Spring 2015 California Sea Otter (*Enhydra lutris nereis*) Census Results

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The spring 2015 mainland sea otter count began on 2 May and wasn't completed until 2 July. The delay in finishing the census was due primarily to limited availability of the survey plane (because of the need for the plane during the oil spill in the Refugio State Beach area). Overall viewing conditions this year were more favorable than those during the 2014 spring census (View Score = 2.6 vs. 2.3, where 0=poor, 1=fair, 2=good, 3=very good, and 4=excellent). The surface canopies of kelp (*Macrocystis sp*.) were considered by most participants to be about normal for this time of year. Sea otters along the mainland were surveyed (using a combination of ground-based and aerial-based surveys) from Pillar Point in San Mateo County in the north, to Rincon Point in the south at the Santa Barbara/Ventura County line (Figure 1).

A separate ground-based survey of the sea otter population at San Nicolas Island was completed earlier (April 17-April 20). Surface kelp canopies at the time of survey were estimated to be below normal and survey viewing conditions were fair to good (View Score = 1.5). The population of sea otters at San Nicolas Island, the most remote of the Channel Islands in southern California, is the result of a translocation effort in 1987–1990 and remains geographically distinct from the mainland range; however, this population is no longer classified as an experimental population, and beginning in 2013 the San Nicolas counts have been added to the counts for the mainland range to arrive at a California-wide index of abundance.

The U.S. Fish and Wildlife Service's Southern Sea Otter Recovery Plan (US FWS 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 comprise the official index of abundance for southern sea otters, the current value of which is 3,054 (Table 1, Figure 2). For southern sea otters to be considered for removal from threatened status under the Endangered Species Act, the index of abundance would

have to exceed 3,090 for three consecutive years, according to the threshold established under the U.S. Fish and Wildlife Service's Southern Sea Otter Recovery Plan (US FWS 2003).

We emphasize that there is a considerable degree of uncertainty (random variation due to sampling and measurement error) in any one year's count, and thus longer-term trends are far more informative than year-to-year differences – for consistency we report all trends as the 5-year geometric mean annual rate of change. The 3-year running average count of the mainland population is 2,990 (Table 1), which is up from previous years and reflects an increasing trend of approximately 1.7% per year (Figure 2). Both the number of pups and independent sea otters (juveniles and older) counted in the mainland range this spring were record highs, with the number of pups per 100 independent sea otters remaining high at 18.8 (just below last year's ratio; Table 1). The 3-year running average count of the San Nicolas Island population is 64 (Table 1), which continues a positive trend of approximately 13% per year (Figure 2). The overall 5-year trend for southern sea otters (including both the mainland and San Nicolas Island populations) is 2.2% per year.

Within the mainland range, regional trends in abundance vary considerably, with some surprising patterns emerging from this year's survey. The center portion of the range, between Seaside and Cayucos (Figure 1), showed a sharp uptick in numbers (Figure 3) leading to an increasing trend of 3.4%. The range center supports the highest density of sea otters (Figure 4) and has been considered to be at carrying capacity with respect to its prey resources for some time, and so the increase here was somewhat unexpected. However, a clue to what may be driving this pattern comes from long-term monitoring of nearshore sub-tidal ecosystems by University of California Santa Cruz researchers (http://www.piscoweb.org/). Scuba-based survey data show that the abundance of sea urchins (preferred prey of sea otters) has increased enormously over the last 1-2 years in the area between Big Sur and Monterey, possibly due to unusually high larval recruitment combined with the loss of sea star predators due to wasting disease which began in 2013. The resulting boost in food availability may be fueling the sea otter population increase in this same area (Figure 5), which likely represents both immigration of males from outlying areas as well as increased survival of juveniles and adults. While still hypothetical, such an explanation is consistent with all observed data and will be further investigated over the next three years by a collaborative research project headed by University of California Santa Cruz and USGS. To the north and south of the central region the patterns are very different, with a 5-year trend of approximately -2% per year in the northern region and -3.4% per year in the southern

region (Figure 3). These localized declines are consistent with a dramatic increase in shark bite mortality over the last 10 years (www.werc.usgs.gov/ProductDetails.aspx?ID=5343). Notably, the specific areas where the population trends are most negative (from Pigeon Pt. to north Monterey Bay, and from Cayucos to Pt. Conception; Figure 5) coincide exactly with hot spots of shark bite mortality (Tinker et al 2015). Overall, the increase in numbers in the range center is encouraging, but the lack of growth to the north and south (areas from which future range expansion will have to occur) means that questions remain about longer term recovery.

