

California Sea Otter (*Enhydra lutris nereis*) Census Results, Spring 2019



Data Series 1118

Front Cover. A male sea otter grooming between foraging dives in Elkhorn Slough, California. Photograph taken by Joe Tomoleoni, U.S. Geological Survey, February 3, 2016.

Back Cover. A tagged female sea otter feeding on sand dollars in Monterey, California. Photograph taken by Joe Tomoleoni, U.S. Geological Survey, February 28, 2018.

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**U.S. Department of the Interior
U.S. Geological Survey**

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U.S. Geological Survey, Reston, Virginia: 2019

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Suggested citation:

Hatfield, B.B., Yee, J.L., Kenner, M.C., and Tomoleoni, J.A., 2019, California sea otter (*Enhydra lutris nereis*) census results, spring 2019: U.S. Geological Survey Data Series 1118, 12 p., <https://doi.org/10.3133/ds1118>.

Acknowledgments

The annual census is conducted in partnership with personnel of the California Department of Fish and Wildlife, Monterey Bay Aquarium, the U.S. Fish and Wildlife Service and others. Experienced and dedicated volunteers also provided invaluable assistance. The NAVAIR Ranges Sustainability Office of the U.S. Navy is acknowledged for access to and logistical support for the sea otter surveys at San Nicolas Island. The Pacific Gas and Electric Company is acknowledged for providing access to the coastline in the vicinity of the Diablo Canyon Power Plant.

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Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
	Length	
meter (m)	3.281	foot (ft)
meter (m)	1.094	yard (yd)
kilometer (km)	0.6214	mile (mi)

Datum

Horizontal coordinate information is referenced to the World Geodetic System 1994.

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Abstract

The 2019 census of southern sea otters (*Enhydra lutris nereis*), also known as California sea otters, was conducted from early May to early July along the mainland coast of central California and in April at San Nicolas Island in southern California. The range-wide index, defined as the 3-year average of combined counts from the mainland range and San Nicolas Island, was 2,962, a decrease of 166 sea otters from the index for the previous year. The 5-year average trend in the range-wide index, including both the mainland range and San Nicolas Island populations, was flat at 0.12 percent growth per year. The northern range boundary was not calculated because of limitations in survey resources required to survey areas north of the range from the previous year (2018); however, the southern range boundary expanded slightly by 0.5 kilometer, where a negligible trend in sea otter counts (0.55 percent growth per year) corresponded to the lack of meaningful population range expansion at the southern periphery.

Introduction and Methods

A range-wide census is conducted collaboratively each spring by the U.S. Geological Survey, the California Department of Fish and Wildlife, the Monterey Bay Aquarium, and others to monitor trends in abundance and distribution of the southern sea otter (*Enhydra lutris nereis*), also known as California sea otters, and thus to provide State and Federal resource agencies with the information requested for effective management. The standardized census has been conducted and

completed annually since 1982, except for 2011, when weather conditions prevented survey completion. The survey entails a combination of aerial and shore-based counts, providing an uncorrected and exhaustive count of the entire range of the sea otter in coastal California. Shore-based counts are used in all areas accessible by ground-based observers, except in regions where sea otters tend to be located far offshore (such as shallow, sandy embayments) where they are more difficult to count reliably from the shore. In these areas, aerial surveys are flown along contiguous transects oriented parallel to the shore and covering all areas between the coastline and the 60-meter (m) depth contour. Details of survey methods, as well as data and metadata from this survey and surveys from previous years, are available in Hatfield and others (2019).

The spring 2019 mainland sea otter count began on May 1 and was completed by July 9, 2019. Overall viewing conditions in 2019 were very good, better than those encountered during the 2018 spring census (View Score=3.0 in 2019 compared to 2.4 in 2018, where 0=poor, 1=fair, 2=good, 3=very good, and 4=excellent). The surface canopies of kelp (predominantly *Macrocystis pyrifera*) were qualitatively noted by observers to be far below the seasonal normal in the central portions of the mainland range (from Monterey to Cayucos) and about normal near both ends of the mainland range. Sea otters along the mainland were surveyed from Pigeon Point in San Mateo County in the north to Santa Barbara Harbor in Santa Barbara County in the south (fig. 1). A separate, ground-based survey of the sea otter population at San Nicolas Island was completed earlier in the spring (April 19–23) under good/very good survey viewing conditions (View Score=2.5). *Macrocystis* canopies at San Nicolas Island were estimated to be below normal for the time of year.

