**Supplementary Information**

Kevin C. Rowe1,2\*, Karen M.C. Rowe1,2, Morgan W. Tingley3,5, Michelle S. Koo1, , James L. Patton1,4, Chris J. Conroy1, John D. Perrine6, Steven R. Beissinger1,3, Craig Moritz1,7,8.

1Museum of Vertebrate Zoology, University of California, Berkeley, CA 94720-3160, USA

2Present address: Museum Victoria, Sciences Department, GPO Box 666, Melbourne, VIC 3001, AUSTRALIA

3Department of Environmental Science, Policy and Management, University of California, Berkeley, CA 94720-3114, USA

4Department of Integrative Biology, University of California, Berkeley, CA 94720-3160, USA

5Woodrow Wilson School, Princeton University, Princeton, NJ 08544, USA

6Biological Sciences Department, California Polytechnic State University, San Luis Obispo, CA 93407-0401, USA

7Research School of Biology and Centre for Biodiversity Analysis, The Australian National University, Canberra ACT 0200, AUSTRALIA

8The Commonwealth Scientific and Industrial Research Organization Ecosystem Sciences Division, Canberra ACT 2601, AUSTRALIA

\*Corresponding author: Kevin Rowe, krowe@museum.vic.gov.au

**Supplementary Methods**

*Survey Regions and 20th Century Climate Change*

*Survey and Resurvey Data*

We determined the elevation of each historical and modern trapline using a digital elevation model (DEM) (Supplementary Table S1).

Additional modern sites were selected to maximize elevation coverage and to serve as proxies for historical sites that were otherwise inaccessible.

*Species Set*

Our data set included records for 67 species of small mammals in the modern and/or historical eras (Supplementary Table S2

*Modelling Changes in Elevational Ranges*

Following Moritz et al.4, we estimated temporal shifts in the lower and upper range limits for each species on each of the three regions. To test the significance of these shifts, we estimated site-specific detection probabilities (*p\**).

*Testing Predictions of Range Shifts*

We used generalized linear mixed models (GLMM) to examine how patterns of range shifts were related to regional variation and the elevational distributions of species.

*Climatic Nearest Neighbour*

**Supplementary Methods References**

1. <http://arctos.database.museum/project/historic-grinnell-survey-lassen-transect>
2. <http://arctos.database.museum/project/historic-grinnell-survey-yosemite-transect>
3. <http://arctos.database.museum/project/historic-grinnell-survey-southern-sierra-nevada-transect>
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8. <http://arctos.database.museum/project/grinnell-resurvey-project-southern-sierra-nevada-transect>
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16. Daly, C., Gibson, W. P., Taylor, G. H., Johnson, G. L., & Pasteris, P. A knowledge-based approach to the statistical mapping of climate. *Climate Res.* **22,** 99–113. (2002).

# Supplementary Figure Legends

Supplementary Figure S1. Violin plot of BIOCLIM variables included in this study. Each plot represents all cells within 20-kilometer buffer around the minimum convex polygon that encompassed all survey sites for (a) B1 (mean annual temperature), (b) B5 (maximum temperature of the warmest month), (c) B6 (minimum temperature of the coldest month), and (d) B12 (mean annual precipitation) for each region in the historical and modern eras. Median and the upper and lower quartiles are represented by the white circle and black bar, respectively.

Supplementary Figure S2. Distribution by elevation and region of all 67 species of small mammal detected within the study regions over both eras. Green diamonds and crosses represent species presences recorded through quantitative (e.g., Sherman live trap) or non-quantitative (e.g., Shotgun) trapping effort, respectively. Blue crosses represent species presences recorded through observation alone. For species subject to detectability analysis, the size of the open circle represents site-specific detectability. Grey circles represent elevation of surveyed sites for those species not subject to detectability analysis.

Supplementary Figure S3. Occupancy curves in the historical and modern eras by region for the 28 occupancy-modelled small mammal species. Curves represent the probability of occupancy in the historical (dark blue) and modern (green) eras across elevations with the elevation of sites surveyed in each era given by triangles (historical) and circles (modern).

