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Prepared in cooperation with the San Diego Association of Governments (SANDAG)
California Department of Fish and Wildlife, Bureau of Land Management and
U.S. Fish and Wildlife Service

Biotelemetry Data for Golden Eagles (*Aquila chrysaetos*) Captured in Coastal Southern California, February 2016–February 2017

Data Series 1051

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

Cover:

Top: Photograph of a golden eagle being released by biologist (volunteer, Bloom Biological, Inc.) after being captured and fitted with a telemetry unit, January 14, 2017. Photograph by Peter H. Bloom, Bloom Biological, Inc. Used with permission.

Bottom left: Photograph of a soaring juvenile golden eagle, August 9, 2012.

Bottom right: Photograph of a perching golden eagle, February 12, 2015. Photograph by Peter H. Bloom, Bloom Biological, Inc. Used with permission.

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U.S. Department of the Interior
RYAN K. ZINKE, Secretary

U.S. Geological Survey
William H. Werkheiser, Acting Director

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Conversion Factors

International System of Units to Inch/Pound

Multiply	By	To obtain
kilometer (km)	0.6214	mile (mi)
meter per second (m/s)	3.281	foot per second (ft/s)
millimeter (mm)	0.03937	inch (in.)

Biotelemetry Data for Golden Eagles (*Aquila chrysaetos*) Captured in Coastal Southern California, February 2016–February 2017

By Jeff A. Tracey[1], Melanie C. Madden[1], Jeremy B. Sebes[1], Peter H. Bloom[2], Todd E. Katzner[1], and Robert N. Fisher[1]

Abstract

Because of a lack of clarity about the status of golden eagles (*Aquila chrysaetos*) in coastal southern California, the USGS, in collaboration with local, State, and other Federal agencies, began a multi-year survey and tracking program of golden eagles to address questions regarding habitat use, movement behavior, nest occupancy, genetic population structure, and human impacts on eagles. Golden eagle trapping and tracking efforts began in September 2014. During trapping efforts from September 29, 2014, to February 23, 2016, 27 golden eagles were captured. During trapping efforts from February 24, 2016, to February 23, 2017, an additional 10 golden eagles (7 females and 3 males) were captured in San Diego, Orange, and western Riverside Counties. Biotelemetry data for 26 of the 37 golden eagles that were transmitting data from February 24, 2016, to February 23, 2017 are presented. These eagles ranged as far north as northern Nevada and southern Wyoming, and as far south as La Paz, Baja California, Mexico.

Introduction

Growing uncertainty about the status of golden eagles (*Aquila chrysaetos*) in southern California has highlighted the need for ecological information that will allow local managers to evaluate and mitigate the effects of human activities on this species (Scott, 1985; Harlow and Bloom, 1989). Depending on the season, the population of golden eagles in California is typically comprised of resident adult territorial breeders, adult floaters, locally fledged juvenile and subadults, as well as migrants with origins from more northerly or southerly latitudes. A better understanding of the current distribution, status, foraging requirements, and population characteristics of golden eagles can help to manage golden eagle habitat and threats/stressors to each nesting territory in coastal southern California. Recent work has been completed in the Mojave Desert and the Tehachapi Mountains in southern California, but nothing previously from the coastal areas (Braham and others, 2015; Poessel and others, 2016). The U.S. Geological Survey (USGS) in collaboration with U.S. Fish and Wildlife Service (FWS), California Department of Fish and Wildlife (CDFW), Bureau of Land Management (BLM), and San Diego Management and Monitoring Program (SDMMP) began a multi-year survey and tracking program of golden eagles to address questions regarding habitat use, movement behavior, nest occupancy, genetic population structure, and human impacts on eagles. This report presents golden eagle capture and biotelemetry data from February 24, 2016, through February 23, 2017. Capture and biotelemetry data for November 22, 2014, to February 23, 2016, are available in Tracey and others (2016).

[1]U.S. Geological Survey.

[2]Bloom Biological, Inc.

Methods

Biotelemetry

Once captured, each eagle was given an eagle ID for this study, a USGS Bird Banding Laboratory leg band (if it did not already have one), and a Global Positioning System (GPS) transmitter that sends data over the mobile phone network (a GPS-GSM transmitter; Lanzone and others, 2012). The eagle ID consists of a four-letter code for the species, a two-letter code for the county of capture, and an "F" or "M" followed by a numeral (with up to two leading zeros) to indicate the sex and capture order of the individual. For example, the first female eagle captured in San Diego County was given an eagle ID of GOEA-SD-F001. We use the county code OC for Orange County and RV for Riverside County.

Standard morphological measurements and samples were taken from each captured eagle. Measurements included (1) weight, (2) hallux and culmen, and (3) characteristics of the primary and secondary flight feathers. Samples included (1) blood samples for genetic and lead testing; (2) swabs of the eyes, mouth, and cloaca for chlamydia testing by University of California, Davis; and (3) two to four feathers for lead, stable isotope, and genetic testing. For the health of the eagle, rapid processing and release took precedence over collecting measurements and samples. Thus, in some cases we did not collect weight measurements or take blood samples for field lead testing in favor of properly attaching the GPS-GSM unit and releasing the eagle in a timely manner. When time and the ambient temperatures permitted, eagles were tested in the field for lead toxicity using a LeadCare® II testing unit. If lead testing results were greater than 60 µL/dL, we planned to deliver the eagle to Scott Weldy DVM (Orange County Bird of Prey Center, Serrano Animal & Bird Hospital) for therapy. All samples were collected under Dr. Peter Bloom's scientific collecting permit (Bloom Biological, Inc.) and delivered to the appropriate parties (University of California, Davis Wildlife Health Center, Todd Katzner of USGS, and Andrew DeWoody of Purdue University—each of whom is permitted to receive samples). No samples were retained in California by USGS. Any request for results of analysis of these samples should be directed to the individual or organization to whom the samples were delivered. Sex was determined based on body size, weight, and measurements of the hallux and culmen and will be confirmed genetically. Age was estimated based on molt patterns (Bloom and Clark, 2001).

Each captured eagle was fitted with a Cellular Tracking Technologies (CTT™) CTT™-1070a GPS-GSM telemetry unit (Dunstan, 1972; Kenward, 1985; Lanzone and others, 2012). The units were attached to the eagles using 11 mm natural tubular Teflon™ tape fed through the attachment holes on the GSP-GSM unit and around the wings to form a "backpack" (Dunstan, 1972; Kenward, 1985). The Teflon™ ribbon is non-abrasive and is the standard method for attaching telemetry units to eagles. If the eagle had other markings or telemetry devices, in addition to a USGS Bird Banding Laboratory (BBL) leg band, we were directed by the BBL to remove them.

Data Filtering

Once data were downloaded from CTT™ servers, the data were formatted (for example, formatting dates and converting text strings with latitude and longitude data into numerical values) and merged with data from prior downloads when needed. We applied two filters to the records to eliminate potentially erroneous locations prior to merging the new data with prior data.

To pass the first filter, six conditions had to be satisfied:

1. Location had to be at least 2D,
2. Horizontal dilution of precision (HDOP) had to be less than or equal to 4,
3. Vertical dilution of precision (VDOP), if available, had to be less than or equal to 4,
4. Longitude values had to be available and be on the interval [−180, 180] degrees,
5. Latitude values had to be available and be on the interval [−90, 90] degrees, and
6. Fixes had to be at least 4 seconds apart (based on discussion with engineers at CTT™).

The second filter depends on distance metrics. To pass the second filter, three conditions had to be satisfied:

1. The start and end location must have passed the first filter (above),
2. Location had to be within UTM zones 10, 11, or 12 and both the start and end location had to be in the same UTM zone (because the UTM coordinates were used to calculate the move distances for step 3 that follows), and
3. Rate of displacement had to be realistic ($\leq$ 89.4 m/s horizontal or $\leq$ 20.0 m/s vertical).

Biotelemetry Data for Captured Golden Eagles

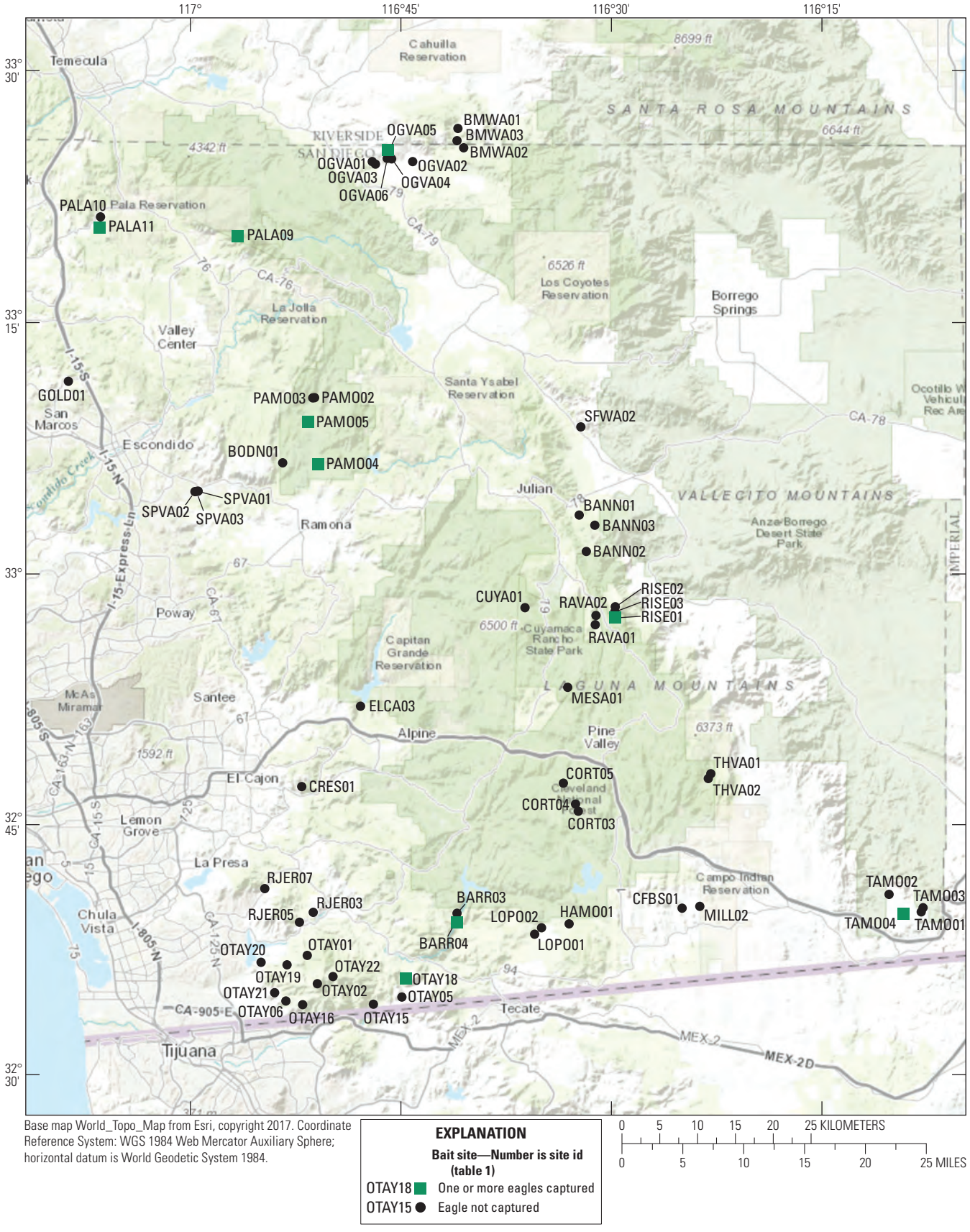
From September 29, 2014, and February 23, 2017, we baited at 135 different locations in San Diego, Orange, and western Riverside Counties of southern California and captured a total of 37 golden eagles. During this reporting period, February 24, 2016–February 23, 2017, we baited at 64 locations, captured 10 new golden eagles at nine trapping locations, and collected biotelemetry data from a total of 26 golden eagles, including 16 that were captured prior to February 24, 2016 (table 1, fig. 1). For the 16 eagles captured prior to February 24, 2016, see Tracey and others (2016) for a map of the bait sites at which they were captured. Of the eagles for which telemetry data were collected during the reporting period, there were 18 eagles with active transmitters, 2 eagles with transmitters of unknown status, 3 eagles with inactive transmitters, and 3 eagles known to have died (see "Status" column, table 1). An active transmitter is one from which we have received data within the past 10 days. A transmitter with unknown status is one from which we have received data from 11 to 60 days ago, an inactive transmitter is one from which we have not received data in more than 60 days, and a fatality indicates that we have recovered the eagle's remains. Several eagles with inactive transmitters have been observed alive in the field. Fourteen of the eagles appeared to have had breeding territories, five appeared to have been floaters (that is, adults without a breeding territory), and seven had undetermined territorial behavior (see "Behavior" column, table 1). For territorial adults, the place name of the territory is given in the "Territory Name" column. No telemetry data were collected during this reporting period for 11 golden eagles (4 confirmed fatalities and 7 apparent transmitter failures) that were included in Tracey and others (2016).

A view of the location data over the entire extent of the area used by the golden eagles is shown in figure 2. Note that a lack of eagle data for a particular area does not necessarily imply that it is not used by eagles. We are only tracking a subset of the population of eagles in southern California, so empty areas could still be utilized by eagles that we are not tracking. Location data for 26 captured golden eagles with transmitters that produced telemetry data during the reporting period are shown in figures 3–28.

Table 1. Summary of golden eagles tracked in southern California, February 24, 2016–February 23, 2017.

