

Wildlife Program

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

Biotelemetry Data for Golden Eagles (*Aquila chrysaetos*) Captured in Coastal Southern California, February 2017– December 2019



Data Series 1128

Cover Photo: Photograph of a golden eagle approaching a bait station followed by common ravens, March 23, 2018. Photograph taken by a motion-triggered wildlife camera.

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By Jeff A. Tracey, Melanie C. Madden, James C. Molden, Jeremy B. Sebes,
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Data Series 1128

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

U.S. Department of the Interior
DAVID BERNHARDT, Secretary

U.S. Geological Survey
James F. Reilly II, Director

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Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
Length		
millimeter (mm)	0.03937	inch
kilometer (km)	0.6214	mile (mi)
Flow rate		
meter per second (m/s)	3.281	foot per second (ft/s)
Mass		
gram (g)	0.03527	ounce, avoirdupois (oz)

Datum

Vertical coordinate information is referenced to the World Geodetic System 1984 (WGS 84).

Horizontal coordinate information is referenced to the World Geodetic System 1984 (WGS 84).

Altitude, as used in this report, refers to distance above the vertical datum.

Supplemental Information

Concentrations of lead in blood are given in micrograms per deciliter ($\mu\text{g}/\text{dL}$). $1 \mu\text{g}/\text{dL}$ is the equivalent of 0.001 parts per million (ppm).

Biotelemetry Data for Golden Eagles (*Aquila chrysaetos*) Captured in Coastal Southern California, February 2017–December 2019

By Jeff A. Tracey¹, Melanie C. Madden¹, James C. Molden¹, Jeremy B. Sebes¹, Peter H. Bloom², and Robert N. Fisher¹

Abstract

Because of a lack of clarity about the status of golden eagles (*Aquila chrysaetos*) in coastal southern California, the U.S. Geological Survey, in collaboration with U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, Bureau of Land Management, and San Diego Management and Monitoring Program, 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, 2017, 37 golden eagles were captured. During trapping efforts from February 24, 2017, to December 2, 2019, an additional 7 golden eagles (4 females and 3 males) were captured, and one previously captured female was recaptured in San Diego County. Biotelemetry data for 27 of the 44 golden eagles that were transmitting data from February 24, 2017, to December 2, 2019, are presented. These eagles ranged as far north as British Columbia, Canada, and as far south as Ciudad Insurgentes, 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 typically is comprised of adult territorial breeders, adult floaters, locally fledged juvenile and subadults, nomadic birds of all ages, 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 (Braham and others, 2015; Poessel and others, 2016), but there is no previous work from the coastal areas or the Sonoran Desert. The U.S. Geological Survey (USGS) in collaboration with U.S. Fish and Wildlife Service (USFWS), 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, 2017, through December 2, 2019. Capture and biotelemetry data for November 22, 2014, to February 23, 2017, are available in Tracey and others (2016, 2017).

Methods

Biotelemetry

Eagles were captured by using a remotely triggered bow net trap baited with a carcass. Once captured, each eagle was given an eagle identification (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.

¹U.S. Geological Survey.

²Bloom Biological, Inc.

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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 the 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 micrograms per deciliter ($\mu\text{g}/\text{dL}$), 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 the 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 or CTT™-1000-BT3 GPS-GSM telemetry unit (Lanzone and others, 2012). The about 72-gram units (about 1–2 percent of an eagle's total weight) were attached to the eagles using 11 millimeter (mm) natural tubular Teflon™ tape fed through the attachment holes on the GPS-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). We applied two filters to the records to eliminate potentially erroneous locations.

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

1. Location had to be a 3D fix,
2. Horizontal dilution of precision (HDOP) had to be less than or equal to 5,
3. Vertical dilution of precision (VDOP), if available, had to be less than or equal to 5,
4. Longitude values had to be available and be on the interval $[-180, -100]$ degrees,
5. Latitude values had to be available and be on the interval $[20, 72]$ degrees, and
6. Fixes had to be at least 2 seconds apart (based on discussion with engineers at CTT™ taking new flight mode firmware into account).

The second filter depends on move step (in other words, a displacement between two consecutive observed locations) 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 three that follows), and
3. Rate of displacement had to be realistic (less than or equal to 89.4 meters per second $[\text{m}/\text{s}]$ horizontal or less than or equal to 20.0 m/s vertical).

After filtering on move step distances, any location that was not the beginning or end point of a move step was removed because it was associated only with a move step that had unrealistic rates of movement.

Biotelemetry Data for Captured Golden Eagles

From September 29, 2014, to December 2, 2019, we baited at 168 different locations in San Diego, Orange, and western Riverside Counties of southern California and captured a total of 44 golden eagles. During this reporting period, February 24, 2017–December 2, 2019, we baited at 30 locations, captured 7 new and recaptured 1 golden eagle for a total of 8 golden eagles at 4 trapping locations, and collected biotelemetry data from a total of 27 golden eagles, including 20 that were captured prior to February 24, 2017 (table 1; fig. 1). For the 20 eagles captured prior to February 24, 2017, see Tracey and others (2016, 2017) 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 8 eagles with operational transmitters, 2 eagles with transmitters of unknown status, 11 eagles with non-functional transmitters, 3 eagles known to have removed their transmitters (based on telemetry data and recovery of the transmitter) and 3 eagles known to have died (see “Status” column, table 1). An operational 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 prior, a non-functional 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 non-functional transmitters have been observed alive in the field. Fifteen of the eagles appeared to have had breeding territories, seven appeared to have been adult floaters (that is, adults without a breeding territory), four were nomadic subadults (that is, wandering eagles typically too young to hold a breeding territory), and one 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 17 golden eagles (8 confirmed fatalities and 11 apparent transmitter failures) that were included in Tracey and others (2016, 2017).

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 still could be utilized by eagles that we are not tracking. Location data for 27 captured golden eagles with transmitters that produced telemetry data during the reporting period are shown in figures 3–29. The San Diego Association of Governments (SANDAG) funded the telemetry data collection for this report and the data will be housed with the SDMMMP.

Table 1. Summary of golden eagles tracked in southern California, February 24, 2017–December 2, 2019.

[**Bait site ID:** Locations of bait site IDs are shown in [figure 1](#) of this report or in Tracey and others (2016, 2017; [fig. 1](#)). **Abbreviations:** ID, identification; mm-dd-yyy hh:mm, month-day-year hour:minute; no., number; 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 (mm-dd-yyyy hh:mm)	Location	Bait site ID	Figure no. for location data	Sex	Age at time of capture	Status ¹	Behavior ²	Territory name
GOEA-SD-F001	11-22-2014 17:00	Boulder Oaks	IRON03	3	F	AFY	Operational	Territory-holder	Iron Mountain
³ GOEA-SD-F002	03-06-2018 08:00	Pamo Valley	PAMO05	4	F	AFFY	Operational	Adult Floater	
GOEA-SD-F007	02-23-2015 17:00	Long Potrero	LOPO01	5	F	AFFY	Removed	Territory-holder	Tecate
GOEA-RV-F010	12-12-2015 09:20	Santa Rosa Plateau	SRPT01	6	F	AFY	Non-functional	Territory-holder	Los Alamos
GOEA-SD-F011	12-20-2015 11:23	Proctor Valley	RJER07	7	F	TY	Non-functional	Nomadic Subadult	
GOEA-OC-F012	02-10-2016 17:00	Fremont Canyon	FRMT03	8	F	AFFY	Non-functional	Adult Floater	
GOEA-SD-F013	02-11-2016 17:00	Boucher Hill	PALA09	9	F	AFFY	Removed	Territory-holder	Boucher Hill
GOEA-OC-F014	02-12-2016 17:00	Fremont Canyon	FRMT03	10	F	AFFY	Fatality	Adult Floater	
GOEA-OC-F015	02-12-2016 17:00	Fremont Canyon	FRMT03	11	F	AFFY	Fatality	Territory-holder	Fremont Canyon
GOEA-SD-F016	03-05-2016 12:00	Barrett Lake	BARR04	12	F	AFFY	Removed	Territory-holder	Barrett/Echo Mountain
GOEA-SD-F017	11-04-2016 11:30	Little Tecate	OTAY18	13	F	AFY	Operational	Territory-holder	Marron Valley
GOEA-SD-F019	01-14-2017 06:55	Pamo Valley	PAMO05	14	F	FY	Unknown	Nomadic Subadult	
GOEA-SD-F020	01-21-2017 15:00	Gregory Mountain	PALA11	15	F	AFFY	Non-functional	Adult Floater	
GOEA-SD-F021	01-29-2017 09:30	Pamo Valley	PAMO05	16	F	SY	Non-functional	Nomadic Subadult	
GOEA-SD-F022	01-30-2017 08:00	Oak Grove	OGVA05	17	F	AFFY	Operational	Territory-holder	Oak Grove
GOEA-SD-F026	02-09-2018 06:30	Pamo Valley	PAMO09	18	F	SY	Non-functional	Nomadic Subadult	
GOEA-SD-F027	02-21-2018 07:30	Pamo Valley	PAMO09	19	F	SY	Operational	Nomadic Subadult	
GOEA-SD-F028	03-18-2018 09:00	Pamo Valley	PAMO09	20	F	FY	Unknown	Nomadic Subadult	
GOEA-SD-M001	12-05-2014 17:00	Cedar Canyon	OTAY01	21	M	AFY	Operational	Territory-holder	Cedar Canyon
GOEA-SD-M003	02-03-2015 17:00	Rancho Canada	IRON05	22	M	AFFY	Non-functional	Territory-holder	Iron Mountain
GOEA-SD-M005	02-23-2015 17:00	Long Potrero	LOPO01	23	M	AFFY	Non-functional	Territory-holder	Barrett/Echo Mountain Lower Intake/San Luis Rey River Gorge
GOEA-SD-M007	12-09-2015 10:15	Long Valley	CORT04	24	M	AFY	Non-functional	Territory-holder	
GOEA-SD-M013	11-20-2016 17:00	Boucher Hill	PALA09	25	M	AFY	Operational	Territory-holder	Boucher Hill
GOEA-SD-M015	01-28-2017 15:30	Table Mountain	TAMO04	26	M	AFFY	Non-functional	Undetermined	
GOEA-SD-M019	01-30-2018 11:00	Gregory Mountain	PALA13	27	M	AFFY	Fatality	Territory-holder	Gregory Mountain
GOEA-SD-M020	01-31-2018 07:50	Pamo Valley	PAMO09	28	M	SY	Non-functional	Nomadic Subadult	
GOEA-SD-M021	02-23-2018 10:00	McCain Valley	MCCN09	29	M	AFFY	Operational	Territory-holder	Carrizo Gorge

¹In Tracey and others (2016, 2017), “Operational” was referred to as “Active” and “Non-functional” was referred to as “Inactive.”