# Supplementary Tables

Supplementary Table S1. Historical and modern locality data for sites included in this study.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Aggregate name | Latitude | Longitude | Era | Slope | Region | Elevation (m) |
| Red Bluff 4 | 40.1903286 | -122.2252066 | H | W | N | 83 |
| Red Bluff 5 | 40.2121782 | -122.2297661 | H | W | N | 89 |
| Red Bluff 3 | 40.1707 | -122.1254 | H | W | N | 90 |
| Red Bluff 1 | 40.1339 | -122.2061 | H | W | N | 92 |
| Battle Creek | 40.37479 | -122.18016 | H | W | N | 103 |
| Red Bluff 2 | 40.24038 | -122.110955 | H | W | N | 167 |
| Red Bluff 6 | 40.3221638 | -122.2855723 | H | W | N | 177 |
| Dales, Payne Creek | 40.3146 | -122.0695 | H | W | N | 208 |
| Manton | 40.425439 | -121.889271 | H | W | N | 535 |
| Lymans | 40.3096 | -121.7678 | H | W | N | 1051 |
| Turners | 40.30825 | -121.738116 | H | W | N | 1335 |
| Petes Valley | 40.52927 | -120.46209 | H | E | N | 1382 |
| Mineral 3 | 40.3377636 | -121.5961291 | H | W | N | 1478 |
| Eagle Lake 3 | 40.5729252 | -120.838016 | H | W | N | 1561 |
| Eagle Lake 2 | 40.6709426 | -120.7895831 | H | W | N | 1564 |
| Mineral, Summit Creek 2 | 40.3628 | -121.5663 | H | W | N | 1583 |
| Eagle Lake 1 | 40.73439 | -120.719636 | H | W | N | 1586 |
| Grasshopper Valley | 40.850087 | -120.756895 | H | E | N | 1616 |
| Termo | 40.8915 | -120.4564 | H | E | N | 1622 |
| West Red Rock PO | 40.8995 | -120.25399 | H | E | N | 1626 |
| Mineral, Summit Creek 1 | 40.3489 | -121.5878 | H | W | N | 1627 |
| North Observation Peak 1 | 40.86135 | -120.17049 | H | E | N | 1628 |
| East Ravendale | 40.79823 | -120.23207 | H | E | N | 1668 |
| Willow Lake | 40.4052369 | -121.3657268 | H | W | N | 1672 |
| Kellys 2 | 40.4326779 | -121.3520687 | H | W | N | 1675 |
| North Fredonyer Peak | 40.801001 | -120.61175 | H | E | N | 1711 |
| South West Ravendale | 40.6969 | -120.409 | H | E | N | 1717 |
| Hot Spring Valley | 40.44423 | -121.3938 | H | W | N | 1784 |
| Manzanita Lake | 40.5314 | -121.5648 | H | W | N | 1790 |
| Butte Lake | 40.5642 | -121.3023907 | H | W | N | 1845 |
| Black Butte | 40.4147 | -121.5319 | H | W | N | 1971 |
| Warner Creek 1 | 40.4596926 | -121.4418428 | H | W | N | 2061 |
| Warner Creek 2 | 40.4635115 | -121.4719669 | H | W | N | 2462 |
| Lake Helen | 40.469128 | -121.518495 | H | W | N | 2514 |
| Sacramento River, Blue Tent Creek | 40.2026 | -122.21628 | M | W | N | 80 |
| Coyote Creek | 40.09325 | -122.22687 | M | W | N | 92 |
| Sacramento River, Perry Riffle | 40.29721 | -122.17534 | M | W | N | 97 |
| Jellys Ferry | 40.319965 | -122.18149 | M | W | N | 103 |
| Reading Island | 40.38927333 | -122.1922033 | M | W | N | 111 |
| Paynes Creek | 40.30254 | -122.10614 | M | W | N | 168 |
| Dales Lake | 40.330645 | -122.072605 | M | W | N | 207 |
| Hog Lake | 40.28261 | -122.12289 | M | W | N | 270 |
| Vasquez Ranch | 40.436528 | -121.875444 | M | W | N | 608 |
| Lyman Springs | 40.31124 | -121.764275 | M | W | N | 1044 |
| Petes Valley | 40.52613667 | -120.4655133 | M | E | N | 1383 |
| Battle Creek | 40.34945 | -121.631705 | M | W | N | 1459 |
| Battle Creek Meadows | 40.33948 | -121.609185 | M | W | N | 1468 |
| Eagle Lake, Merrill Creek | 40.552305 | -120.814665 | M | W | N | 1559 |
| Eagle Lake Pine Creek | 40.66796 | -120.78612 | M | W | N | 1566 |
| Eagle Lake, Brockman | 40.59293 | -120.844295 | M | W | N | 1584 |
| Summit Creek | 40.35804 | -121.55757 | M | W | N | 1616 |
| Wilson Lake | 40.344115 | -121.439425 | M | W | N | 1620 |
| Coyote Flat | 40.88974 | -120.26846 | M | E | N | 1621 |
| Eagle Lake, Papoose Meadow | 40.525815 | -120.76727 | M | W | N | 1628 |
| Observation Peak 1 | 40.86155 | -120.1599 | M | E | N | 1631 |
| Observation Peak 2 | 40.84532 | -120.17653 | M | E | N | 1632 |
| Dodge Ranch | 40.89014 | -120.17355 | M | E | N | 1632 |
| Horne Ranch | 40.82822 | -120.13889 | M | E | N | 1647 |
| Slate Creek | 40.842596 | -120.769944 | M | E | N | 1663 |
| Willow Lake | 40.40586 | -121.362885 | M | W | N | 1680 |
| Tuledad Road | 40.92563 | -120.13857 | M | E | N | 1696 |
| Bailey Creek | 40.805722 | -120.610026 | M | E | N | 1702 |
| Summit Creek North | 40.3689 | -121.53831 | M | W | N | 1723 |
| Dodge Reservoir | 40.96926 | -120.135055 | M | E | N | 1759 |
| Pole Spring | 40.5872 | -121.2870167 | M | W | N | 1783 |
| Drakesbad | 40.444655 | -121.4085 | M | W | N | 1785 |
| Manzanita Lake | 40.53759 | -121.57018 | M | W | N | 1791 |
| Butte Lake | 40.562405 | -121.29966 | M | W | N | 1850 |
| Bluff Falls | 40.4122025 | -121.531905 | M | W | N | 1990 |
| Kings Creek Falls | 40.45971 | -121.44478 | M | W | N | 2100 |
| Upper Kings Creek Meadow | 40.46521 | -121.4764 | M | W | N | 2276 |
| Helen, Emerald Lakes | 40.4697275 | -121.5139775 | M | W | N | 2491 |
| Minkler | 36.7166 | -119.4641 | H | W | S | 118 |
| Bakersfield | 35.4198391 | -119.0087676 | H | W | S | 180 |
| Dunlap | 36.717103 | -119.132257 | H | W | S | 636 |
| Bodfish | 35.600131 | -118.496674 | H | W | S | 721 |
| Mill Creek | 35.5305856 | -118.6221592 | H | W | S | 787 |
| Weldon, South | 35.666083 | -118.28948 | H | W | S | 809 |
| Onyx | 35.685739 | -118.21827 | H | E | S | 865 |
| Weldon, Fay Creek North | 35.7412 | -118.31 | H | W | S | 1261 |
| Walker Pass 06 | 35.6692 | -118.0371 | H | E | S | 1416 |
| Walker Pass 05 | 35.6877503 | -118.0493023 | H | E | S | 1424 |
| Walker Pass 07, Freeman Canyon | 35.6501 | -118.0109 | H | E | S | 1481 |
| Kings River Canyon | 36.7938 | -118.581 | H | W | S | 1529 |
| Hume Lake | 36.787727 | -118.913013 | H | W | S | 1592 |
| Carroll Creek | 36.5051 | -118.10244 | H | E | S | 1699 |
| Smith Meadow, Trout Creek | 35.96474 | -118.22947 | H | W | S | 1860 |
| Kiavah Mountain, Scodie Mountains | 35.682227 | -118.085094 | H | E | S | 1959 |
| Jordan Hot Springs | 36.229654 | -118.30169 | H | W | S | 1984 |
| Hockett Trail 1 | 36.49339 | -118.13676 | H | E | S | 2000 |
| Hockett Trail 4 | 36.49577 | -118.1123 | H | E | S | 2142 |
| Taylor Meadow | 35.830658 | -118.29175 | H | W | S | 2147 |
| Cannell Meadow | 35.825082 | -118.36717 | H | W | S | 2268 |
| Hockett Trail 3 | 36.477695 | -118.137275 | H | E | S | 2281 |
| Hockett Trail 5 | 36.49732 | -118.11483 | H | E | S | 2313 |