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Figure 1. Distribution of sea otters (*Enhydra lutris nereis*) along the mainland coast of central California and at San Nicolas Island, 2019.

California Sea Otter Census Results

Range-Wide Summary

The Southern Sea Otter Recovery Plan (U.S. Fish and Wildlife Service, 2003) recommends using the 3-year running average of total counts as the official metric for monitoring trends, thereby reducing the influence of anomalously high or low counts from any particular year. The 3-year average of combined counts from the mainland range and San Nicolas Island therefore represents the official index of relative abundance for southern sea otters, the current value of which is 2,962 (table 1).

Range-Wide Trends

There is a considerable degree of uncertainty (random variation owing to sampling and measurement error) in any 1-year count, and thus longer-term trends are far more informative than year-to-year differences. We therefore report trends over the past 5 years as $\bar{\lambda}$ (the geometric mean of the annual rate of change λ) and as mean percent change. The annual λ values are computed by dividing the 3-year running average count by the equivalent value from the previous year. Thus, $\lambda = 1$ indicates a constant population or 0-percent change. Mean percent change is calculated from the mean rate of change as $(\bar{\lambda} - 1) \times 100$ percent.

The 3-year running average count of the mainland population is 2,863, a decrease of 5.7 percent from the previous-year value (table 1). This decrease in the 3-year average is associated with a flattened 5-year trend for the mainland (–0.13 percent per year; $\bar{\lambda} = 1.00$). The high pup-to-independent ratio observed in the spring of 2018 (22.5) in the mainland population dropped to a more typical value of 16.0 in 2019 (table 1). The 3-year running average total count of the San Nicolas Island population increased to 99 (table 1), which continues a positive trend of about 9.58 percent per year ($\bar{\lambda} = 1.10$; fig. 2). The overall 5-year trend for southern sea otters (including both mainland and San Nicolas Island populations) is flat at 0.12 percent per year ($\bar{\lambda} = 1.00$).

Regional Trends

Regional trends in abundance within the mainland range can vary considerably. The 5-year trend for the center segment of the range, between Seaside and Cayucos (fig. 3), remains positive at 2.38 percent per year ($\bar{\lambda} = 1.02$). One factor possibly contributing to the positive trend in the central range is the recent increase in availability of sea urchins and mussels (sea otter prey), a phenomenon that likely has several causes including the ecological absence of the predatory sunflower star, *Pycnopodia helianthoides*, from a sea star wasting disease (Burt and others, 2018). This surge in prey availability might explain the larger number of sea otters in this part of the range over the last several years compared to the long-term average. As previously noted by Hatfield and others (2018), the slowing trend in this area suggests a limit to the potential growth owing to the prey subsidy.

The pattern is different to the north of the central region, with a 5-year trend of –8.72 percent per year ($\bar{\lambda} = 0.91$). The 5-year trend in the southern region was also negative this year (–1.62 percent per year with $\bar{\lambda} = 0.98$; fig. 3). The trends in the northern and southern regions are consistent with elevated observations of shark-bite mortality in recent years in these outer regions of lower population density (fig. 4). The specific areas where the population trends are most negative are in the north from Davenport to north Monterey Bay and in the south from Pismo Beach to Lompoc (fig. 5). These areas tend to have little or no kelp canopy and thus represent high-risk areas for sea otters, as the presence of kelp is believed to provide some degree of refuge from shark bites (Tinker and others, 2015; Nicholson and others, 2018).

There is no evidence of population growth in the 2019 range-wide 5-year trend, nor in many areas to the north and to the south of the central region (areas from which future range expansion would occur; fig. 5; Tinker and others, 2008; Lafferty and Tinker, 2014). Using the northern range extent calculated in 2018, the 5-year trend in sea otter counts was positive in the northern 30 kilometer (km) of the range at 9.4 percent growth per year and negligible in the southern 30 km of the range at 0.55 percent growth per year.

Table 1. Summary of spring survey counts of sea otters (*Enhydra lutris nereis*) in California, and 3-year averages, 1983–2019.