The northern-most otter detected in this year's mainland survey was just upcoast of Point Año Nuevo. At the south end of the mainland range, 45 otters were counted southeast of Point Conception compared to 56 counted during the spring 2014 census. None were counted this year southeast of Gaviota State Beach. The northern limit of the sea otter's range along the mainland coast remains approximately unchanged from 2013: the northern boundary is considered to be approximately 2.5 km southeast of Pigeon Pt. The southern limit of the range retracted slightly and is now considered to be 7 km west of Gaviota State Beach (Figure 1). The mainland range limits are defined as the points farthest from the range center (to the north and south) at which 5 or more otters are counted within a 10km contiguous stretch of coastline (as measured along the 10m bathymetric contour) during the two most recent spring censuses, or at which these same criteria were met in the previous year.

Further data summaries and GIS data, as well as detailed methods and metadata, are available online at the USGS-WERC web site: *http://dx.doi.org/10.5066/F7F47M5C*. The annual census is a cooperative effort between USGS-Western Ecological Research Center, California Department of Fish and Wildlife–Marine Wildlife Veterinary Care and Research Center, Monterey Bay Aquarium, University of California-Santa Cruz, the U.S. Fish and Wildlife Service, and many experienced and dedicated volunteers. Assistance was also received from staff of the Bureau of Ocean Energy Management.

References

US FWS. 2003. Final revised recovery plan for the southern sea otter (Enhydra lutris nereis). U.S. Fish and Wildlife Service. xi +165 pp. pp.

Tinker, M. T., B. B. Hatfield, M. D. Harris and J. A. Ames. 2015. Dramatic increase in sea otter mortality from white sharks in California. Marine Mammal Science, Early Edition, DOI: 10.1111/mms.12261.

Table 1. Summary of spring survey counts and 3-year averages, 1990-2015.

	Mainland Range							San Nicolas Island				Range-wide
Year	Independents (raw count)	Pups (raw count)	Total (raw count)	Pups per 100 Indep.	Independents (3-year avg.)	Pups (3-year avg.)	**Total (3-year avg.)**	Independents (raw count)	Pups (raw count)	Total (raw count)	**Total (3-year avg.)**	**Index of Abundance**
1990	1466	214	1680	14.6	1514	240	**1754**	14	3	**17**		
1991	1700	241	1941	14.2	1579	247	**1826**	14	2	**16**		
1992	1810	291	2101	16.1	1659	249	**1907**	10	2	**12**	**15**	
1993	2022	217	2239	10.7	1844	250	**2094**	7	4	**11**	**13**	
1994	2076	283	2359	13.6	1969	264	**2233**	10	4	**14**	**12**	
1995	2095	282	2377	13.5	2064	261	**2325**	9	4	**13**	**13**	
1996	1963	315	2278	16.0	2045	293	**2338**	12	4	**16**	**14**	
1997	1919	310	2229	16.2	1992	302	**2295**	16	0	**16**	**15**	
1998	1955	159	2114	8.1	1946	261	**2207**	12	2	**14**	**15**	
1999	1858	232	2090	12.5	1911	234	**2144**	18	3	**21**	**17**	
2000	2053	264	2317	12.9	1955	218	**2174**	21	2	**23**	**19**	
2001	1863	298	2161	16.0	1925	265	**2189**	21	5	**26**	**23**	
2002	1846	293	2139	15.9	1921	285	**2206**	22	5	**27**	**25**	
2003	2270	235	2505	10.4	1993	275	**2268**	33	5	**38**	**30**	
2004	2495	330	2825	13.2	2204	286	**2490**	27	4	**31**	**32**	
2005	2417	318	2735	13.2	2394	294	**2688**	22	3	**25**	**31**	
2006	2369	323	2692	13.6	2427	324	**2751**	36	5	**41**	**32**	
2007	2637	389	3026	14.8	2474	343	**2818**	26	4	**30**	**32**	
2008	2434	326	2760	13.4	2480	346	**2826**	22	3	**25**	**32**	
2009	2263	391	2654	17.3	2445	369	**2813**	27	6	**33**	**29**	
2010	2452	267	2719	10.9	2383	328	**2711**	38	7	**45**	**34**	
2011								44	6	**50**	**43**	
2012	2486	379	2865	15.2	2469	323	**2792**	48	10	**58**	**51**	
2013	2444	455	2899	18.6	2465	417	**2882**	54	8	**62**	**57**	**2939**
2014	2410	469	2879	19.5	2447	434	**2881**	59	9	**68**	**63**	**2944**
2015	2688	505	3193	18.8	2514	476	**2990**	54	7	**61**	**64**	**3054**
		5-year geometric mean annual growth rate (% change):					**1.7**		San Nicolas:	**13.1**	Total	**2.2**