²In Tracey and others (2016, 2017), we used the term “Floater” as a general term for nomadic eagles of all ages. Here we distinguish between nomadic subadults (“Nomadic Subadult”) that typically are too young to hold a breeding territory and nomadic adults (“Adult Floater”) that may be actively searching for a breeding territory.

³Recaptured golden eagle. The original transmitter was malfunctioning, so she was fitted with a new transmitter. The original capture date was November 28, 2014, on Otay Mountain at the OTAY1 bait site.

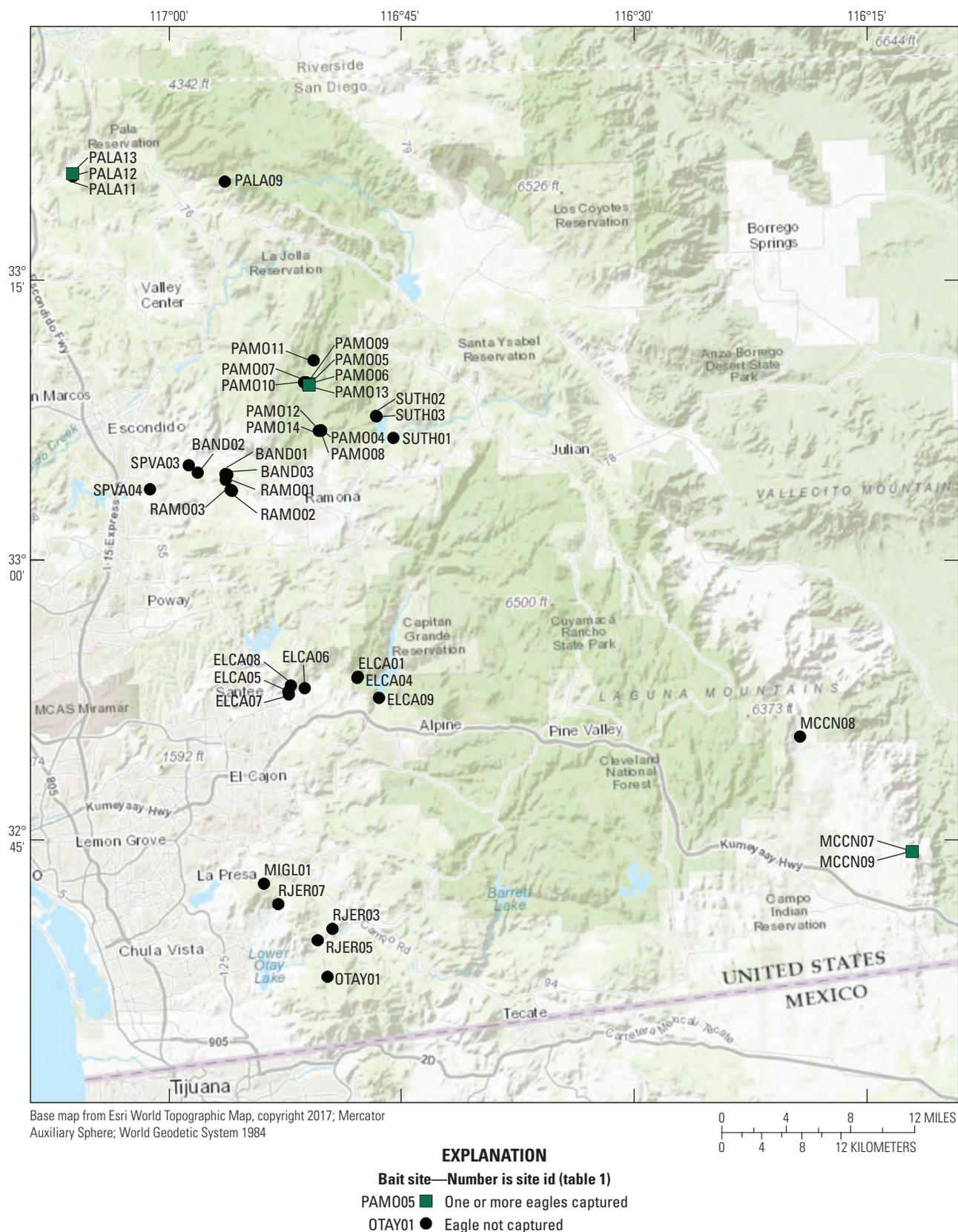


Figure 1. Golden eagles trapping locations in southern California, February 24, 2017–December 2, 2019.

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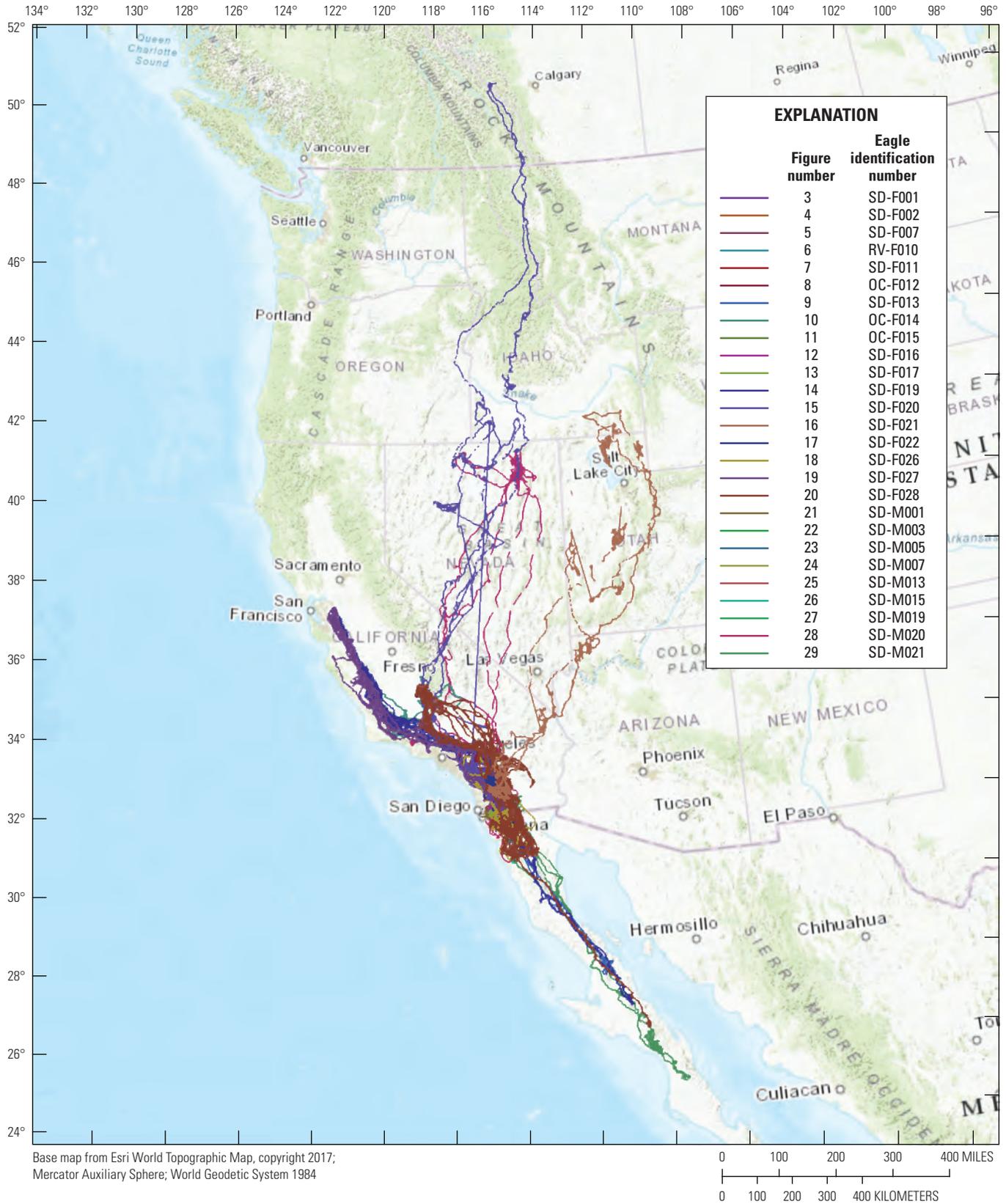


Figure 2. Movement data for all eagles tracked, February 24, 2017–December 2, 2019.