[—, no data; %, percent]

Year	Mainland range							San Nicolas Island				Range-wide
	Independents (raw count)	Pups (raw count)	Total (raw count)	Pups per 100 independents	Independents (3-year average)	Pups (3-year average)	Total (3-year average)	Independents (raw count)	Pups (raw count)	Total (raw count)	Total (3-year average)	Index of relative abundance
1983	1,156	121	1,277	10.5	—	—	—	—	—	—	—	—
1984	1,180	123	1,303	10.4	—	—	—	—	—	—	—	—
1985	1,119	242	1,361	21.6	1,152	162	1,314	—	—	—	—	—
1986	1,358	228	1,586	16.8	1,219	198	1,417	—	—	—	—	—
1987	1,436	226	1,662	15.7	1,304	232	1,536	—	—	—	—	—
1988	1,504	221	1,725	14.7	1,433	225	1,658	—	—	—	—	—
1989	1,571	285	1,856	18.1	1,504	244	1,748	—	—	—	—	—
1990	1,466	214	1,680	14.6	1,514	240	1,754	14	3	17	—	—
1991	1,700	241	1,941	14.2	1,579	247	1,826	14	2	16	—	—
1992	1,810	291	2,101	16.1	1,659	249	1,907	10	2	12	15	—
1993	2,022	217	2,239	10.7	1,844	250	2,094	7	4	11	13	—
1994	2,076	283	2,359	13.6	1,969	264	2,233	10	4	14	12	—
1995	2,095	282	2,377	13.5	2,064	261	2,325	9	4	13	13	—
1996	1,963	315	2,278	16.0	2,045	293	2,338	12	4	16	14	—
1997	1,919	310	2,229	16.2	1,992	302	2,295	16	0	16	15	—
1998	1,955	159	2,114	8.1	1,946	261	2,207	12	2	14	15	—
1999	1,858	232	2,090	12.5	1,911	234	2,144	18	3	21	17	—
2000	2,053	264	2,317	12.9	1,955	218	2,174	21	2	23	19	—
2001	1,863	298	2,161	16.0	1,925	265	2,189	21	5	26	23	—
2002	1,846	293	2,139	15.9	1,921	285	2,206	22	5	27	25	—
2003	2,270	235	2,505	10.4	1,993	275	2,268	33	5	38	30	—
2004	2,495	330	2,825	13.2	2,204	286	2,490	27	4	31	32	—
2005	2,417	318	2,735	13.2	2,394	294	2,688	22	3	25	31	—
2006	2,369	323	2,692	13.6	2,427	324	2,751	36	5	41	32	—
2007	2,637	389	3,026	14.8	2,474	343	2,818	26	4	30	32	—
2008	2,434	326	2,760	13.4	2,480	346	2,826	22	3	25	32	—
2009	2,263	391	2,654	17.3	2,445	369	2,813	27	6	33	29	—
2010	2,452	267	2,719	10.9	2,383	328	2,711	38	7	45	34	—
2011	—	—	—	—	—	—	—	44	6	50	43	—

Table 1. Summary of spring survey counts of sea otters (*Enhydra lutris nereis*) in California, and 3-year averages, 1983–2019.—Continued

[—, no data; %, percent]

Year	Mainland range							San Nicolas Island				Range-wide
	Independents (raw count)	Pups (raw count)	Total (raw count)	Pups per 100 independents	Independents (3-year average)	Pups (3-year average)	Total (3-year average)	Independents (raw count)	Pups (raw count)	Total (raw count)	Total (3-year average)	Index of relative abundance
2012	2,486	379	2,865	15.2	2,469	323	2,792	48	10	58	51	—
2013	2,444	455	2,899	18.6	2,465	417	2,882	54	8	62	57	2,939
2014	2,410	469	2,879	19.5	2,447	434	2,881	59	9	68	63	2,944
2015	2,688	505	3,193	18.8	2,514	476	2,990	54	7	61	64	3,054
2016	3,078	433	3,511	14.1	2,725	469	3,194	92	12	104	78	3,272
2017	2,211	396	2,607	17.9	2,659	445	3,104	72	9	81	82	3,186
2018	2,438	548	2,986	22.5	2,576	459	3,035	81	14	95	93	3,128
2019	2,583	413	2,996	16.0	2,411	452	2,863	109	12	121	99	2,962
5-year (2015–19) geometric mean annual growth rate (% change):						Mainland: –0.13		San Nicolas: 9.58			Combined: 0.12	