[**Bait site ID**: Locations of bait site IDs are shown in figure 1 of this report or in Tracey and others (2016, fig. 1). **Sex:** F, female; M, male. **Age:** HY, hatch year; TY, third year; FY, fourth year; AFY, after fourth year; AFFY, after fifth year]

Eagle ID	Date / Time	Location	Bait site ID	Figure No. for location data	Sex	Age at time of capture	Status	Behavior	Territory name
GOEA-SD-F001	11-22-2014 17:00:00	Boulder Oaks	IRON03	3	F	AFY	Active	Territory-holder	Iron Mountain
GOEA-SD-F007	02-23-2015 17:00:00	Long Potrero	LOPO01	4	F	AFFY	Active	Territory-holder	Tecate
GOEA-RV-F010	12-12-2015 09:20:00	Santa Rosa Plateau	SRPT01	5	F	AFY	Active	Territory-holder	Los Alamos
GOEA-SD-F011	12-20-2015 11:23:00	Proctor Valley	RJER07	6	F	TY	Active	Floater	
GOEA-OC-F012	02-10-2016 17:00:00	Fremont Canyon	FRMT03	7	F	AFFY	Inactive	Floater	
GOEA-SD-F013	02-11-2016 17:00:00	Boucher Hill	PALA09	8	F	AFFY	Active	Territory-holder	Boucher Hill
GOEA-OC-F014	02-12-2016 17:00:00	Fremont Canyon	FRMT03	9	F	AFFY	Active	Floater	
GOEA-OC-F015	02-12-2016 17:00:00	Fremont Canyon	FRMT03	10	F	AFFY	Inactive	Territory-holder	Fremont Canyon
GOEA-SD-F016	03-05-2016 12:00:00	Barrett Lake	BARR04	11	F	AFFY	Active	Territory-holder	Barrett/Echo Mountain
GOEA-SD-F017	11-04-2016 11:30:00	Little Tecate	OTAY18	12	F	AFY	Active	Territory-holder	Marron Valley
GOEA-SD-F018	12-21-2016 15:00:00	Oriflamme Mountain	RISE01	13	F	AFY	Unknown	Undetermined	
GOEA-SD-F019	01-14-2017 06:55:00	Pamo Valley	PAMO05	14	F	FY	Active	Floater	
GOEA-SD-F020	01-21-2017 15:00:00	Gregory Mountain	PALA11	15	F	AFFY	Active	Territory-holder	Gregory Mountain
GOEA-SD-F021	01-29-2017 09:30:00	Pamo Valley	PAMO05	16	F	SY	Active	Floater	
GOEA-SD-F022	01-30-2017 08:00:00	Oak Grove	OGVA05	17	F	AFFY	Active	Territory-holder	Oak Grove
GOEA-SD-M001	12-05-2014 17:00:00	Cedar Canyon	OTAY01	18	M	AFY	Active	Territory-holder	Cedar Canyon
GOEA-SD-M003	02-03-2015 17:00:00	Rancho Canada	IRON05	19	M	AFFY	Active	Territory-holder	Iron Mountain
GOEA-SD-M005	02-23-2015 17:00:00	Long Potrero	LOPO01	20	M	AFFY	Active	Territory-holder	Barrett/Echo Mountain
GOEA-SD-M006	12-01-2015 08:00:00	Barrett Lake	BARR03	21	M	AFY	Inactive	Undetermined	
GOEA-SD-M007	12-09-2015 10:15:00	Long Valley	CORT04	22	M	AFY	Active	Territory-holder	Lower Intake/San Luis Rey River Gorge
GOEA-SD-M010	12-17-2015 06:35:00	Proctor Valley	RJER07	23	M	HY	Fatality	Undetermined	
GOEA-SD-M011	12-21-2015 07:00:00	Barrett Lake	BARR04	24	M	AFY	Fatality	Undetermined	
GOEA-OC-M012	12-27-2015 17:00:00	Brush Canyon	BRUSH01	25	M	FY	Fatality	Undetermined	
GOEA-SD-M013	11-20-2016 17:00:00	Boucher Hill	PALA09	26	M	AFY	Active	Territory-holder	Boucher Hill
GOEA-SD-M014	01-13-2017 11:50:00	Pamo Valley	PAMO04	27	M	AFFY	Unknown	Undetermined	
GOEA-SD-M015	01-28-2017 15:30:00	Table Mountain	TAMO04	28	M	AFFY	Active	Undetermined	



Base map World_Topo_Map from Esri, copyright 2017. Coordinate Reference System: WGS 1984 Web Mercator Auxiliary Sphere; horizontal datum is World Geodetic System 1984.

EXPLANATION

Bait site—Number is site id (table 1)

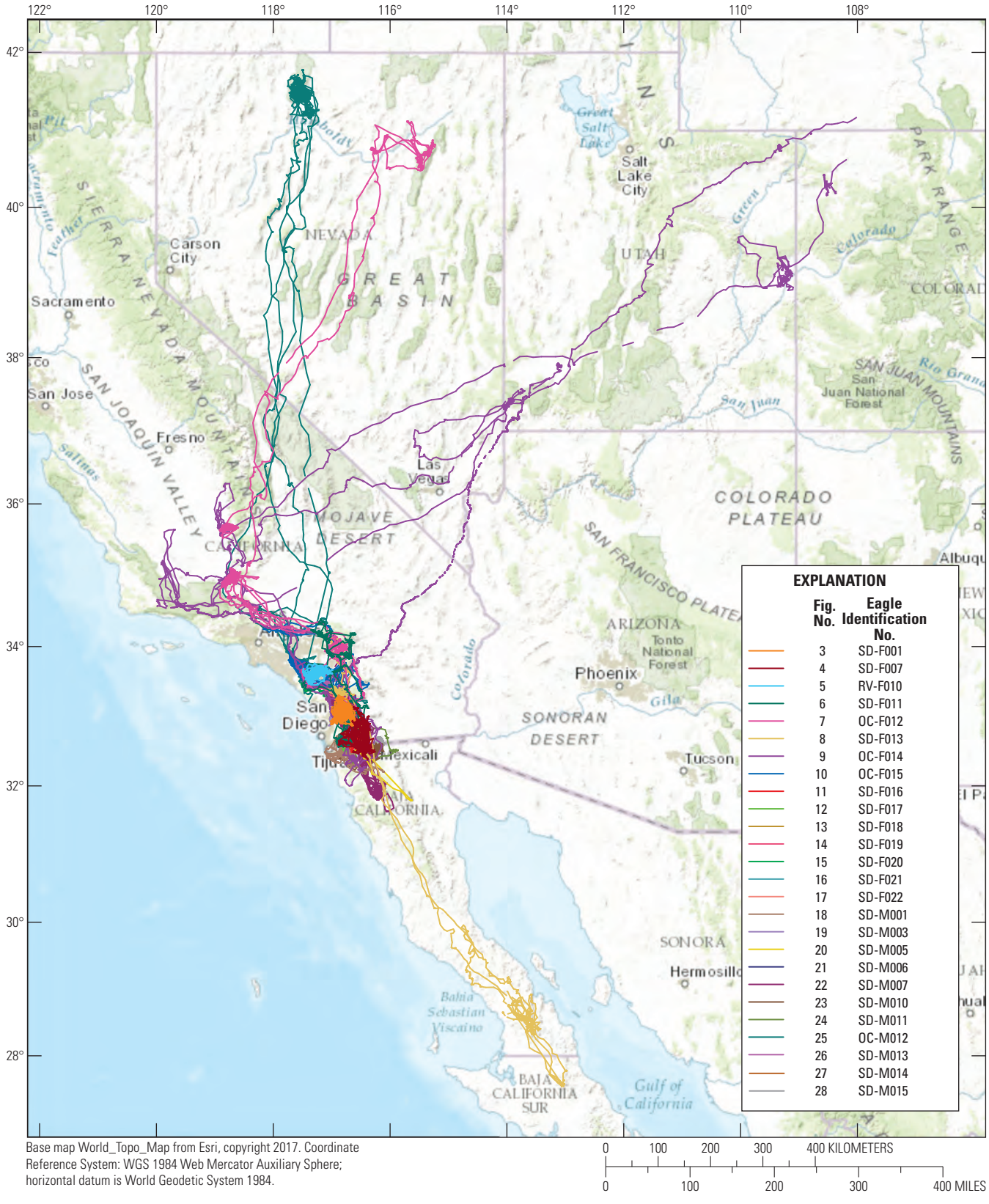
OTAY18 One or more eagles captured

OTAY15 Eagle not captured

0 5 10 15 20 25 KILOMETERS

0 5 10 15 20 25 MILES

Figure 1. Golden eagles trapping locations in southern California, February 24, 2016–February 23, 2017.



Base map World_Topo_Map from Esri, copyright 2017. Coordinate Reference System: WGS 1984 Web Mercator Auxiliary Sphere; horizontal datum is World Geodetic System 1984.

Figure 2. Location data for the 26 golden eagles tracked in southern California, February 24, 2016–February 23, 2017.

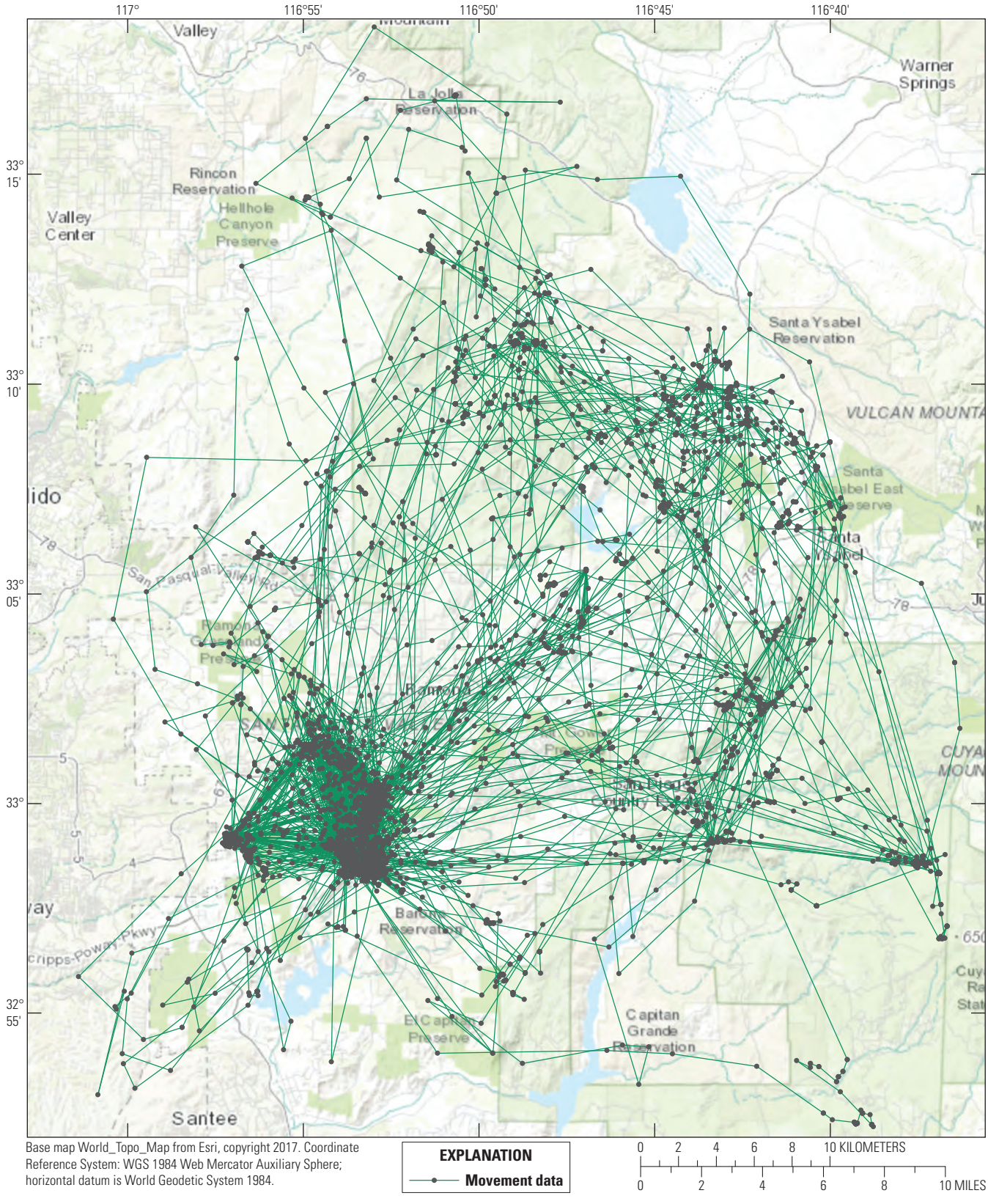


Figure 3. Location data for eagle GOEA-SD-F001 captured at Boulder Oaks, San Diego County, California, November 22, 2014.

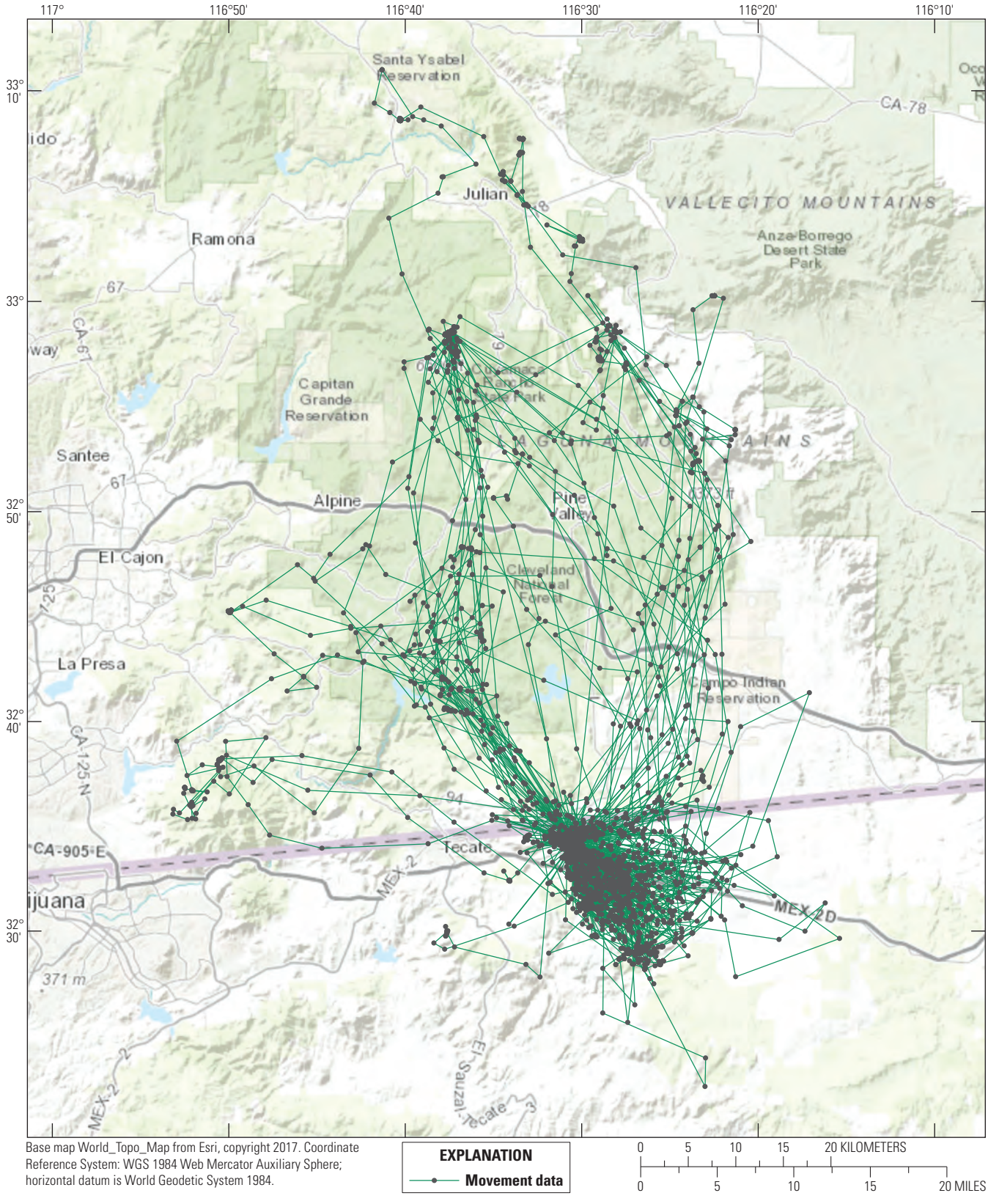


Figure 4. Location data for eagle GOEA-SD-F007 captured at Long Potrero, San Diego County, California, February 23, 2015.