| Horse Corral Meadow | 36.74744 | -118.75404 | H | W | S | 2314 |
| Jackass Meadow | 36.092861 | -118.2262 | H | W | S | 2364 |
| Broder/Monache Meadow | 36.16332 | -118.18188 | H | W | S | 2424 |
| Dry Meadows | 36.214523 | -118.25257 | H | W | S | 2624 |
| Redrocks Meadow | 36.270108 | -118.271385 | H | W | S | 2657 |
| Onion Valley | 36.77438267 | -118.3310457 | H | W | S | 2732 |
| Sirretta Meadows | 35.942 | -118.328 | H | W | S | 2755 |
| Little Pete Meadow | 37.101522 | -118.5958 | H | W | S | 2761 |
| Aster Lake | 36.6001448 | -118.6748248 | H | W | S | 2796 |
| McClure/Colby Meadows | 37.1713 | -118.7024 | H | W | S | 2952 |
| Rock Creek | 36.496066 | -118.326482 | H | W | S | 2954 |
| Whitney Meadow | 36.434131 | -118.2671 | H | W | S | 2969 |
| Little Cottonwood Creek | 36.47914 | -118.128635 | H | W | S | 2997 |
| Little Brush Meadow, Olancha Peak | 36.2541 | -118.13 | H | W | S | 3005 |
| Hockett Trail 2 | 36.49415 | -118.09586 | H | E | S | 3036 |
| Bubbs Creek | 36.763891 | -118.406272 | H | W | S | 3040 |
| Mitchell Peak | 36.732308 | -118.713693 | H | W | S | 3128 |
| Crabtree Meadow, Whitney Creek | 36.551234 | -118.35854 | H | W | S | 3147 |
| Flower/Heart Lake | 36.7695434 | -118.3561116 | H | W | S | 3177 |
| Moose Lake | 36.600674 | -118.637441 | H | W | S | 3214 |
| Bullfrog Lake | 36.772973 | -118.403983 | H | W | S | 3249 |
| Olancha Peak, West Slope | 36.259758 | -118.123273 | H | W | S | 3287 |
| Evolution Lake | 37.1686 | -118.6933 | H | W | S | 3313 |
| Cottonwood Lakes | 36.498147 | -118.220007 | H | W | S | 3384 |
| Dusy Lake | 37.102299 | -118.555 | H | W | S | 3392 |
| Humphreys Basin | 37.2653 | -118.7056 | H | W | S | 3460 |
| Piute Pass, off trapline | 37.231039 | -118.68916 | H | W | S | 3474 |
| Cirque Peak | 36.461735 | -118.238346 | H | W | S | 3503 |
| Kearsarge Pass | 36.7725 | -118.3761 | H | E | S | 3575 |
| Mt. Gould | 36.78039 | -118.37854 | H | W | S | 3940 |
| Minkler 04, Jesse Morrow Mountain | 36.712887 | -119.416629 | M | W | S | 135 |
| Minkler 01, 02, 03 | 36.7504894 | -119.4403854 | M | W | S | 138 |
| Bakersfield | 35.5138617 | -118.8709479 | M | W | S | 231 |
| Bakersfield, Jackrabbit Flat | 35.49501 | -119.0572608 | M | W | S | 250 |
| Dunlap, Mill Creek | 36.7301617 | -119.1186399 | M | W | S | 583 |
| Bodfish 04, Sandy Flat Campground | 35.587765 | -118.440047 | M | W | S | 705 |
| Bodfish 01, 02 | 35.599554 | -118.4967251 | M | W | S | 732 |
| Mill Creek | 35.5353281 | -118.6173197 | M | W | S | 741 |
| Weldon 02, 03, 06, 08, South | 35.6785335 | -118.2953012 | M | W | S | 810 |
| Kelso Creek Road | 35.63622 | -118.24572 | M | W | S | 861 |
| Onyx 01, 03, Canebrake Ecological Reserve | 35.7284779 | -118.1716634 | M | E | S | 866 |
| Onyx 02, 04, Scodie Canyon | 35.6794096 | -118.2144064 | M | E | S | 906 |
| Bodfish 03, Erskine Creek | 35.587765 | -118.440047 | M | W | S | 932 |
| Weldon 01, 05, 07, 09, Fay Ranch Road, Fay Creek North | 35.7163161 | -118.3052221 | M | W | S | 999 |
| Olancha Creek | 36.27383 | -118.02917 | M | E | S | 1221 |
| Walker Pass 04 | 35.725013 | -118.075586 | M | E | S | 1226 |
| Kings River Canyon | 36.791109 | -118.600285 | M | W | S | 1507 |
| Walker Pass 01, Freeman Canyon | 35.6556102 | -118.0138127 | M | E | S | 1514 |
| Smith Meadow, Trout Creek | 35.965359 | -118.2266916 | M | W | S | 1542 |
| Hume Lake | 36.7919836 | -118.9040388 | M | W | S | 1614 |
| Walker Pass 02 | 35.663848 | -118.026011 | M | E | S | 1625 |
| Carroll Creek | 36.510223 | -118.1029541 | M | E | S | 1672 |
| Walker Pass 03 | 35.6663777 | -118.040982 | M | E | S | 2071 |
| Taylor Meadow | 35.8300014 | -118.2957237 | M | W | S | 2167 |
| Horse Corral Meadow | 36.746714 | -118.7664448 | M | W | S | 2262 |
| Cannell Meadow | 35.8334444 | -118.3707494 | M | W | S | 2282 |
| Jackass Meadow | 36.0929196 | -118.2269272 | M | W | S | 2373 |
| Broder/Monache Meadow | 36.1660483 | -118.1919061 | M | W | S | 2413 |
| Evolution Valley 5 | 37.0991 | -118.597 | M | W | S | 2710 |
| Sirretta Meadows | 35.9447078 | -118.3274356 | M | W | S | 2760 |
| Onion Valley | 36.77509 | -118.334185 | M | W | S | 2772 |
| Aster Lake | 36.60162 | -118.6779 | M | W | S | 2785 |
| Little Cottonwood Creek 01, 02 | 36.4753532 | -118.120386 | M | W | S | 2905 |
| Little Brush Meadow, Olancha Peak | 36.2532438 | -118.1341831 | M | W | S | 2940 |
| Whitney Meadow | 36.4314867 | -118.2748239 | M | W | S | 2990 |
| Little Cottonwood Creek 03 | 36.47915687 | -118.1286138 | M | W | S | 2997 |
| Evolution Valley 2 | 37.1717 | -118.716 | M | W | S | 3012 |
| Little Cottonwood Creek, camp | 36.45175 | -118.17046 | M | W | S | 3072 |
| Crabtree Meadow, Whitney Creek | 36.552653 | -118.3576782 | M | W | S | 3166 |
| Bullfrog Lake | 36.7701135 | -118.4040739 | M | W | S | 3240 |
| Moose Lake | 36.603901 | -118.641 | M | W | S | 3269 |
| Rocky Basin Lakes | 36.4444875 | -118.3181318 | M | W | S | 3298 |
| Evolution Valley 4 | 37.1623 | -118.691 | M | W | S | 3316 |
| Cottonwood Lakes | 36.49873 | -118.20772 | M | W | S | 3398 |
| Evolution Valley 3 | 37.188599 | -118.702 | M | W | S | 3441 |
| Evolution Valley 6 | 37.1027 | -118.556 | M | W | S | 3454 |
| Evolution Valley 1 | 37.2099 | -118.689 | M | W | S | 3640 |
| La Grange 1 | 37.6661 | -120.469857 | H | W | C | 52 |
| Snelling 1 | 37.52686909 | -120.4374364 | H | W | C | 80 |
| Pleasant Valley 1 | 37.65638 | -120.29042 | H | W | C | 251 |
| Pleasant Valley 2 | 37.64441 | -120.30118 | H | W | C | 335 |
| Coulterville 1 | 37.710817 | -120.214514 | H | W | C | 493 |
| El Portal 2 | 37.673726 | -119.7935365 | H | W | C | 583 |
| Mt. Bullion 1 | 37.50822 | -120.043898 | H | W | C | 661 |
| El Portal 1 | 37.67989 | -119.783175 | H | W | C | 752 |
| Coulterville 3 | 37.753536 | -120.1058 | H | W | C | 904 |
| Coulterville 2 | 37.73845 | -120.14187 | H | W | C | 975 |
| Sweetwater 1 | 37.588966 | -119.881282 | H | W | C | 1068 |
| Cascade 1 | 37.725765 | -119.710935 | H | W | C | 1101 |
| El Portal 3 | 37.688188 | -119.764217 | H | W | C | 1202 |
| Yosemite Valley 2 | 37.73731867 | -119.6024683 | H | W | C | 1211 |
| Yosemite Valley 3 | 37.739314 | -119.572044 | H | W | C | 1213 |
