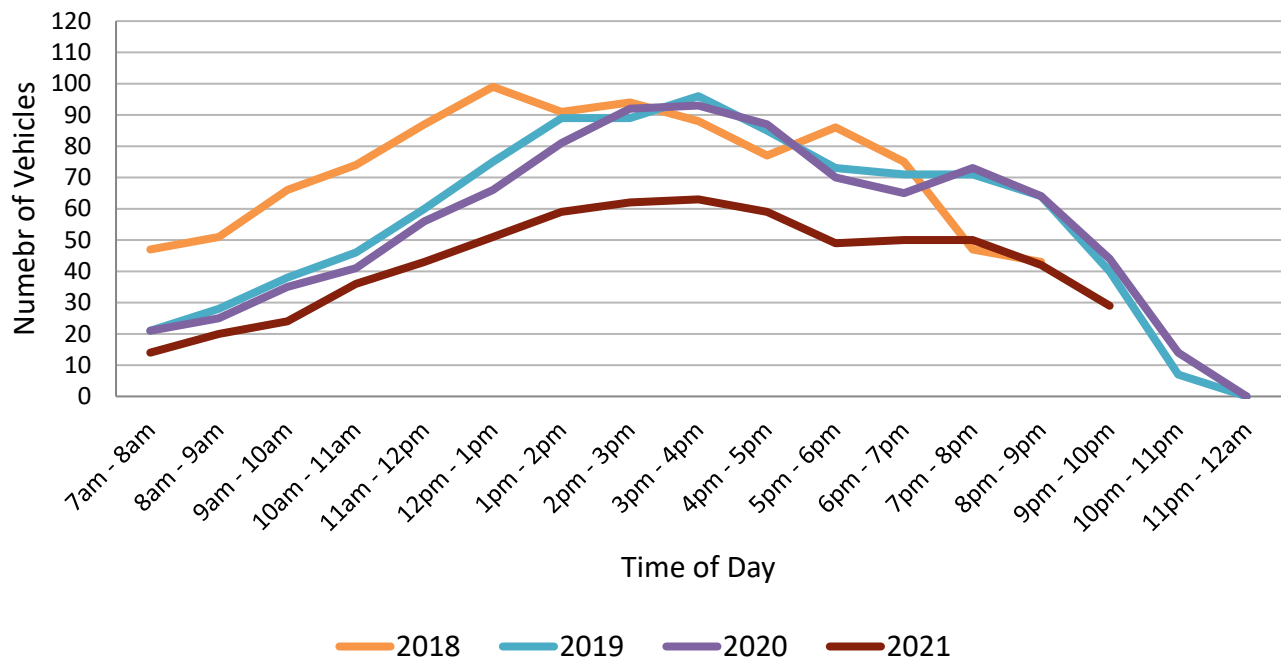


Figure 6. Average Hourly Vehicle Arrivals for Carlsbad State Beach

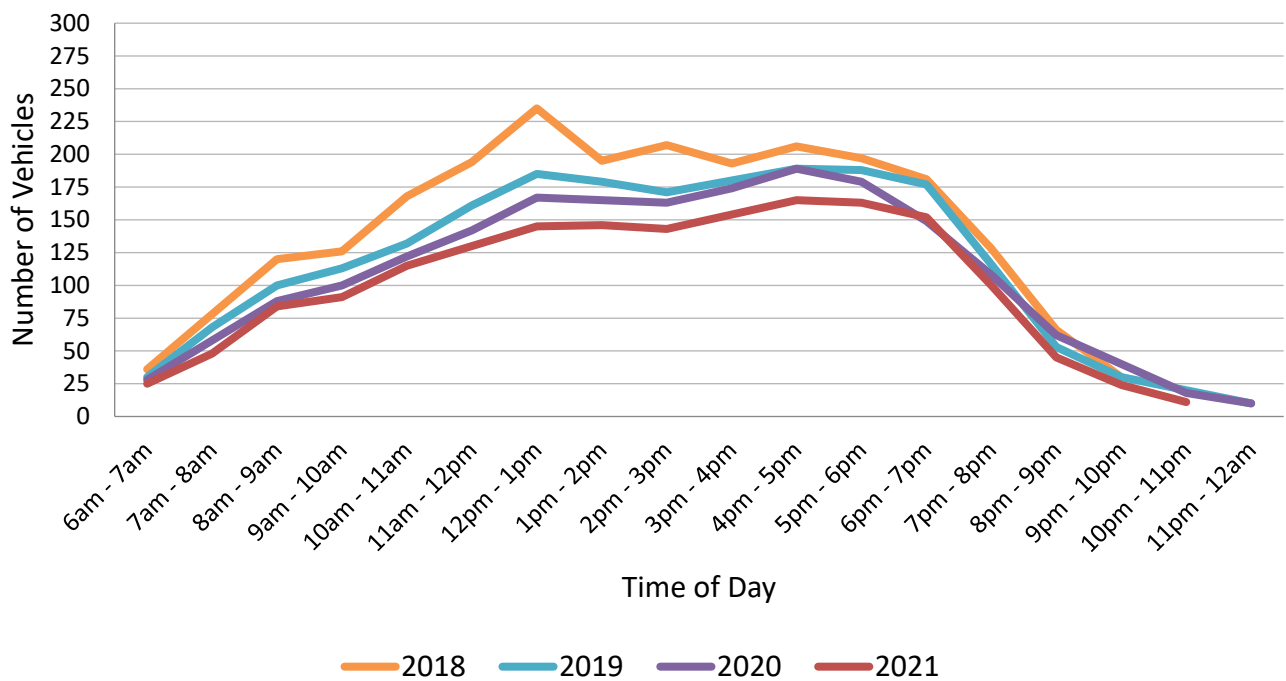


Figure 7. Average Hourly Vehicle Arrivals for South Carlsbad State Beach

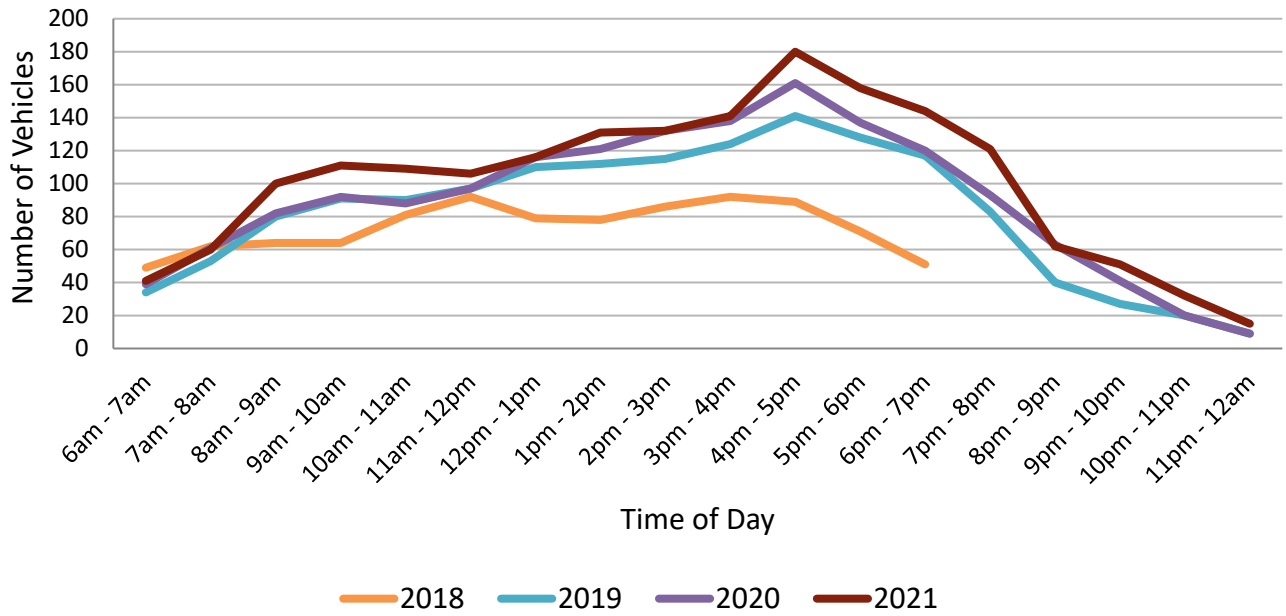


Figure 8. Average Hourly Vehicle Arrivals for San Elijo State Beach

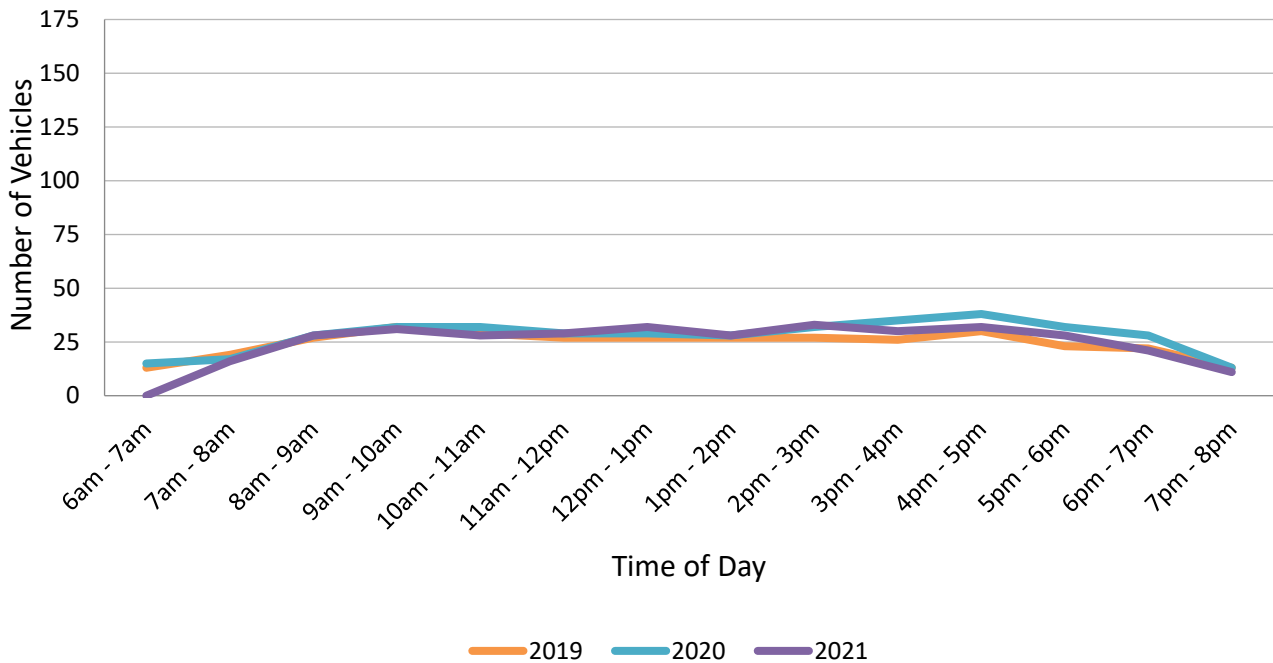


Figure 9. Hourly Vehicle Arrivals to Tijuana Estuary NERR

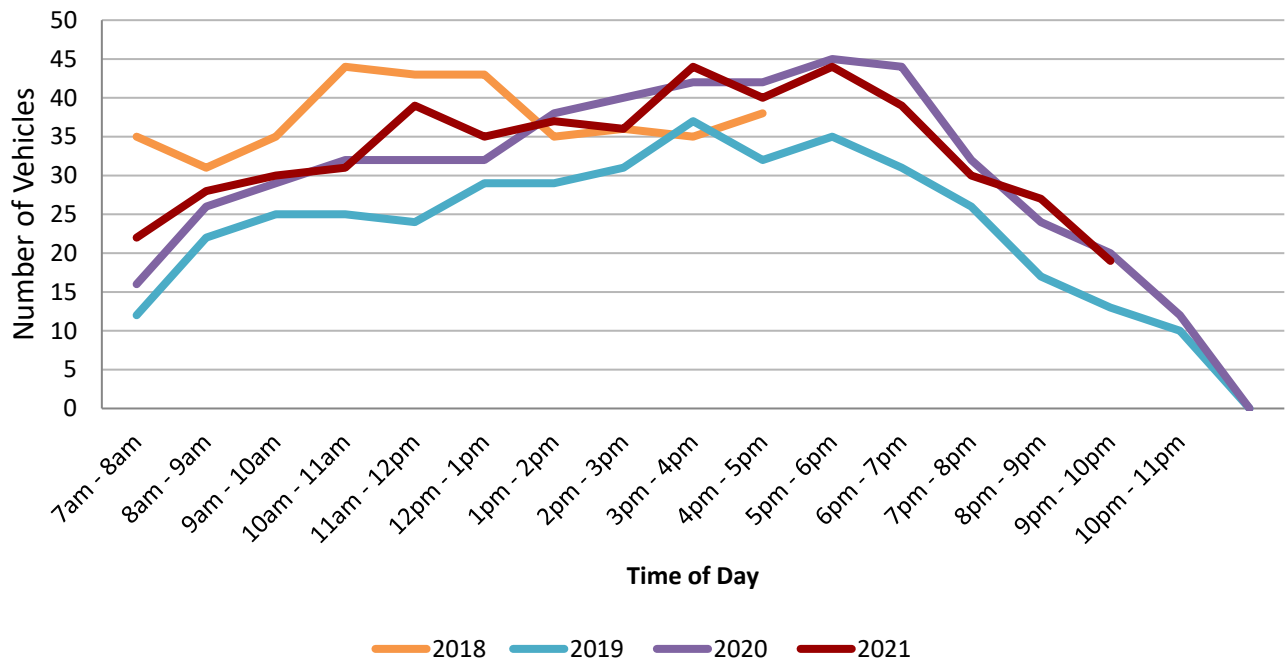


Figure 10. Hourly Vehicle Arrivals to Torrey Pines State Beach

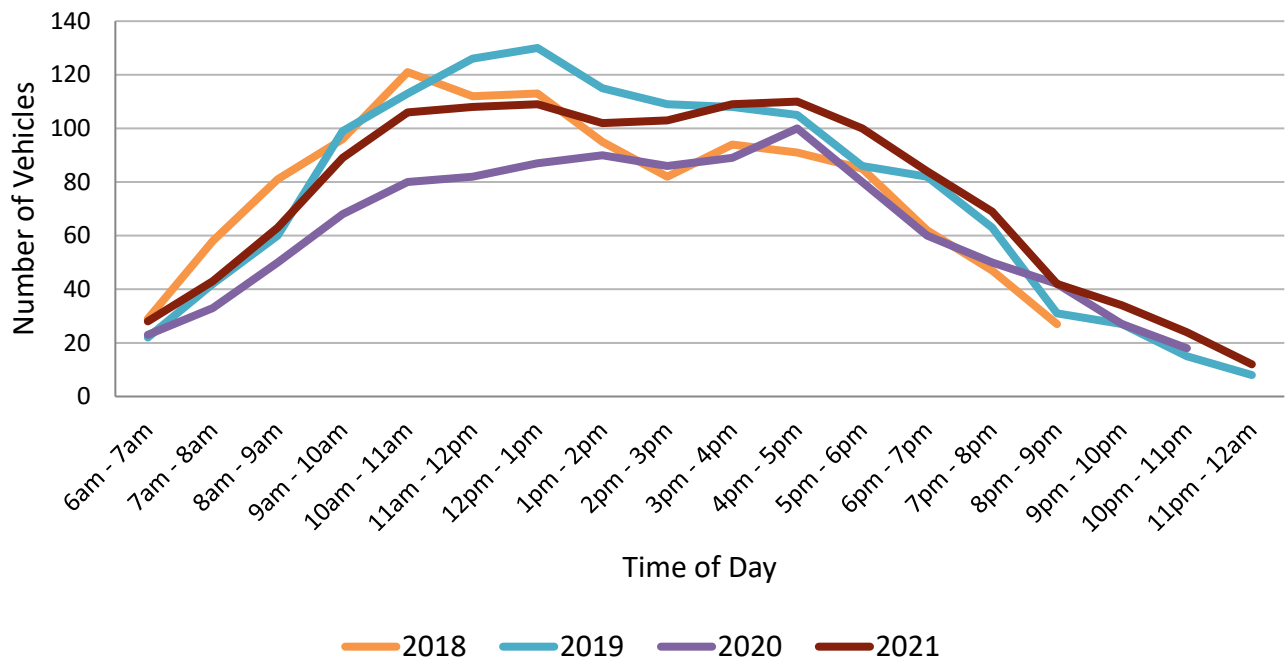
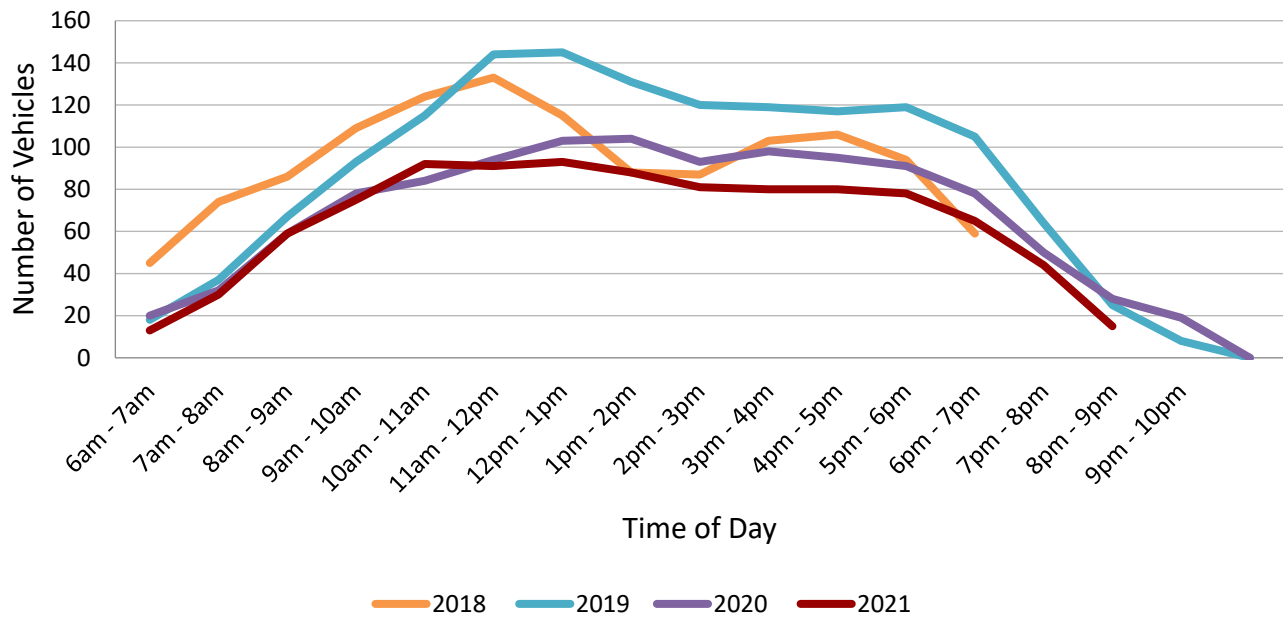


Figure 11. Hourly Vehicle Arrivals to Torrey Pines
State Natural Reserve



Question 3: What is the number of daily parking lot car arrivals?