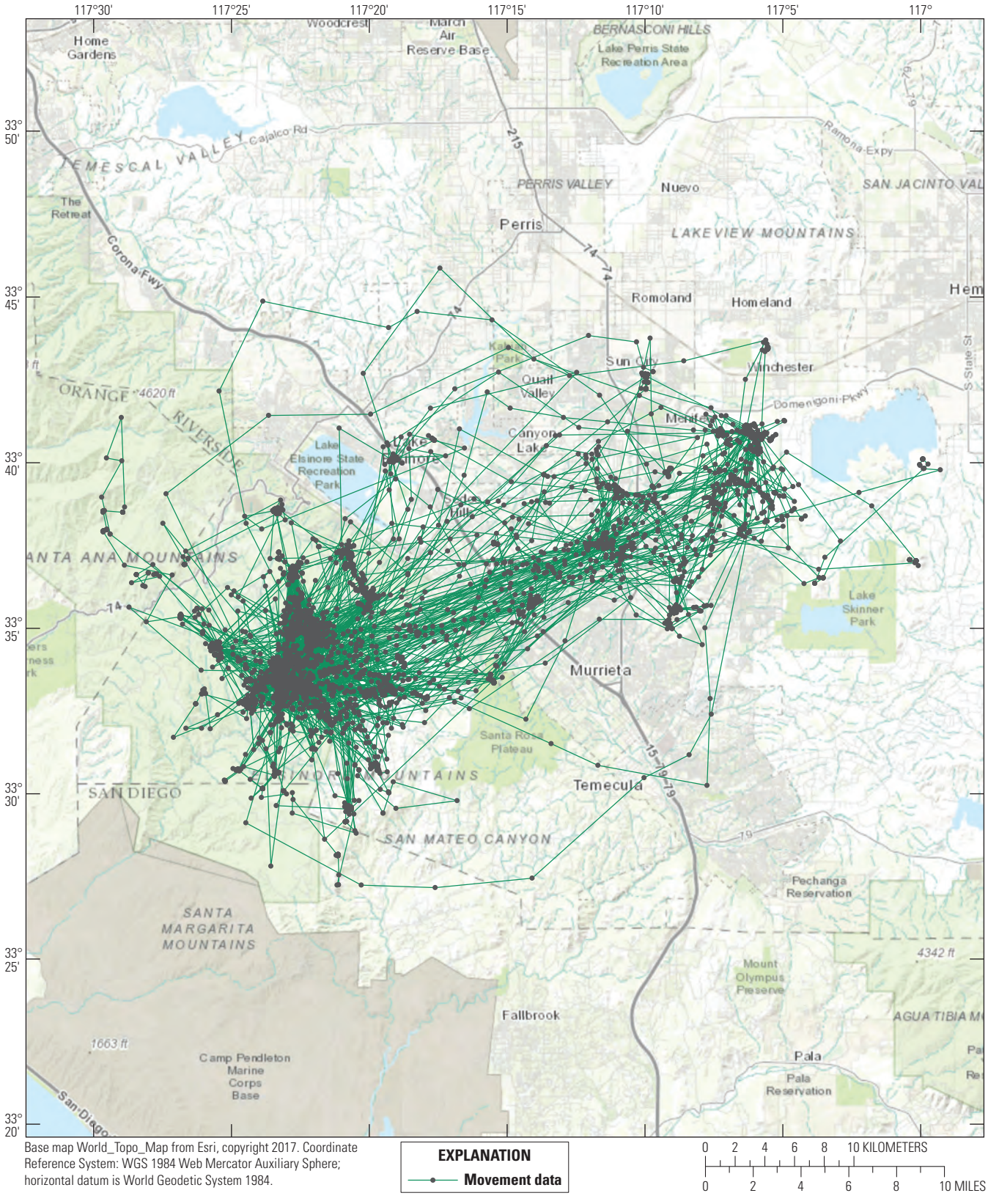


Figure 5. Location data for eagle GOEA-RV-F010 captured at Santa Rosa Plateau, Riverside County, California, December 12, 2015.

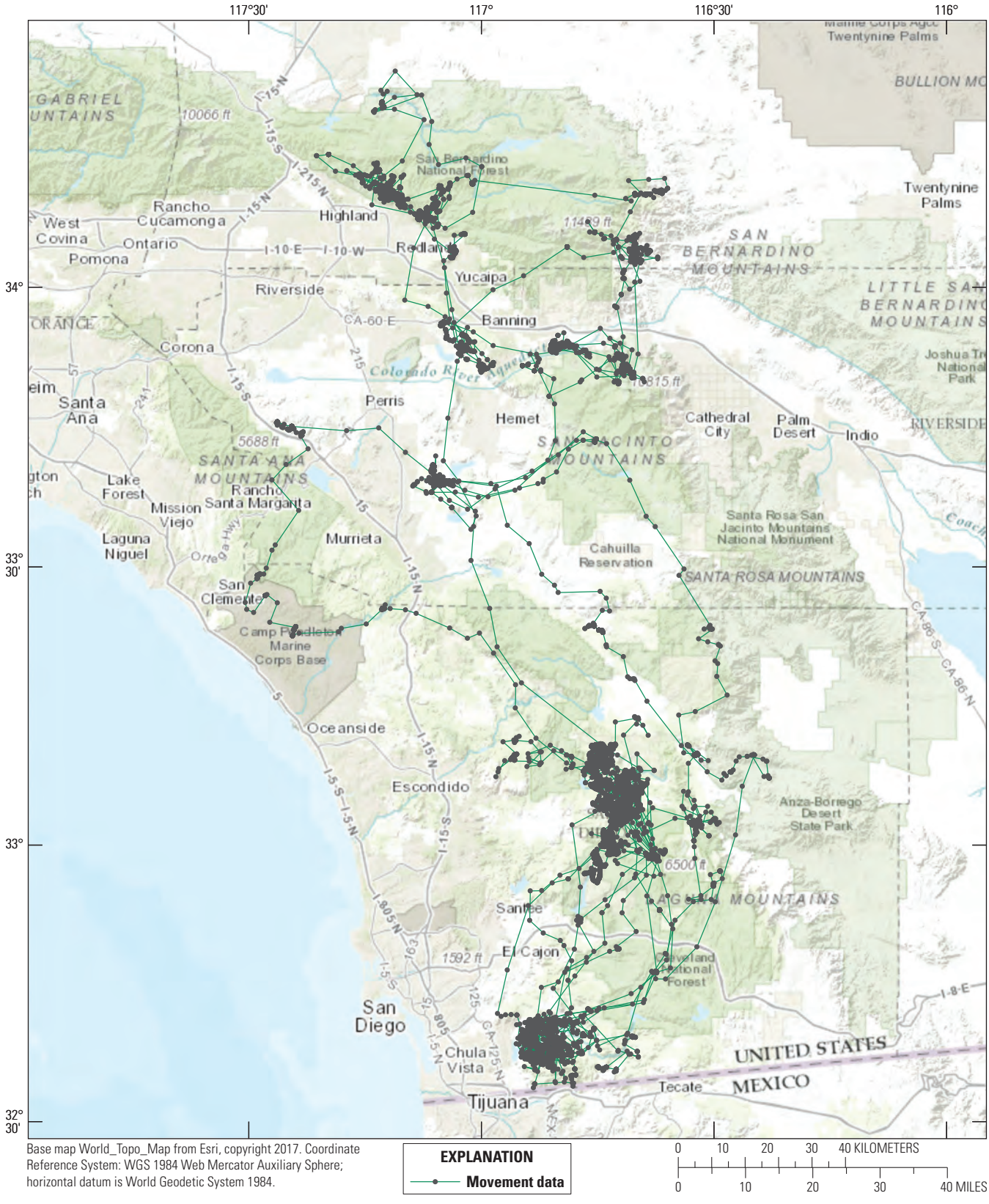


Figure 6. Location data for eagle GOEA-SD-F011 captured at Proctor Valley, San Diego County, California, December 20, 2015.

Figure 7. Location data for eagle GOEA-OC-F012 captured at Fremont Canyon, Orange County, California, February 10, 2016.

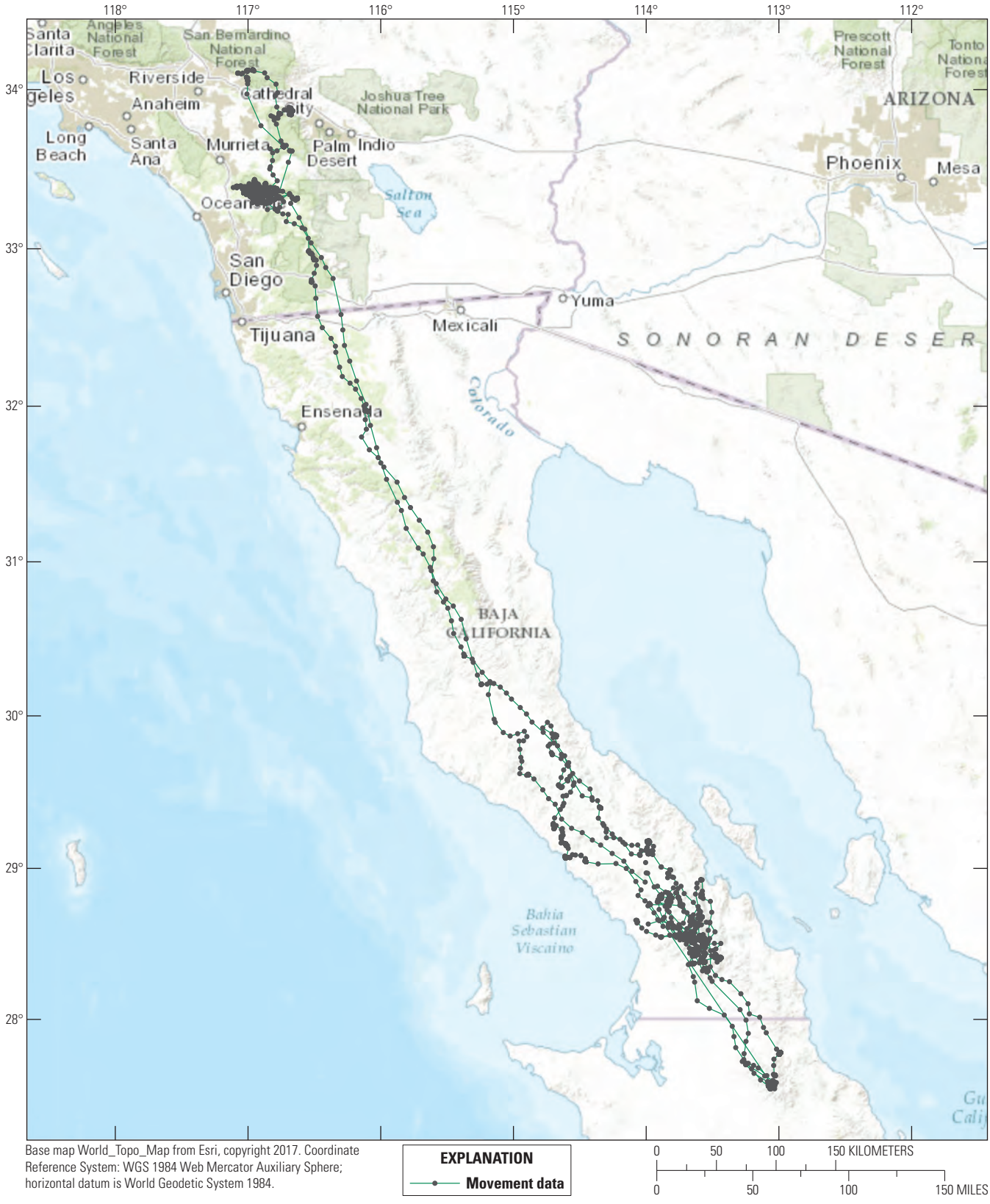


Figure 8. Location data for eagle GOEA-SD-F013 captured at Boucher Hill, San Diego County, California, February 11, 2016.

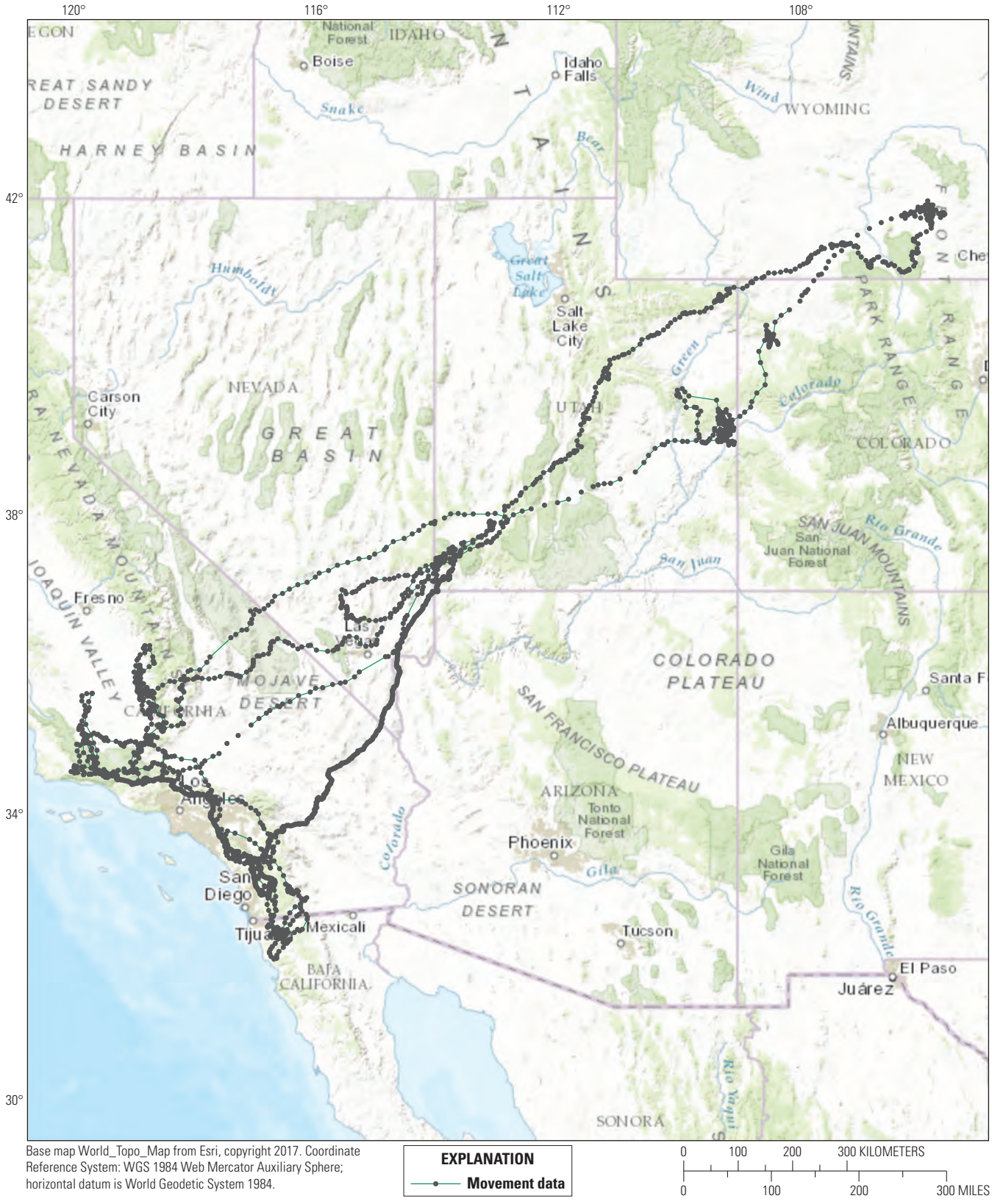


Figure 9. Location data for eagle GOEA-OC-F014 captured at Fremont Canyon, Orange County, California, February 12, 2016.