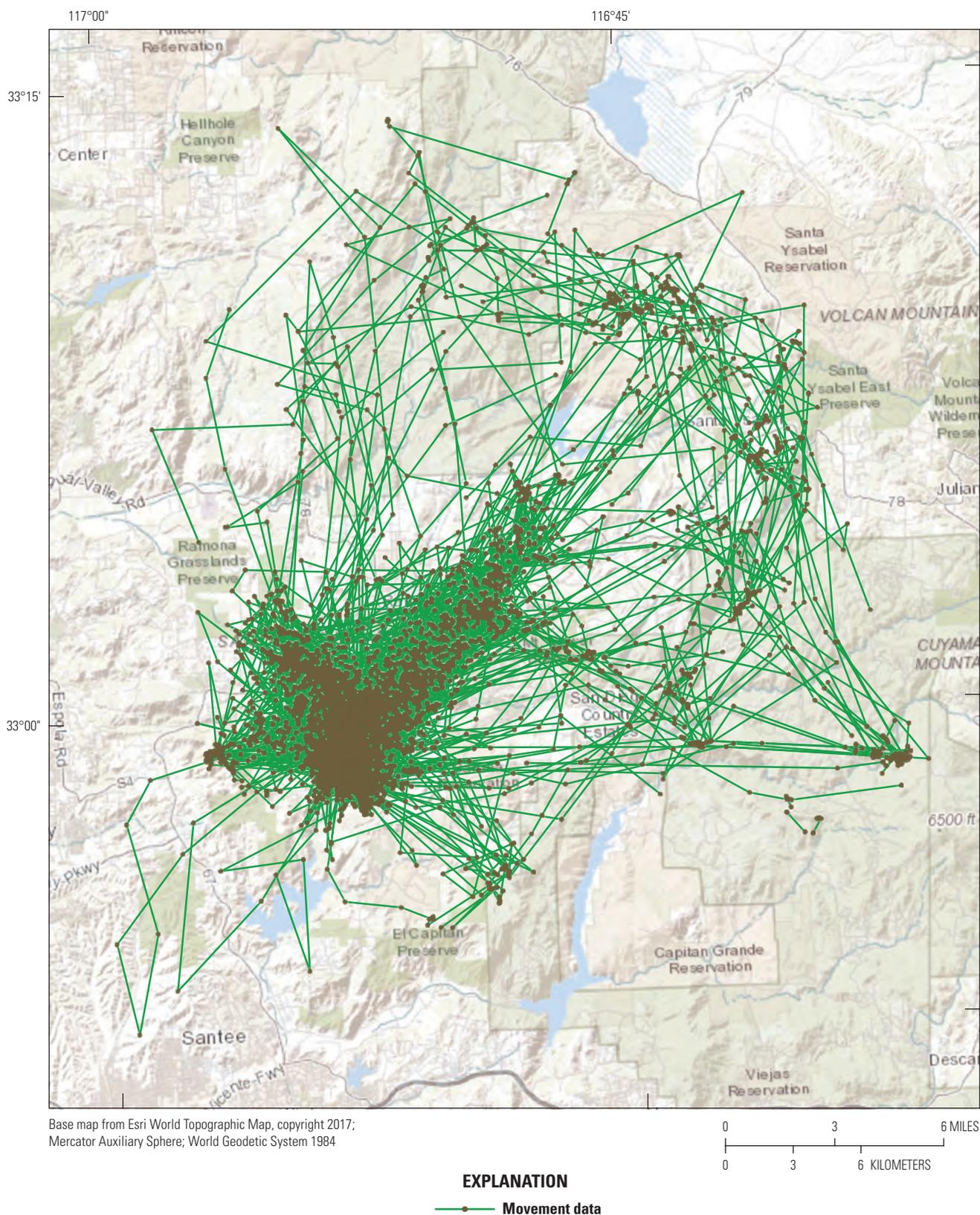


Figure 3. Location data for eagle GOEA-SD-F001 captured at Boulder Oaks, San Diego County, California, November 22, 2014.

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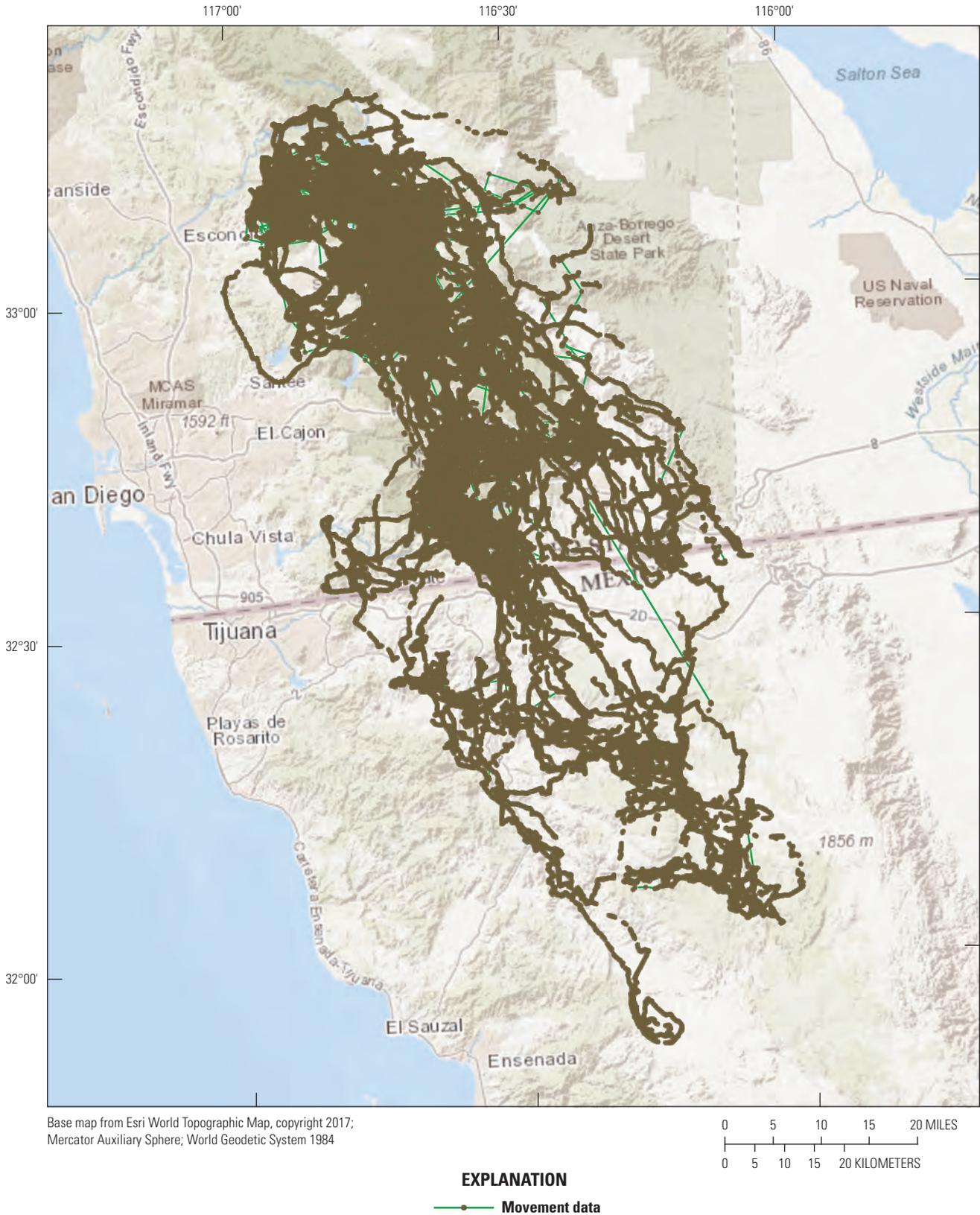


Figure 4. Location data for eagle GOEA-SD-F002 recaptured at Pamo Valley, San Diego County, California, March 6, 2018.

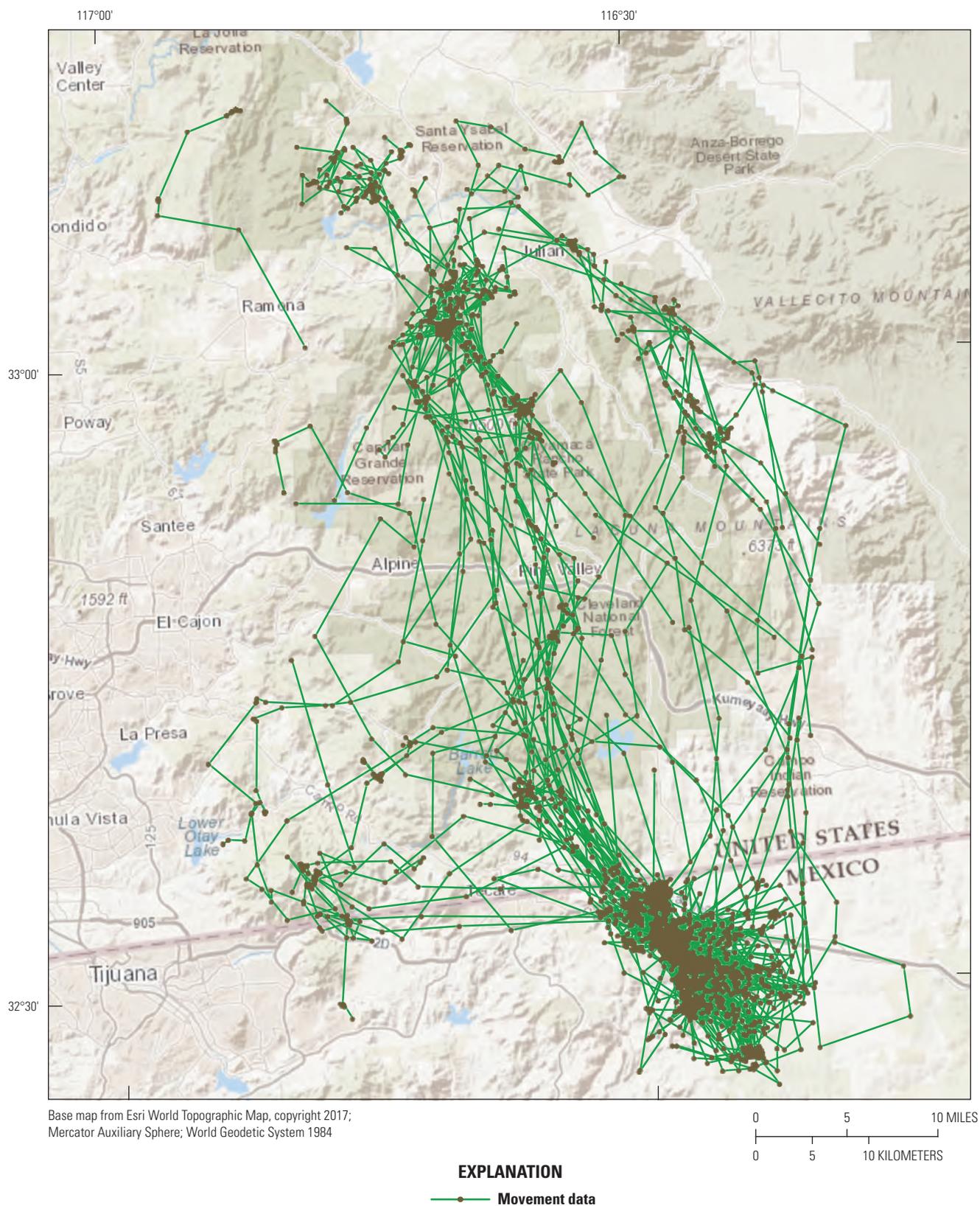


Figure 5. Location data for eagle GOEA-SD-F007 captured at Long Potrero, San Diego County, California, February 23, 2015.