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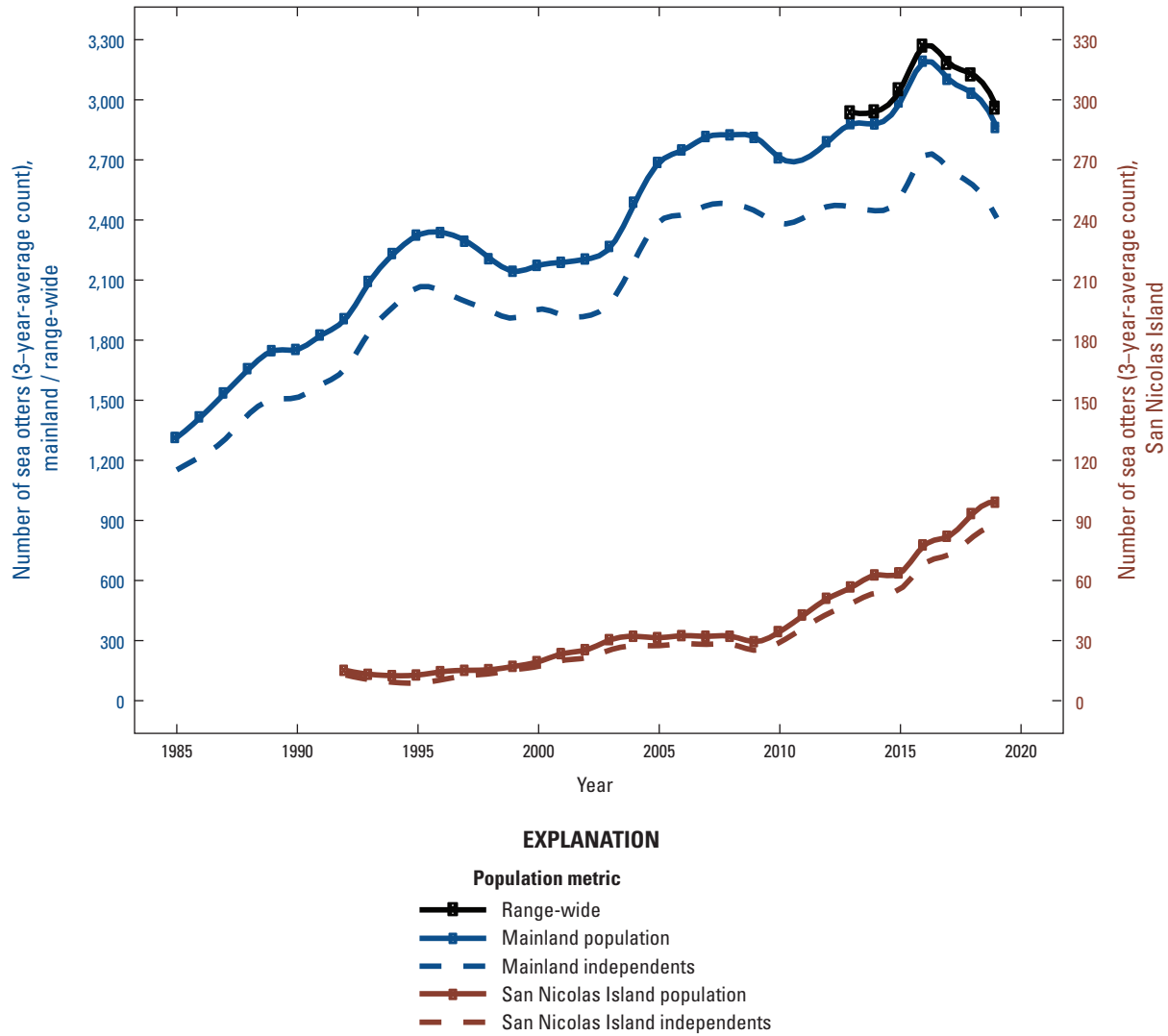


Figure 2. Trends in abundance of sea otters (*Enhydra lutris nereis*) in California, based on 3-year running averages of raw counts. Data are shown for all sea otters (solid lines) and independents (non-pups; dashed lines) for the mainland range (left axis, blue lines), San Nicolas Island (right axis, brown lines), and for the entire range after 2012 (left axis, solid black line), when counts were combined to create the official index of relative abundance.