| Happy Isles 1 | 37.7316 | -119.561 | H | W | C | 1231 |
| Yosemite Valley 1 | 37.74984527 | -119.5905486 | H | W | C | 1251 |
| Yosemite Valley 4 | 37.7458 | -119.6054 | H | W | C | 1420 |
| Merced Grove 1 | 37.74872617 | -119.83866 | H | W | C | 1647 |
| Cascade Creek 1 | 37.73869815 | -119.7029034 | H | W | C | 1803 |
| Aspen Valley 1 | 37.827725 | -119.771211 | H | W | C | 1878 |
| Chinquapin 1 | 37.65236433 | -119.702601 | H | W | C | 1884 |
| Crane Flat 1 | 37.75558867 | -119.7980497 | H | W | C | 1896 |
| Mono PO 1 | 37.990578 | -119.141074 | H | E | C | 1953 |
| Glen Aulin 2 | 37.928858 | -119.461163 | H | W | C | 1971 |
| Salmon Ranch 1 | 37.96326 | -118.9236 | H | E | C | 2001 |
| Dry Creek 1 | 37.9346515 | -118.935186 | H | E | C | 2076 |
| Williams Butte 1 | 37.90891 | -119.1053 | H | E | C | 2090 |
| Mono Craters 2 | 37.90167 | -118.9914 | H | E | C | 2167 |
| Mono Meadow 1 | 37.663396 | -119.592267 | H | W | C | 2176 |
| Indian Canyon 1 | 37.77432 | -119.56902 | H | W | C | 2195 |
| Silver Lake 1 | 37.79923 | -119.1213 | H | E | C | 2216 |
| Merced Lake 1 | 37.728064 | -119.391793 | H | W | C | 2228 |
| Mono Mills 1 | 37.887635 | -118.959868 | H | E | C | 2241 |
| Glen Aulin 1 | 37.91206 | -119.42135 | H | W | C | 2386 |
| Walker Lake 1 | 37.87338 | -119.171 | H | W | C | 2438 |
| Porcupine Flat 1 | 37.80526 | -119.55632 | H | W | C | 2464 |
| Tuolumne Meadows 2 | 37.8785 | -119.3665 | H | W | C | 2622 |
| Tuolumne Meadows 1 | 37.87941 | -119.39498 | H | W | C | 2632 |
| Warren Fork 1 | 37.95505 | -119.2283 | H | W | C | 2773 |
| Gem Lake 1 | 37.75857 | -119.1594 | H | W | C | 2773 |
| Ten Lakes 1 | 37.9038915 | -119.5255205 | H | W | C | 2784 |
| Mt. Hoffman 1 | 37.84461 | -119.50018 | H | W | C | 3026 |
| Lyell Canyon 1 | 37.773896 | -119.260877 | H | W | C | 3026 |
| Young Lakes 1 | 37.9378 | -119.340629 | H | W | C | 3047 |
| Vogelsang 1 | 37.790895 | -119.34256 | H | W | C | 3161 |
| Lyell Canyon 2 | 37.76408752 | -119.2520804 | H | W | C | 3281 |
| LG2 | 37.621805 | -120.525885 | M | W | C | 50 |
| LG3 | 37.66747286 | -120.4679471 | M | W | C | 57 |
| LG1 | 37.6248 | -120.56688 | M | W | C | 76 |
| S2 | 37.53619 | -120.48598 | M | W | C | 89 |
| S1 | 37.51121 | -120.38391 | M | W | C | 90 |
| S3 | 37.529065 | -120.35093 | M | W | C | 115 |
| S4 | 37.54692 | -120.35495 | M | W | C | 118 |
| CPV6 | 37.70881 | -120.22121 | M | W | C | 420 |
| CPV2 | 37.65594 | -120.22132 | M | W | C | 545 |
| CPV4 | 37.72381333 | -120.2637533 | M | W | C | 557 |
| CPV8 | 37.71951 | -120.17941 | M | W | C | 569 |
| CPV5 | 37.73883 | -120.24826 | M | W | C | 646 |
| CPV1 | 37.64055333 | -120.21173 | M | W | C | 728 |
| CPV3 | 37.614215 | -120.18232 | M | W | C | 832 |
| MD2 | 37.74401 | -120.03202 | M | W | C | 853 |
| CPV9 | 37.73636 | -120.166455 | M | W | C | 873 |
| MD1 | 37.75542 | -120.08468 | M | W | C | 887 |
| CPV7 | 37.68405 | -120.12141 | M | W | C | 899 |
| Ca1 | 37.72315 | -119.7120025 | M | W | C | 1045 |
| FM3 | 37.54498 | -119.83822 | M | W | C | 1122 |
| FM2 | 37.5790375 | -119.88213 | M | W | C | 1129 |
| YV1 | 37.71515 | -119.665 | M | W | C | 1191 |
| YV2 | 37.72193 | -119.63632 | M | W | C | 1205 |
| YV5 | 37.74053 | -119.57217 | M | W | C | 1209 |
| YV4 | 37.74276333 | -119.58765 | M | W | C | 1209 |
| YV3 | 37.73242333 | -119.6077033 | M | W | C | 1219 |
| YV6 | 37.73267 | -119.55807 | M | W | C | 1227 |
| YV7 | 37.753365 | -119.54557 | M | W | C | 1256 |
| FM1 | 37.56624 | -119.86851 | M | W | C | 1268 |
| YV8 | 37.75236 | -119.58723 | M | W | C | 1321 |
| F1 | 37.70369 | -119.740075 | M | W | C | 1354 |
| HM1 | 37.79611 | -119.86781 | M | W | C | 1424 |
| MG1 | 37.748264 | -119.839376 | M | W | C | 1646 |
| HG1 | 37.76525 | -119.86233 | M | W | C | 1701 |
| MG2 | 37.76208 | -119.84264 | M | W | C | 1811 |
| AV1 | 37.82534 | -119.77221 | M | W | C | 1872 |
| CF2 | 37.75287813 | -119.7976925 | M | W | C | 1881 |
| Ch1 | 37.68598667 | -119.7243933 | M | W | C | 1951 |
| CF1 | 37.75331 | -119.8089 | M | W | C | 1956 |
| TF1 | 37.75456 | -119.74298 | M | W | C | 2018 |
| CF3 | 37.75775 | -119.7699 | M | W | C | 2098 |
| MMe3 | 37.667798 | -119.623188 | M | W | C | 2126 |
| TC1 | 37.81096 | -119.71286 | M | W | C | 2143 |
| MoMe1 | 37.66637333 | -119.6721133 | M | W | C | 2153 |
| MMe2 | 37.66671667 | -119.5944433 | M | W | C | 2166 |
| WB1 | 37.90766 | -119.12214 | M | E | C | 2180 |
| BC1 | 37.90028 | -119.12977 | M | E | C | 2199 |
| ML2 | 37.73970714 | -119.40517 | M | W | C | 2222 |
| WC1 | 37.89667 | -119.13013 | M | E | C | 2231 |
| IC1 | 37.77716 | -119.566745 | M | W | C | 2232 |
| SM1 | 37.673565 | -119.654315 | M | W | C | 2237 |
| ML1 | 37.729643 | -119.392858 | M | W | C | 2238 |
| MMi1 | 37.88811 | -118.96021 | M | E | C | 2239 |
| YC1 | 37.85038333 | -119.5763733 | M | W | C | 2283 |
| MMe1 | 37.69924 | -119.58647 | M | W | C | 2372 |
| WW3 | 37.83879 | -119.59254 | M | W | C | 2383 |
| WW1 | 37.85844 | -119.651202 | M | W | C | 2426 |
| GA1 | 37.9117 | -119.42495 | M | W | C | 2433 |
| WW2 | 37.849072 | -119.622823 | M | W | C | 2455 |
| WL1 | 37.8730675 | -119.1629695 | M | W | C | 2474 |
| PF1 | 37.80894333 | -119.5686267 | M | W | C | 2495 |
| FD1 | 37.87649 | -119.41609 | M | W | C | 2554 |
| SN1 | 37.822 | -119.504705 | M | W | C | 2610 |
| JR1 | 37.88358 | -119.3634 | M | W | C | 2685 |
| GM1 | 38.16254 | -119.60461 | M | W | C | 2745 |
| WF1 | 37.954035 | -119.22714 | M | W | C | 2784 |
| LM1 | 37.8827 | -119.34655 | M | W | C | 2815 |
| DeM1 | 37.89922 | -119.3477 | M | W | C | 2866 |
| DL1 | 38.1729675 | -119.5947525 | M | W | C | 2874 |
| TL1 | 37.90404 | -119.533565 | M | W | C | 2883 |
| KM1 | 38.12200714 | -119.48195 | M | W | C | 2884 |
| LC1 | 37.779085 | -119.26102 | M | W | C | 2936 |
| MF1 | 37.84097 | -119.49964 | M | W | C | 2938 |
| DD1 | 37.90828 | -119.3475 | M | W | C | 2961 |
| RC1 | 38.06129 | -119.33899 | M | W | C | 3014 |
| WF2 | 37.95899 | -119.26701 | M | W | C | 3052 |
| V1 | 37.792494 | -119.348524 | M | W | C | 3074 |
| LC2 | 37.76912667 | -119.2568567 | M | W | C | 3097 |
| V2 | 37.79766 | -119.335133 | M | W | C | 3131 |
| TP1 | 37.90811 | -119.26396 | M | W | C | 3148 |
| LC3 | 37.76164333 | -119.25687 | M | W | C | 3255 |