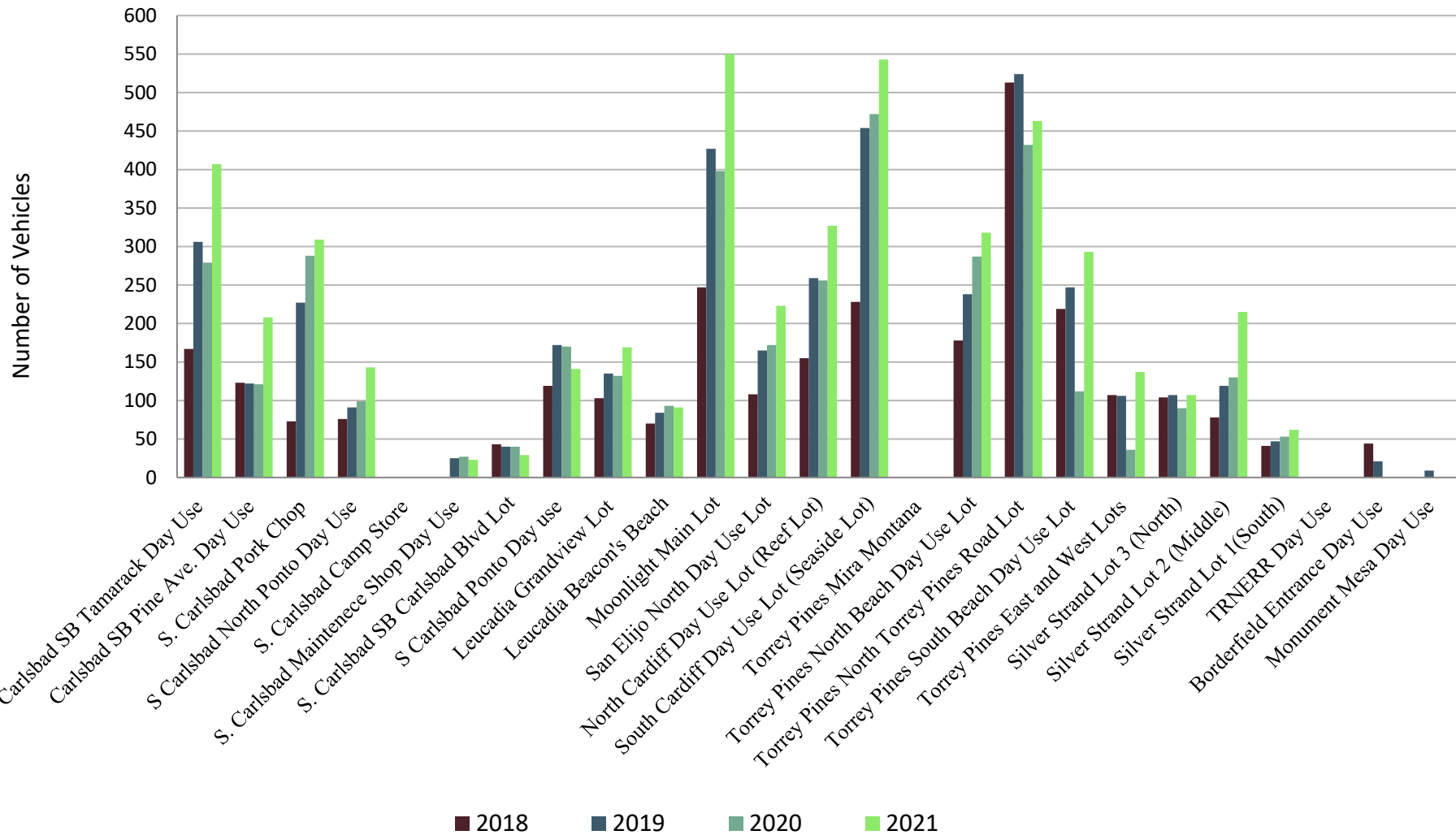
Methods

The ZAA was performed on parking lot polygons for 2018-2021 to understand vehicle arrivals specifically in these locations. To gauge the volume of parking lot arrivals, we only used the data returned for trips that *ended* in the park polygons, excluding trips that started in the polygons. The platform calculates an *average daily volume* – meaning it is an average across all days of the week and all days of the year that have been selected for the analysis.

Results and Discussion

Where possible and specified by the available polygons, we determined average daily parking lot arrivals (Figure 12) to all locations. Overall trends suggest increased parking lot arrivals in 2021, which in many cases is a continuation of trends of annual increases, but also is a significant spike in arrivals in several locations such as the Moonlight main lot and Carlsbad State Beach Tamarack Day use.

Figure 12. Average Daily Parking Lot Arrivals



Question 4: How many visitors are using park beaches and campgrounds?

Methods

Because there is no motor vehicle access to the beaches within the whole park units, we ran the ZAA for twelve separate beach polygons provided by Coastal Quest using the *Pedestrian Tool* within the Streetlight platform. Because we did not have access to any location specific counts or trail counter data to calibrate the pedestrian tool, we used the Streetlight Pedestrian Index, which is best viewed as an index of arrivals and to make relative comparisons zones to one another (Streetlight Data, 2022). Pedestrian trips based on device behavior were derived for *average daily arrivals* as well as ‘peak season’ and ‘off-season’ use, using the same methodology as noted above.

Campground visitation was measured using the Single Factor Vehicle Calibration tool within the ZAA tool. There were three individual campgrounds designated into their own unique polygon. We ran analyses for all years available on the platform (2018-2021) as well as ‘peak-season’ and ‘off-season’ metrics. The output for this analysis was *average daily arrivals* for vehicles.

Results and Discussion

Beach visitation (Figure 13) has increased in all locations since 2018, with 2021 levels being similar to or slightly greater than 2020 levels. Campground location vehicle arrivals have increased substantially in 2021 from previous years (Figure 14). Seasonal examinations of beach and campground use across all years shows a strong trend of increased use during peak season (Memorial Day through Labor Day) compared to off-season.

Figure 13: Average Daily Beach Visitation

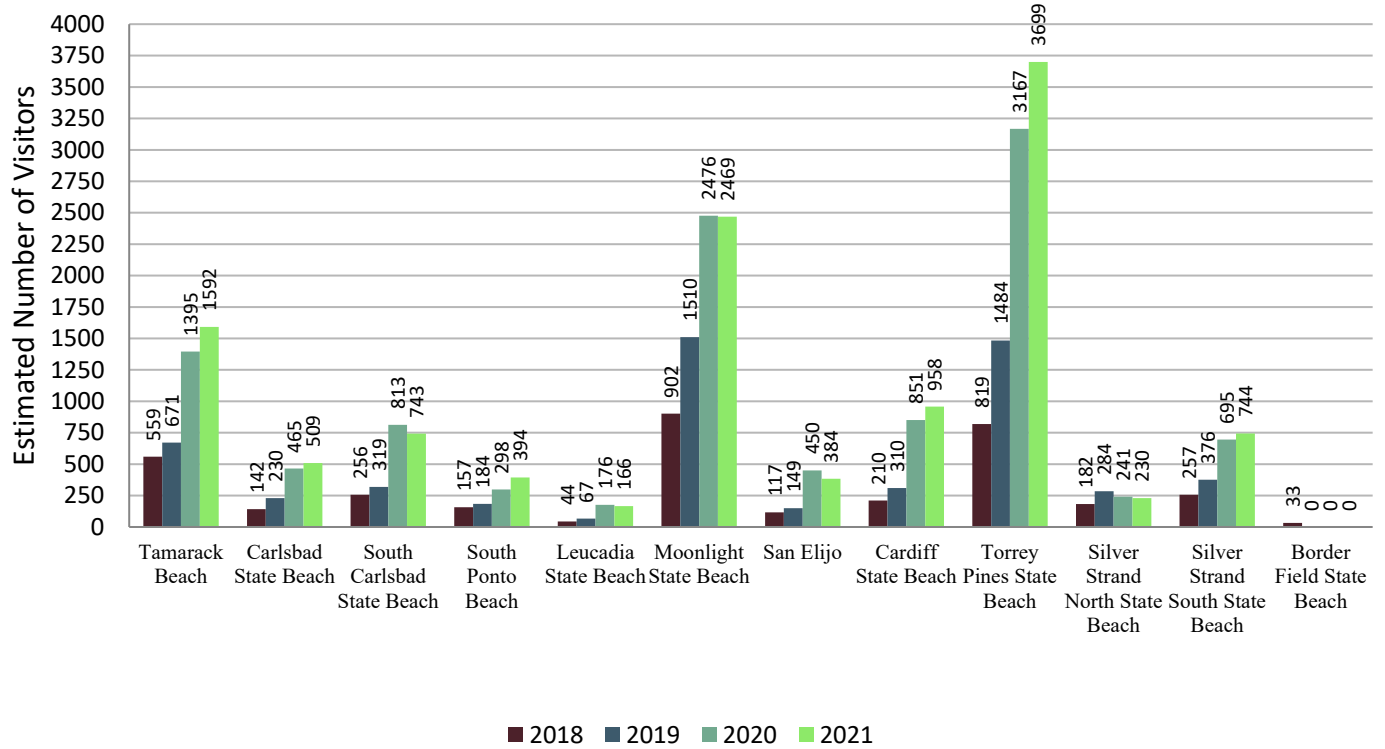
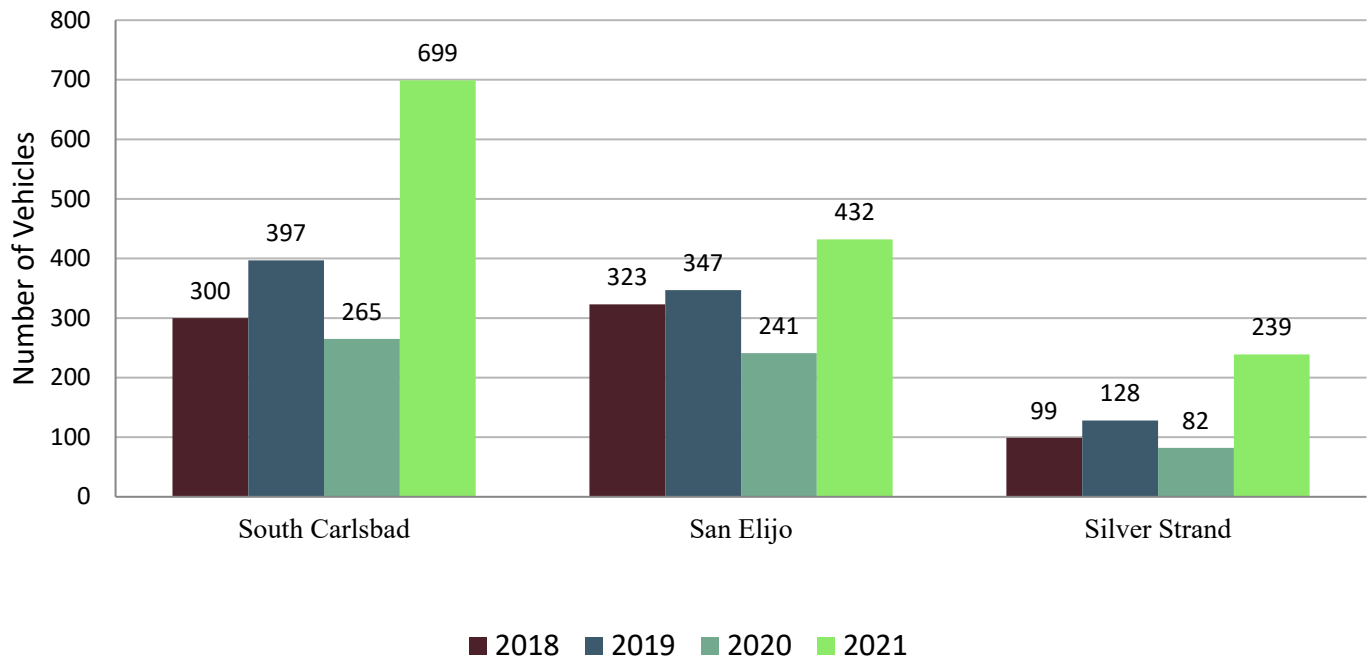


Figure 14: Daily Vehicle Arrivals to Campgrounds



Question 5: What are the most used point locations (i.e., entry points, road, and trail locations) in each park unit?

Methods

We used the virtual features (i.e., geofences; virtual gates) provided by State Parks and the Pedestrian tool (where appropriate) to determine how many devices passed through specific locations of interest. In a geographic information systems (GIS) environment, a geofence is a simple virtual feature—in this case a polyline—placed directly over the location of interest. We examined these features in a bi-directional manner to capture devices traveling both ways along the line. The virtual feature corresponds with three actual features on the landscape, roads, trails, and bike paths. Therefore, the ZAA was run three separate ways specifying the most appropriate analysis strategy, i.e., vehicles numbers were estimated on road features, pedestrians were examined on trails and bicycles on bike paths. We conducted this analysis for the 2021 calendar year only as this was the most complete data set available for pedestrians and bicycles.

Results and Discussion

A wide range of locations were successfully examined in the parks for pass-through activity (Table 3). This analysis demonstrates that adequate pedestrian data are available for these locations and consequently future monitoring of trends of use would be possible. These findings also suggest locations of intensive use for facility maintenance and monitoring.