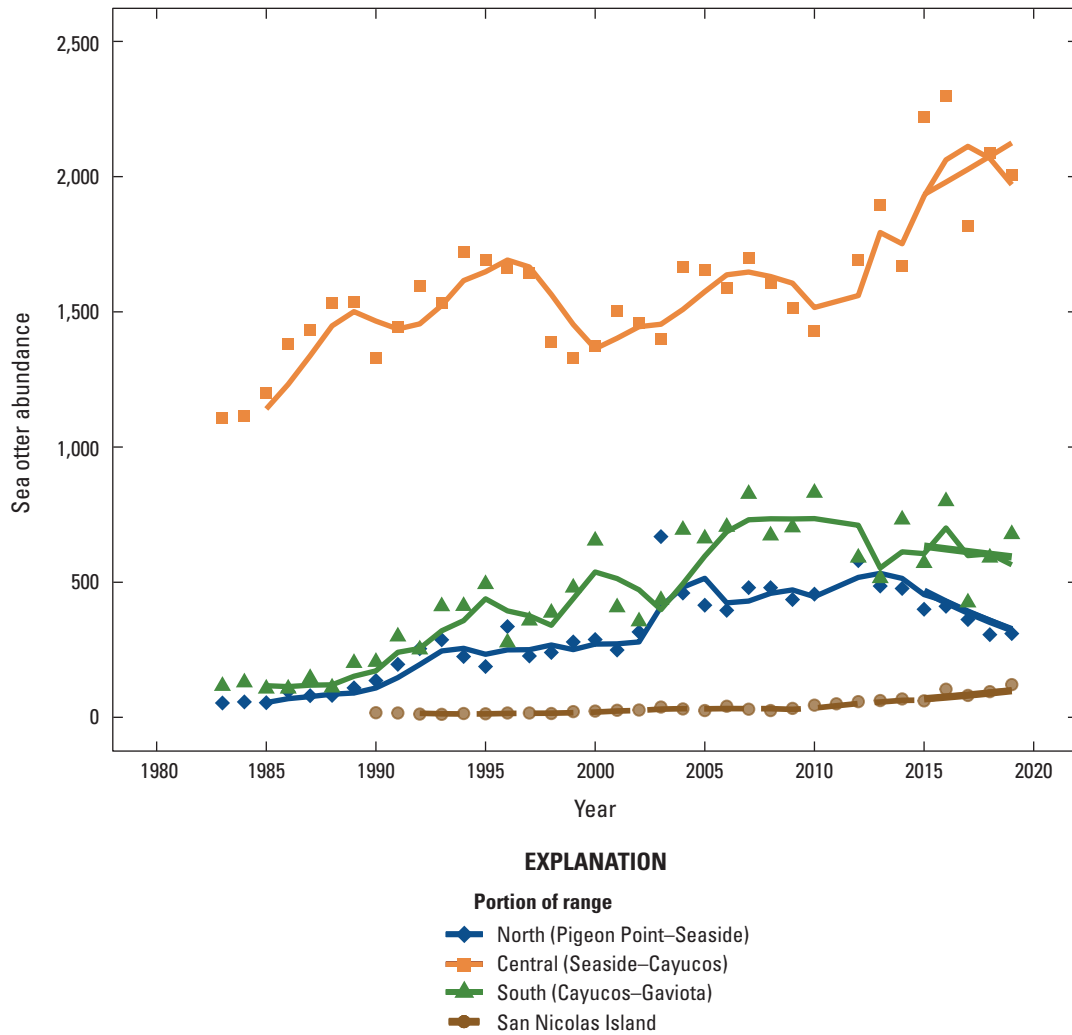


Figure 3. Regional trends in abundance of sea otters (*Enhydra lutris nereis*) along the mainland coast, central California, and at San Nicolas Island, southern California. Raw counts and 3-year running averages (solid lines across entire length of each time series) are plotted for the north (blue), central (dark coral), and southern (green) regions of the mainland coast and for San Nicolas Island (brown). The most recent 5-year average trend (calculated as the geometric mean annual rate of change) is shown as a solid line at the end of each time series.

