Table S1. Study areas where we monitored the survival and cause-specific mortality of radiocollared mountain lions from 1974-2020 across California, USA. Shown are the years of study, number of animals tracked (*n* = 590), number of deaths recorded (*n* = 263), the type of telemetry used (GPS or VHF) for each study area, and study area cluster identified by hierarchical cluster analysis (GPS only).

Study Area	Years	Animals	Deaths	Data	Cluster
Eastern Sierra	1991-2020	132	62	VHF/GPS	3
Santa Cruz Mountains	2008-2020	69	32	GPS	1
Los Angeles Area	2002-2020	55	29	GPS	1
Eastern Peninsular	2001-2016	49	25	GPS	2
Santa Ana Mountains 2	2005-2016	36	15	GPS	1
Santa Ana Mountains 1	1986-1993	31	18	VHF	1
North Kings	1983-1990	30	20	VHF	---
Modoc	2016-2019	29	11	GPS	3
Mt. Diablo	1984-1988	19	7	VHF	---
North Bay	2016-2020	16	5	GPS	1
Sierra Foothills	2003-2006	19	7	GPS	2
Siskiyou	2016-2019	14	8	GPS	3
Hunter Liggett	1974-1975	13	0	VHF	---
Central Coast	2018-2019	10	3	GPS	2
Hoopa	2017-2019	9	2	GPS	2
Peninsular	2020-2020	9	4	GPS	2
Redwoods	1998-2000	9	3	VHF	---
Southern Sierra	2014-2017	8	2	GPS	3
Mono	1987-1993	8	1	VHF	---
Mendocino	2010-2012	7	3	GPS	2
Plumas	2016-2016	7	2	GPS	3
Yosemite	1997-1998	7	2	VHF	---
Sacramento Valley	2016-2017	2	1	GPS	---
Transverse Range	2019-2019	2	1	GPS	2

Table S2. Number of mortality events (*n* = 263) by sex and age-class for each mortality cause of radiocollared mountain lions in California, USA, 1974-2020.

Sex	Age class	Management	Poached	Vehicle	Other Human	Strife	Natural (Non-Strife)	Unknown
Female	Adult	18	11	12	3	7	19	27
Female	Subadult	2	1	0	1	4	3	4
Male	Adult	29	12	12	5	11	6	24
Male	Subadult	12	2	15	0	9	5	9

Appendix S1. Exploring the uncertainty of unknown mortality

The rate of unknown mortality introduced some uncertainty into our test of the compensatory mortality hypothesis. Specifically, the uncertainty would be with the prediction that natural mortality should decline with increasing human-caused mortality through its influence on both the response and predictor variables. Unknown mortality could have been biased towards natural mortality given that some forms of human-caused mortality are easier to identify (1). However, some of the unknown mortality in our dataset may have been the result of illegal killing (‘cryptic poaching’) in cases where people disposed of collars separately from the carcass (2). Additionally, if poachers destroyed or disabled radiotransmitters, these mortality events would have been missed and the human-caused mortality rate would be biased low (3). Finally, animals injured in collisions with vehicles sometimes travel away from the road before dying, which can obscure cause of death if the carcass is not recovered promptly. We suspect that the unknown mortality in our study was a combination of natural and human-causes mortality, but acknowledge that it could have been biased towards natural mortality. To explore uncertainty introduced by the unknown mortality events, we modeled a range of hypothetical scenarios attributing the unknown mortality to varying proportions of natural and human causes (see Table S3 below). These results indicate that our prediction test (see Results, section 3.2) investigating whether natural mortality changed as a function of increasing human-caused mortality was robust to uncertainty from unknown mortality.

Table S3. Regression coefficients (β) and 90% Highest Posterior Density (HPD) intervals from hypothetical models attributing unknown mortality events to varying proportions of human-caused and natural mortality. We used these models to gauge the potential influence of unknown mortality on our test of a key prediction for the compensatory mortality hypothesis, i.e. that if mortality is compensatory than natural mortality should decrease with increasing rates of human-caused mortality. All hypothetical scenarios showed no significant trend in natural mortality as human-caused mortality increased. Thus, these models fail to support the compensatory mortality hypothesis indicating that our overall model (see Results, section 3.2 in text) was robust to uncertainty from unknown mortality events.