Table 3. Average Daily Activity at Specific Locations (Geo-fence Locations)	
Gate Name/ID	Daily pass-through count estimates (2021)
Tamarack Boardwalk	2158
Carlsbad Blvd Sidewalk	790
Carlsbad Blvd Beach Access	151
S Carlsbad S Beach Access Path	270
South Ponto Beach Path	385
S Carlsbad Beach Access (off of Tattenham Rd)	355
Moonlight Ln Beach Access	879
San Elijo Beach Path (Lifeguard 19)	778
San Elijo Beach Access (by restrooms)	216
San Elijo Beach Access (Campsite Dr to Lifeguard Tower)	199
San Elijo Amphitheater	315
San Elijo Beach Access (Campground)	175
San Elijo (Bay Access)	154
N Torrey Pines Rd Beach Access	679
Torrey Pines Park Rd*	1817
Torrey Pines Park Rd (Golf Course)*	98
Broken Hill Trail Beach Access	605
Flintkote Ave*	38
Silver Strand Beach Parking Lot Access *	754
Silver Strand Bike Path North**	232
Silver Strand Bike Path South**	70
All numbers are derived from the pedestrian tool unless otherwise noted	
* Pass-throughs derived from <i>vehicle tool</i>	
** Pass-throughs derived from <i>bicycle tool</i>	

Question 6: Where are SDCD park visitors coming from?

Methods

Visitor home geographies and associated US Census-based demographic data can be included in any analysis conducted with the Streetlight platform. The home location is derived from where a device is located between 7pm and 8am. The Streetlight algorithm assigns the devices to a particular one-kilometer grid, which is chosen as a home grid for the device if it is one of the top five locations for the month where the device is located (Streetlight Data, 2022). Aggregating home location data allows the assignment to other standard geographies like ZIP-codes (Streetlight Data, 2022), which was our unit of analysis for home location for this study. As stated previously, these data are anonymous and aggregated and thus impossible to associate with any one individual.

Results and Discussion

Average daily arrivals analyzed by ZIP code tend to show a strong trend of local visitation, with the highest number of visitors arriving from locations less than five miles away, across all parks (Figures 15 to 23). Note that also for this analysis the two Silver Strand beaches and Border Field State Park returned insufficient data on an hourly basis and thus are not included.