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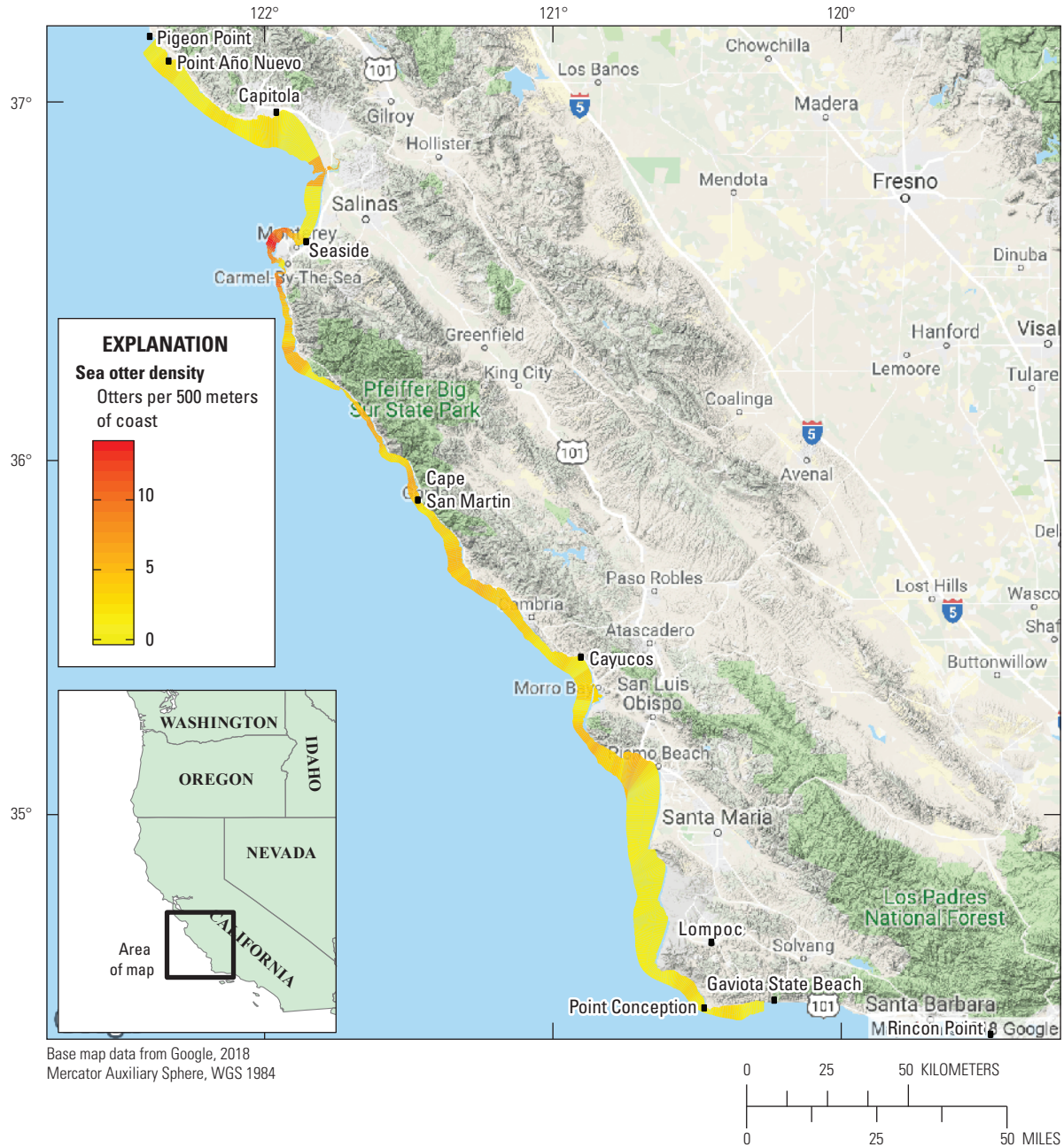


Figure 4. Variation in local population density (number of sea otters per 500 meters of coast) of sea otters (*Enhydra lutris nereis*) along the mainland coast, central California. Data for San Nicolas Island are not shown because spatially explicit analyses are not currently conducted for San Nicolas Island.