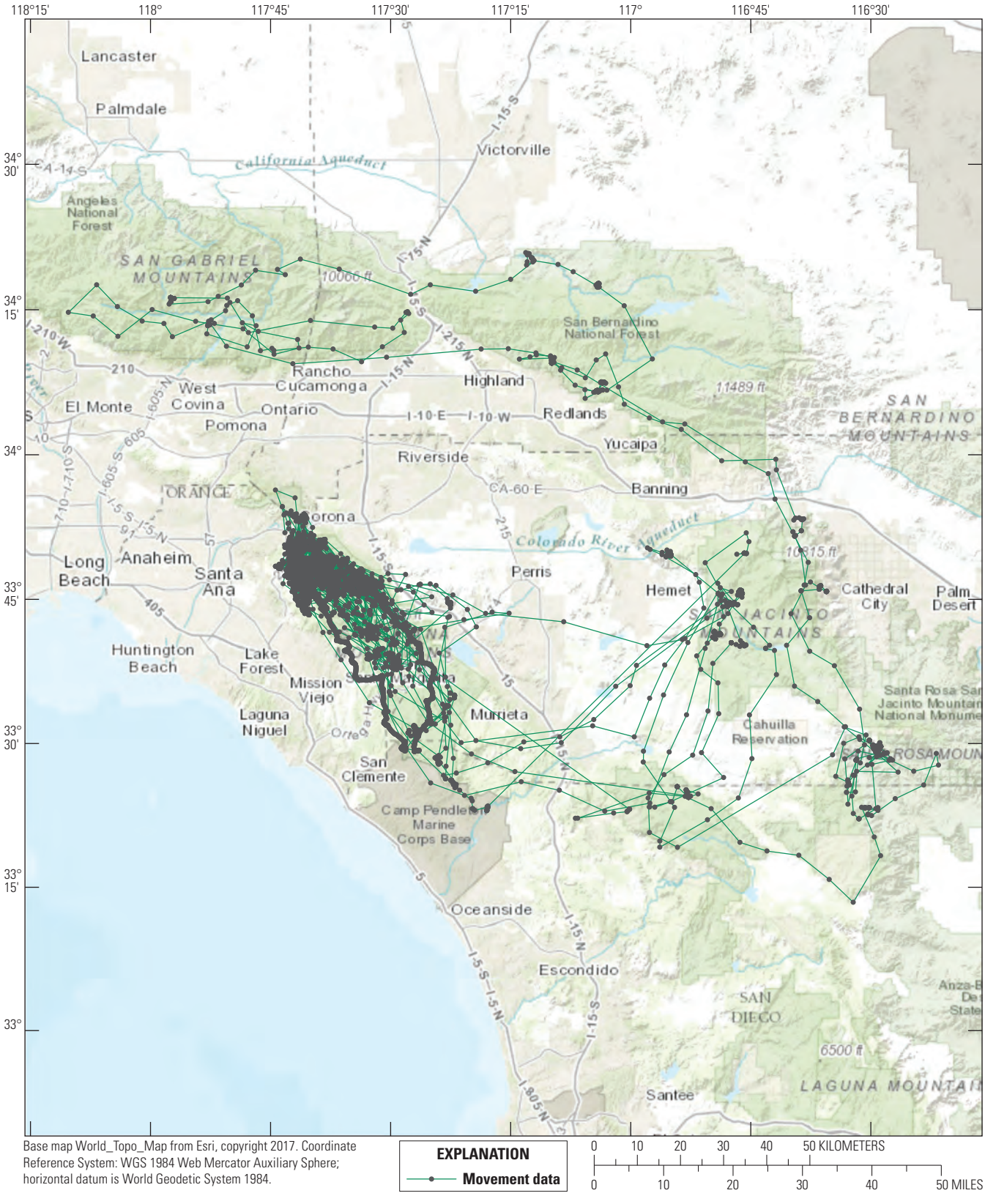


Figure 10. Location data for eagle GOEA-OC-F015 captured at Fremont Canyon, Orange County, California, February 12, 2016.

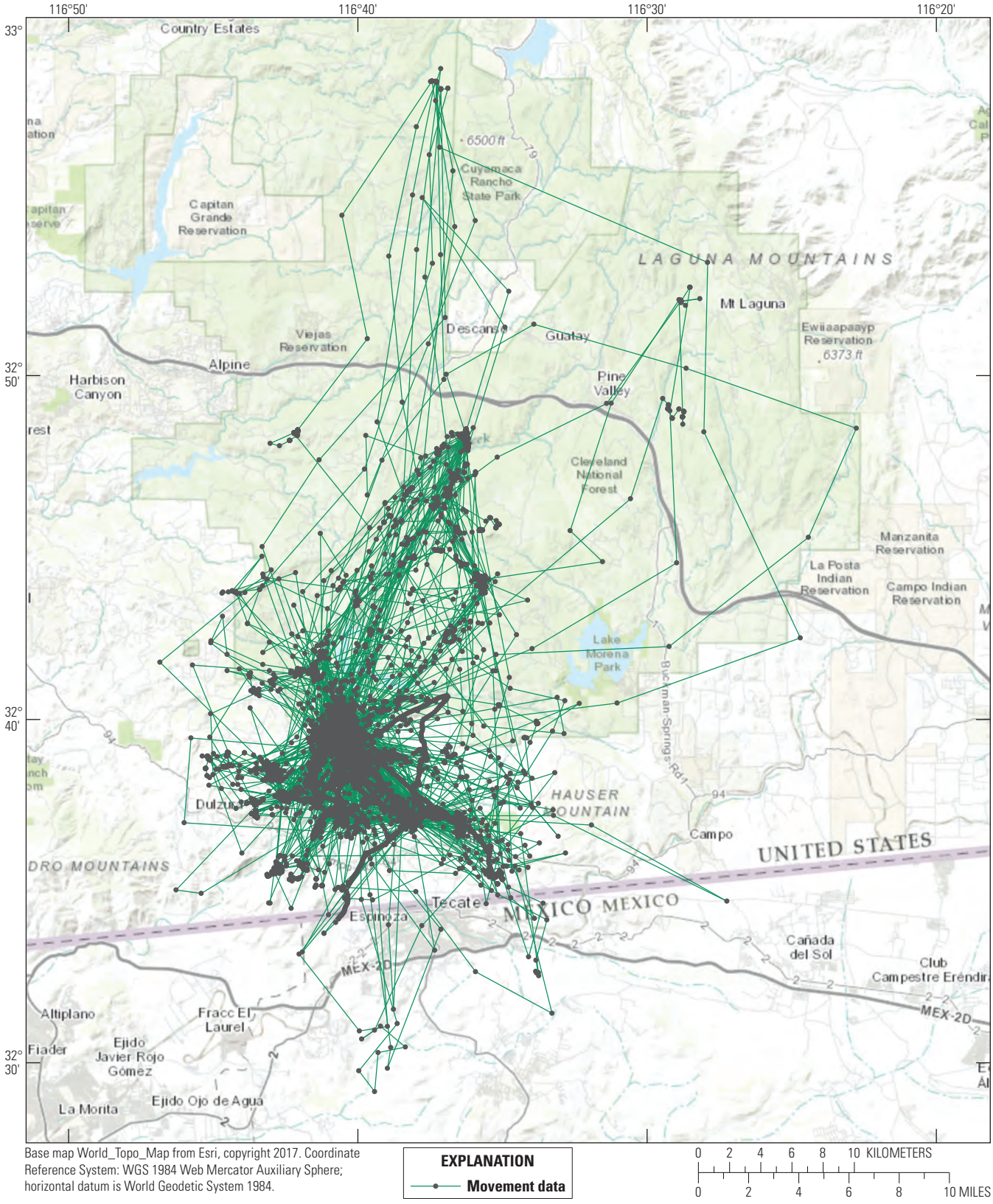


Figure 11. Location data for eagle GOEA-SD-F016 captured at Barrett Lake, San Diego County, California, March 5, 2016.

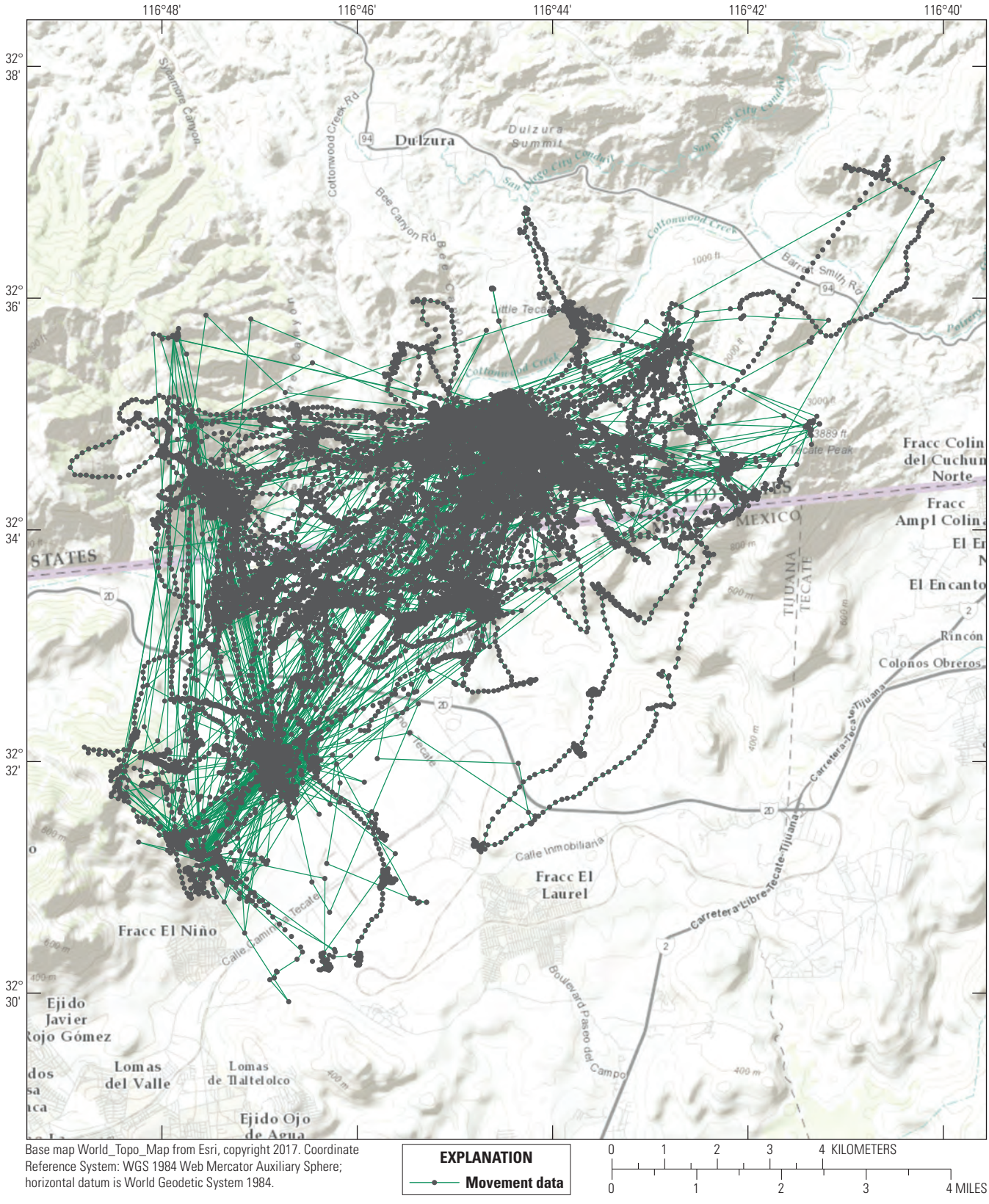


Figure 12. Location data for eagle GOEA-SD-F017 captured at Little Tecate, San Diego County, California, November 4, 2016.

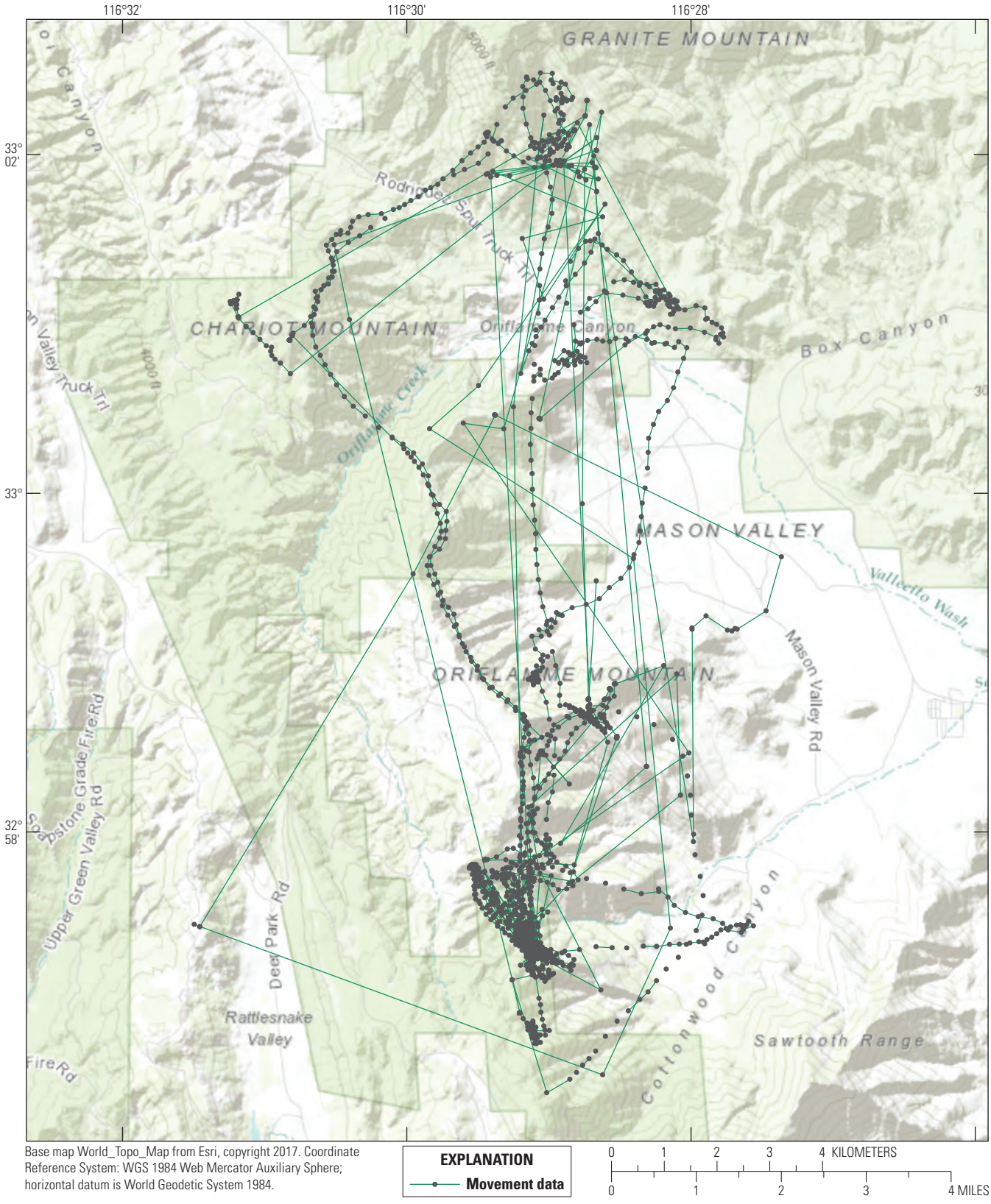


Figure 13. Location data for eagle GOEA-SD-F018 captured at Oriflamme Mountain, San Diego County, California, December 21, 2016.