Figure 15. Primary ZIP Codes for Visitor to Cardiff State Beach

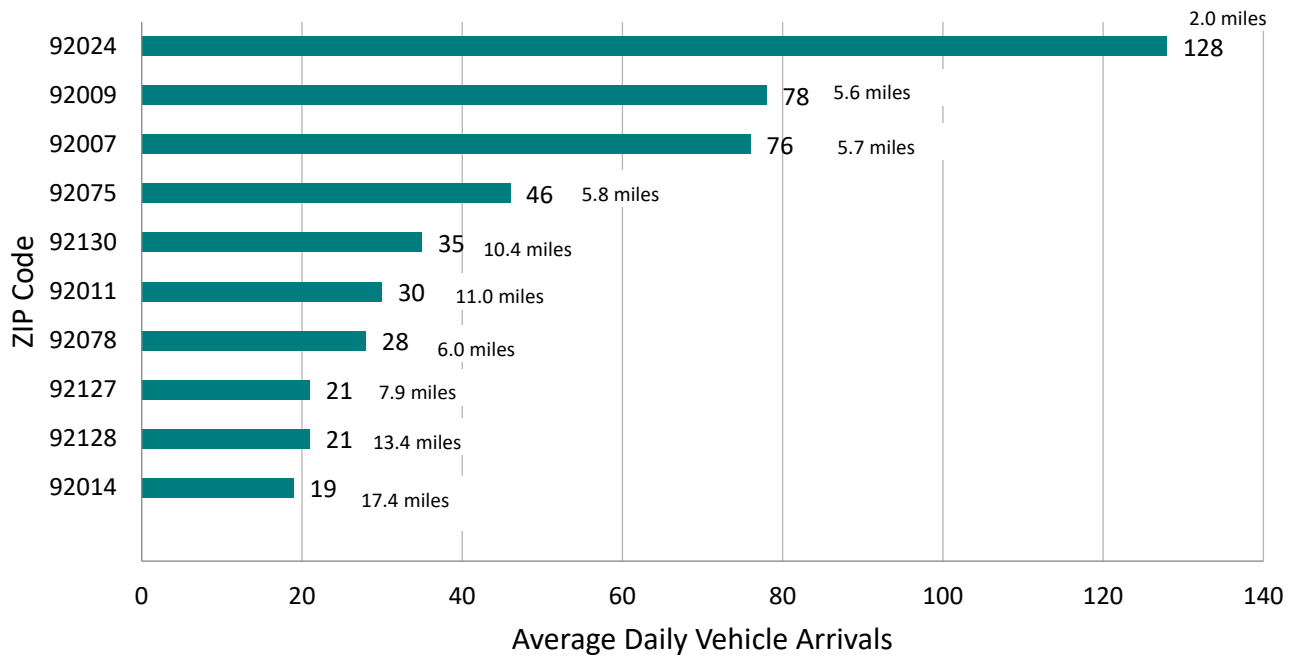


Figure 16. Primary ZIP Codes for Visitors to Carlsbad State Beach

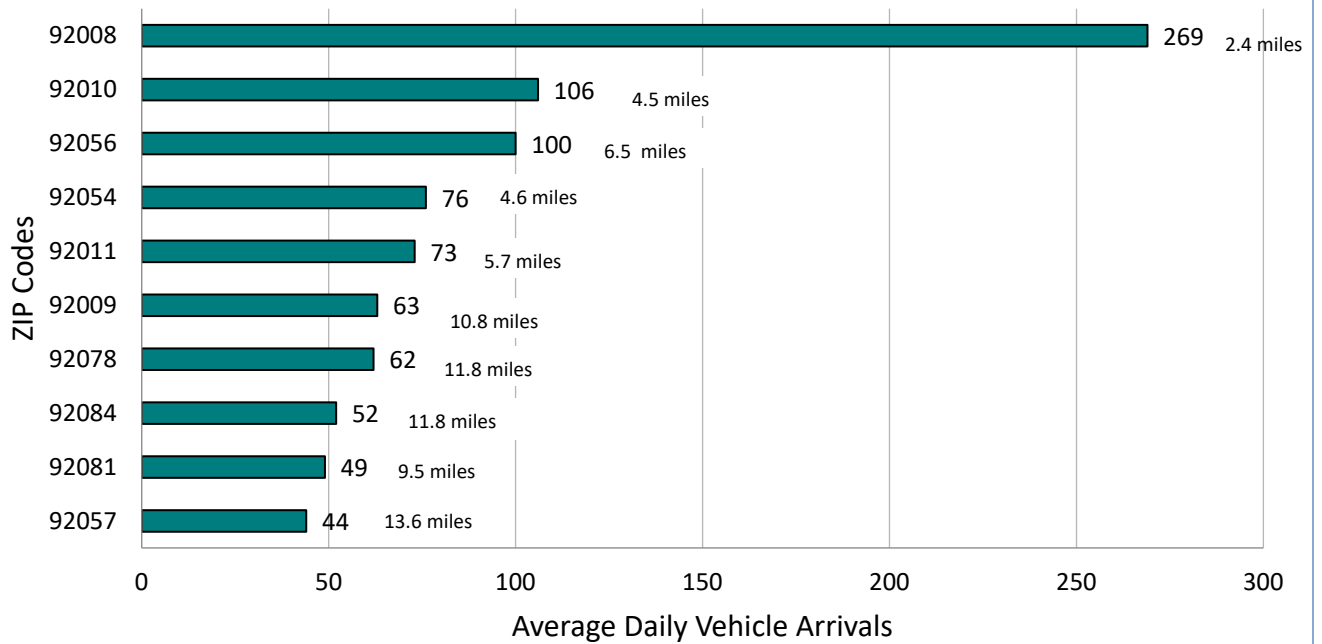


Figure 17. Primary ZIP Codes for Visitors to South Carlsbad State Beach

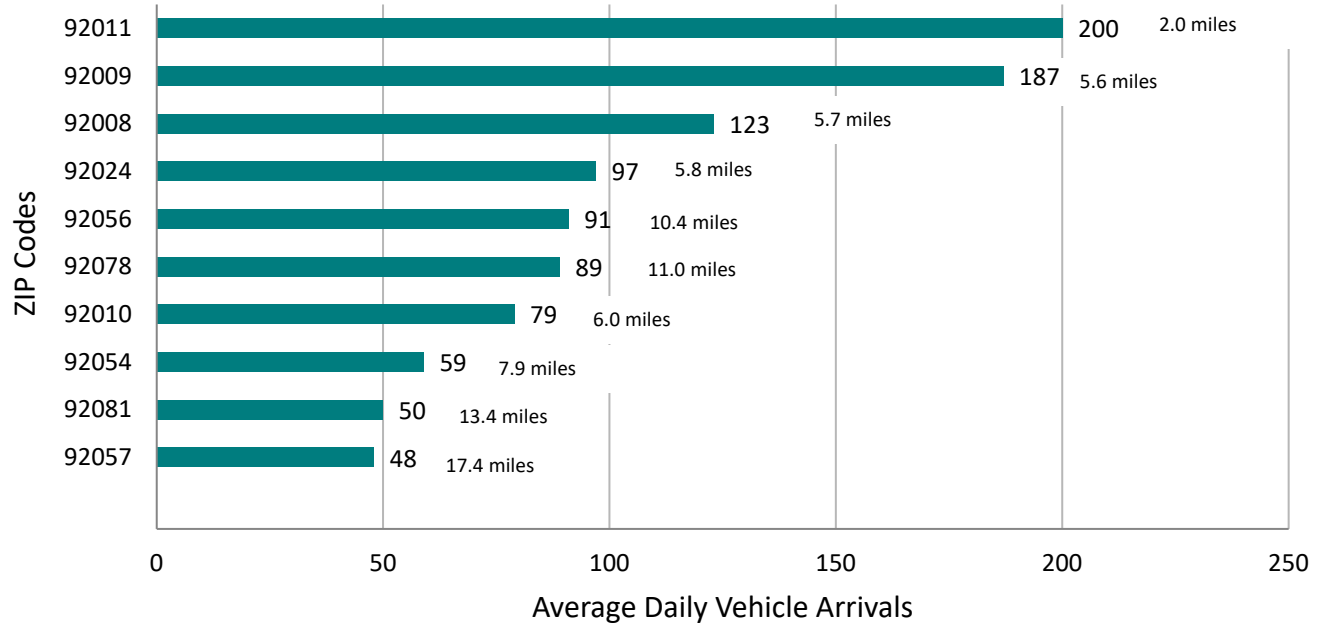


Figure 18. Primary ZIP Codes for Visitors to San Elijo State Beach

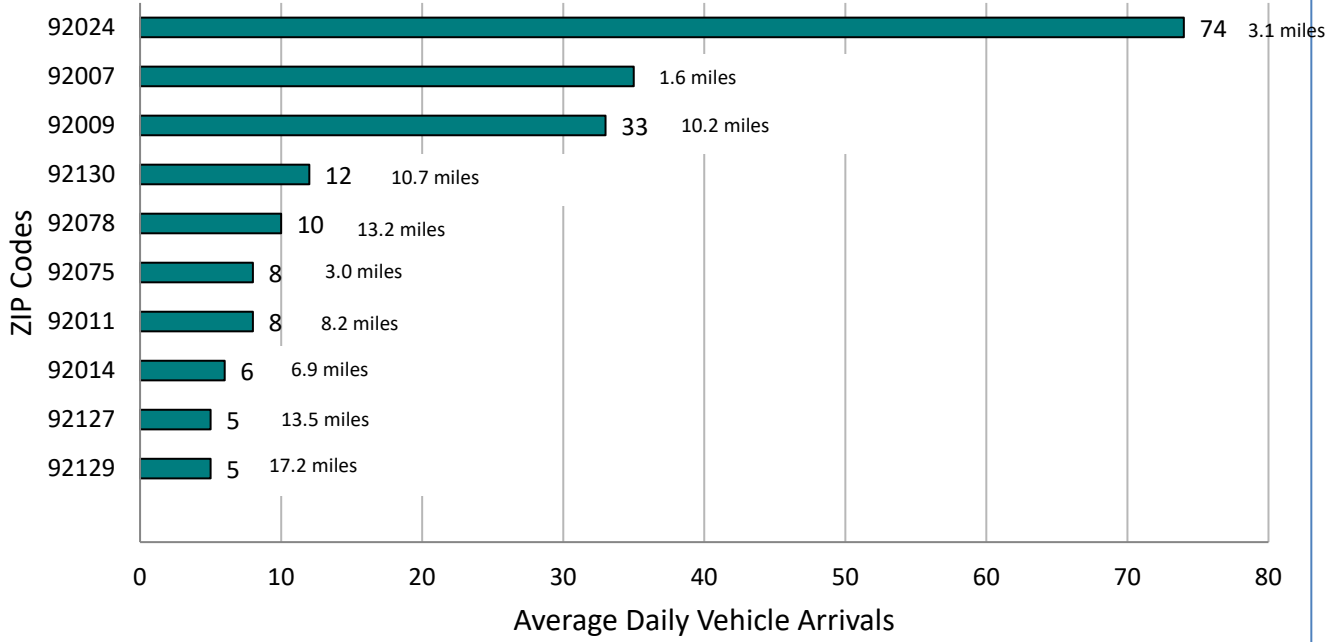


Figure 19. Primary ZIP Codes for Visitors to Leucadia State Beach

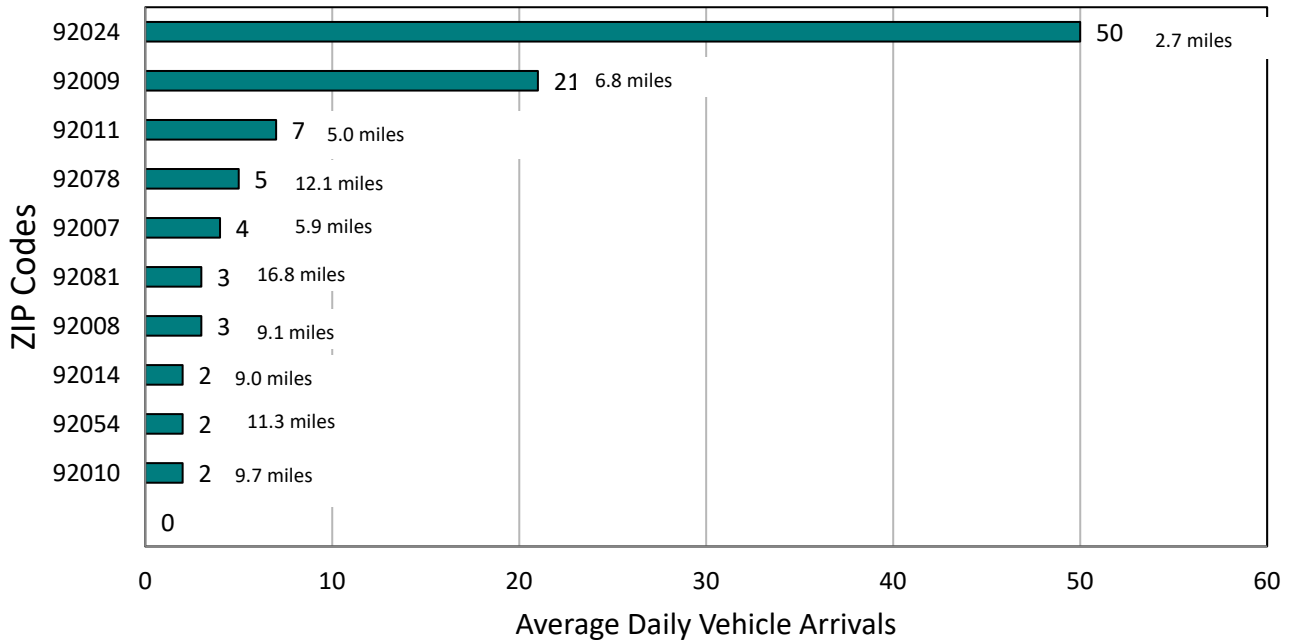


Figure 20. Primary ZIP Codes for Visitors to Moonlight State Beach

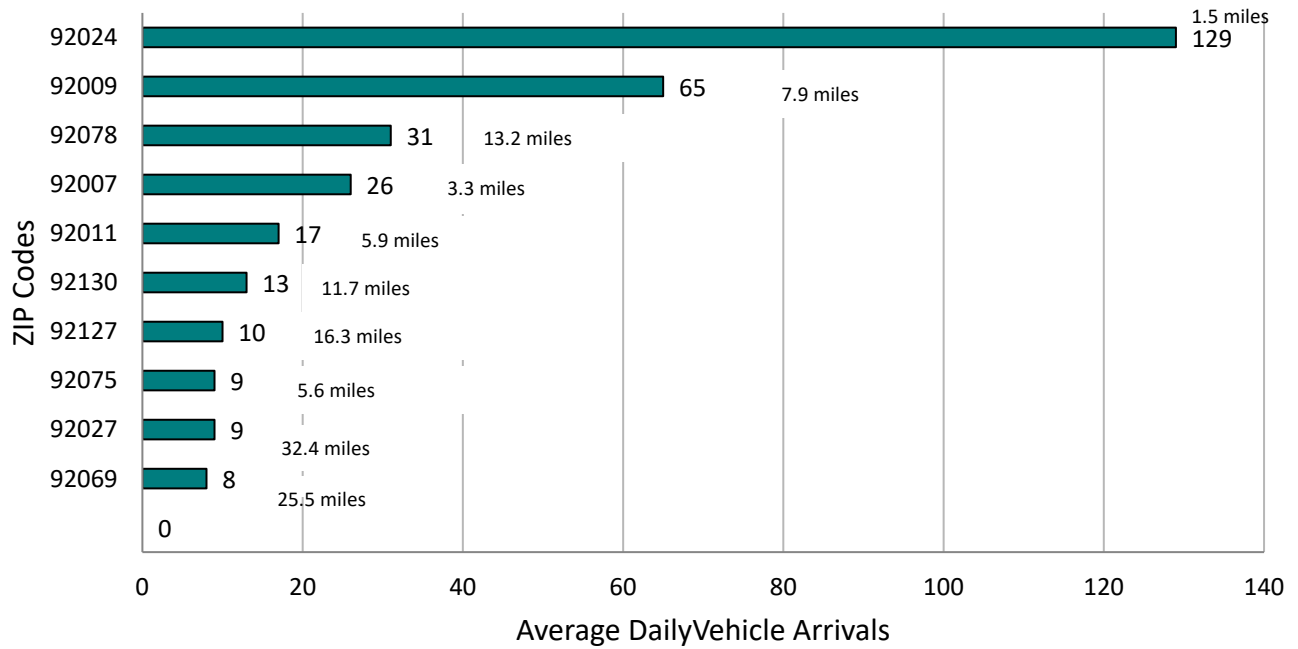


Figure 21. Primary Zip Codes for Visitors to Torrey Pines State Beach

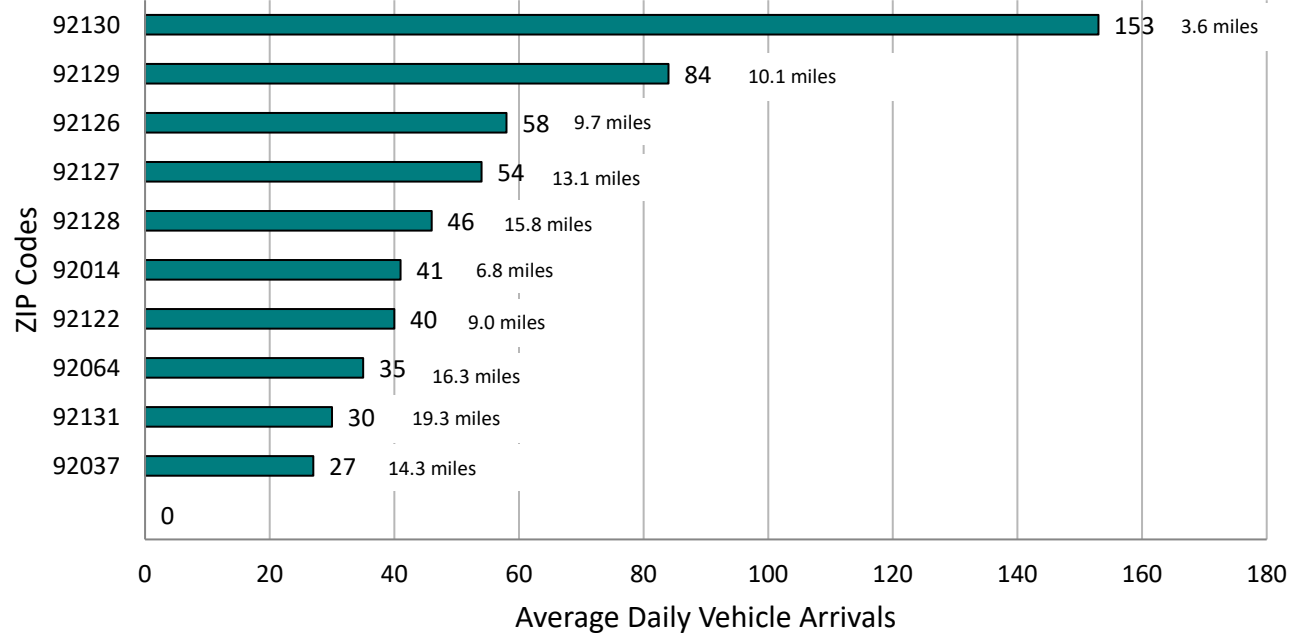


Figure 22. Primary Zip Codes for Visitors to Torrey Pines State Natural Reserve

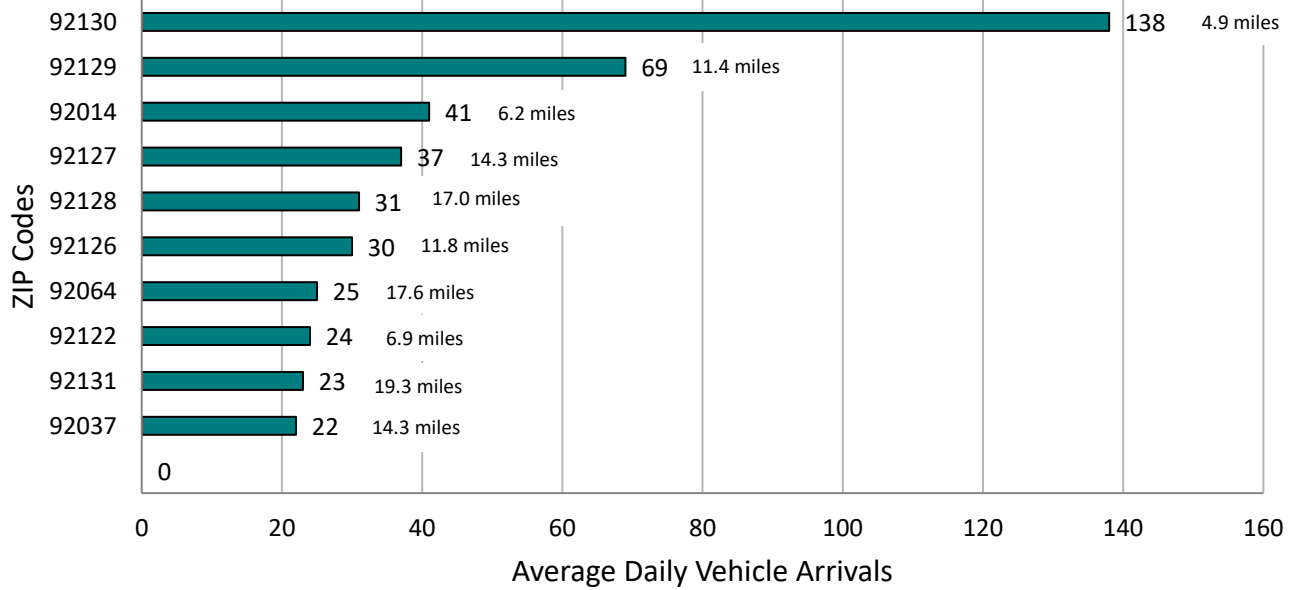
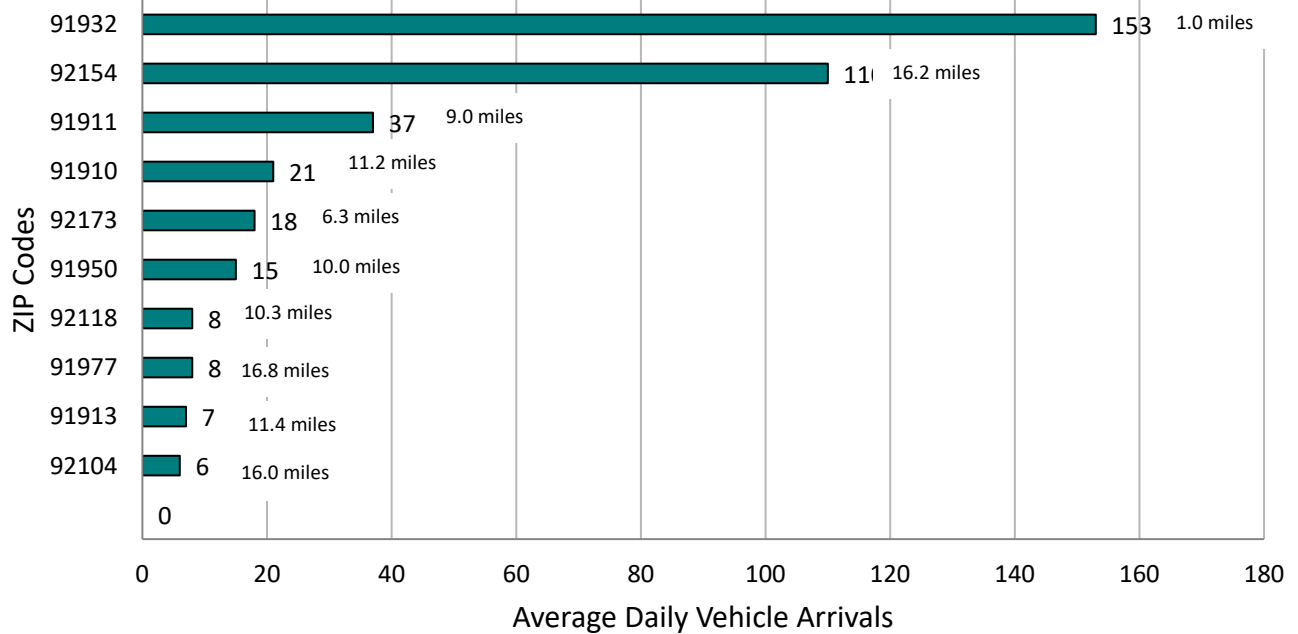


Figure 23. Primary ZIP Codes for Visitors to Tijuana Estuary NERR



Question 7: What are the demographics of SDCD park visitors?

Methods

All demographic data was derived via the InSight platform based on the census block determination as described under Question 6 (above) and the most currently available US Census data as of when we performed the analysis in January through May of 2022 (Streetlight Data, 2022). Demographic data on race and income were determined in aggregate, which is the average by US Census Block.

Table 4. Visitor Race by Park
(% of total visitor population)

Park Unit	White		Black		Indian		Asian		Islander		Other Race		Multiple Races		Hispanic	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Carlsbad State Beach	75.7%	76.0%	2.7%	2.8%	0.8%	0.7%	7.4%	7.3%	0.4%	0.4%	8.4%	8.4%	4.6%	4.4%	22.3%	21.9%
South Carlsbad State Beach	76.9%	75.8%	2.3%	2.6%	0.6%	0.7%	7.8%	7.7%	0.3%	0.4%	7.5%	8.2%	4.6%	4.6%	19.9%	21.1%