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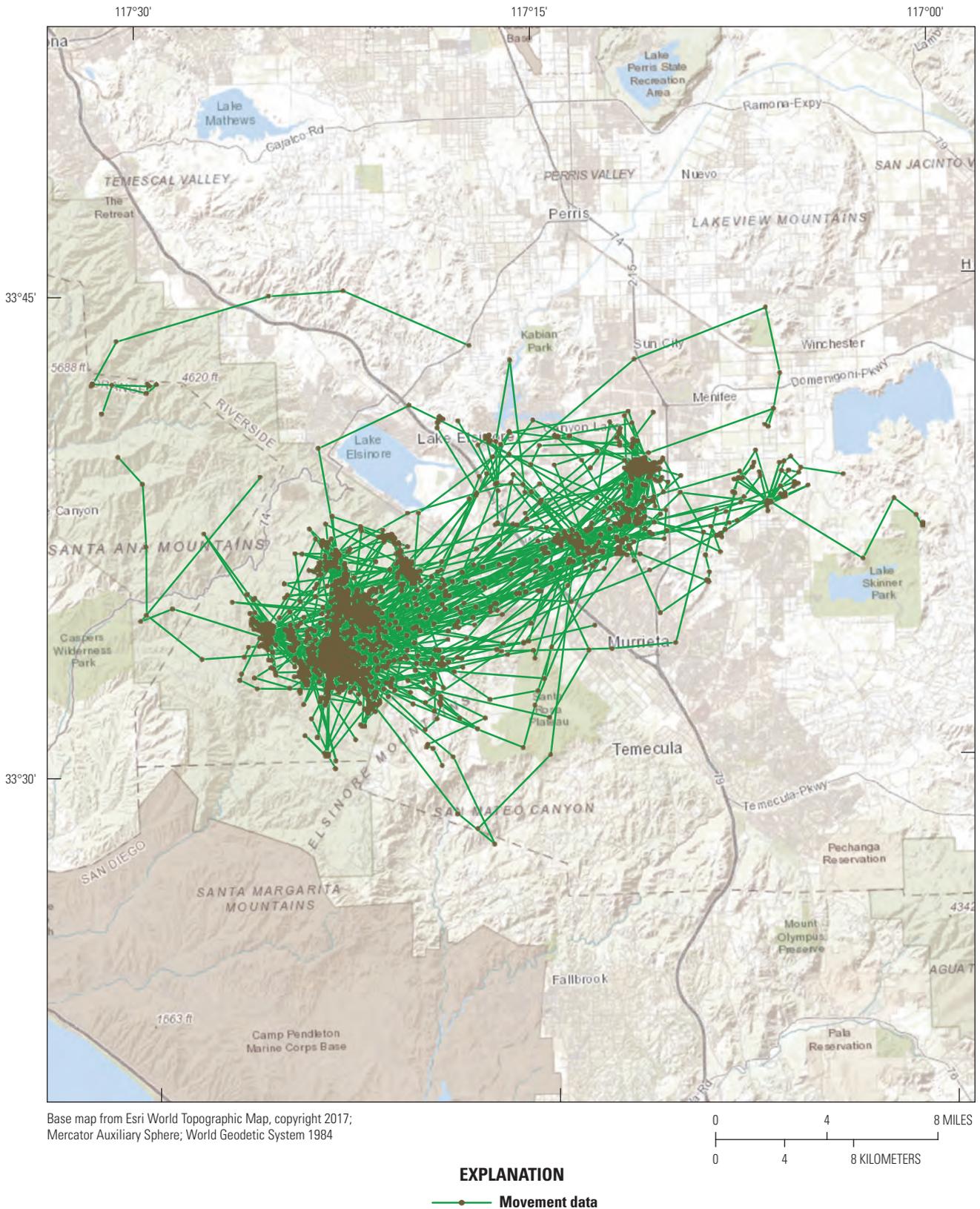


Figure 6. Location data for eagle GOEA-RV-F010 captured at Santa Rosa Plateau, Riverside County, California, December 12, 2015.

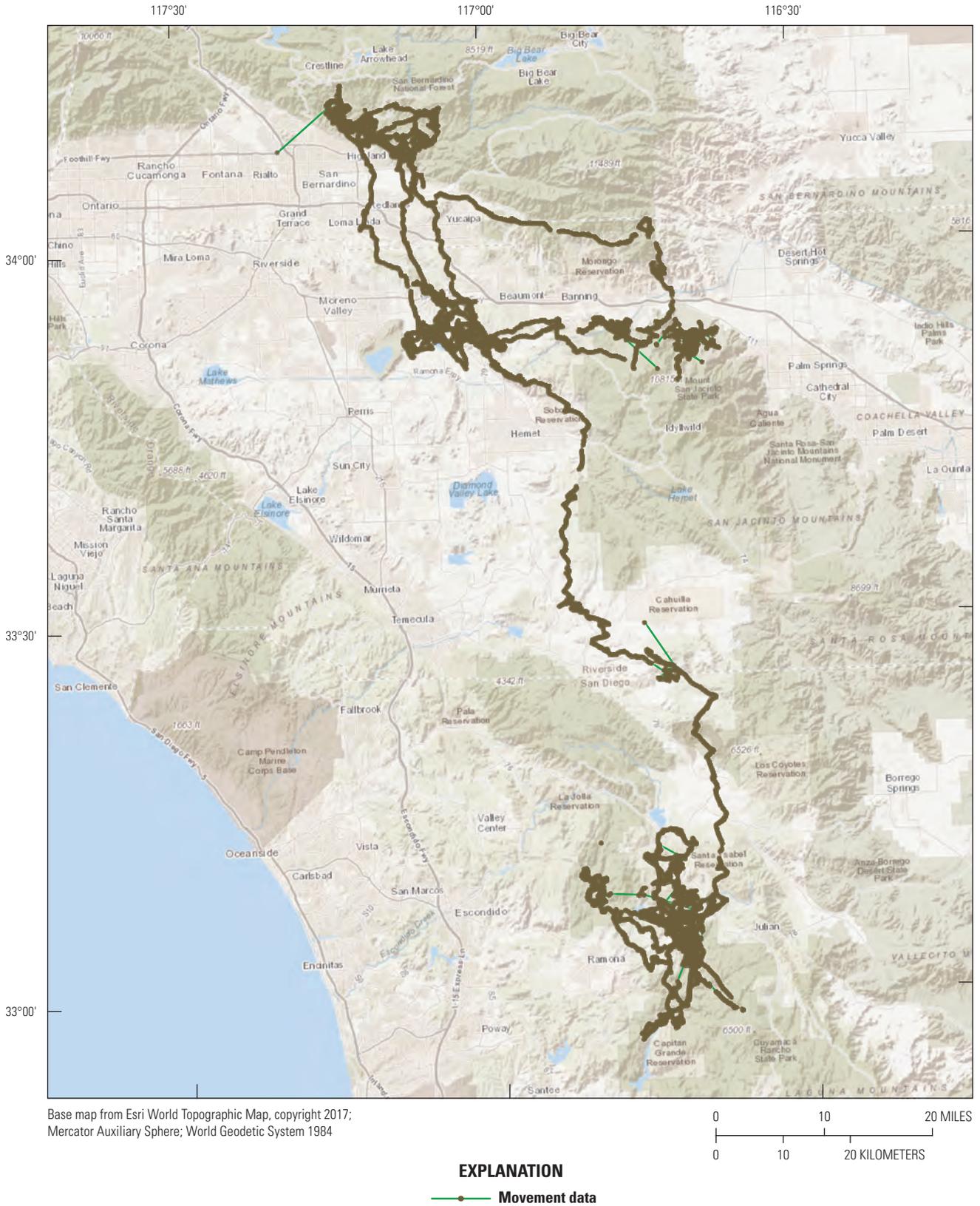


Figure 7. Location data for eagle GOEA-SD-F011 captured at Proctor Valley, San Diego County, California, December 20, 2015.

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Figure 8. Location data for eagle GOEA-OC-F012 captured at Fremont Canyon, Orange County, California, December 10, 2016.



Figure 9. Location data for eagle GOEA-SD-F013 captured at Boucher Hill, San Diego County, California, February 11, 2016.