Scenario	β	Lower 90% HPD	Higher 90% HPD	Conclusion
All human	-0.24	-0.90	0.44	No increase or decrease in natural morality
Natural 25%, human 75%	-0.28	-0.88	0.30	No increase or decrease in natural morality
Natural 50%, human 50%	-0.08	-0.54	0.41	No increase or decrease in natural morality
Natural 75%, human 25%	0.02	-0.44	0.53	No increase or decrease in natural morality
All natural	0.03	-0.45	0.51	No increase or decrease in natural morality

Appendix S2. Test of compensatory mortality with additional study areas

In our test of the compensatory mortality hypothesis, we limited our analysis to study areas (n = 8) with ≥29 radiocollared mountain lions to ensure survival and mortality rates were representative of these populations. Here, we relaxed those requirements by including all study areas (n = 13) with ≥10 radiocollared mountain lions (n = 522 total) and repeated the analysis to investigate whether the results were consistent. Overall survival decreased as a function of increasing human-caused mortality in populations across California (failing to support P2; β = -0.72, 90% Highest Posterior Density Interval [HPD; -0.02, -1.34], n = 13; Fig. S1). Natural mortality did not decline and instead showed a positive trend in relation to increasing human-caused mortality (failing to support P3; β = 0.61, 90% HPD [0.03, 1.16], n = 13; Fig. S1). Thus, consistent with the results of our analysis in the main paper, our data provide no support for compensatory mortality and suggested that human-caused mortality was additive. In fact, this exploratory analysis actually suggests that human-caused mortality might be over-additive given the increasing trend in natural mortality relative to increased human-caused mortality. Over-additive mortality occurs when natural mortality increases with increased human-caused mortality (4). However, these results should be interpreted cautiously given the modest sample sizes of animals and events in some study areas. Nonetheless, the consistency in our prediction tests with different subsets of the data indicates that the results of our test of the compensatory mortality hypothesis are robust to both sample size and spatial variation in survival and mortality across California.