Leucadia State Beach	80.0%	81.6%	1.7%	1.9%	0.5%	0.6%	7.0%	6.2%	0.2%	0.2%	6.6%	5.5%	4.0%	4.0%	16.8%	15.1%
Moonlight State Beach	77.3%	77.5%	2.2%	2.4%	0.6%	0.6%	8.8%	8.5%	0.3%	0.3%	6.5%	6.5%	4.3%	4.2%	17.4%	17.2%
San Elijo State Beach	79.7%	79.5%	1.8%	2.1%	0.5%	0.5%	8.6%	8.2%	0.2%	0.2%	5.2%	5.4%	4.0%	4.1%	14.8%	15.5%
Cardiff State Beach	80.3%	79.7%	1.8%	2.1%	0.5%	0.5%	8.6%	9.0%	0.2%	0.2%	4.7%	4.6%	3.9%	3.9%	13.9%	13.7%
Torrey Pines State Beach	68.1%	68.1%	3.3%	3.5%	0.5%	0.5%	17.2%	16.6%	0.3%	0.3%	5.9%	6.4%	4.7%	4.6%	16.6%	17.5%
Torrey Pines State Natural Reserve	70.1%	70.7%	2.8%	3.1%	0.5%	0.5%	16.3%	15.3%	0.3%	0.3%	5.4%	5.6%	4.6%	4.5%	15.4%	15.8%
Silver Strand State Beach North	68.0%	70.6%	4.6%	4.3%	0.7%	0.8%	9.8%	9.1%	0.5%	0.5%	11.5%	10.2%	4.9%	4.5%	31.3%	28.6%
Silver Strand State Beach South	66.2%	67.7%	4.3%	4.6%	1.0%	0.9%	11.0%	8.7%	0.4%	0.3%	12.2%	13.0%	4.9%	4.8%	33.2%	32.3%
Tijuana Estuary NERR	61.3%	61.0%	4.5%	4.5%	0.9%	0.9%	9.4%	9.2%	0.5%	0.5%	17.9%	18.2%	5.5%	5.7%	47.7%	48.6%
Border Field State Park	61.8%		6.2%		0.4%		9.9%		0.4%		16.0%		5.3%		47.5%	

**Table 5. Visitor Income Profile by Park Unit
(% of total visitor population)**

Park Unit	Less than \$20K		20K to \$35K		\$35K to \$50K		\$50K to \$75K		\$75K to \$100K		\$100K to \$125K		\$125K to \$150K		\$150K to \$200K		More than \$200K	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Carlsbad State Beach	10.5%	10.7%	11.6%	11.6%	12.4%	12.2%	17.2%	17.4%	14.1%	14.2%	10.7%	10.5%	7.6%	7.5%	8.3%	8.2%	7.6%	7.7%
South Carlsbad State Beach	9.9%	10.3%	10.6%	10.9%	11.1%	11.4%	16.0%	16.4%	13.6%	13.5%	10.9%	10.7%	8.2%	8.1%	9.4%	9.1%	10.3%	9.6%
Leucadia State Beach	10.8%	10.4%	10.1%	10.0%	10.3%	10.4%	14.1%	14.8%	13.3%	13.0%	11.0%	11.2%	7.5%	7.6%	10.2%	10.4%	12.7%	12.2%