H = Historical, M = Modern; E = East Slope, W = West Slope; N = Northern, C = Central, S = Southern

**Supplementary Table S2. List of small mammal species examined in this study.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | Northern‡ | | |  | Central | | |  | Southern | | |
| Species |  | Detection method§ | Occupancy analysis† |  | Slope | H | M |  | Slope | H | M |  | Slope | H | M |
| *Ammospermophilus leucurus* |  | St | - |  | E | 0 | 1 |  | --- | | |  | E + W | 1 | 1 |
| *Ammospermophilus nelsoni* |  | St | - |  | --- | | |  | --- | | |  | W | 1 | 0 |
| *Aplodontia rufa* |  | Sp | - |  | W | 0 | 1 |  | E + W | 1 | 1 |  | --- | | |
| *Brachylagus idahoensis* |  | Obs | - |  | E | 1 | 0 |  | --- | | |  | --- | | |
| *Callospermophilus lateralis* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Chaetodipus californicus* |  | St | Y |  | --- | | |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Clethrionomys californicus* |  | St | - |  | W | 1 | 1 |  | --- | | |  | --- | | |
| *Dipodomys agilis* |  | St | Y |  | --- | | |  | --- | | |  | E + W | 1 | 1 |
| *Dipodomys californicus* |  | St | - |  | E + W | 1 | 1 |  | --- | | |  | --- | | |
| *Dipodomys heermanni* |  | St | Y |  | --- | | |  | E + W | 1 | 1 |  | E + W | 1 | 0 |
| *Dipodomys merriami* |  | St | - |  | --- | | |  | --- | | |  | E + W | 1 | 1 |
| *Dipodomys nitratoides* |  | St | - |  | --- | | |  | --- | | |  | W | 1 | 0 |
| *Dipodomys ordii* |  | St | - |  | E | 1 | 1 |  | --- | | |  | --- | | |
| *Dipodomys panamintinus* |  | St | - |  | --- | | |  | E | 1 | 1 |  | E + W | 1 | 1 |
| *Glaucomys sabrinus* |  | St | - |  | W | 1 | 1 |  | W | 1 | 1 |  | --- | | |
| *Lemmiscus curtatus* |  | St | - |  | E | 1 | 1 |  | E | 1 | 1 |  | --- | | |
| *Marmota flaviventris* |  | Obs | N |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | W | 1 | 1 |
| *Microdipodops megacephalus* |  | St | - |  | E | 1 | 1 |  | E | 1 | 0 |  | --- | | |
| *Microtus californicus* |  | St | Y |  | W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Microtus longicaudus* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Microtus montanus* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Neotoma bryanti* |  | St | - |  | --- | | |  | --- | | |  | E + W | 1 | 1 |
| *Neotoma cinerea* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Neotoma fuscipes* |  | St | Y |  | E + W | 1 | 1 |  | --- | | |  | --- | | |
| *Neotoma lepida* |  | St | - |  | E | 1 | 1 |  | --- | | |  | E + W | 1 | 1 |
| *Neotoma macrotis* |  | St | Y |  | --- | | |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Ochotona princeps* |  | Obs | N |  | E + W | 1 | 1 |  | W | 1 | 1 |  | W | 1 | 1 |
| *Onychomys leucogaster* |  | St | - |  | E | 1 | 1 |  | E | 1 | 1 |  | --- | | |
| *Onychomys torridus* |  | St | - |  | --- | | |  | --- | | |  | E + W | 1 | 1 |
| *Otospermophilus beecheyi* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Perognathus inornatus* |  | St | - |  | --- | | |  | W | 1 | 1 |  | W | 1 | 1 |
| *Perognathus longimembris* |  | St | - |  | --- | | |  | --- | | |  | E + W | 1 | 1 |
| *Perognathus parvus* |  | St | - |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E | 1 | 0 |
| *Peromyscus boylii* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Peromyscus californicus* |  | St | - |  | --- | | |  | W | 1 | 1 |  | W | 1 | 1 |
| *Peromyscus crinitus* |  | St | - |  | E | 1 | 1 |  | --- | | |  | E + W | 1 | 1 |
| *Peromyscus maniculatus* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Peromyscus truei* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Phenacomys intermedius* |  | St | - |  | --- | | |  | W | 1 | 1 |  | W | 1 | 1 |
| *Reithrodontomys megalotis* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Scapanus latimanus* |  | Sp | - |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | W | 1 | 0 |
| *Sciurus griseus* |  | Obs | N |  | W | 1 | 1 |  | W | 1 | 1 |  | W | 1 | 1 |
| *Sorex merriami* |  | St | - |  | E | 1 | 0 |  | --- | | |  | --- | | |
| *Sorex monticolus* |  | St | Y |  | --- | | |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Sorex ornatus* |  | St | Y |  | --- | | |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Sorex palustris* |  | St | Y |  | W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Sorex tenellus* |  | St | - |  | --- | | |  | W\* | 0 | 1 |  | W | 0 | 1 |
| *Sorex trowbridgii* |  | St | Y |  | E + W | 1 | 1 |  | W | 1 | 1 |  | W\* | 0 | 1 |
| *Sorex vagrans* |  | St | Y |  | E + W | 1 | 1 |  | --- | | |  | --- | | |
| *Sylvilagus audubonii* |  | Obs | - |  | W | 1 | 0 |  | W | 1 | 1 |  | E + W | 1 | 1 |
| *Sylvilagus bachmani* |  | Obs | - |  | W | 1 | 0 |  | W | 1 | 1 |  | W | 1 | 0 |
| *Sylvilagus nuttallii* |  | Obs | - |  | E + W | 1 | 1 |  | E | 1 | 1 |  | W | 0 | 1 |
| *Tamias alpinus* |  | St | Y |  | --- | | |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Tamias amoenus* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | --- | | |
| *Tamias merriami* |  | St | Y |  | --- | | |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Tamias minimus* |  | St | - |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | W | 1 | 1 |
| *Tamias panamintinus* |  | St | - |  | --- | | |  | --- | | |  | E + W | 1 | 1 |
| *Tamias quadrimaculatus* |  | St | Y |  | --- | | |  | E + W | 1 | 1 |  | --- | | |
| *Tamias senex* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | --- | | |
| *Tamias speciosus* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Tamias umbrinus* |  | St | - |  | --- | | |  | --- | | |  | E + W | 1 | 0 |
| *Tamiasciurus douglasii* |  | Obs | N |  | E + W | 1 | 1 |  | W | 1 | 1 |  | W | 1 | 1 |
| *Thomomys bottae* |  | Sp | N |  | W | 1 | 1 |  | W | 1 | 1 |  | W | 1 | 1 |
| *Thomomys monticola* |  | Sp | N |  | W | 1 | 1 |  | W | 1 | 1 |  | --- | | |
| *Thomomys talpoides* |  | Sp | - |  | E | 1 | 0 |  | E + W | 1 | 1 |  | --- | | |
| *Urocitellus beldingi* |  | St | Y |  | E + W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
| *Zapus princeps* |  | St | Y |  | W | 1 | 1 |  | E + W | 1 | 1 |  | E + W | 1 | 1 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Total 67** |  | **54** | **34** |  |  | **45** | **45** |  |  | **48** | **48** |  |  | **50** | **50** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**§Detection methods were standardized trapping (St), specialized trapping (Sp), or observation (Obs).**