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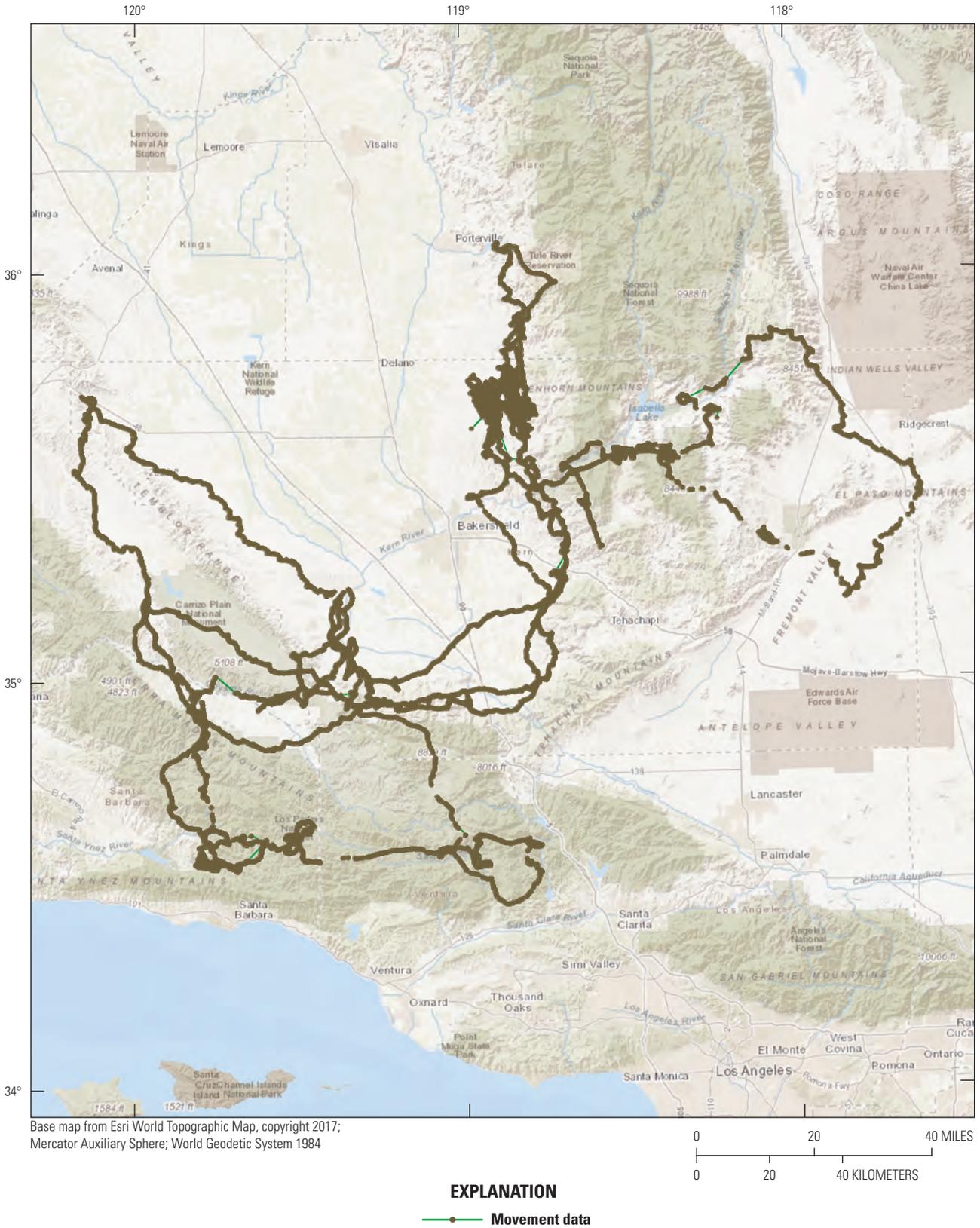
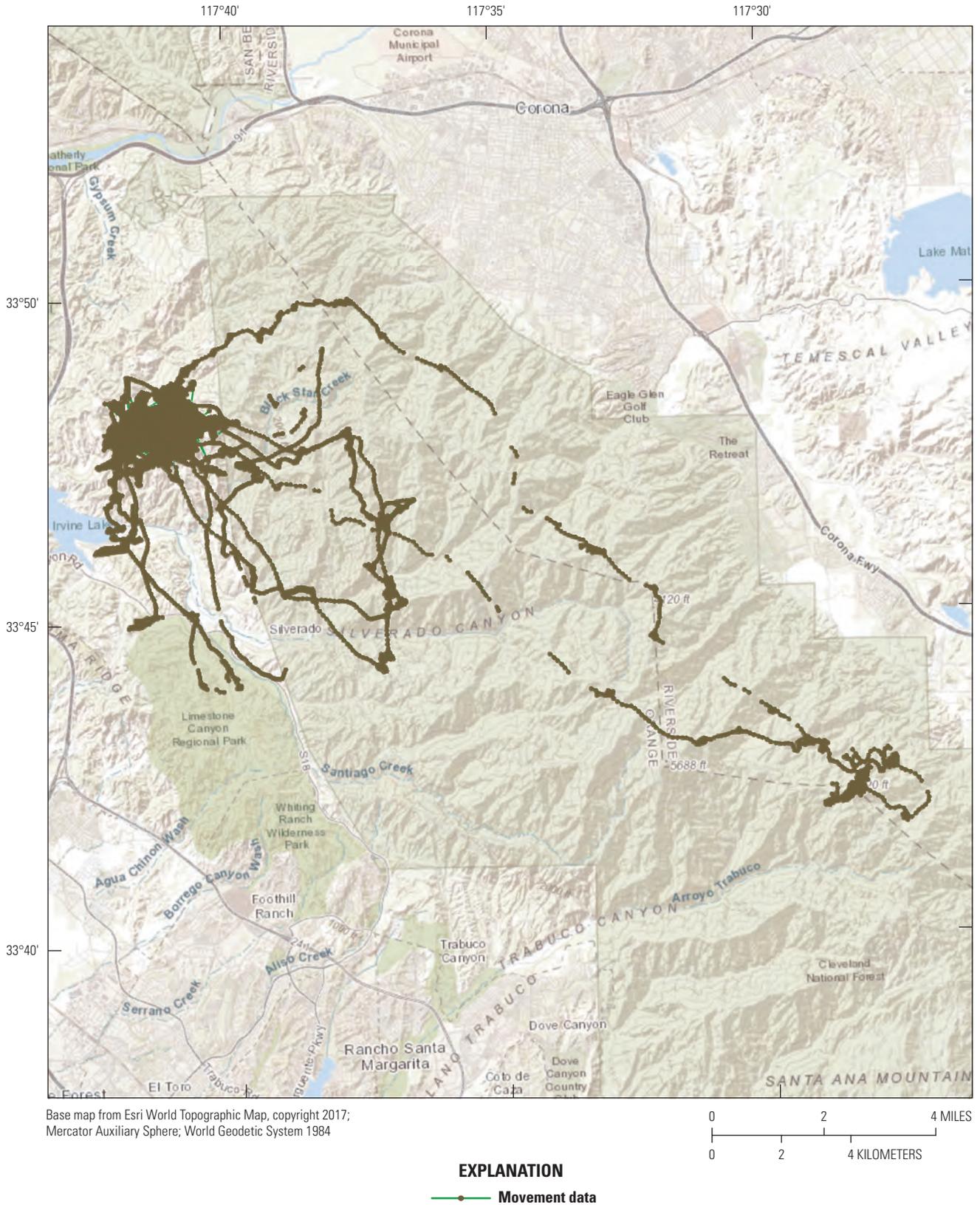


Figure 10. Location data for eagle GOEA-OC-F014 captured at Fremont Canyon, Orange County, California, February 12, 2016.



Base map from Esri World Topographic Map, copyright 2017; Mercator Auxiliary Sphere; World Geodetic System 1984

Figure 11. Location data for eagle GOEA-OC-F015 captured at Fremont Canyon, Orange County, California, February 12, 2016.

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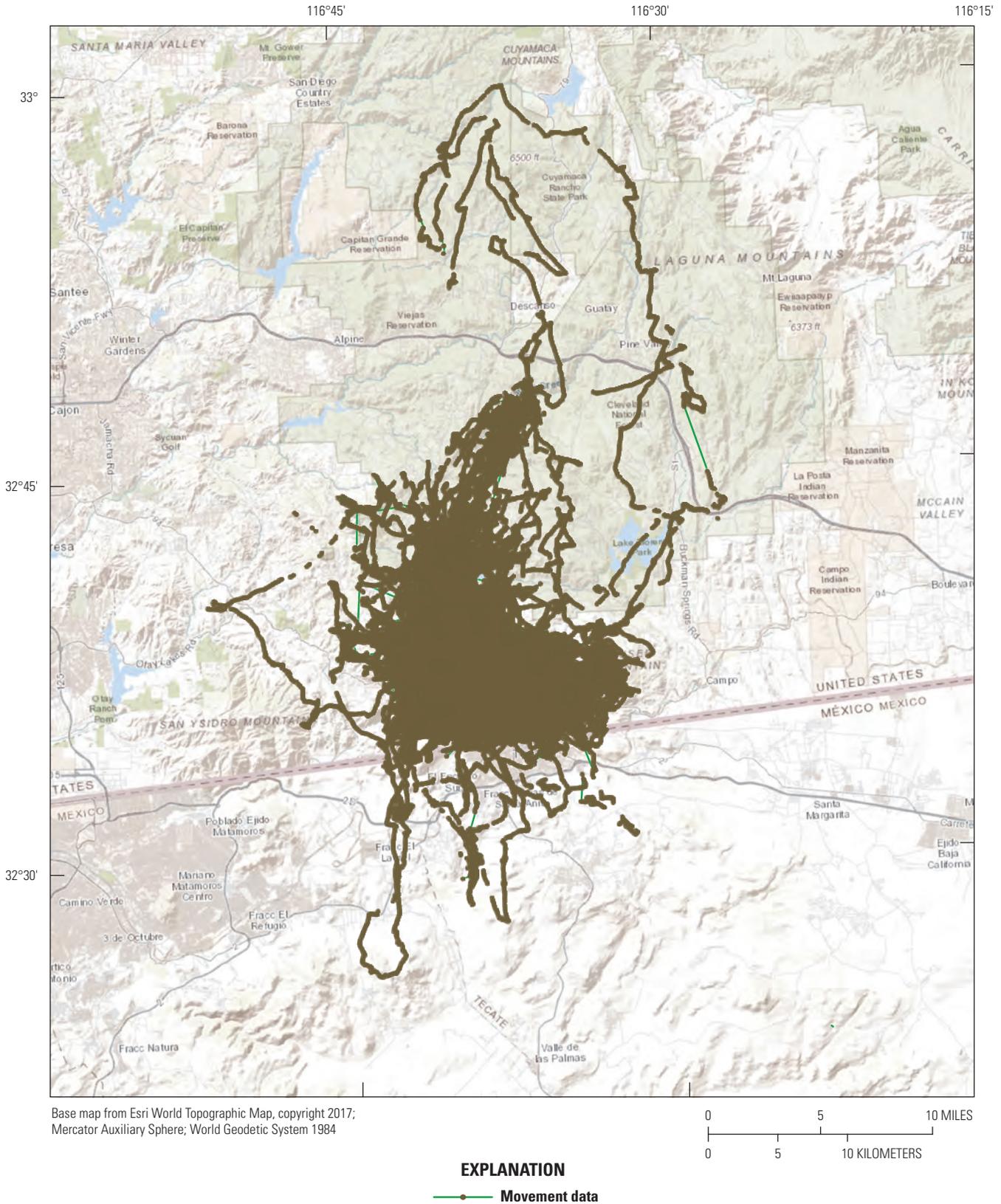


Figure 12. Location data for eagle GOEA-SD-F016 captured at Barrett Lake, San Diego County, California, March 5, 2016.