Sea Otter Census, 2015

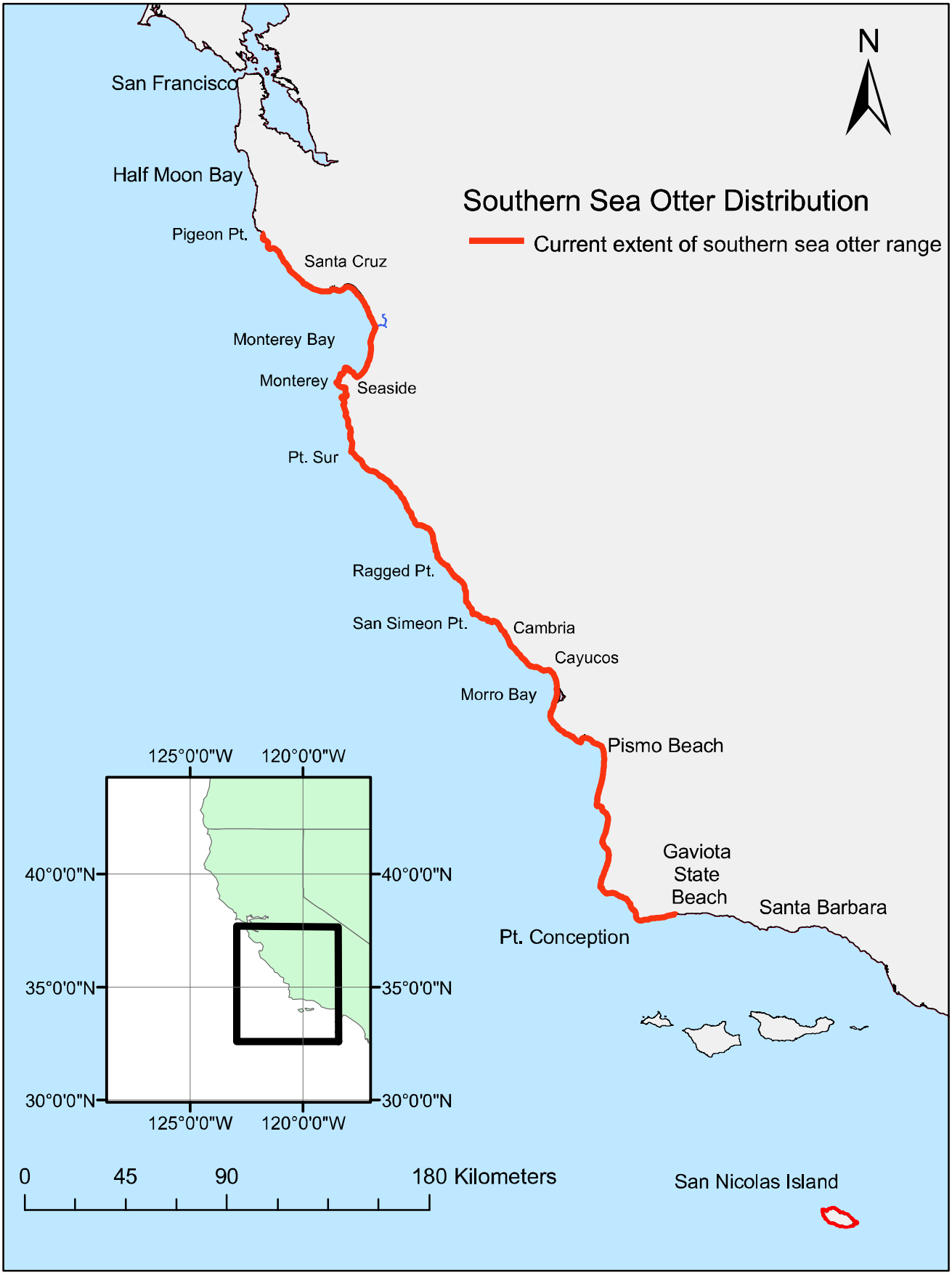

Figure 1 Map of central California showing the distribution of sea otters along the mainland coast and San Nicolas Island.