**†Species included in the analysis of range shifts were both species with (Y) and without (N) sufficient data for occupancy analysis. Of the 67 species we examined, 54 were detected using standardized trapping, 28 were included in the occupancy analyses and an additional 6 species were included in the analysis of range shifts.**

**‡Species were detected on the east (E) and/or west (W) slopes within each region and detections within each region are listed as detected (0) or not detected (1) in the historical (H) or the modern (M) eras.**

**\* New species records detected during our surveys.**

**Supplementary Table S3. Generalized linear mixed models examining patterns of range limit shifts of 32 montane small mammals of California.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Elevation Range Metric | Model | Parameters\* | AIC | ΔAIC | AIC Weight |
| All Species | Basic | Zone:Limit | 170.80 | 0.00 | 1.00 |
| Any Shift | - | Null | 189.90 | 19.10 | 0.00 |
|  | - | Zone | 190.50 | 19.70 | 0.00 |
|  | - | Limit | 191.90 | 21.10 | 0.00 |
|  | - | Limit+Zone | 192.50 | 21.70 | 0.00 |
|  | - | Region | 193.60 | 22.80 | 0.00 |
|  | - | Region+Zone | 194.10 | 23.30 | 0.00 |
|  | - | Limit+Region | 195.60 | 24.80 | 0.00 |
|  | - | Limit+Zone+Region | 196.10 | 25.30 | 0.00 |
|  | - | Region:Zone | 196.60 | 25.80 | 0.00 |
|  | - | Region:Limit | 197.60 | 26.80 | 0.00 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| High Elevation Species | Basic | Limit | 109.50 | 0.00 | 0.63 |
| Any Shift | - | Region:Limit | 111.90 | 2.40 | 0.19 |
|  | - | Region+Limit | 112.20 | 2.70 | 0.16 |
|  | - | Null | 117.70 | 8.20 | 0.01 |
|  | - | Region | 120.80 | 11.30 | 0.00 |
|  |  |  |  |  |  |
| Low Elevation Species | Basic | Limit | 63.19 | 0.00 | 0.73 |
| Any Shift | - | Region+Limit | 65.66 | 2.47 | 0.21 |
|  | - | Region:Limit | 68.53 | 5.34 | 0.05 |
|  | - | Null | 74.46 | 11.27 | 0.00 |
|  | - | Region | 77.44 | 14.25 | 0.00 |
|  |  |  |  |  |  |
| High Elevation Species | Basic | Region+Limit | 35.80 | 0.00 | 0.82 |
| Shift up vs down | - | Limit | 39.98 | 4.18 | 0.10 |
|  | - | Region:Limit | 42.56 | 6.76 | 0.03 |
|  | - | Region | 42.58 | 6.78 | 0.03 |
|  | - | Null | 43.34 | 7.54 | 0.02 |
|  |  |  |  |  |  |
| Low Elevation Species | Basic | Null | 32.84 | 0.00 | 0.52 |
| Shift up vs down | - | Limit | 34.04 | 1.20 | 0.29 |
|  | - | Region | 36.02 | 3.18 | 0.11 |
|  | - | Region+Limit | 37.11 | 4.27 | 0.06 |
|  | - | Region:Limit | 39.09 | 6.25 | 0.02 |

\* Model parameters included: Region (Northern, Central, Southern), Limit (upper elevation limit, lower elevation limit), and Zone (high or low elevation species).