Moonlight State Beach	10.0%	10.5%	9.8%	10.1%	10.3%	10.4%	14.8%	15.4%	13.2%	12.9%	11.0%	11.0%	8.1%	7.9%	10.1%	9.6%	12.7%	12.2%
San Elijo State Beach	9.5%	10.1%	8.9%	9.5%	9.9%	10.2%	14.7%	15.1%	12.8%	13.0%	11.1%	10.8%	8.6%	8.6%	10.6%	10.1%	13.9%	12.6%
Cardiff State Beach	9.6%	9.7%	8.9%	9.0%	9.7%	9.7%	14.2%	14.6%	12.8%	12.9%	11.0%	11.0%	8.1%	8.2%	10.9%	10.6%	14.8%	14.3%
Torrey Pines State Beach	9.9%	10.6%	9.1%	9.7%	9.6%	10.0%	14.7%	14.9%	13.6%	13.6%	11.5%	11.1%	8.3%	8.1%	10.5%	10.0%	12.8%	12.0%
Torrey Pines State Natural Reserve	9.4%	10.1%	8.6%	9.1%	9.1%	9.5%	14.0%	14.2%	13.3%	13.3%	11.6%	11.3%	8.6%	8.3%	11.4%	10.8%	14.0%	13.4%
Silver Strand State Beach North	12.5%	12.1%	13.1%	12.9%	12.9%	12.4%	17.7%	17.3%	14.5%	14.2%	9.9%	10.6%	6.5%	6.9%	7.1%	6.7%	5.8%	6.9%
Silver Strand State Beach South	12.8%	13.1%	12.5%	13.5%	12.1%	13.4%	18.5%	17.2%	14.3%	15.0%	10.4%	9.9%	6.7%	5.8%	6.6%	6.4%	6.1%	5.7%
Tijuana Estuary NERR	15.5%	16.5%	15.8%	16.7%	14.6%	14.8%	19.0%	18.4%	14.3%	14.2%	7.8%	7.3%	5.1%	4.7%	4.3%	4.0%	3.6%	3.4%
Border Field State Park	11.1%		10.8%		13.8%		18.8%		17.0%		11.4%		5.9%		5.0%		6.2%	

Results and Discussion

Across all park units, most visitors identify as white with a low of 61.0% in Tijuana Estuary and highs of over 75% in several locations (Tables 4). Other ethnicities are represented in various degrees, but notable is the higher proportion of Asian visitors in both Torrey Pines locations (approximately 16-17% of total) and the high proportion of Latinx visitors at Tijuana Estuary (48.6% in 2021). We note that some double counting is occurring with these data due to the nature of how “race” was handled in the 2010 Census, that is, Hispanic was included as a separate yes or no question in addition to the race question. Income metrics suggest highest proportion of visitors across many parks fall into the \$75K to 100K income category (Table 5).