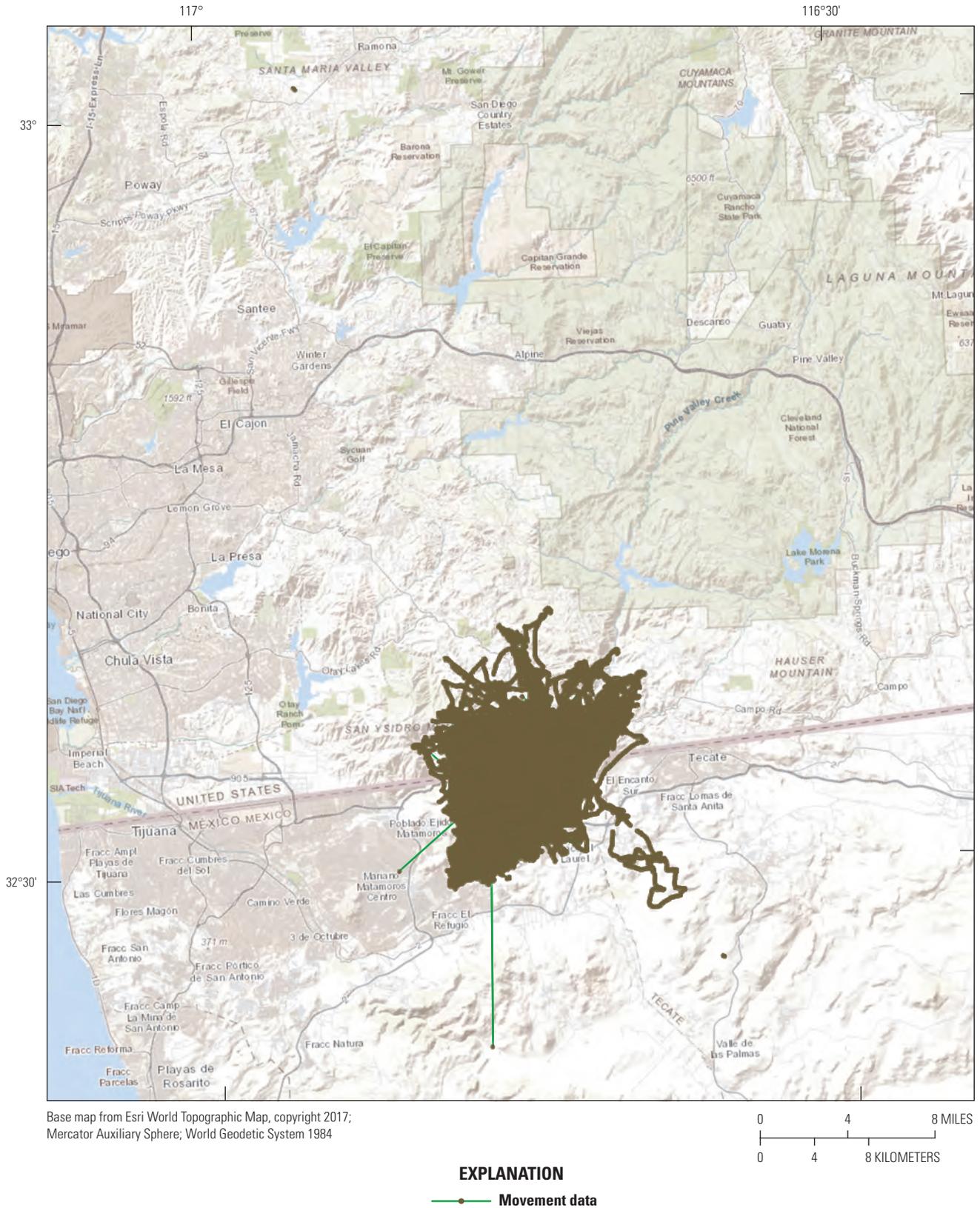


Figure 13. Location data for eagle GOEA-SD-F017 captured at Little Tecate, San Diego County, California, November 4, 2016.

18 Biotelemetry Data for Golden Eagles Captured in Coastal Southern California



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

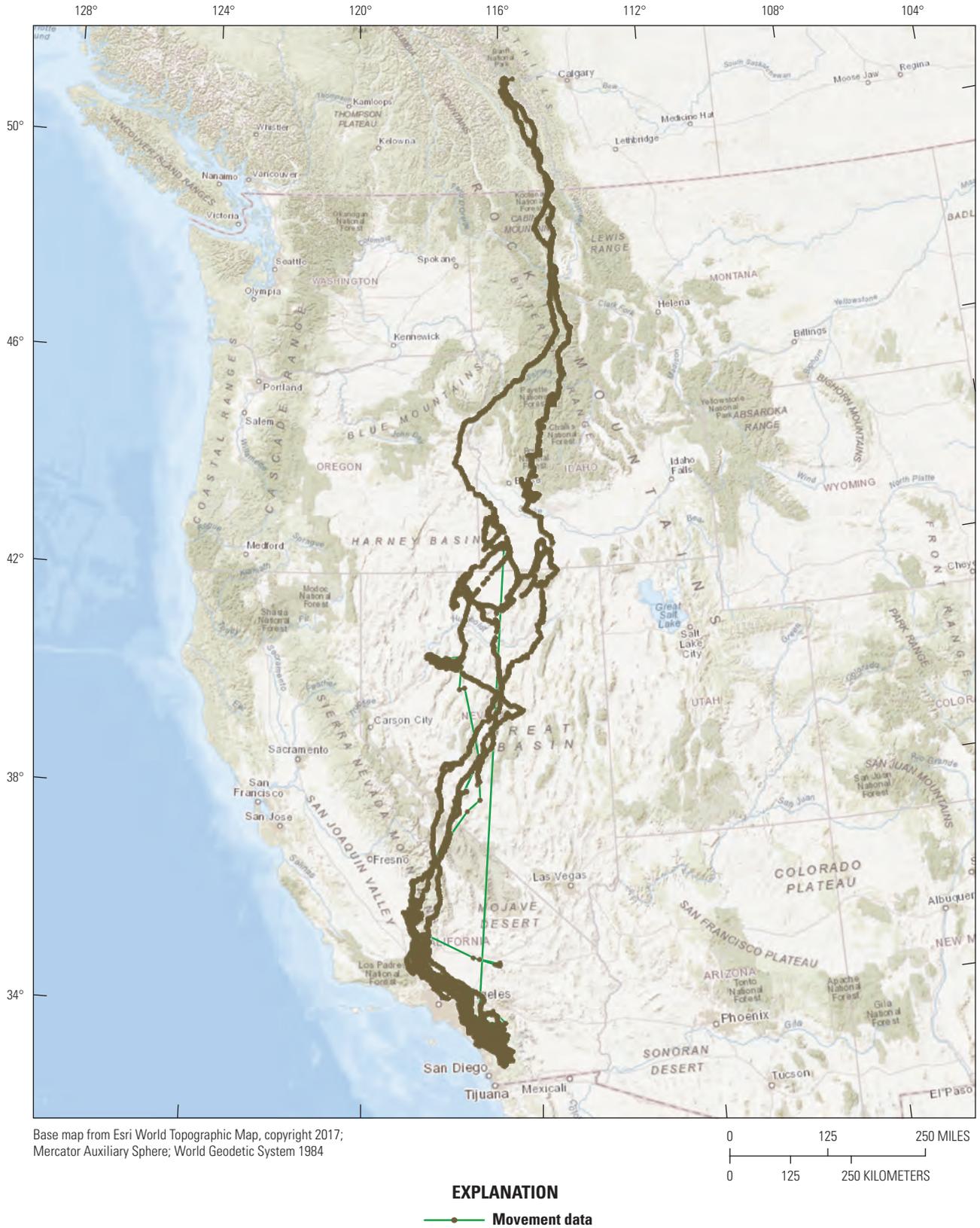
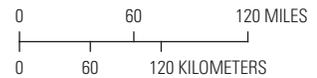


Figure 15. Location data for eagle GOEA-SD-F020 captured at Gregory Mountain, San Diego County, California, January 21, 2017.

20 Biotelemetry Data for Golden Eagles Captured in Coastal Southern California



Base map from Esri World Topographic Map, copyright 2017; Mercator Auxiliary Sphere; World Geodetic System 1984



EXPLANATION

—●— Movement data

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

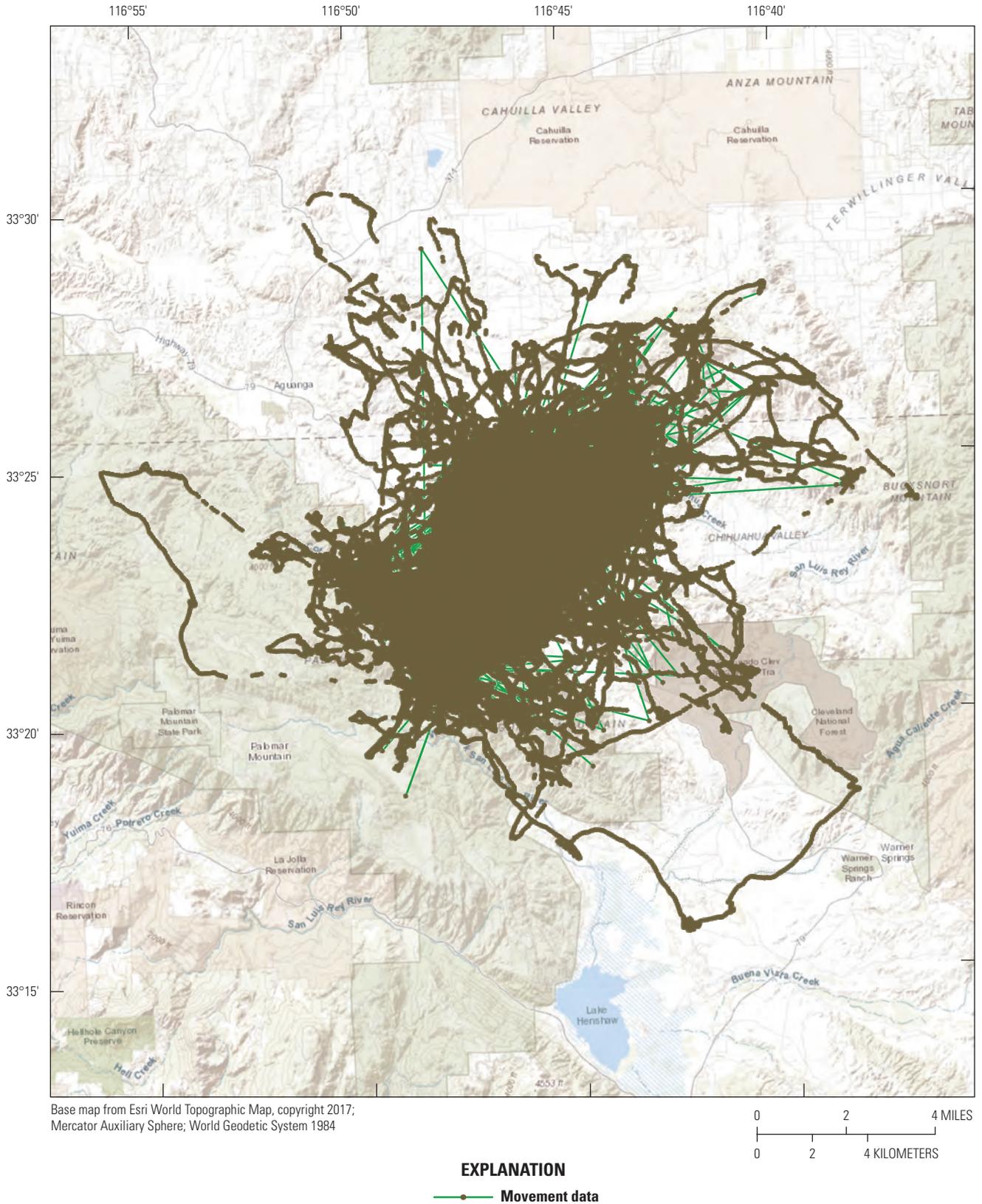


Figure 17. Location data for eagle GOEA-SD-F022 captured at Oak Grove, San Diego County, California, January 30, 2017.