**Supplementary Table S4. Range limits and shifts of the 34 modelled species examined in this study.**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Species | Region | *p* (H) § | *p* (M) | Historical Elevation Range (m) | Lower Limit Shift | Upper Limit Shift | Pattern | Best Occupancy Model† | AICc Weight | Historical Life Zone¶ |
| 1 | ***Sorex ornatus*** |  |  |  |  |  |  |  | era + elev + elev2 + region | 0.2246 | Upper Sonoran (L) |
|  |  | Northern | NA | NA | NA | NA | NA | NA |
|  |  | Central | 0.55 | 0.32 | 549-914 | -492 | No Change | Expand -L |
|  |  | Southern | 0.31 | 0.49 | 118-180 | No Change | +1362 | Expand +U |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 2 | ***Dipodomys heermanni*** |  |  |  |  |  |  |  | era + elev + region + era\*elev | 0.2148 | Lower-Upper Sonoran (L) |
|  |  | Northern | NA | NA | NA | NA | NA | NA |
|  |  | Central | 0.35 | 0.61 | 52-975 | No Change | -247 | Contract -U |
|  |  | Southern | 0.95 | Undetected | 118-636 | Undetected Current | Undetected Current | NA |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 3 | ***Microtus californicus*** |  |  |  |  |  |  |  | era + elev + region + elev\*region | 0.0669 | Lower-Upper Sonoran (L) |
|  |  | Northern | 0.83 | 0.89 | 79-1335 | No Change | No Change | No Change |
|  |  | Central | 0.76 | 0.60 | 52-1647 | No Change | No Change | No Change |
|  |  | Southern | 0.96 | 0.90 | 118-1261 | +465 | No Change | Contract +L |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | ***Reithrodontomys megalotis*** |  |  |  |  |  |  |  | elev | 0.1738 | Lower–Upper Sonoran (L) |
|  |  | Northern | 0.82 | 0.86 | 79-1478 | No Change | -434 | Contract -U |
|  |  | Central | 0.90 | 0.64 | 52-1158 | No Change | +110 | Expand +U |
|  |  | Southern | 0.96 | 0.90 | 118-1860 | No Change | -861 | Contract -U |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 5 | ***Chaetodipus californicus*** |  |  |  |  |  |  |  | era + elev + elev2 + region | 0.2355 | Lower-Upper Sonoran (L) |
|  |  | Northern | NA | NA | NA | NA | NA | NA |
|  |  | Central | 0.37 | 0.75 | 183-914 | No Change | +787 | Expand +U |
|  |  | Southern | 0.83 | 0.91 | 118-2147 | +113‡ | +226 | Shift +LU |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 6 | ***Neotoma fuscipes/macrotis*** |  |  |  |  |  |  |  |  |  |  |
|  | ***Neotoma fuscipes*** | Northern | 0.69 | 0.98 | 79-1051 | +32‡ | +515 | Expand +U | elev + elev2 + region | 0.2508 | Lower Sonoran–Transition (L) |
|  | ***Neotoma macrotis*** | Central | 0.57 | 0.78 | 183-1647 | No Change | No Change | No Change | elev + elev2 + region + elev\*region + elev2\*region | 0.1464 | Lower Sonoran–Transition (L) |
|  | ***Neotoma macrotis*** | Southern | 0.59 | 0.91 | 118-2147 | +113‡ | +226 | Shift +LU |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 7 | ***Peromyscus truei*** |  |  |  |  |  |  |  | era + elev + elev2 + region + era\*elev + era\*elev2 + era\*region + elev\*region + elev2\*region + era\*elev\*region + era\*elev2\*region | 0.4677 | Upper Sonoran (L) |
|  |  | Northern | 0.67 | 0.60 | 79-1051 | +529 | +408 | Shift +LU |
|  |  | Central | 0.85 | 0.74 | 183-975 | +374 | +836 | Shift +LU |
|  |  | Southern | 0.82 | 0.74 | 636-3147 | -53‡ | -207 | Contract -U |
|  |  |  |  |  |  |  |  |  |  |  |  |
| \*8 | ***Sciurus griseus*** |  |  |  |  |  |  |  | \*Not subject to occupancy analyses | | Lower–Upper Sonoran (L) |
|  |  | Northern |  |  | 103-1051 | No Change | +671 | Expand +U |
|  |  | Central |  |  | 183-1951 | No Change | -262 | Contact -U |
|  |  | Southern |  |  | 787-2364 | +720 | -750 | Contract +L, -U |
|  |  |  |  |  |  |  |  |  |  |  |  |
| \*9 | ***Dipodomys agilis*** |  |  |  |  |  |  |  | era + elev + elev2 + region | 0.2470 | Lower-Upper Sonoran (L) |
|  |  | Northern | NA | NA | NA | NA | NA | NA |
|  |  | Central | NA | NA | NA | NA | NA | NA |
|  |  | Southern | 0.49 | 0.49 | 721-1860 | +89‡ | +307 | Expand +U |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 10 | ***Tamias merriami*** |  |  |  |  |  |  |  | elev + region | 0.1284 | Lower–Upper Sonoran (L) |
|  |  | Northern | NA | NA | NA | NA | NA | NA |
|  |  | Central | 0.25 | 0.21 | 488-1524 | No Change | No Change | No Change |
|  |  | Southern | 0.43 | 0.59 | 636-2732 | No Change | No Change | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 11 | ***Peromyscus boylii*** |  |  |  |  |  |  |  | era + elev + elev2 + region + elev\*region + elev2\*region | 0.5811 | Upper Sonoran–Transition (L) |
|  |  | Northern | 0.85 | 0.99 | 79-1051 | +89‡ | No Change | Contract +L |
|  |  | Central | 0.88 | 0.88 | 183-2464 | -126‡ | No Change | Expand -L |
|  |  | Southern | 0.97 | 0.99 | 118-3147 | +20‡ | -865 | Contract -U |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 12 | ***Thomomys bottae*** |  |  |  |  |  |  |  | \*Not subject to occupancy analyses | | Lower Sonoran-Transition (L) |
|  |  | Northern |  |  | 75-1335 | No Change | No Change | No Change |
|  |  | Central |  |  | 57-1676 | No Change | No Change | No Change |
|  |  | Southern |  |  | 118-3384 | No Change | No Change | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 13 | ***Otospermophilus beecheyi*** |  |  |  |  |  |  |  | era + elev + elev2 + era\*elev + era\*elev2 | 0.1069 | Lower Sonoran–Canadian (W) |
|  |  | Northern | 0.05 | 0.67 | 79-1051 | No Change | +734 | Expand +U |
|  |  | Central | 0.28 | 0.42 | 61-2632 | No Change | No Change | No Change |
|  |  | Southern | 0.07 | 0.82 | 118-2997 | No Change | -57‡ | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 14 | ***Peromyscus maniculatus*** |  |  |  |  |  |  |  | era + elev + elev2 + region + era\*elev + era\*elev2 + era\*region + elev\*region + elev2\*region + era\*elev\*region + era\*elev2\*region | 0.4195 | Lower Sonoran–Arctic-Alpine (W) |
|  |  | Northern | 0.94 | 0.99 | 79-2514 | No Change | No Change | No Change |
|  |  | Central | 0.95 | 0.93 | 52-3281 | No Change | No Change | No Change |
|  |  | Southern | 0.99 | 0.99 | 118-3384 | No Change | No Change | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 15 | ***Sorex trowbridgii*** |  |  |  |  |  |  |  | elev + elev2 + region | 0.0988 | Transition–Canadian (H) |
|  |  | Northern | 0.49 | 0.68 | 1051-2061 | No Change | No Change | No Change |
|  |  | Central | 0.65 | 0.68 | 1068-2286 | No Change | -54‡ | No Change |
|  |  | Southern | 0.76 | 0.69 | 1507-2373 (Modern) | Undetected Historical | Undetected Historical | New record Modern |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 16 | ***Tamias quadrimaculatus*** |  |  |  |  |  |  |  | elev + elev2 + region | 0.1681 | Transition–Canadian (H) |
|  |  | Northern | NA | NA | NA | NA | NA | NA |
|  |  | Central | 0.54 | 0.49 | 1494-2210 | No Change | No Change | No Change |
|  |  | Southern | NA | NA | NA | NA | NA | NA |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 17 | ***Sorex vagrans*** |  |  |  |  |  |  |  | elev + region | 0.0963 | Transition–Canadian (H) |
|  |  | Northern | 0.62 | 0.96 | 1335-2514 | No Change | No Change | No Change |
|  |  | Central | NA | NA | NA | NA | NA | NA |
|  |  | Southern | NA | NA | NA | NA | NA | NA |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 18 | ***Tamias senex*** |  |  |  |  |  |  |  | elev + elev2 + region | 0.2866 | Canadian (H) |
|  |  | Northern | 0.55 | 0.99 | 1478-2462 | No Change | No Change | No Change |
|  |  | Central | 0.87 | 0.49 | 1402-2743 | +981 | -360 | Contract +L-U |
|  |  | Southern | NA | NA | NA | NA | NA | NA |
|  |  |  |  |  |  |  |  |  |  |  |  |
| \*19 | ***Tamiasciurus douglasi*** |  |  |  |  |  |  |  | \*Not subject to occupancy analyses | | Transition-Hudsonian (H) |
|  |  | Northern |  |  | 886-2061 | No Change | +430 | Expand +U |
|  |  | Central |  |  | 1229-3185 | No Change | No Change | No Change |
|  |  | Southern |  |  | 1592-3384 | No Change | No Change | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 20 | ***Zapus princeps*** |  |  |  |  |  |  |  | elev + elev2 + region |  | Transition–Hudsonian (H) |
|  |  | Northern | 0.78 | 0.87 | 1478-2462 | +138 | No Change | Contract +L | 0.1800 |
|  |  | Central | 0.92 | 0.86 | 1211-3281 | +213 | No Change | Contract +L |
|  |  | Southern | 0.92 | 0.85 | 1592-2657 | +821 | +583 | Shift +LU |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 21 | ***Microtus montanus*** |  |  |  |  |  |  |  | elev + elev2 + region + elev\*region + elev2\*region | 0.6766 | Transition-Hudsonian (H) |
|  |  | Northern | 0.77 | 0.92 | 1335-1784 | +133 | +66‡ | Shift +L |
|  |  | Central | 0.65 | 0.90 | 1211-3161 | No Change | No Change | No Change |
|  |  | Southern | 0.95 | 0.89 | 1984-3384 | No Change | No Change | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 22 | ***Microtus longicaudus*** |  |  |  |  |  |  |  | elev + elev2 | 0.2043 | Transition-Hudsonian (H) |
|  |  | Northern | 0.95 | 0.84 | 1672-2462 | -204 | No Change | Expansion |
|  |  | Central | 0.94 | 0.81 | 583-3281 | +644 | No Change | Contract +L |
|  |  | Southern | 0.99 | 0.88 | 1529-3474 | +638 | No Change | Contract +L |
|  |  |  |  |  |  |  |  |  |  |  |  |
| \*23 | ***Thomomys monticola*** |  |  |  |  |  |  |  | \*Not subject to occupancy analyses | | Canadian–Hudsonian (H) |
|  |  | Northern |  |  | 1561-2514 | No Change | No Change | No Change |
|  |  | Central |  |  | 1905-3155 | No Change | No Change | No Change |
|  |  | Southern |  |  | NA | NA | NA | NA |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 24 | ***Neotoma cinerea*** |  |  |  |  |  |  |  | era + elev + elev2 + region + era\*elev + era\*elev2 + era\*region + elev\*region + elev2\*region + era\*elev\*region + era\*elev2\*region | 0.1123 | Canadian–Arctic-Alpine (H) |
|  |  | Northern | 0.66 | 0.67 | 1478-2514 | +202 | -729 | Contract +L-U |
|  |  | Central | 0.79 | 0.51 | 1803-3281 | +580 | -807 | Contract +L-U |
|  |  | Southern | 0.67 | 0.87 | 1529-3384 | No Change | No Change | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 25 | ***Tamias speciosus*** |  |  |  |  |  |  |  | era + elev + elev2 + era\*elev + era\*elev2 | 0.4140 | Canadian–Hudsonian (H) |
|  |  | Northern | 0.78 | 0.98 | 1561-2514 | +222 | No Change | Contract +L |
|  |  | Central | 0.76 | 0.82 | 1768-3281 | +113‡ | No Change | No Change |
|  |  | Southern | 0.96 | 0.97 | 1529-3384 | +638 | No Change | Contract +L |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 26 | ***Tamias amoenus*** |  |  |  |  |  |  |  | elev + elev2 + region | 0.0765 | Transition–Hudsonian (H) |
|  |  | Northern | 0.79 | 0.96 | 1561-2514 | No Change | No Change | No Change |
|  |  | Central | 0.96 | 0.96 | 2438-2865 | +36‡ | -81‡ | No Change |
|  |  | Southern | NA | NA | NA | NA | NA | NA |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 27 | ***Sorex palustris*** |  |  |  |  |  |  |  | era + elev + region + era\*elev + era\*region + elev\*region + era\*elev\*region | 0.2046 | Canadian–Hudsonian (H) |
|  |  | Northern | 0.53 | 0.24 | 1583-2514 | -975 | -1906 | Contract -L,-U |
|  |  | Central | 0.46 | 0.15 | 1647-3161 | +506 | No Change | Contract +L |
|  |  | Southern | 0.77 | 0.40 | 2314-3384 | +676 | No Change | Contract +L |
|  |  |  |  |  |  |  |  |  |  |  |  |
| \*28 | ***Marmota flaviventris*** |  |  |  |  |  |  |  | \*Not subject to occupancy analyses | | Canadian–Arctic-Alpine (H) |
|  |  | Northern |  |  | 1561-1971 | No Change | +520 | Expand +U |
|  |  | Central |  |  | 2469-3353 | No Change | No Change | No Change |
|  |  | Southern |  |  | 2268-3503 | No Change | No Change | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 29 | ***Urocitellus beldingi*** |  |  |  |  |  |  |  | elev + elev2 + region + elev\*region + elev2\*region | 0.1967 | Canadian–Arctic-Alpine (H) |
|  |  | Northern | 0.71 | 0.88 | 1485-1845 | No Change | -217 | Contract -U |
|  |  | Central | 0.74 | 0.66 | 2286-3281 | +399 | No Change | Contract +L |
|  |  | Southern | 0.86 | 0.92 | 2761-3474 | +555 | No Change | Contract +L |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 30 | ***Callospermophilus lateralis*** |  |  |  |  |  |  |  | era + elev + elev2 + region | 0.1752 | Transition-Hudsonian (H) |
|  |  | Northern | 0.60 | 0.89 | 1561-3124 | No Change | No Change | No Change |
|  |  | Central | 0.61 | 0.69 | 1646-3200 | +305 | No Change | Contract +L |
|  |  | Southern | 0.83 | 0.91 | 2147-3474 | +115‡ | No Change | Contract +L |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 31 | ***Sorex monticolus*** |  |  |  |  |  |  |  | era + elev + elev2 + region | 0.1349 | Canadian–Hudsonian (H) |
|  |  | Northern | 0.59 | 0.67 | NA | NA | NA | NA |
|  |  | Central | 0.74 | 0.68 | 2176-3281 | -971 | No Change | Expand -L |
|  |  | Southern | 0.84 | 0.80 | 1529-3474 | No Change | No Change | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| \*32 | ***Ochotona princeps*** |  |  |  |  |  |  |  | \*Not subject to occupancy analyses | | Canadian–Arctic-Alpine (H) |
|  |  | Northern |  |  | 1478-2514 | No Change | No Change | No Change |
|  |  | Central |  |  | 2377-3871 | No Change | No Change | No Change |
|  |  | Southern |  |  | 2732-3384 | No Change | No Change | No Change |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 33 | ***Tamias alpinus*** |  |  |  |  |  |  |  | era + elev + region | 0.0603 | Hudsonian–Arctic-Alpine (H) |
|  |  | Northern | NA | NA | NA | NA | NA | NA |
|  |  | Central | 0.86 | 0.81 | 2386-3353 | +497 | No Change | Contract +L |
|  |  | Southern | 0.92 | 0.86 | 2314-3503 | +471 | No Change | Contract +L |
|  |  |  |  |  |  |  |  |  |  |  |  |