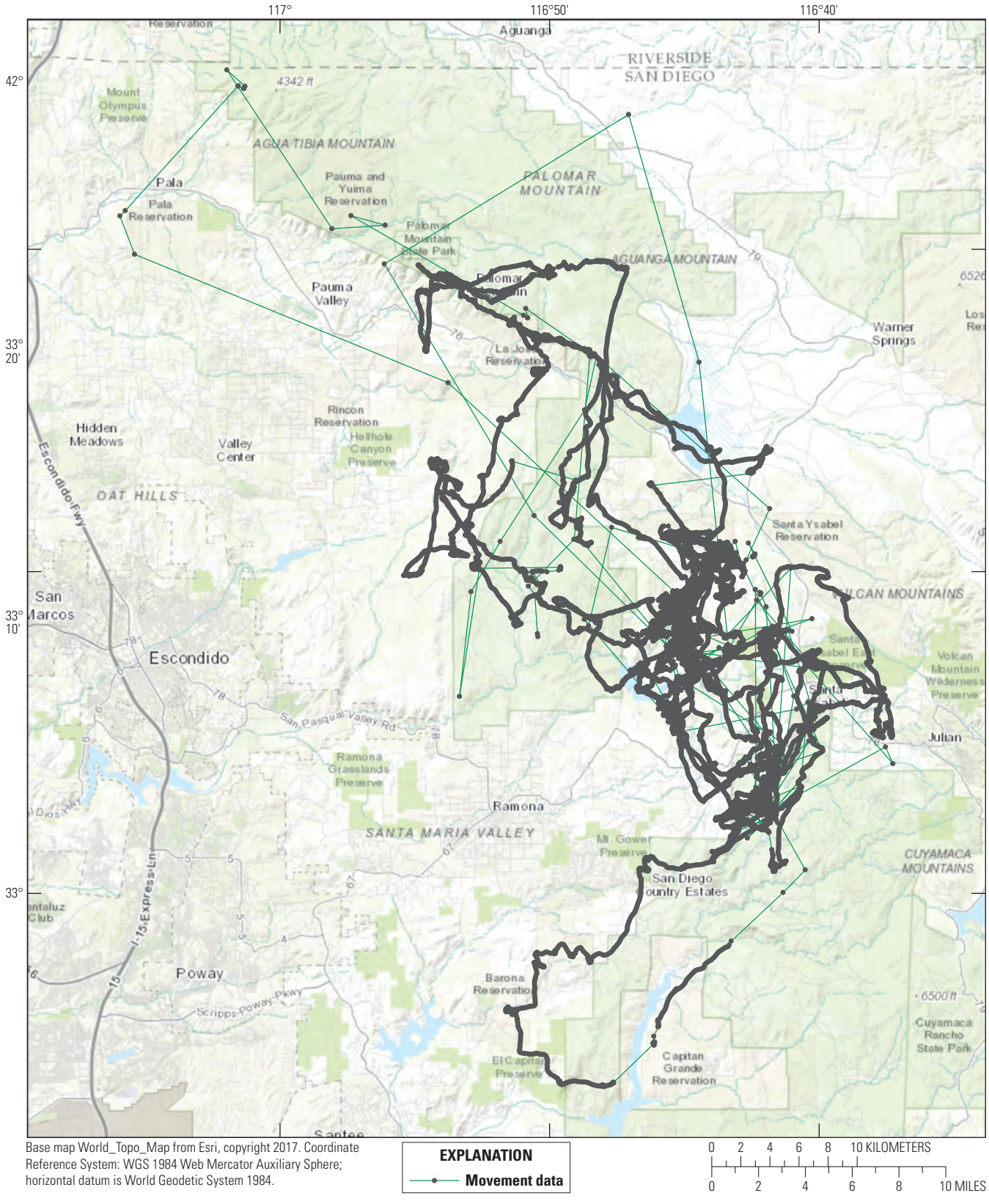


Figure 14. Location data for eagle GOEA-SD-F019 captured at Pamo Valley, San Diego County, California, January 14, 2017.

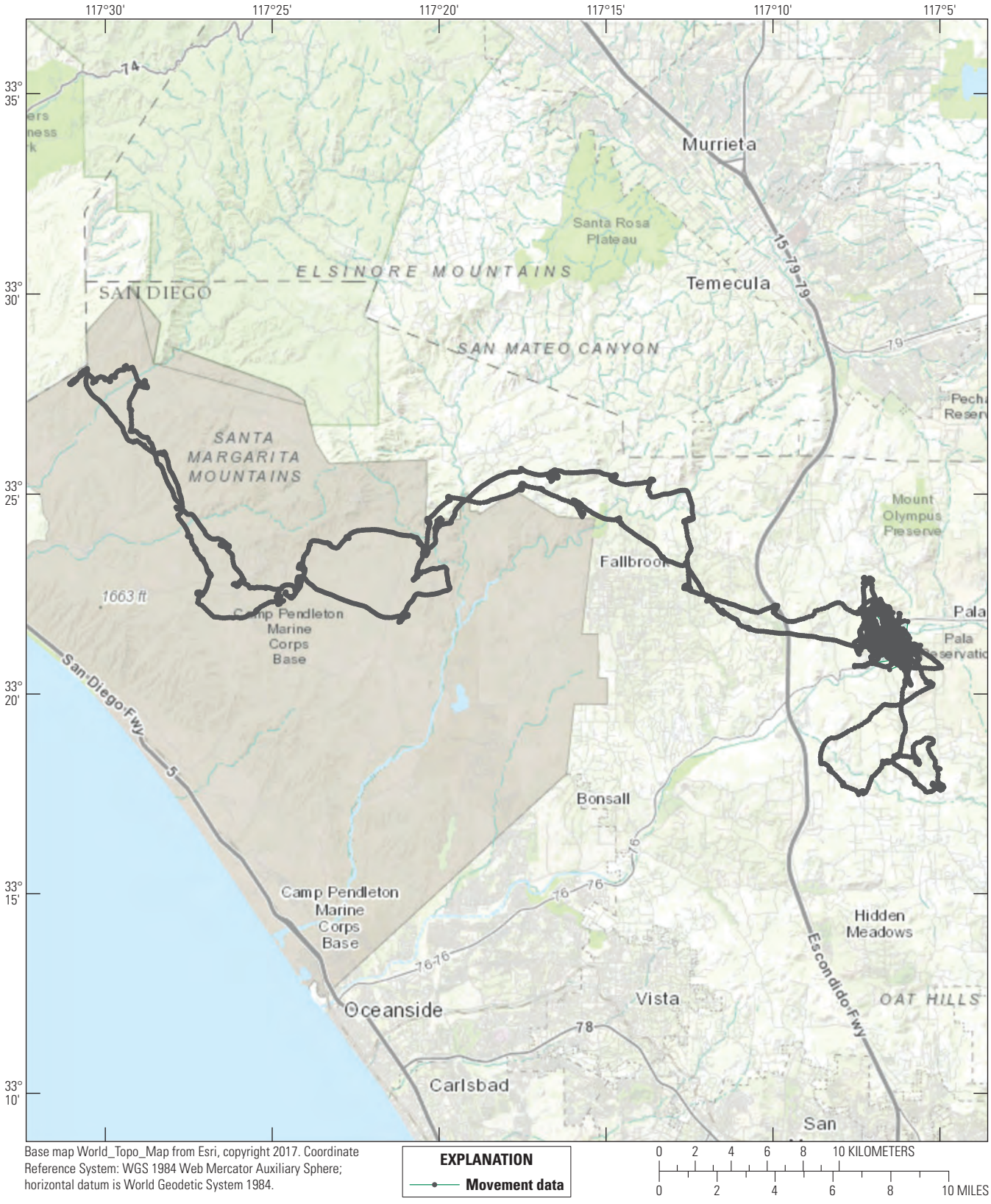


Figure 15. Location data for eagle GOEA-SD-F020 captured at Gregory Mountain, San Diego County, California, January 21, 2017.

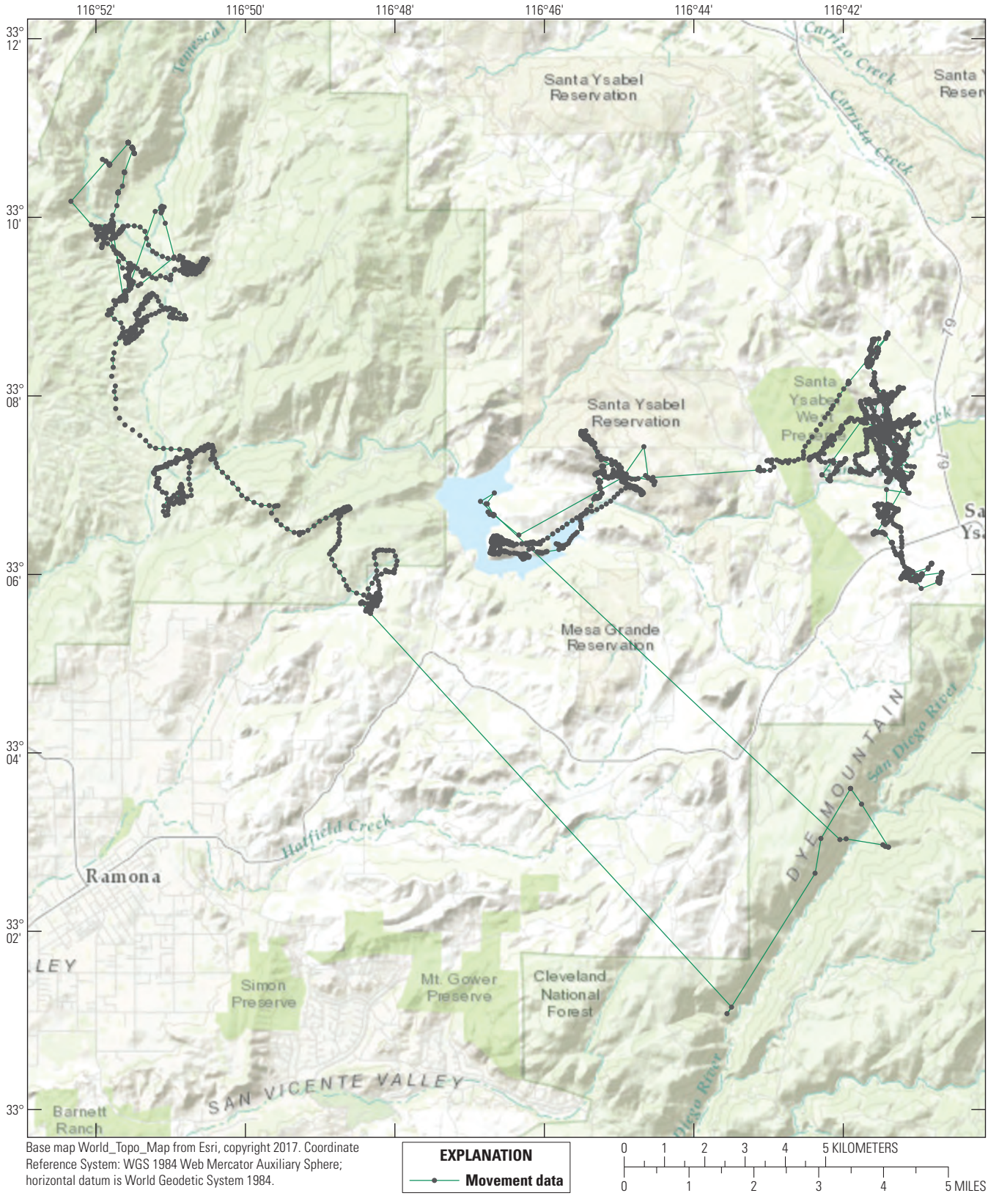


Figure 16. Location data for eagle GOEA-SD-F021 captured at Pamo Valley, San Diego County, California, January 29, 2017.

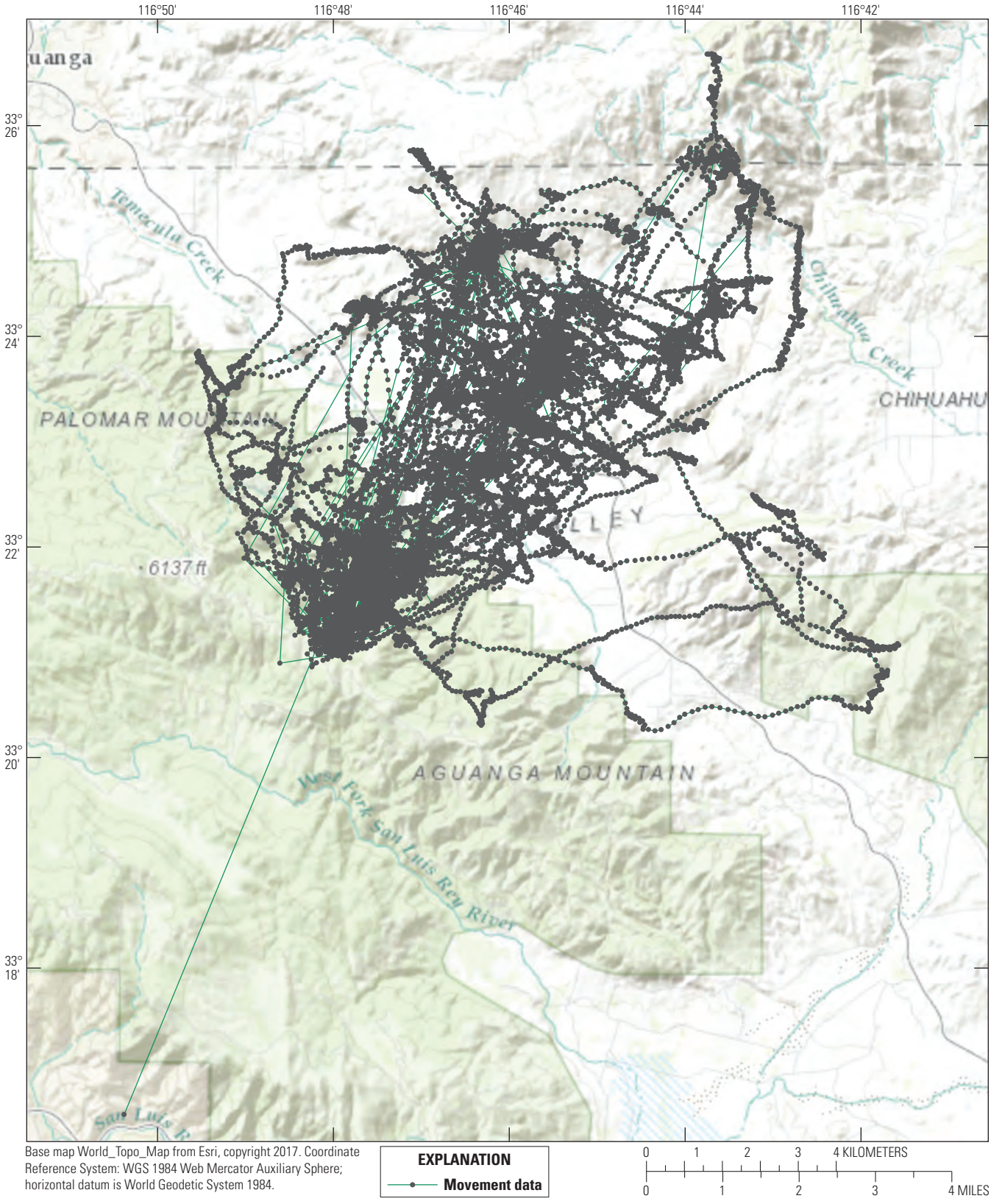


Figure 17. Location data for eagle GOEA-SD-F022 captured at Oak Grove, San Diego County, California, January 30, 2017.