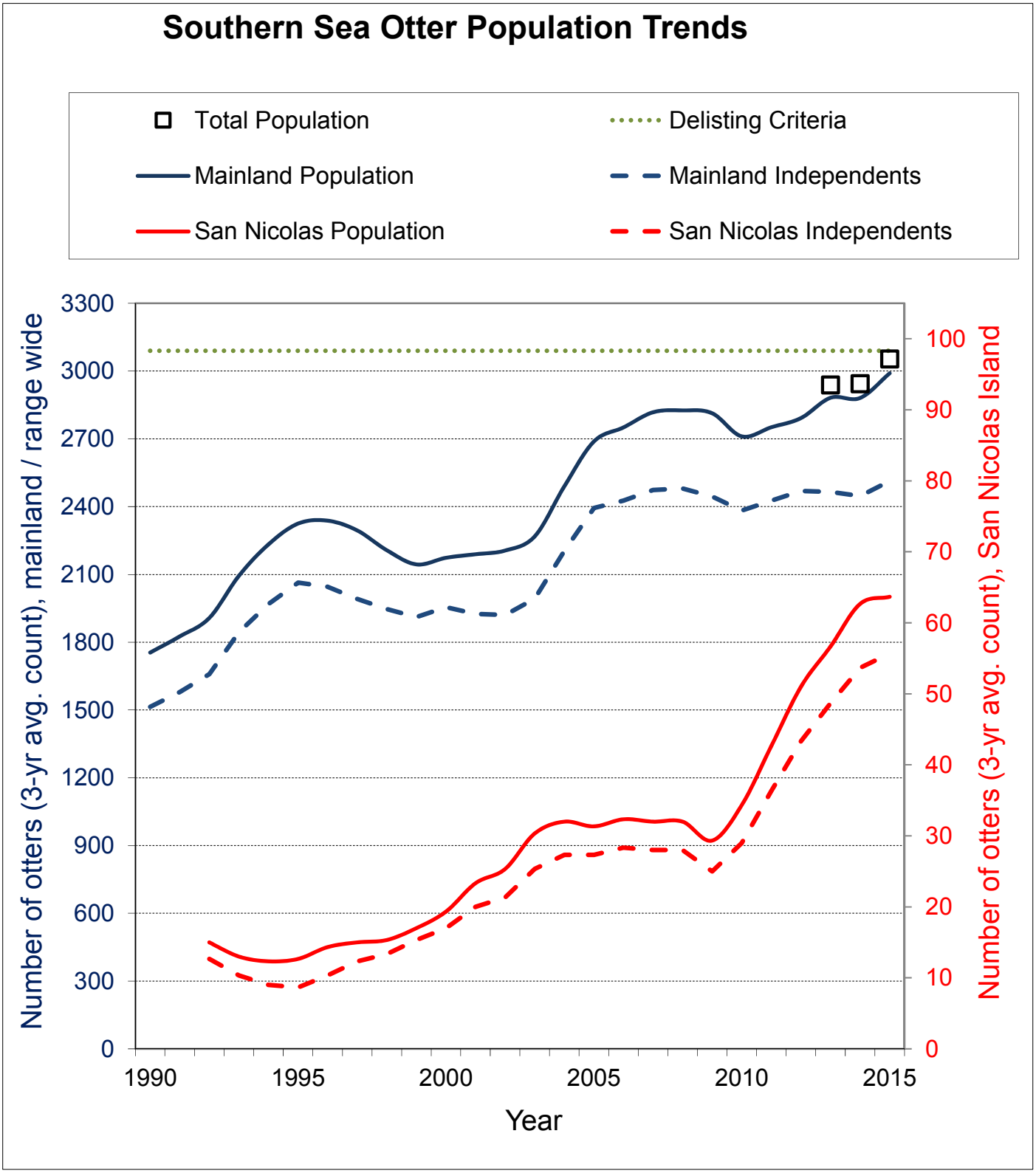

Figure 2 Trends in abundance of sea otters in California, based on 3-year running averages of raw counts. Data are shown for all otters and independents (non-pups) for the mainland range (left axis), San Nicolas Island (right axis), and for the entire range after 2012 (left axis) when counts were combined to create an official index of abundance.