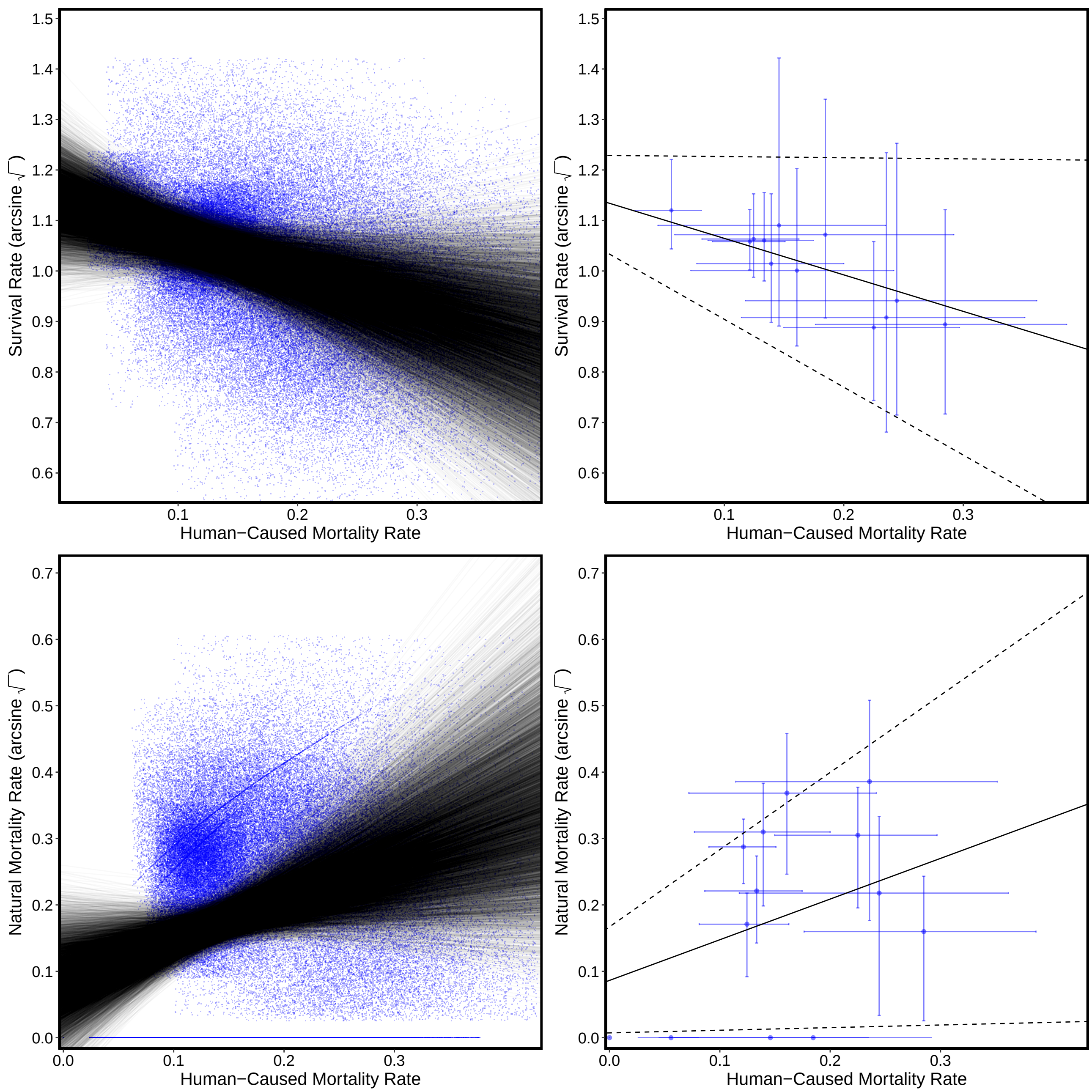

Fig. S1. Plots showing relationships of overall survival and human-caused mortality (A, B) and natural mortality and human-caused mortality (C, D) across 13 study areas (*n* = 522 mountain lions) to test the compensatory mortality hypothesis. Shown are datapoints and regression lines (A, C) generated by drawing 10,000 samples from beta distributions to account for uncertainty in our estimates and regression plots used to estimate mean β and 90% highest posterior density intervals for these relationships (B, D).

Appendix S3. Exploring differences in mortality risk before and after the hunting ban

We investigated whether mortality risk varied before and after the 1990 legislation banning hunting of mountain lions in California in study areas where we had survival data before and after 1990. We acknowledge that our data are limited for this question as most of our data was collected after 1990 (87%) and 2000 (76%). Additionally, we only had data from before and after 1990 in three study areas (Santa Ana Mountains, Mono, and North Kings). Given the strong spatial variation in survival and mortality across the state that we documented (see *Results* in main text), it was important to make this comparison with study areas where mountain lions were tracked during both periods. We used this analysis simply to make sure three were not strong differences in our dataset due to the change in management policy. We conducted a subset analysis with relevant data from these study areas (n = 69 animals, 38 deaths) using a Cox proportional hazard model as described in the main text (see *Materials and Methods*). We included dummy-coded variables for male (male = 1, female = 0), adult (adult = 1, subadult = 0), and pre-1990 (pre = 1, post = 0). There was not a significant difference in mortality risk before and after the 1990 hunting ban (hazard ratio = 0.80, 95% CI [0.32, 1.97]).

Table S4. Specific causes of mortality for mountain lions (*n* = 263) within the broader classes used to estimate cause-specific mortality rates across California, USA, 1974-2020.

Mortality class	Specific cause of death	*n*
Management	Livestock depredation management	46
Management	Public safety	1
Management	Bighorn sheep management	14
Vehicle	Vehicle	39
Other Human	Fire	3
Other Human	Rodenticide poisoning	6
Intraspecific strife	Intraspecific strife	31
Natural (Non-strife)	Disease	11
Natural (Non-strife)	Natural but specific cause unknown	16
Natural (Non-strife)	Starved	6
Poached	Poached	26
Unknown	Unknown cause	64

Table S5. Variables included in principal components analysis and spatial mortality risk model used to cluster different mountain lion study areas according to similarities in human populations and landscape features.