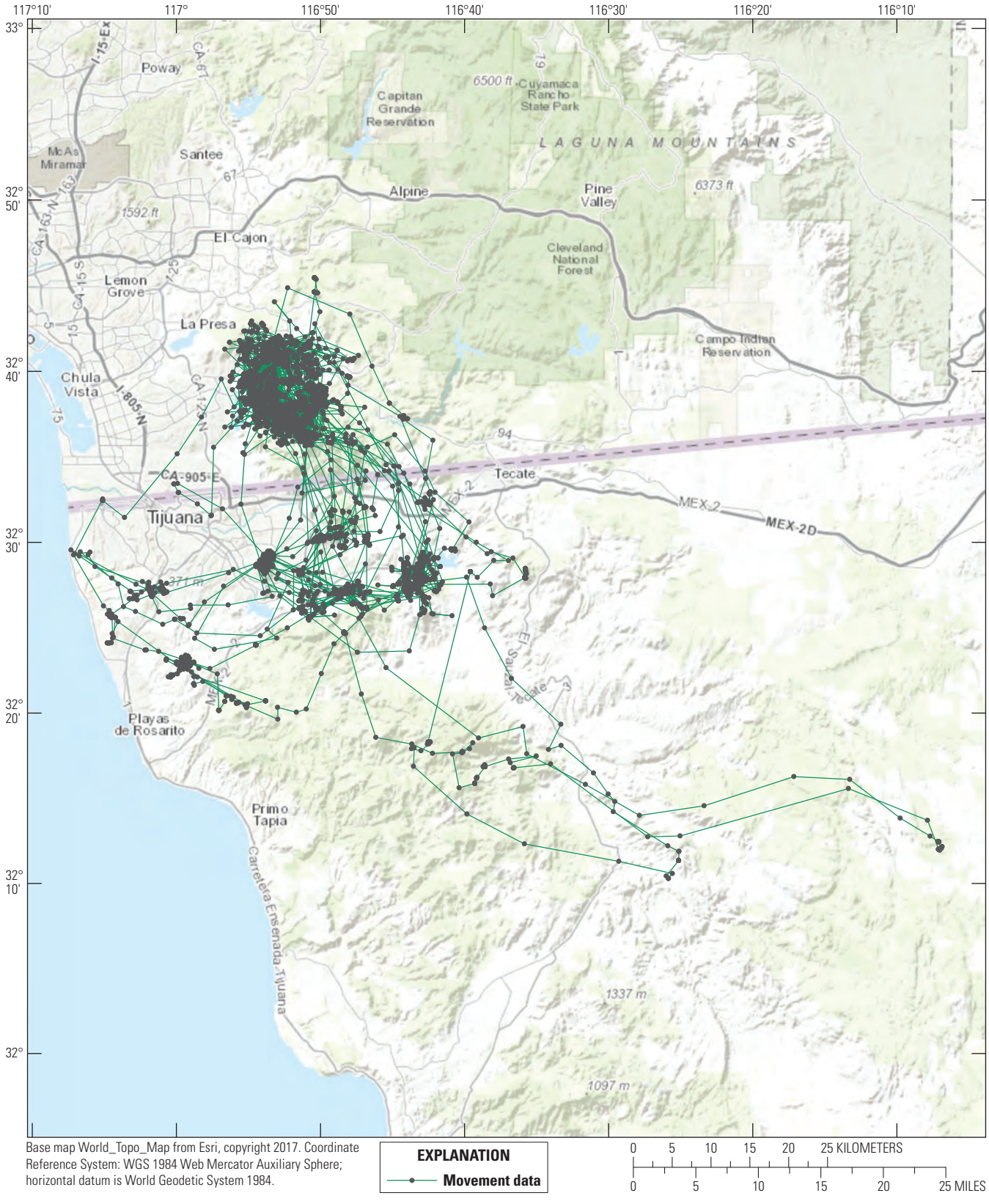


Figure 18. Location data for eagle GOEA-SD-M001 captured at Cedar Canyon, San Diego County, California, December 5, 2014.

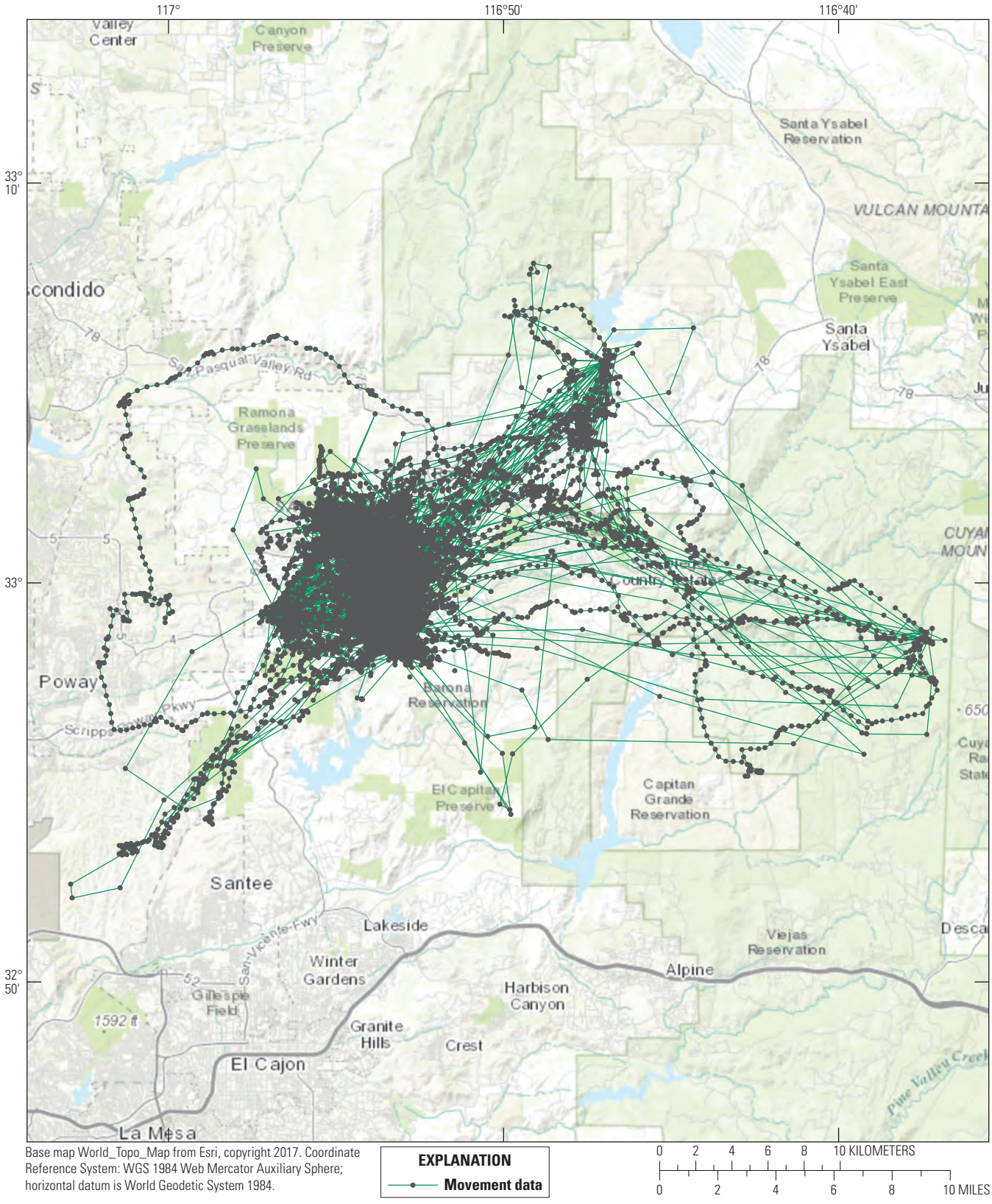


Figure 19. Location data for eagle GOEA-SD-M003 captured at Rancho Canada, San Diego County, California, February 3, 2015.

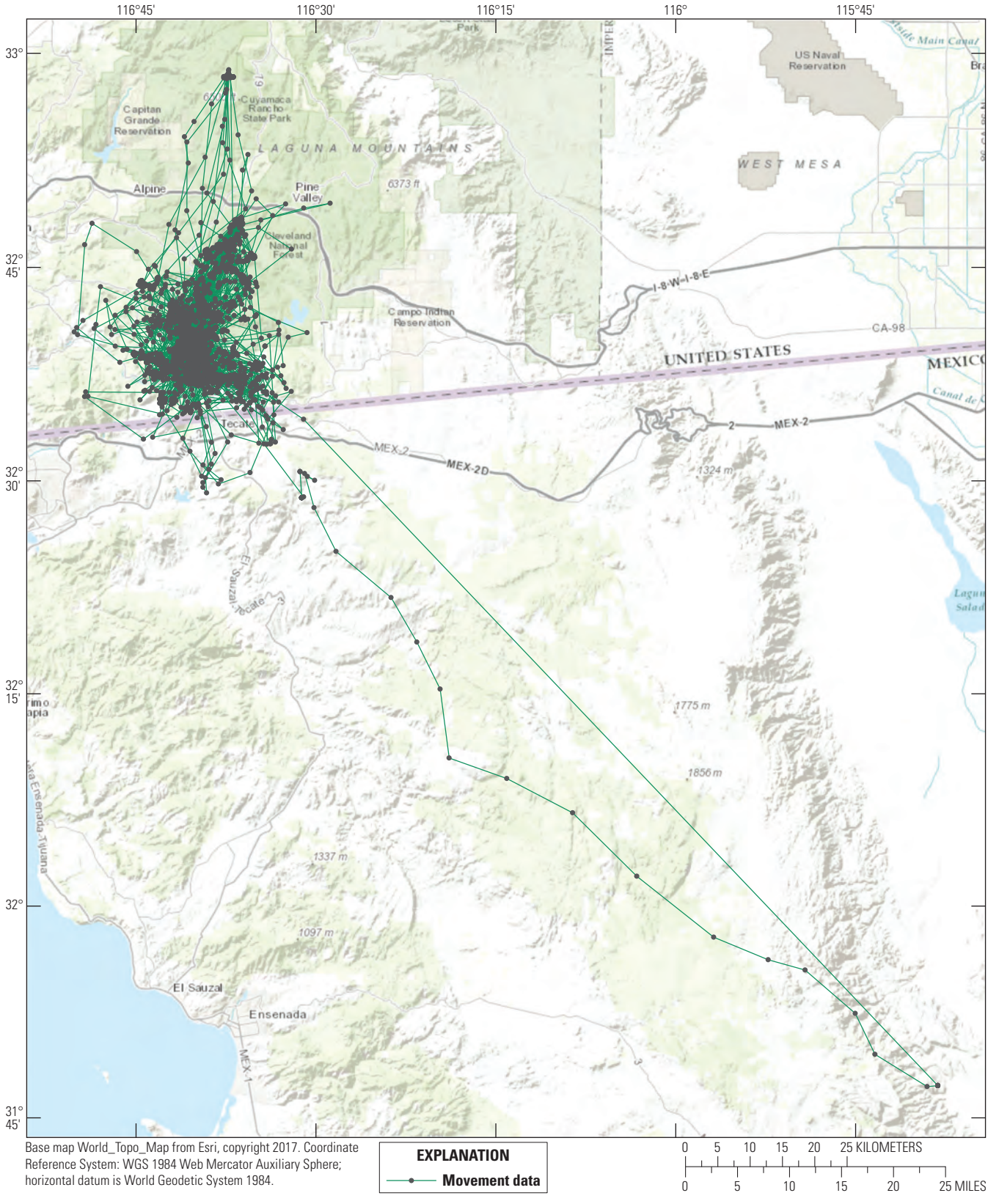


Figure 20. Location data for eagle GOEA-SD-M005 captured at Long Potrero, San Diego County, California, February 23, 2015.

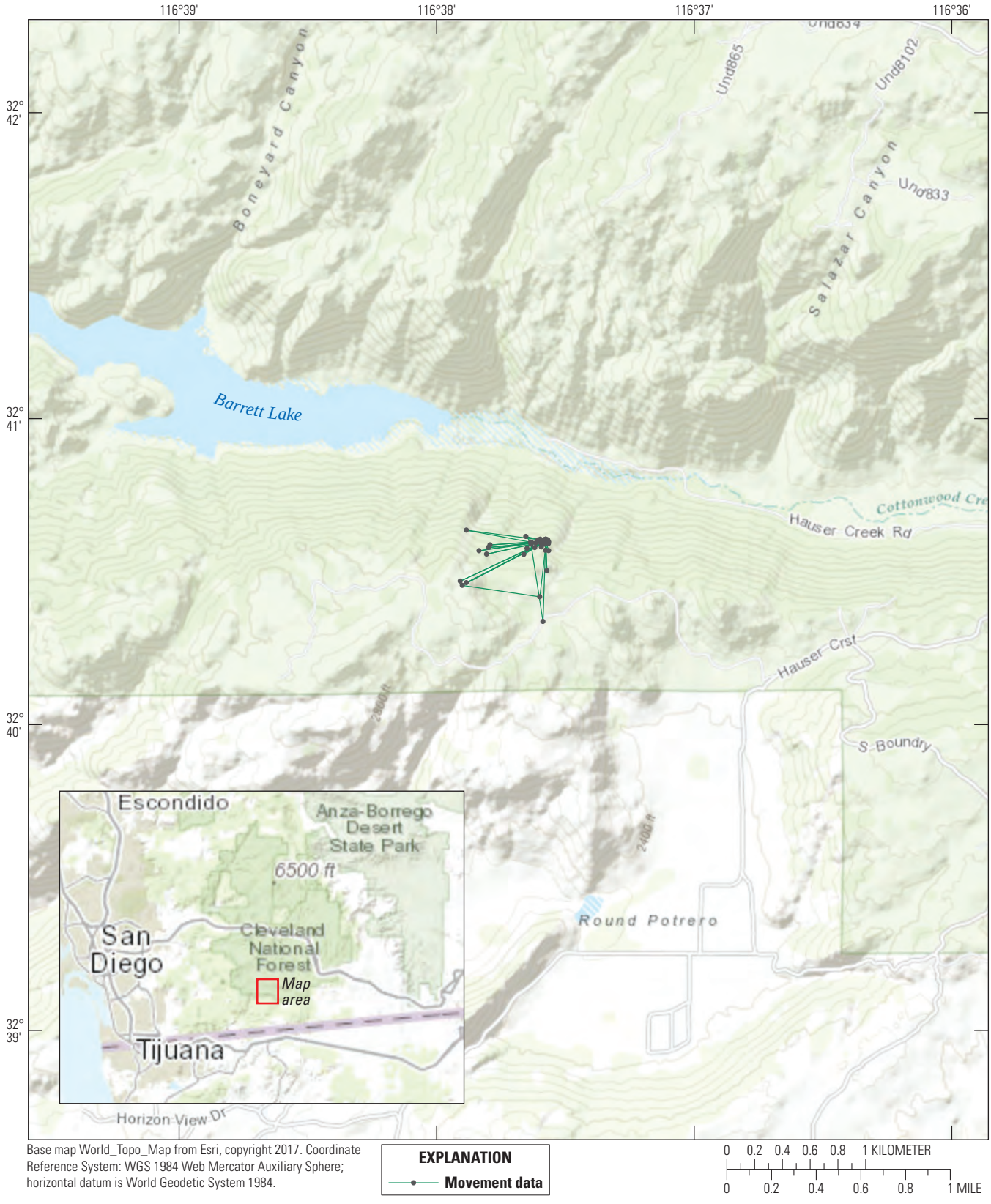


Figure 21. Location data for eagle GOEA-SD-M006 captured at Barrett Lake, San Diego County, California, December 1, 2015.