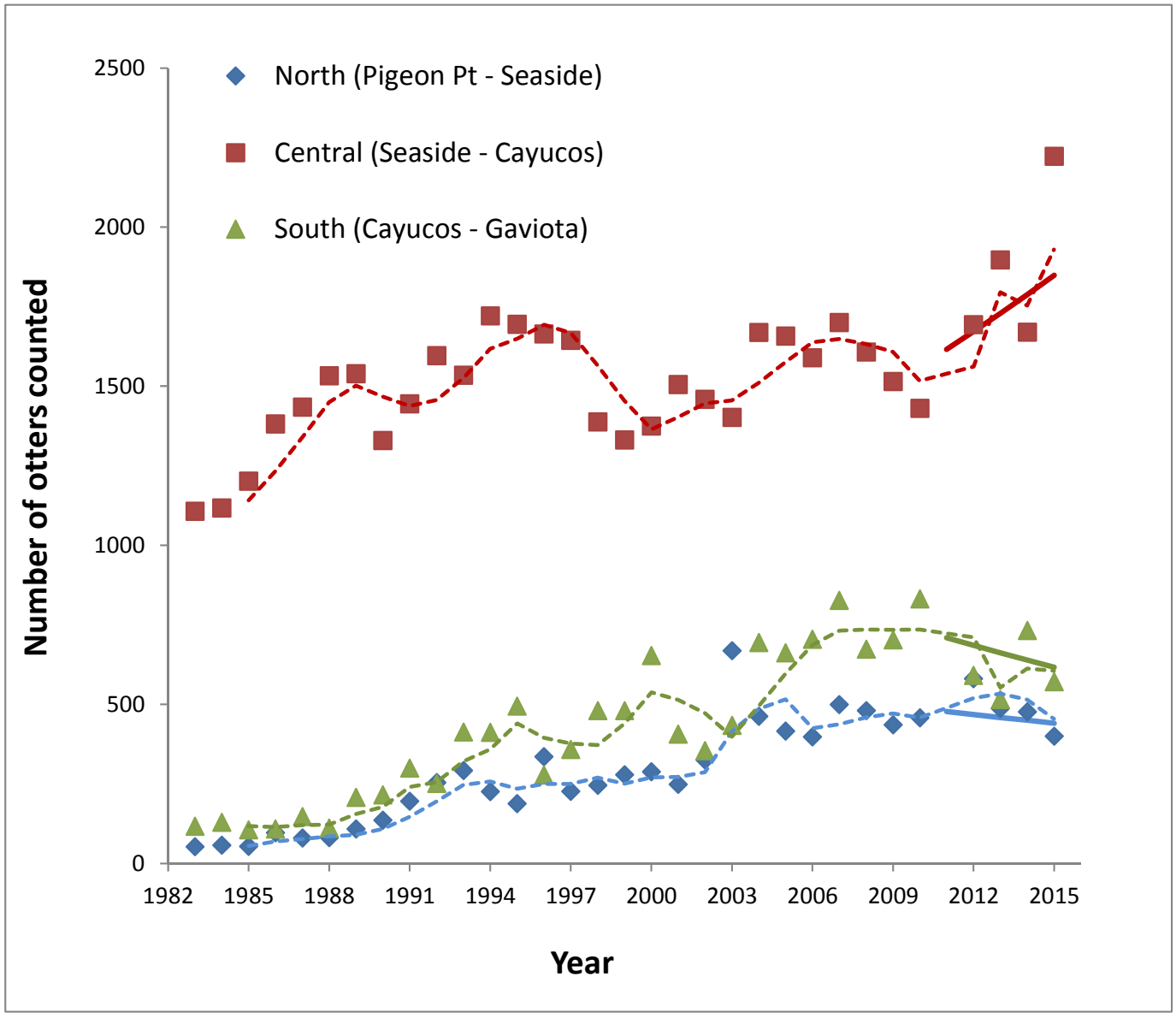

Figure 3 Regional trends in abundance of sea otters along the mainland coast of central California. Raw counts and 3-year running averages (dashed lines) are plotted for the north, central and southern regions. The most recent 5-year average trend (calculated as the geometric mean annual rate of change) is shown as a solid line at the end of each time series.