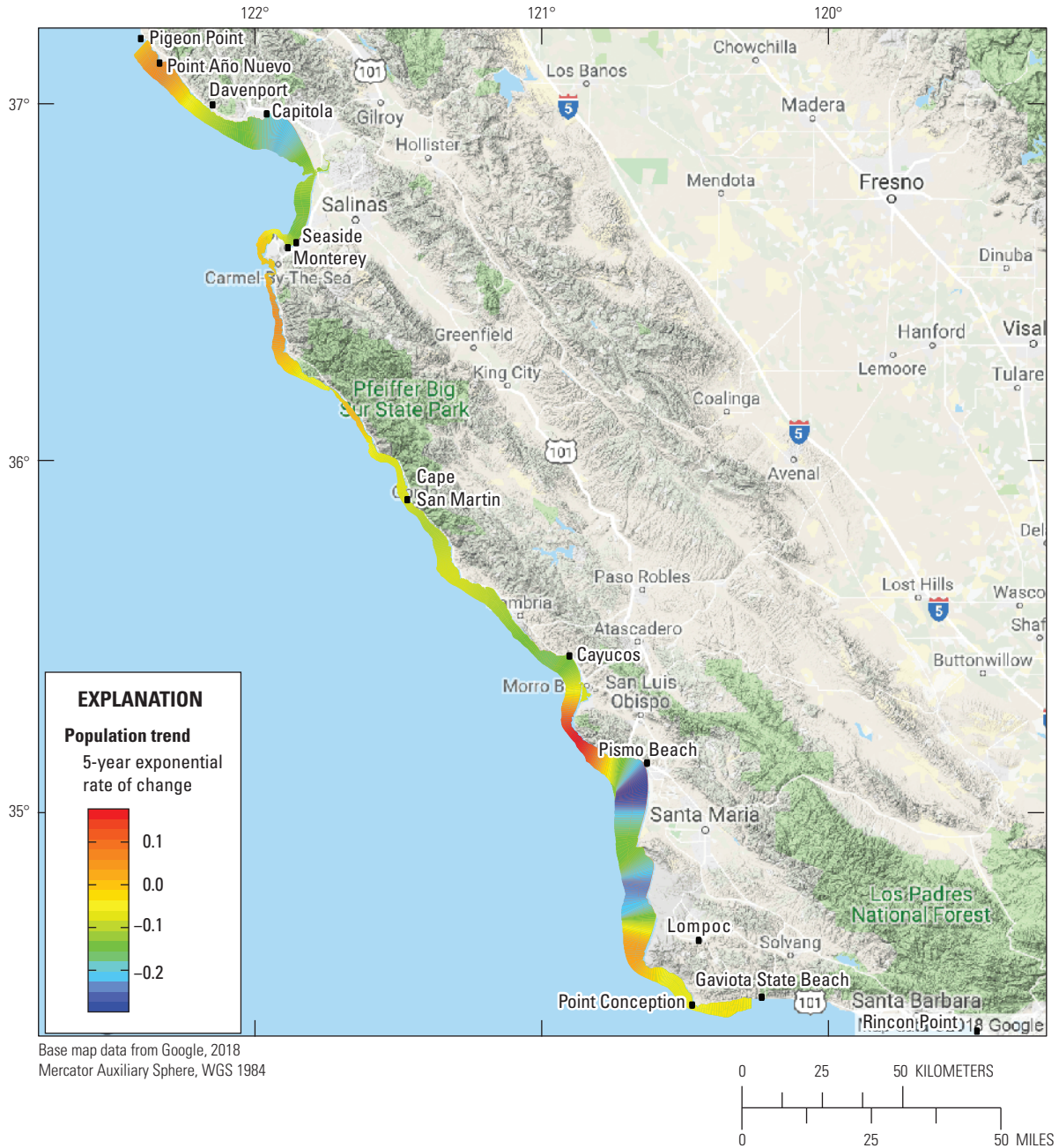


Figure 5. Local trends in abundance of sea otters (*Enhydra lutris nereis*) along the mainland coast, central California. Trends represent mean exponential rates of change, $\log(\lambda)$, estimated by fitting a log-linear model to the most recent 5-year time series at each point on the coast and then spatially smoothing the calculated trend using a 10-kilometer moving window average.

Geographic Distribution

The mainland population of the southern sea otter is descended from a small, remnant population in Big Sur that survived the North Pacific fur trade. Because of this historical pattern of depletion and recovery, the population has been slowly expanding to the north and south along the California coast from the source location in Big Sur. The rate of range expansion to the north and south has varied over time, and traditionally the rate of spatial spread has been faster to the south (Lubina and Levin, 1988) than to the north. Because of the one-dimensional nature of the California coast, the location of the northern and southern range boundaries can be described using the “ATOS” line (the “As The Otter Swims” line). The ATOS line is a linear axis described as a series of points spaced regularly at 500-m intervals along the 10-m depth contour. A value of 0 is arbitrarily assigned to the ATOS point at the southern tip of the Golden Gate Bridge in San Francisco, and then ATOS values increase as one moves south along the coast, with ATOS 1111 corresponding to Point Conception. To standardize descriptions of the sea otter distribution in California, the officially recognized mainland range boundaries are defined by combining independent sea otters within a moving window of 10-km stretches of coastline

(20 contiguous ATOS intervals each) and taking the northern and southern ATOS values, respectively, of the northernmost and southernmost stretches in which at least 5 otters were counted for at least 2 consecutive spring surveys during the last 3 years.

The northernmost sea otters detected in the 2019 mainland survey were near Point Año Nuevo (ATOS 180) again this year. At the southern end of the mainland range, 102 sea otters were counted southeast of Point Conception, 67 more than were counted in 2018. Only one sea otter was counted this year southeast of Gaviota State Beach (ATOS 1162; the same number as last spring), with this animal being observed approximately 25 km east of Gaviota State Beach. Owing to limited availability of the survey aircraft and pilots, we were unable to survey north of Pigeon Point to Pillar Point this year. As a result, the official northern range limit cannot be calculated. However, there have been very few credible reports of stranded or live sea otters north of Pigeon Point during the previous year. It is highly unlikely that many sea otters occur beyond Pigeon Point this year. The southern limit of the official sea otter range along the mainland coast expanded very slightly from 2018 (fig. 6) by one ATOS unit and is about 4.5 km west of Gaviota State Beach (ATOS 1154; fig. 1).