Distance to Developed Open Space: Derived from National Land Cover Database (NLCD) 30m raster layer. Developed Open spaces are defined as areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.

Distance to Low-Intensity Development: Derived from NLCD raster layer. Low-intensity development is defined as areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.

Distance to Medium-Intensity Development: Derived from NLCD raster layer. Medium-intensity development is defined as areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.*

Distance to High-Intensity Development: Derived from NLCD raster layer. High-intensity development is defined as highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses, and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.*

Distance to Cover: Derived from NLCD raster layer. Minimum distance to any cell classified as any type of forest or shrub.

Distance to Primary Roads: Derived from USGS National Transportation Dataset. Controlled-access Highways. Any multiple-lane roadway with controlled access including interstates.*

Distance to Secondary Roads: Derived from USGS National Transportation Dataset. Secondary Highways or Major Connecting Roads. Other highways; carry heavy traffic between cities and have at-grade intersections.

Distance to Local Roads: Derived from USGS National Transportation Dataset. All other roads - residential streets.

Distance to Four Wheel Drive Roads: Derived from USGS National Transportation Dataset. Roads only suitable for travel with a 4WD vehicle, also called vehicular trails.

Population Density: Total population estimates from the decennial census at the block level. Blocks are statistical areas bounded by visible features, such as streets, roads, streams, and railroad tracks, and by nonvisible boundaries, such as selected property lines and city, township, school district, and county limits and short line-of-sight extensions of streets and roads. Generally, census blocks are small in area; for example, a block in a city bounded on all sides by streets. Census blocks in suburban and rural areas may be large, irregular, and bounded by a variety of features, such as roads, streams, and transmission lines. In remote areas, census blocks may encompass hundreds of square miles.

Mean Percentage of Votes Opposing Environmentally-focused Ballot Initiatives: Derived from California Secretary of State Statement of Vote for the 2010, 2016, and 2018 primary and general elections. Average number of votes against a series of environmental/wildlife protections (Propositions 3, 23, 65, 67, and 68). Voting results are at the county level and values are averaged across the 5 propositions.

> Prop 3: A "no" vote opposed this measure to authorize $8.877 billion in general obligation bonds for water infrastructure, groundwater supplies and storage, surface water storage and dam repairs, watershed and fisheries improvements, and habitat protection and restoration.
>
> Prop 23: A "yes" vote supported suspending Assembly Bill 32 (AB 32), which required greenhouse gas emissions to be reduced to 1990 levels by 2020, until California's unemployment rate decreases to 5.5% or less for four consecutive quarters.
>
> Prop 65: A "no" vote opposed this measure redirecting money collected from the sale of carry-out bags by grocery or other retail stores to a special fund administered by the Wildlife Conservation Board.
>
> Prop 67: A "no" vote opposed banning certain plastic bags and enacting Senate Bill 270.
>
> Prop 68: A "no" vote opposed this measure to authorize $4 billion in general obligation bonds for state and local parks, environmental protection projects, water infrastructure projects, and flood protection projects.

Goat & Sheep Farm Density: Derived from the USDA Agricultural Census. Number of goat and sheep farms per square kilometer.

Mean Income: Mean household income from the US Census Bureau, Census tract level.

---

* Not included in spatial mortality risk models because they were rare or non-existent in some areas occupied by mountain lions across California (high and medium-intensity development, primary roads)

SI References

1. C. Collins, R. Kays, Causes of mortality in North American populations of large and medium-sized mammals. *Anim. Conserv.,* **14**, 474-483 (2011).

2. O. Liberg, *et al.*, Shoot, shovel and shut up: cryptic poaching slows restoration of a large carnivore in Europe. *Proc. Royal Soc. B.*, **279**, 910-915 (2012).

3. A. Treves, K.A. Artelle, C.T. Darimont, D.R. Parsons, Mismeasured mortality: correcting estimates of wolf poaching in the United States. *J. Mamm.,* **98**, 1256-1264 (2017).

4. L.M. Wolfe, *et al*., Is anthropogenic cougar mortality compensated by changes in natural mortality in Utah? Insight from long-term studies. *Biol. Conserv.*, **182,** 187-196 (2015).