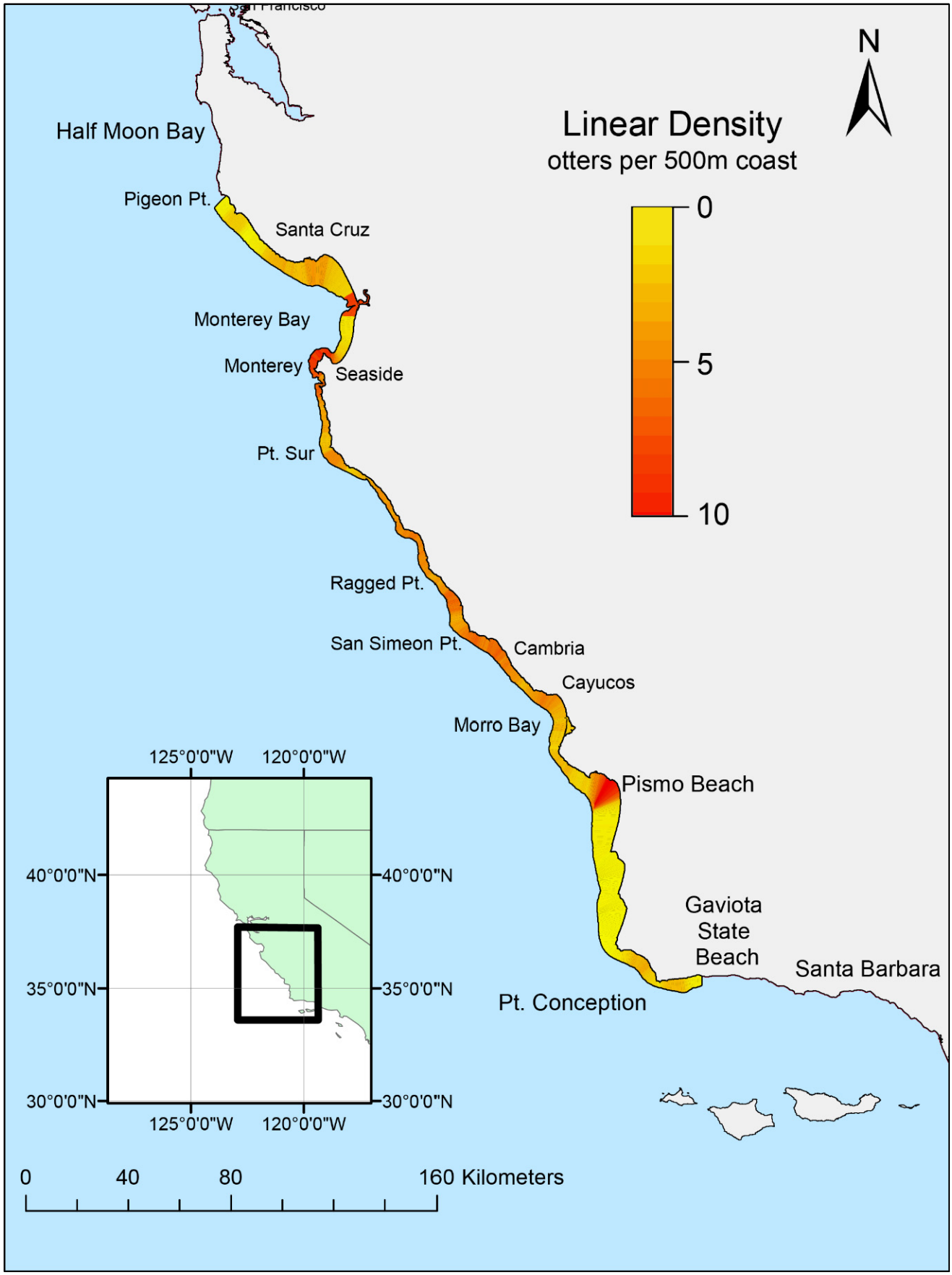

Figure 4 Map of central California showing variation in local population density (number of sea otters per 500m of coast) of sea otters along the mainland coast. Note that data for San Nicolas Island are not shown because spatially-explicit analyses are not currently conducted for San Nicolas.