Question 8: What are the modes of arrival to SDCD park units?

Methods

We Used Streetlight InSight’s “Multimode” capabilities to determine pedestrian, bike, and bus arrivals for all whole park polygons for 2021, which is the only time period these capabilities were available. We performed a series of zone analyses on the whole park polygons using the pedestrian, bus, and bicycle arrival tools to determine the levels of visitor arrivals by mode.

Results and Discussion

The primary mode of arrival to parks is both by pedestrian access and vehicle access. Pedestrian arrivals to the whole park units are significant suggesting the importance of the parks to local residents and/or the arrival if visitors from informal parking locations. A small number also arrive on bike and via bus systems.

Table 6. Multi-Mode Park Arrivals for 2021

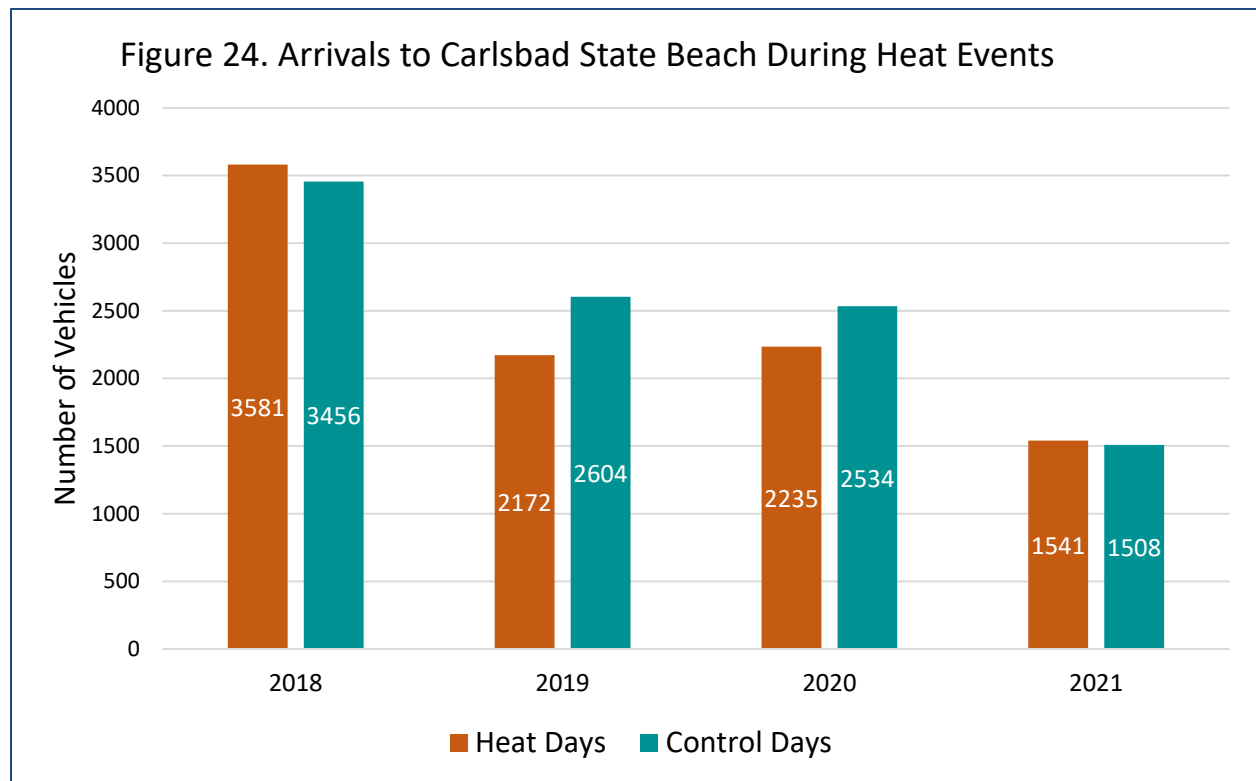
Park Unit	Vehicle Arrivals	Pedestrian Arrivals	Bike Arrivals	Bus Trips
Carlsbad State Beach	1766	6137	151	103
South Carlsbad State Beach	1837	1560	75	80
Leucadia State Beach	161	298	16	1
Moonlight State Beach	680	2403	148	17
Cardiff State Beach	969	1009	41	19
San Elijo State Beach	381	698	42	14
Torrey Pines State Natural Reserve	1005	2960	83	4
Torrey Pines State Beach	1360	3510	72	10

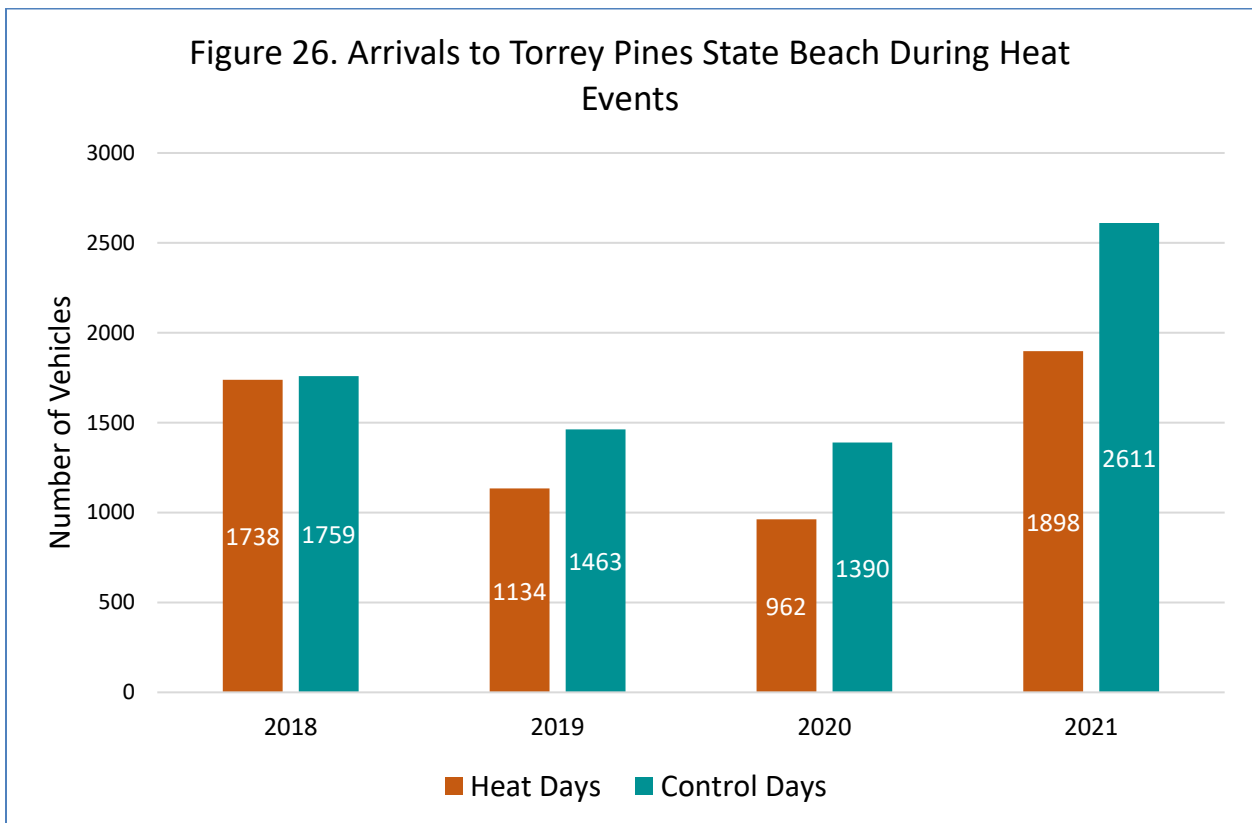
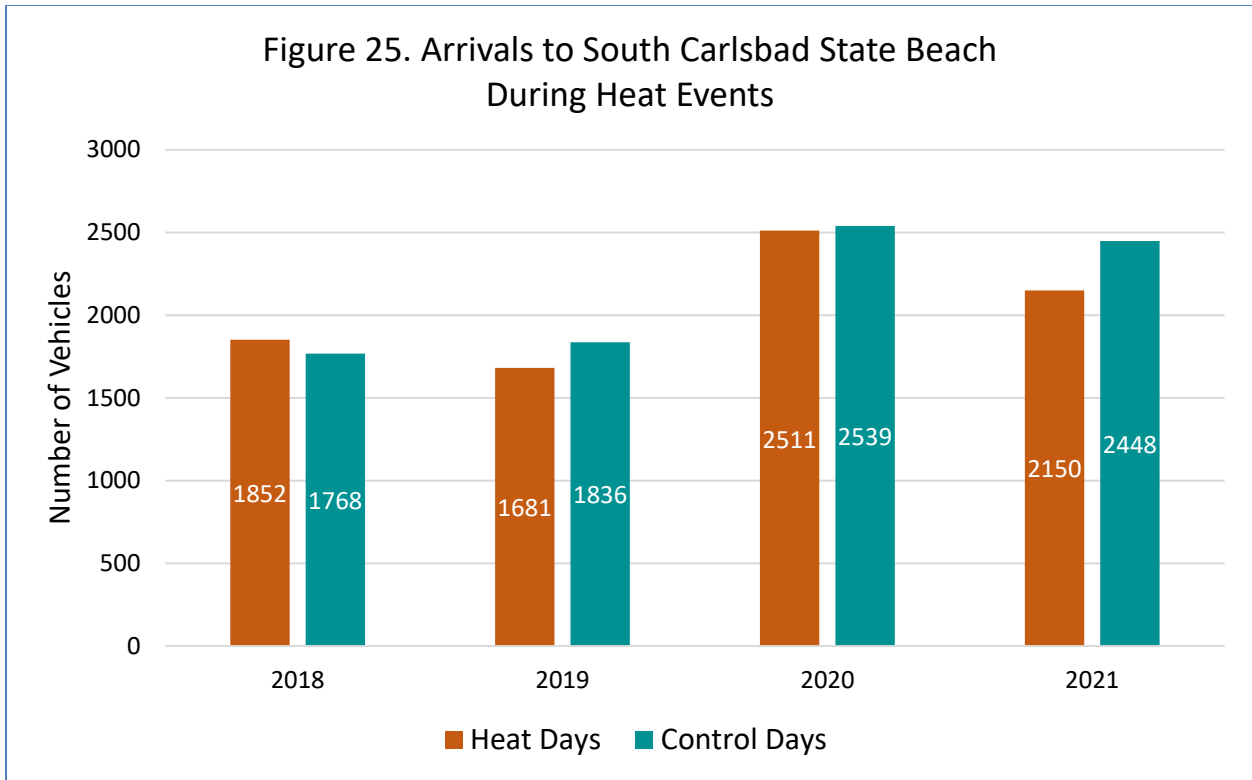
Silver Strand State Beach North	34	204	13	3
Silver Strand State Beach South	37	144	8	3
Tijuana Estuary NERR	555	936	65	24
Border Field State Park	NA	54	12	N/A

Question 9: Do extreme heat events affect vehicle arrivals at select SDCD parks?