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Figure 18. Location data for eagle GOEA-SD-F026 captured at Pamo Valley, San Diego County, California, February 9, 2018.

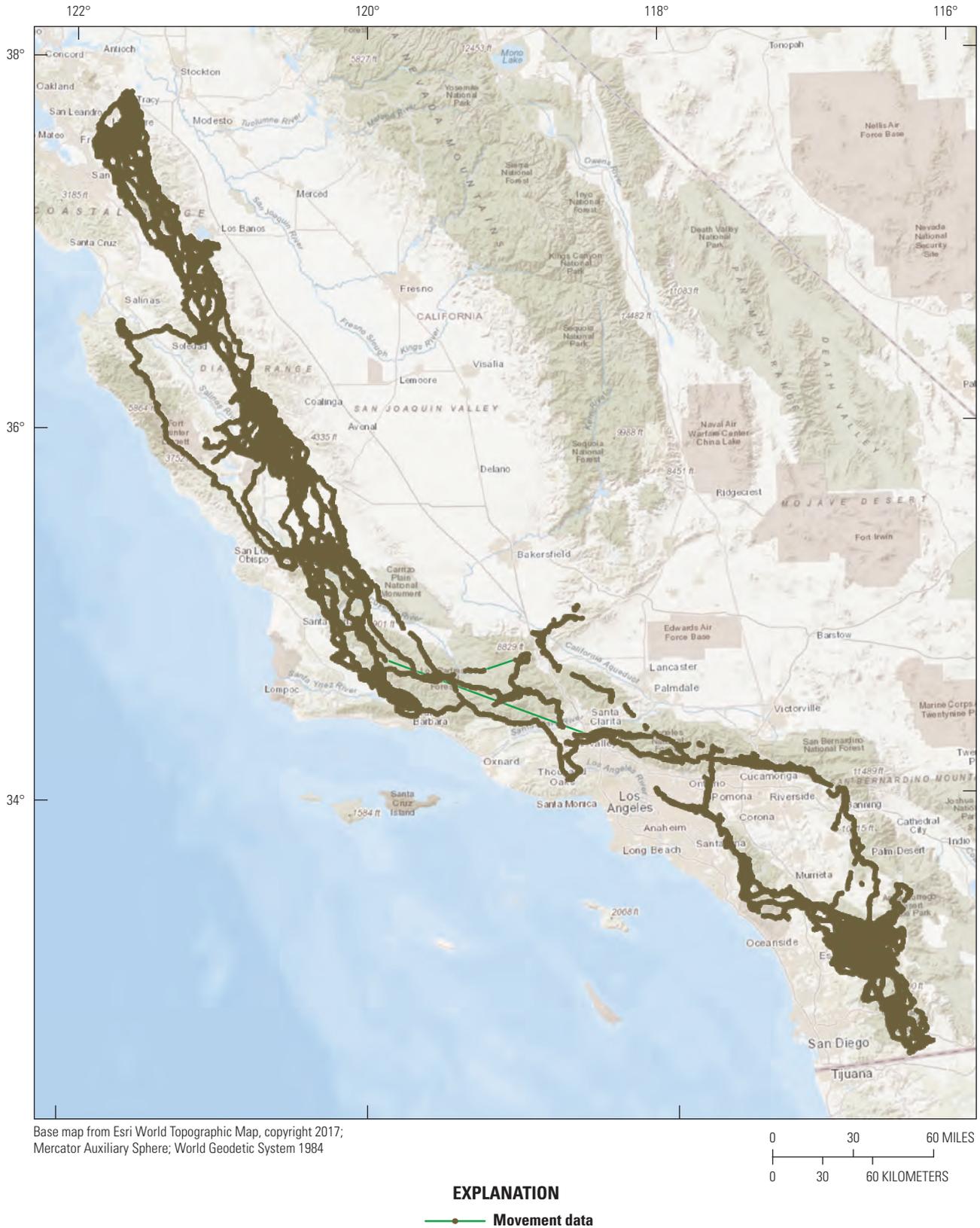


Figure 19. Location data for eagle GOEA-SD-F027 captured at Pamo Valley, San Diego County, California, February 21, 2018.

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Figure 20. Location data for eagle GOEA-SD-F028 captured at Pamo Valley, San Diego County, California, March 18, 2018.

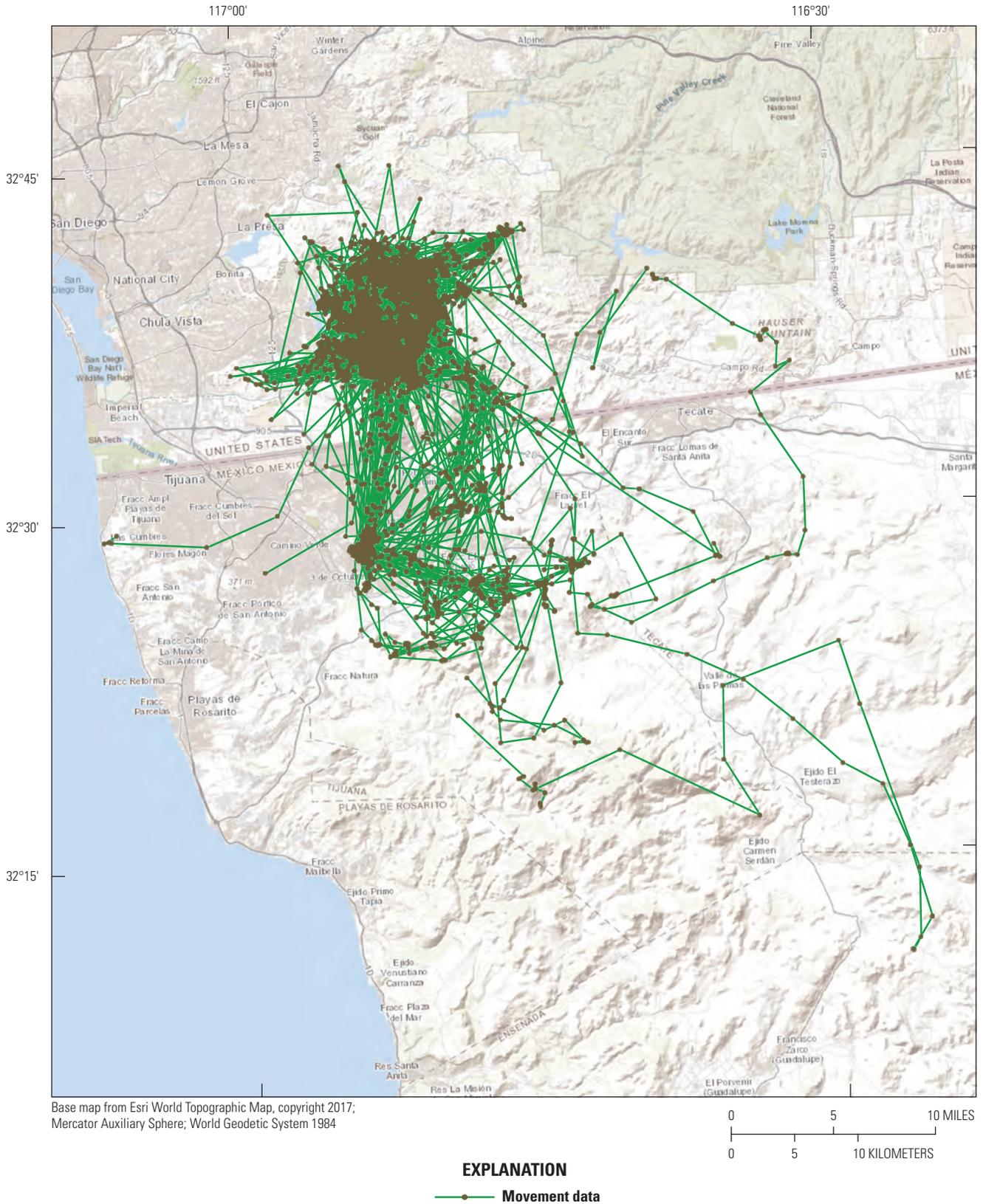


Figure 21. Location data for eagle GOEA-SD-M001 captured at Cedar Canyon, San Diego County, California, December 5, 2014.