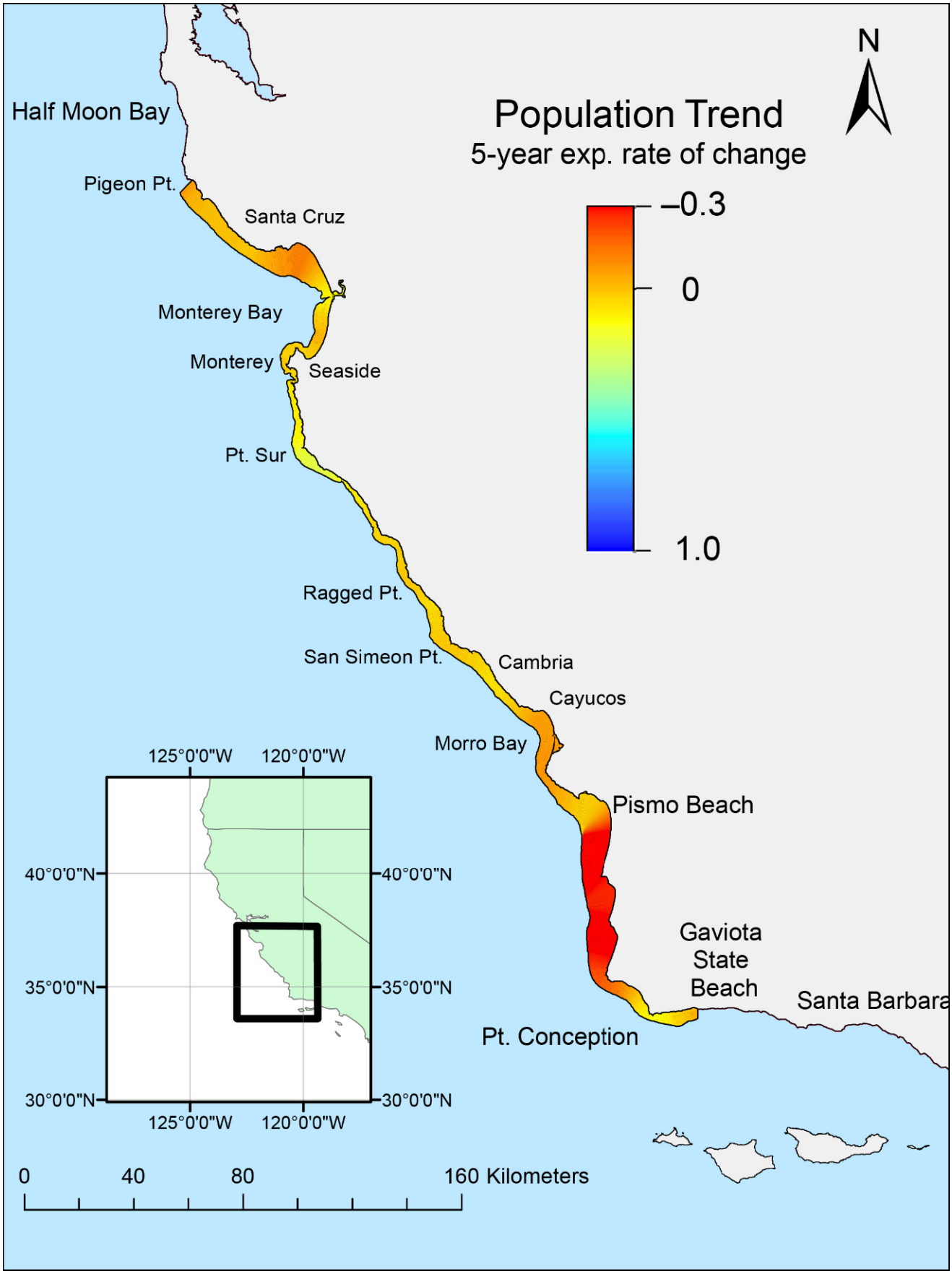

Figure 5 Map of central California showing local trends in abundance of sea otters along the mainland coast. Trends represent 5-year exponential rates of change (fit using maximum likelihood). Note that data for San Nicolas Island are not shown because spatially-explicit analyses are not currently conducted for San Nicolas.