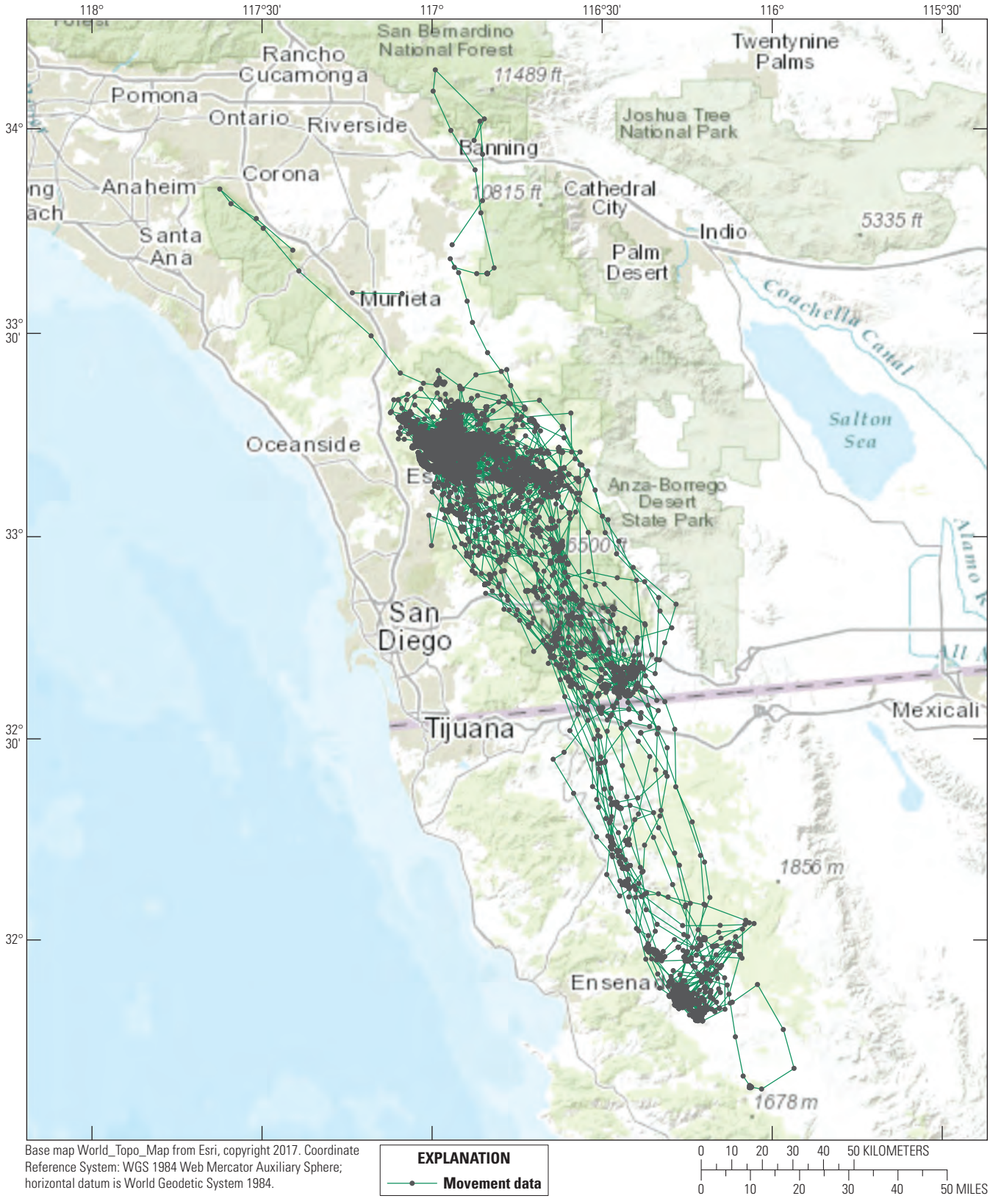


Figure 22. Location data for eagle GOEA-SD-M007 captured at Long Valley, San Diego County, California, December 9, 2015.

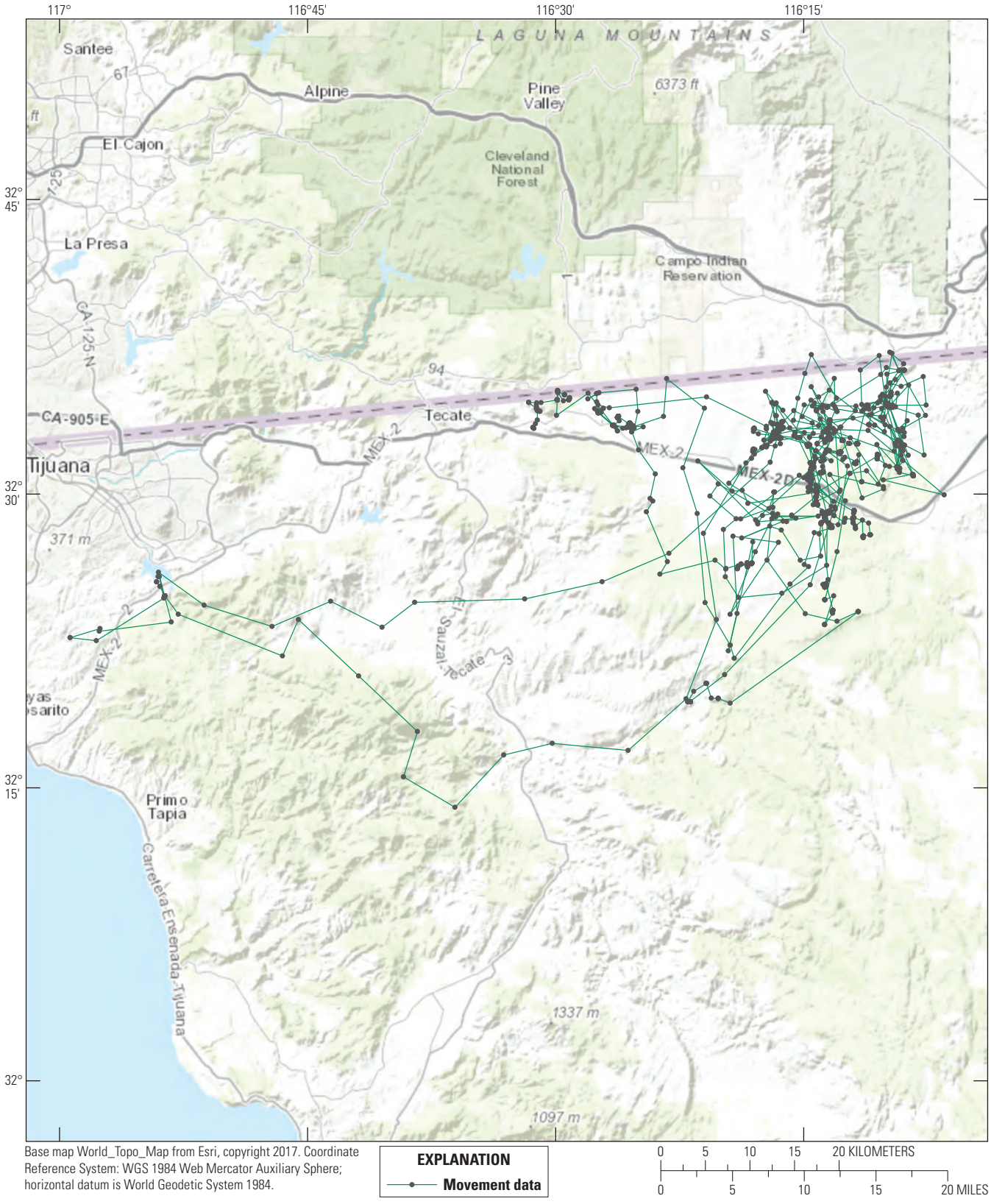
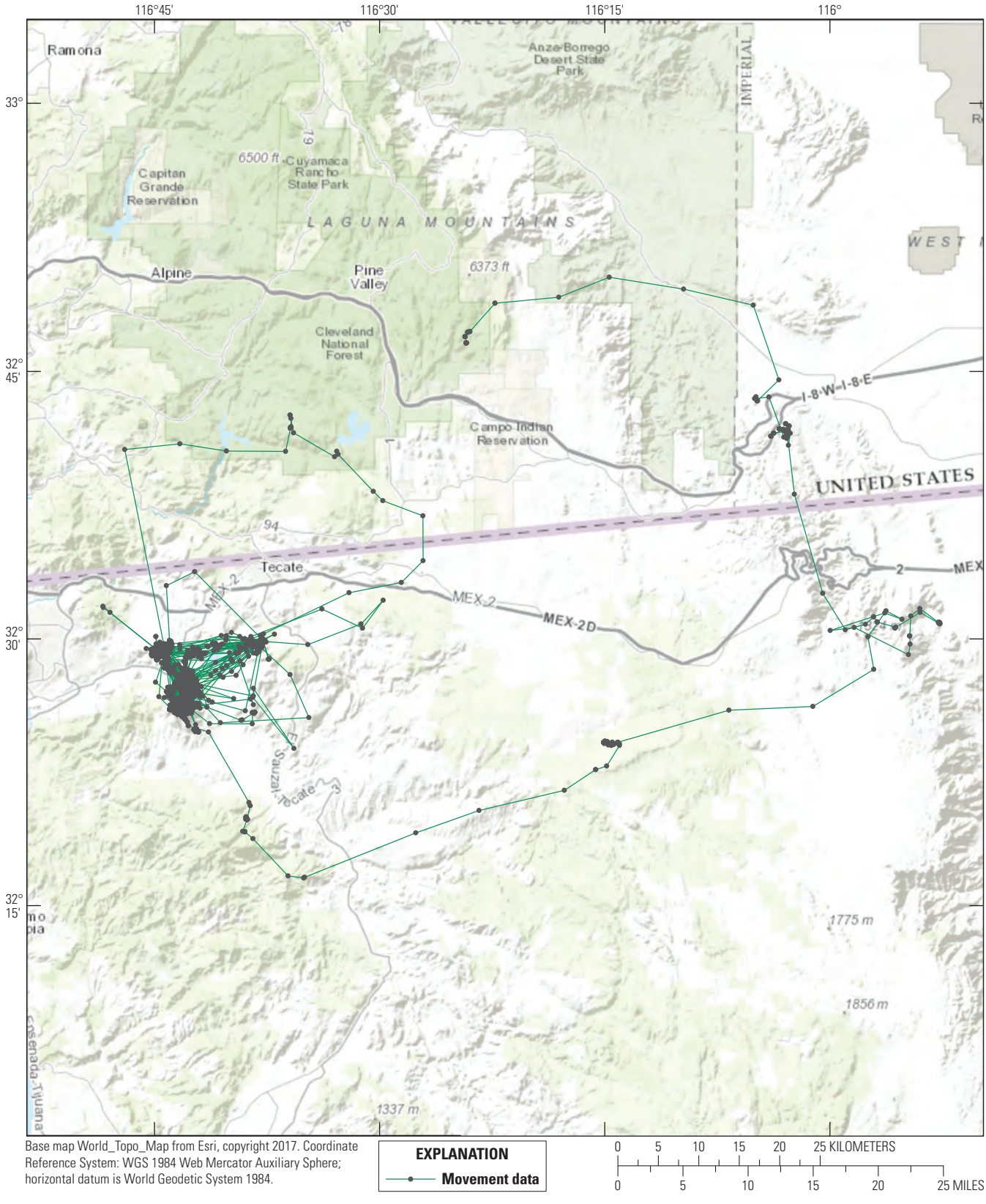


Figure 23. Location data for eagle GOEA-SD-M010 captured at Proctor Valley, San Diego County, California, December 17, 2015.



Base map World_Topo_Map from Esri, copyright 2017. Coordinate Reference System: WGS 1984 Web Mercator Auxiliary Sphere; horizontal datum is World Geodetic System 1984.

Figure 24. Location data for eagle GOEA-SD-M011 captured at Barrett Lake, San Diego County, California, December 21, 2015.