§Detectability (*p*) for the historical (H) and modern (M) era is the average detectability of a given species over all sites within that region.

†The best performing occupancy model is given with the corresponding AICc weight.

¶Historical life zone was used to determine whether a species was classified as a low elevation species (L), high elevation species (H) or widespread species (W) following Moritz et al.4.

Species not subject to occupancy modelling are designated with an asterisk (\*) and those with a statistically significant, but biologically trivial limit shift (i.e., <10% of the species’ historical elevation range and <100 meters in elevation; see Methods) are represented by a double dagger (‡).

**Supplementary Table S5. Model parameterizations of detectability (*p*) and occupancy (*ψ*) run for each species with quantifiable trapping effort data (see Supplementary Table S2 for list of modelled species).**

|  |
| --- |
| **Detectability models (*p*)** |
| 1. null |
| 2. Era+LogT+Era\*LogT+T100+Time |
| 3. Era+LogT+Era\*LogT+Time+Era\*Time+T100 |
| 4. Era+LogT+Era\*logT+Time+Era\*Time |
| 5. Era+logT+Era\*logT+Time |
| 6. Era+logT+Time |
| 7. Era+T100+Era\*T100+logT+Era\*logT+Time |
| 8. Era+T100+Era\*T100+logT+Time |
| 9. Era+T100+Era\*T100+Time+Era\*Time |
| 10. Era+T100+Era\*T100 |
| 11. Era+Time+Era\*Time+logT |
| 12. Era+Time+Era\*Time+T100+logT |
| 13. T100+logT+Time |
| 14. T100+Time |
| 15. Time |
| 16. Era+T100+Era\*T100+logT+Era\*logT+Time+Era\*Time |
|  |
| **Occupancy models (*ψ*)** |
| 1. null |
| 2. Era |
| 3. Elev |
| 4. Elev+Elev2 |
| 5. Region |
| 6. Era+Elev |
| 7. Era+Elev+Elev2 |
| 8. Era+Elev+Era\*Elev |
| 9. Era+Elev+Elev2+Era\*Elev+Era\*Elev2 |
| 10. Era+Region |
| 11. Era+Region+Era\*Region |
| 12. Elev+Region |
| 13. Elev+Elev2+Region |
| 14. Elev+Region+Elev\*Region |
| 15. Elev+Elev2+Region+Elev\*Region+Elev2\*Region |
| 16. Era+Elev+Region |
| 17. Era+Elev+Elev2+Region |
| 18. Era+Elev+Region+Era\*Elev |
| 19. Era+Elev+Elev2+Region+Era\*Elev+Era\*Elev2 |
| 20. Era+Elev+Region+Elev\*Region |
| 21. Era+Elev+Elev2+Region+Elev\*Region+Elev2\*Region |
| 22. Era+Elev+Region+Era\*Region |
| 23. Era+Elev+Elev2+Region+Era\*Region |
| 24. Era+Elev+Region+Era\*Elev+Era\*Region+Elev\*Region+Era\*Elev\*Region |
| 25. Era+Elev+Elev2+Region+Era\*Elev+Era\*Elev2+Era\*Region+Elev\*Region+Elev2\*Region+  Era\*Elev\*Region+Era\*Elev2\*Region |