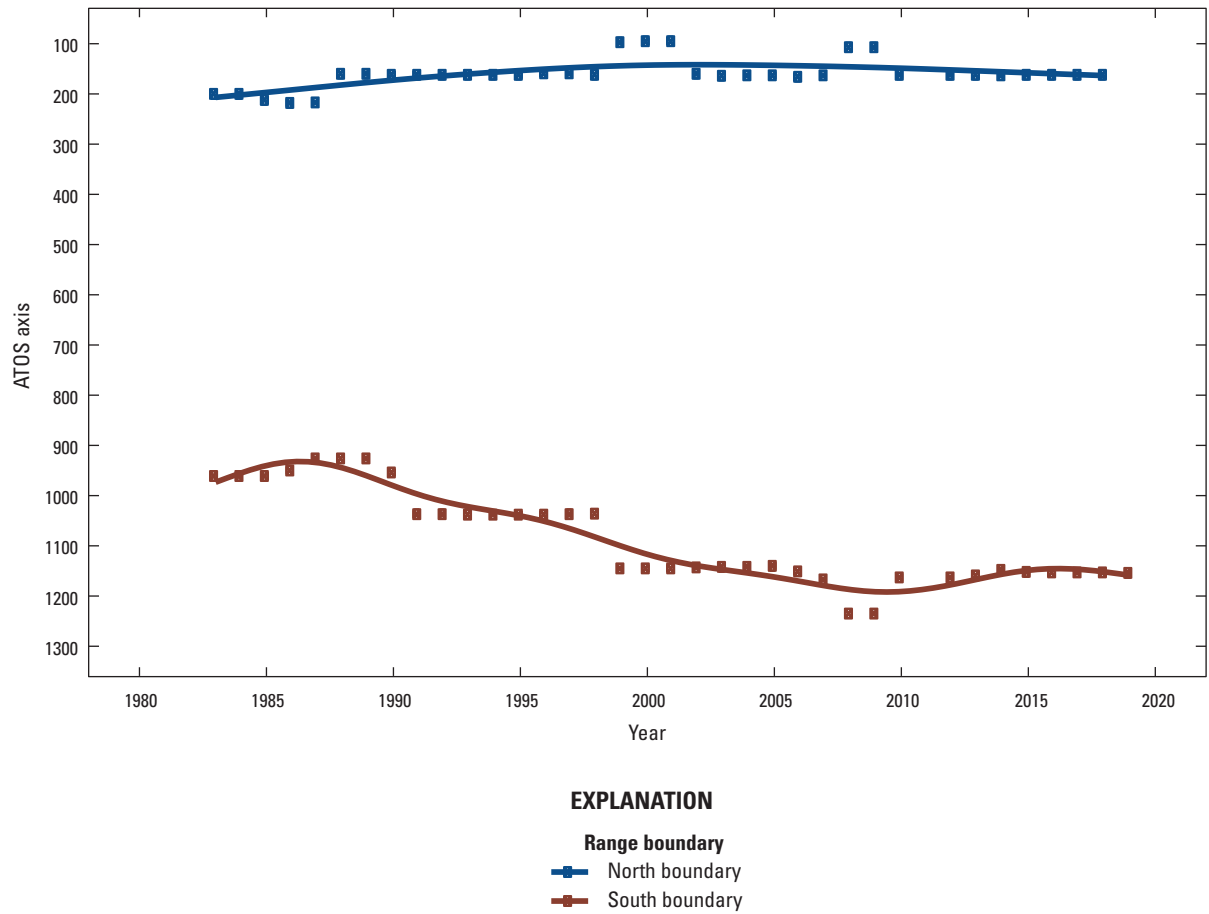


Figure 6. Variation over time in the location of the northern and southern range boundaries (defined on the “As The Otter Swims” [ATOS] scale) of sea otters (*Enhydra lutris nereis*) along the mainland coast, central California, 1983–2019. The northern boundary in 2019 was not calculated owing to limited aerial survey resources. Increasing or decreasing intervals between ATOS values represent the rate of range expansion or contraction.

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Publishing support provided by the U.S. Geological Survey
Science Publishing Network, Sacramento Publishing Service Center