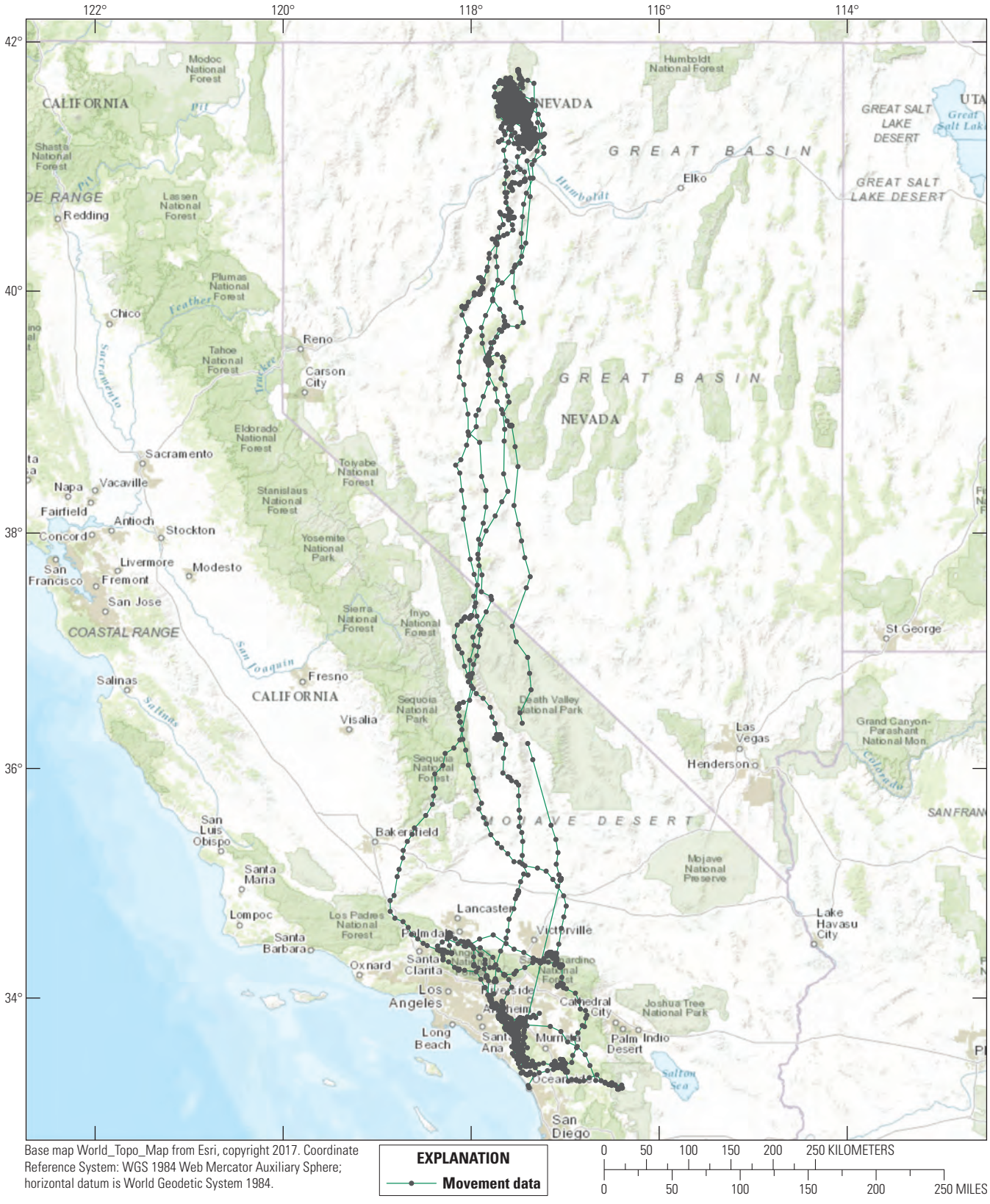


Figure 25. Location data for eagle GOEA-OC-M012 captured at Brush Canyon, Orange County, California, December 27, 2015.

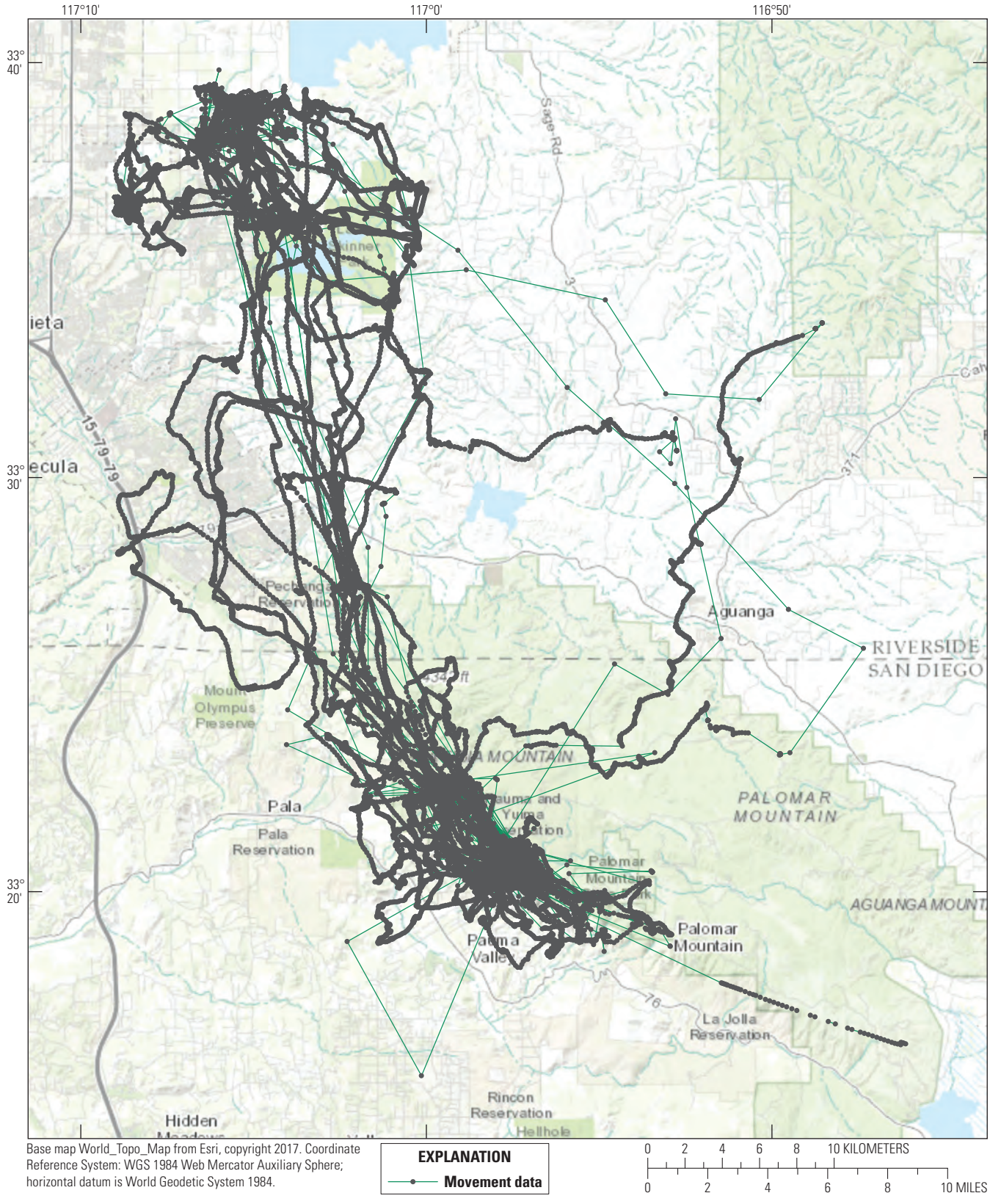


Figure 26. Location data for eagle GOEA-SD-M013 captured at Boucher Hill, San Diego County, California, November 20, 2016.

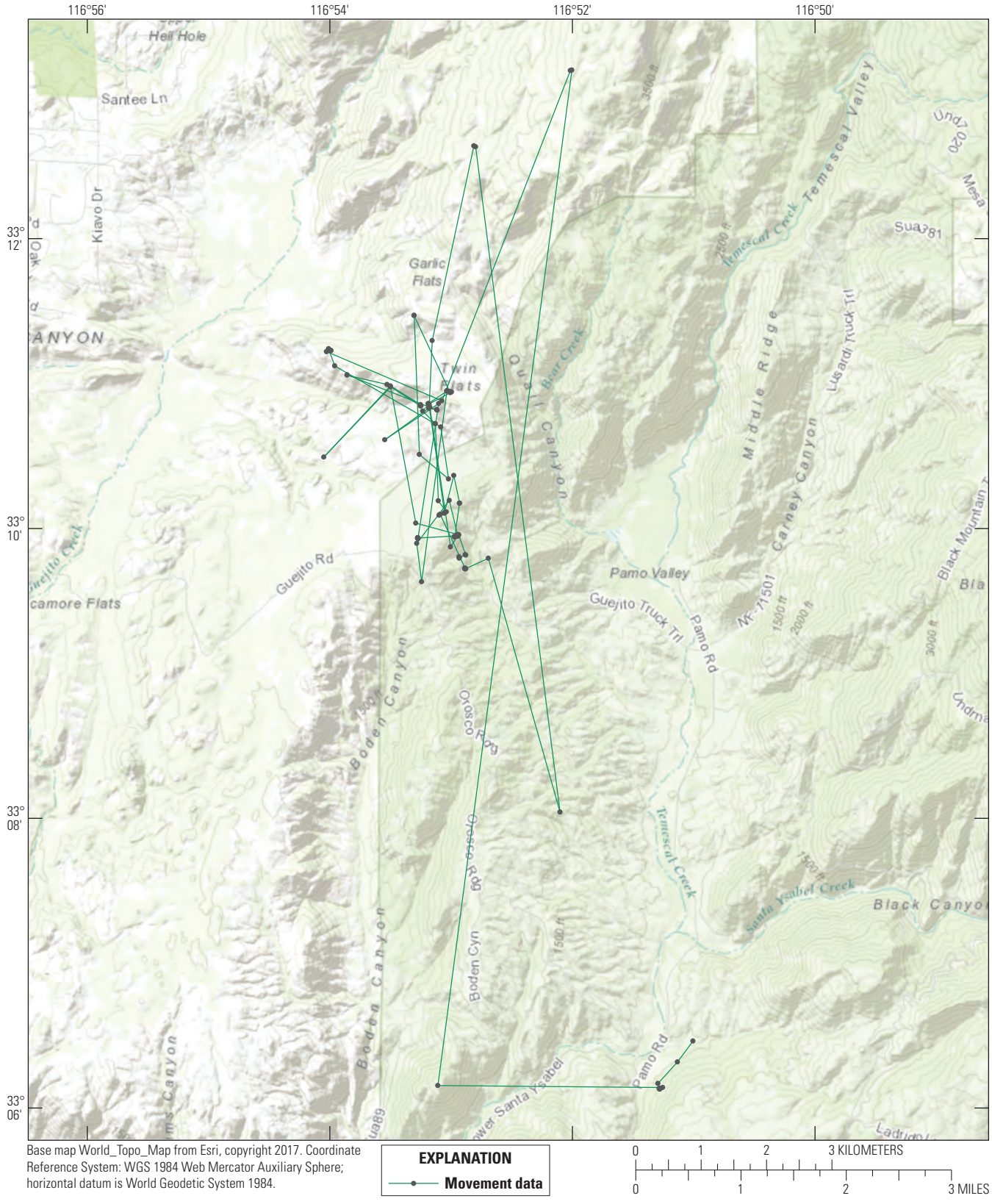


Figure 27. Location data for eagle GOEA-SD-M014 captured at Pamo Valley, San Diego County, January 13, 2017.

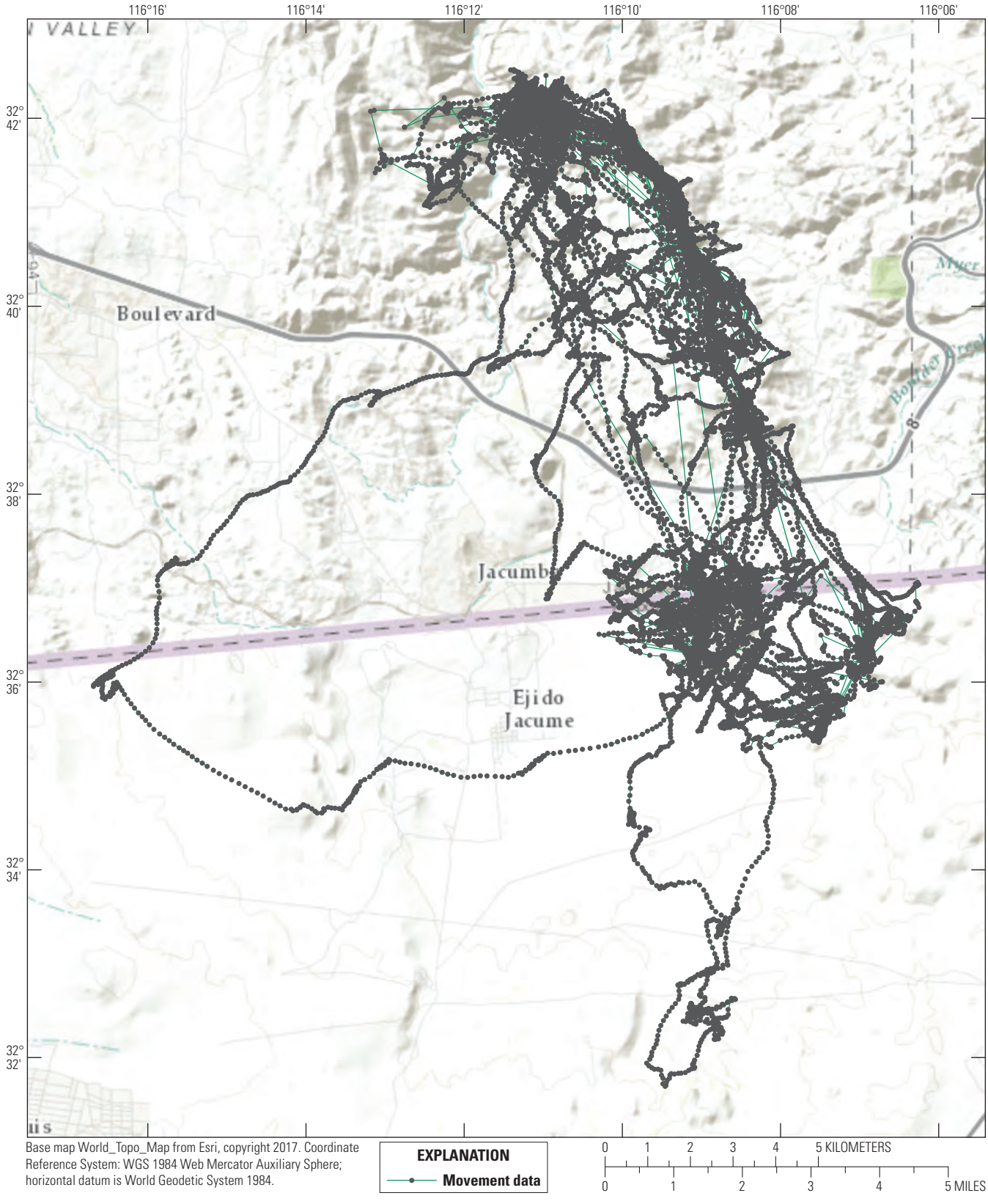


Figure 28. Location data for eagle GOEA-SD-M015 captured at Table Mountain, San Diego, California, January 28, 2017.

A series of photographs of golden eagles are shown at bait sites (figs. 29–30), a telemetered golden eagle being released (fig. 31), and golden eagle cliff nests (figs. 32–34).

Figure 29. A golden eagle visits a bait site. Often, eagles are attracted by the activity of other scavengers, such as the common ravens seen here. The photograph was taken by a motion-triggered camera used to monitor the bait site.

Figure 31. A golden eagle being released by biologist Marla Steele (volunteer with BBI) after being captured and fitted with a telemetry unit, January 30, 2017. Photograph by Peter H. Bloom, Bloom Biological, Inc. Used with permission.

Figure 30. A golden eagle at a bait site, October 29, 2016.

Figure 32. Typical golden eagle nesting habitat in our study area, March 15, 2017. The location of the nest is indicated by the red arrow. Photograph by Peter H. Bloom, Bloom Biological, Inc. Used with permission.

Figure 33. A female golden eagle wearing a telemetry unit incubates her eggs, March 15, 2017. The yellow arrow points to the unit. Photograph by Peter H. Bloom, Bloom Biological, Inc. Used with permission.

Figure 34. A female golden eagle with hatchlings, May 12, 2015. Photograph by Peter H. Bloom, Bloom Biological, Inc. Used with permission.

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