Methods

Four separate weekends, one each year (2018-2021) were identified as exceptionally hot days by Coastal Quest and State Parks staff. For this ZAA, we chose the four-day window (Thurs-Sun) as heat days to determine the volume of visitation on these days, using the whole park polygons and the Single Factor Vehicle Calibration as our measurement. To compare visitation volumes, we ran a separate analysis on all other Thursday-Sunday periods of the month in which the heat event occurred. This was the control period for normal visitation and the monthly stratification helped to control for possible differences in monthly visitation.





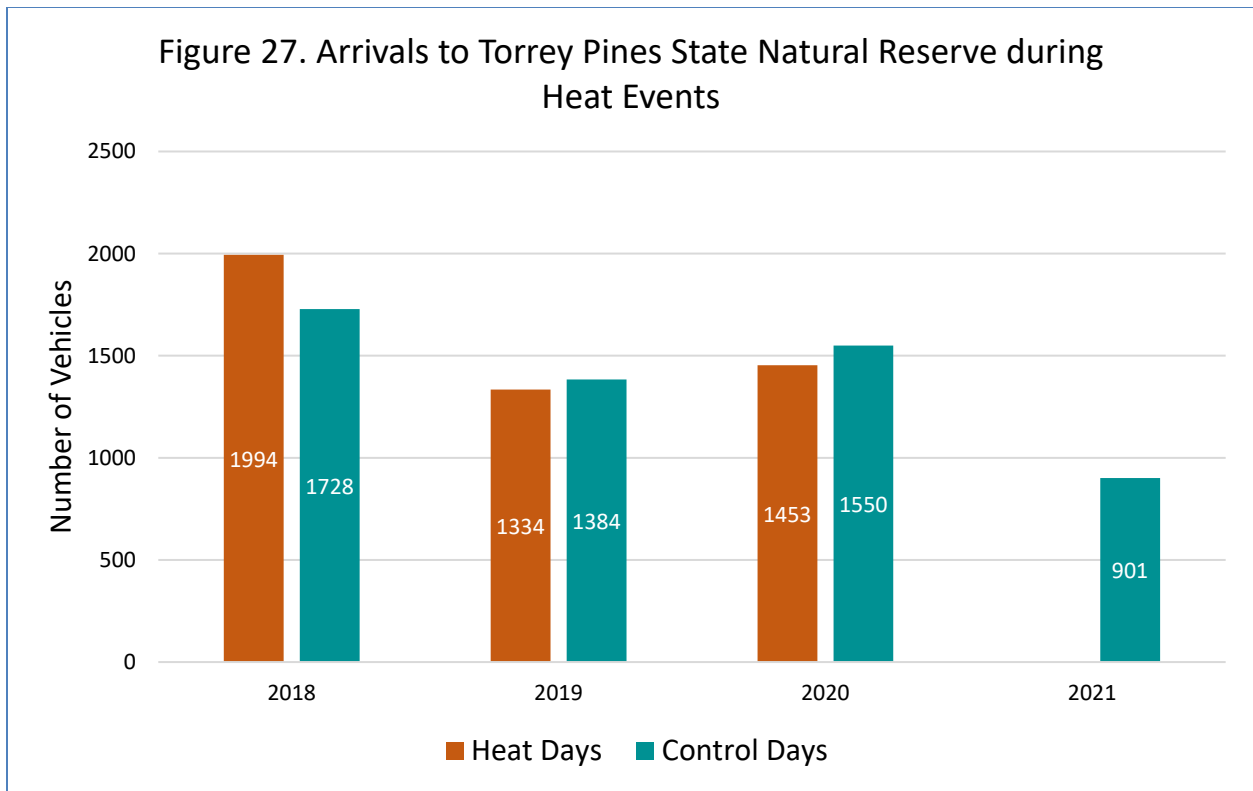


Figure 27.

Results and Discussion

A comparison of arrivals in select locations during periods of exceptional heat (Figures 26-29) revealed no observable “heat effect”, that is, the hotter days did not appear to result in substantial changes in arrivals to the park locations.

Conclusions

Mobile Data for Visitation Studies

Mobile device approaches are rapidly becoming an important tool for park management professionals to estimate trends in arrivals, use patterns, and other characteristics of visitors. The measurement of the trends of visits to publicly managed parks provides managers with the ability to allocate field staff, plan and manage facilities, develop effective communication strategies, and protect sensitive park resources. In addition, understanding travel patterns to and from park locations is important to help understand the attributes of the park visitors, their home locations, access, and equity issues, as well as provision for these uses in a regional context. As such, park managers continually look for new data sources of information related to park visitation and opportunities to improve data collection and analysis. Obtaining readily available data from mobile devices can be helpful in achieving all these needs and objectives. The mobile device data approach used in this study represents an opportunity for State Parks to

obtain reliable data, particularly when on-site assessment is impractical or has not previously been conducted.

Study Implications

Arguably the most important overall implication of this work is that the mobile device assessment approaches employed via the Streetlight InSight platform appear to provide a viable means of monitoring the visitor use of the SDCS parks both at the broad, whole park spatial scale and more limited scales, even down to specific entry points or narrow visitor corridors. The Platform will not return any results if insufficient data are available to meet Streetlight's quality assurance standards. We also note that some locations, such as Border Field State Park were closed or had limited access during the study period, and these locations returned little or no data (i.e., Figure 1) adding to the face validity of the results. While both the availability of data and the apparent validity of the results are reassuring, future work would benefit from some on-site counting methods for additional quality control.

Although this study has little ability to infer causality to the use levels and trends determined, some overall observations are warranted. First, analysis of broad trends in outdoor recreation in the USA in recent years suggest an increased number of individuals participating, with over an 11% increase from 2018-2021 (Outdoor Industry Association, 2022). The recreating public is also more diverse both in ethnicity and across age groups. However, these trends are somewhat offset by a decline in the participation rate on an individual basis, that is, while there are more participants they tend to recreate less frequently. This has resulted in a general decline in the number of overall outings over the past decade, however, 2021 did see a 6% increase in outings compared to 2020 (Outdoor Industry Association, 2022). Of course, all the recent trends have been influenced greatly by the COVID-19 pandemic, with many reports nationally of increased participation and management concerns at parks and natural areas (Outdoor Industry Association, 2020).

How the above national trends affect these findings is unclear and could be addressed in future work with a more comprehensive study of visitor motivations, outcomes, and evaluations of conditions, if desirable. However, given the proximity of the SDCD parks to a large urban population and the ever-increasing importance of outdoor recreation to the public, it is likely that demand for recreation access to these areas will remain high, although some fluctuations in visitation are clearly occurring.

Several notable findings emerge from this analysis. For example, average daily vehicle arrivals exhibited a general declining trend from 2018-2021 at two locations—Carlsbad State Beach and Moonlight State Beach. However, there was an increasing trend at South Carlsbad State Beach. Other locations remained consistent or showed no clear trend or pattern in average daily and annual arrivals. On a monthly basis, December appears to consistently be the lowest or one of the lowest months of visitation across all parks, followed by a marked increase in visitation in

January, which is one of the highest months of use at many parks (Table 2). Use levels tend to decline slightly in February, but many locations retain this level of visitation throughout the rest of the year and into early fall. Peak hours of visitation vary considerably by park (Figures 3- 11), but many locations exhibit a peak of use in late morning and another peak in late afternoon or early evening.

While visitor demographics are somewhat limited to general characteristics such as income and ethnicity in mobile device data approaches, the findings suggest that visitors to SDCD Parks are predominantly white (60-80% depending on park and year), but a wide range of ethnicities are also served by the park system. There is also a remarkably even distribution across all income categories, and no major differences between 2020 and 2021 analysis years, suggesting a broad and consistent income equity of access. SDCD parks draw visitors from a broad geographic area, the highest number of visitors from any one ZIP code tend to be within proximity—five miles or less. The importance of local use is further supported by the high pedestrian arrivals observed (Table 6). Last, exceptionally hot days did not appear to result in dramatic changes in visitation as compared to similar days of normal seasonal temperature.

Study Limitations

Several important considerations are warranted when examining the results presented in this study. Most of the results appear to be representing the observed experience of park managers in terms of what has been occurring with visitation at these parks. We (the authors) have previously tested many of the approaches used in this report at several locations, most notably in Orange County, CA. For these studies, mobile device approaches fared favorably when compared to on-sight counts of visitation and demographics determined by visitor questionnaires (Monz et al., 2019 & 2021; Creany et al., 2021). For this work, the mobile device data was calibrated within the operations of the Streetlight Platform using current best practices, so the overall approach suggests a reasonable level of quality control and assurance.

However, we note that a few results appear anomalous, such as the marked increase in arrivals to campgrounds in 2021 (Figure 14). We note that this is a consistent finding for 2021 across the three campground areas we examined. This suggests that there may be some use or behavior related change that is being detected by the mobile device analysis and it warrants further scrutiny, such as some field-based counts or observations. We also note that a significant limitation of the study overall is the lack of available, location-specific counts, such as a vehicle tube counter or trail counter, that could be used to as a means of further calibration and quality control. This approach was demonstrated in Creany et al., (2021) and should be considered should the San Diego Coast District and Coastal Quest seek to continue obtaining use metrics via mobile device approaches. Having a few locations of both pedestrian and vehicle counts to have some means of comparison to more traditional use estimation approaches would be a substantial benefit.

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