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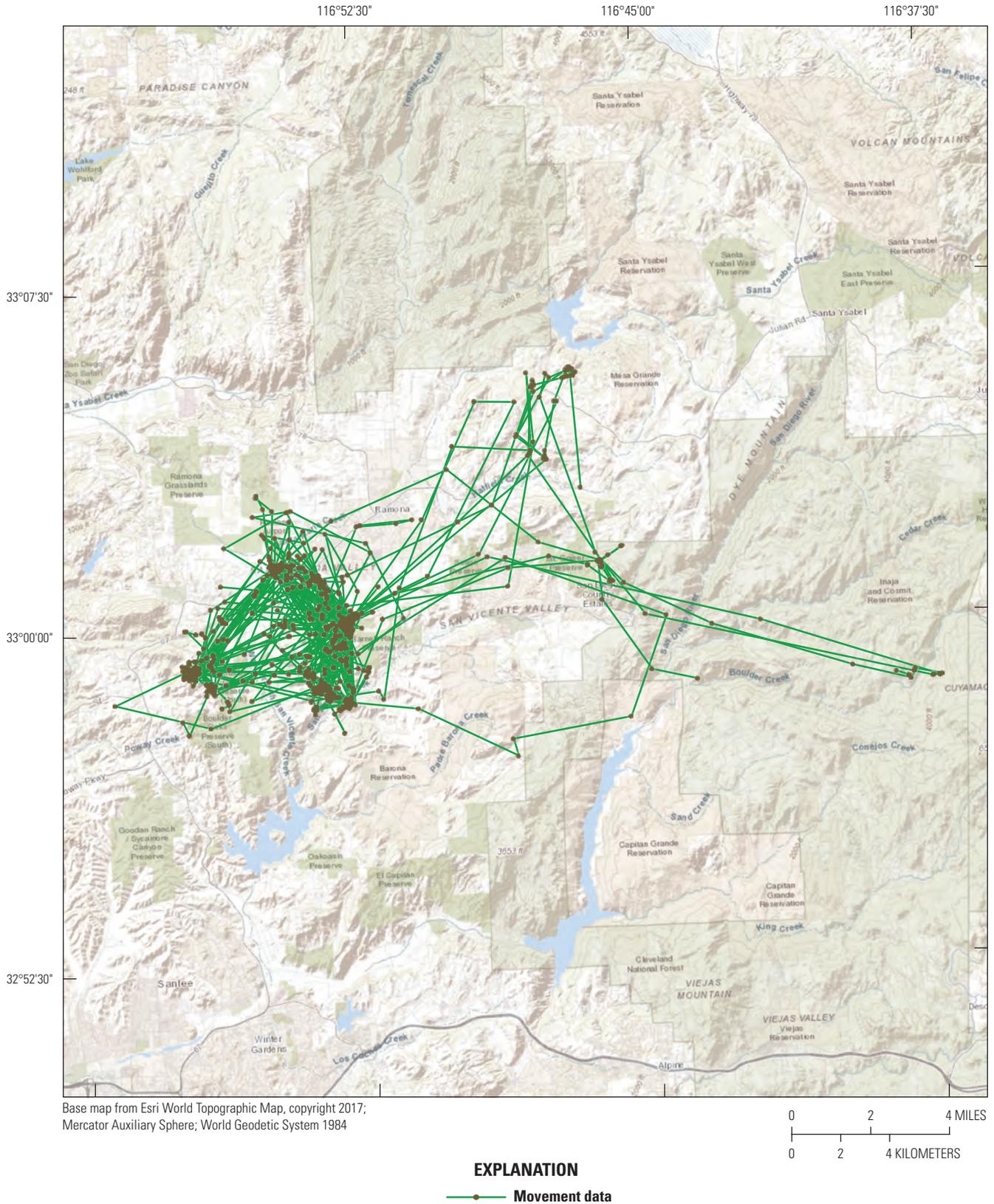


Figure 22. Location data for eagle GOEA-SD-M003 captured at Rancho Cañada, San Diego County, California, February 3, 2015.

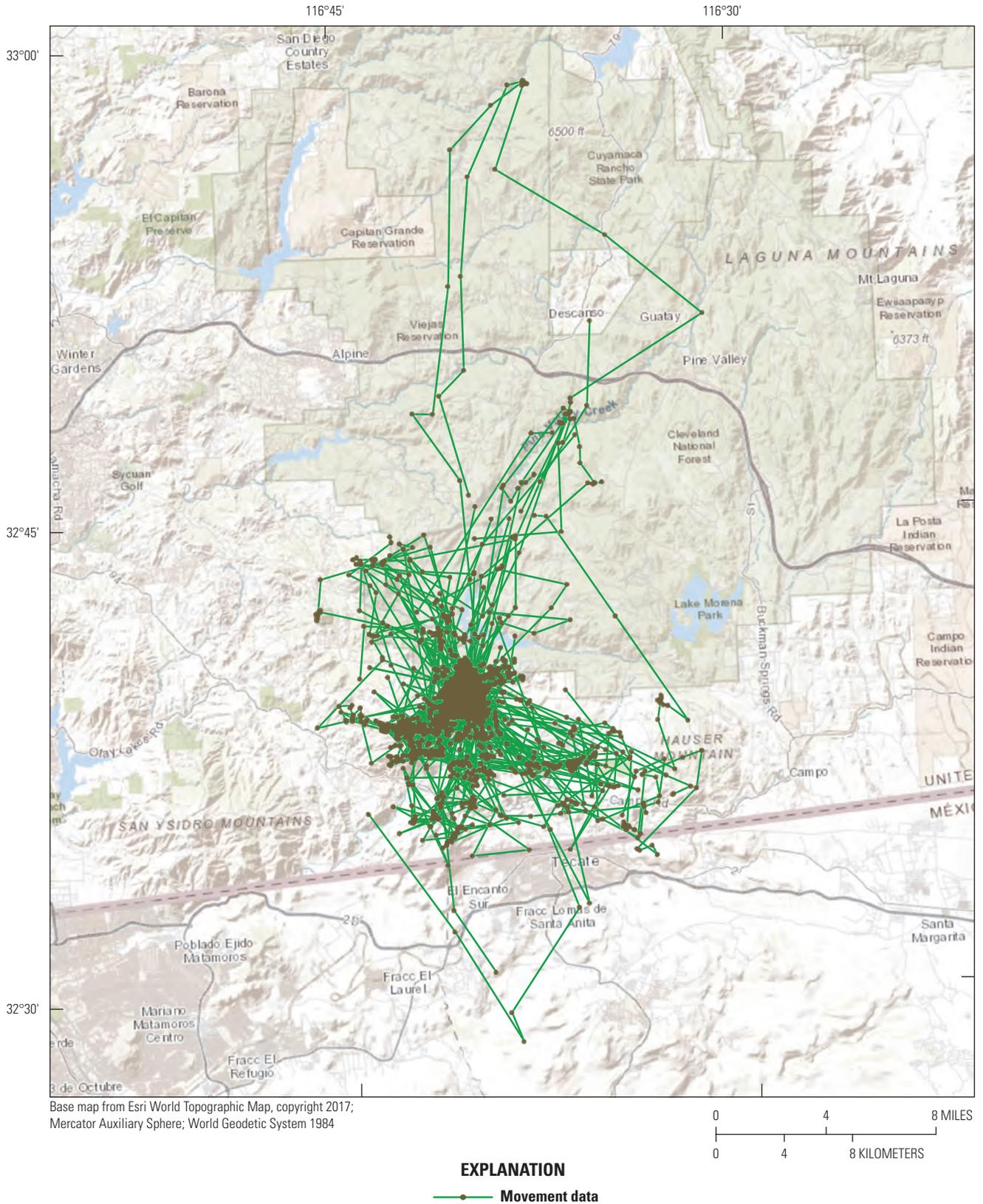


Figure 23. Location data for eagle GOEA-SD-M005 captured at Long Potrero, San Diego County, California, February 23, 2015.

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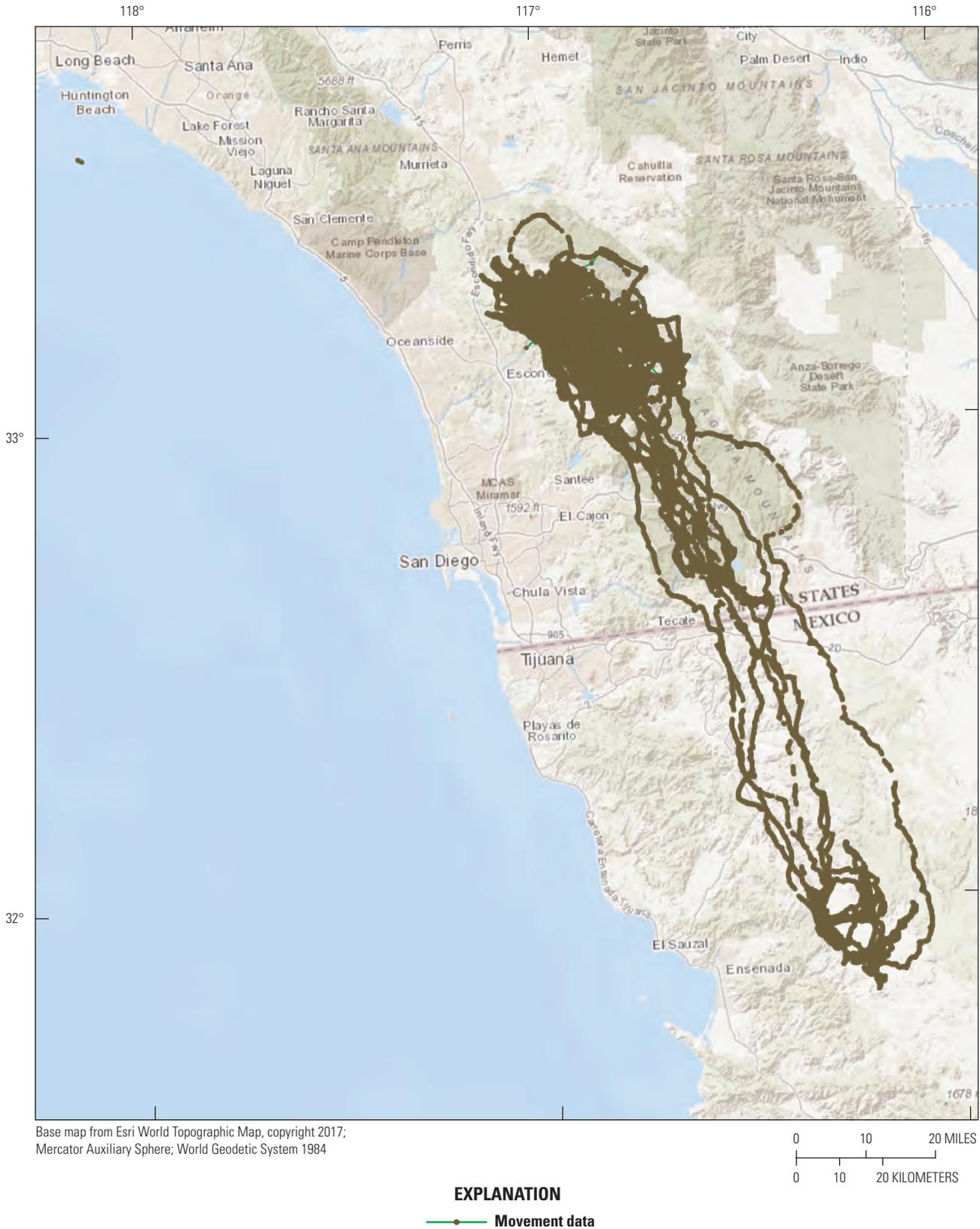


Figure 24. Location data for eagle GOEA-SD-M007 captured at Long Valley, San Diego County, California, December 9, 2015.

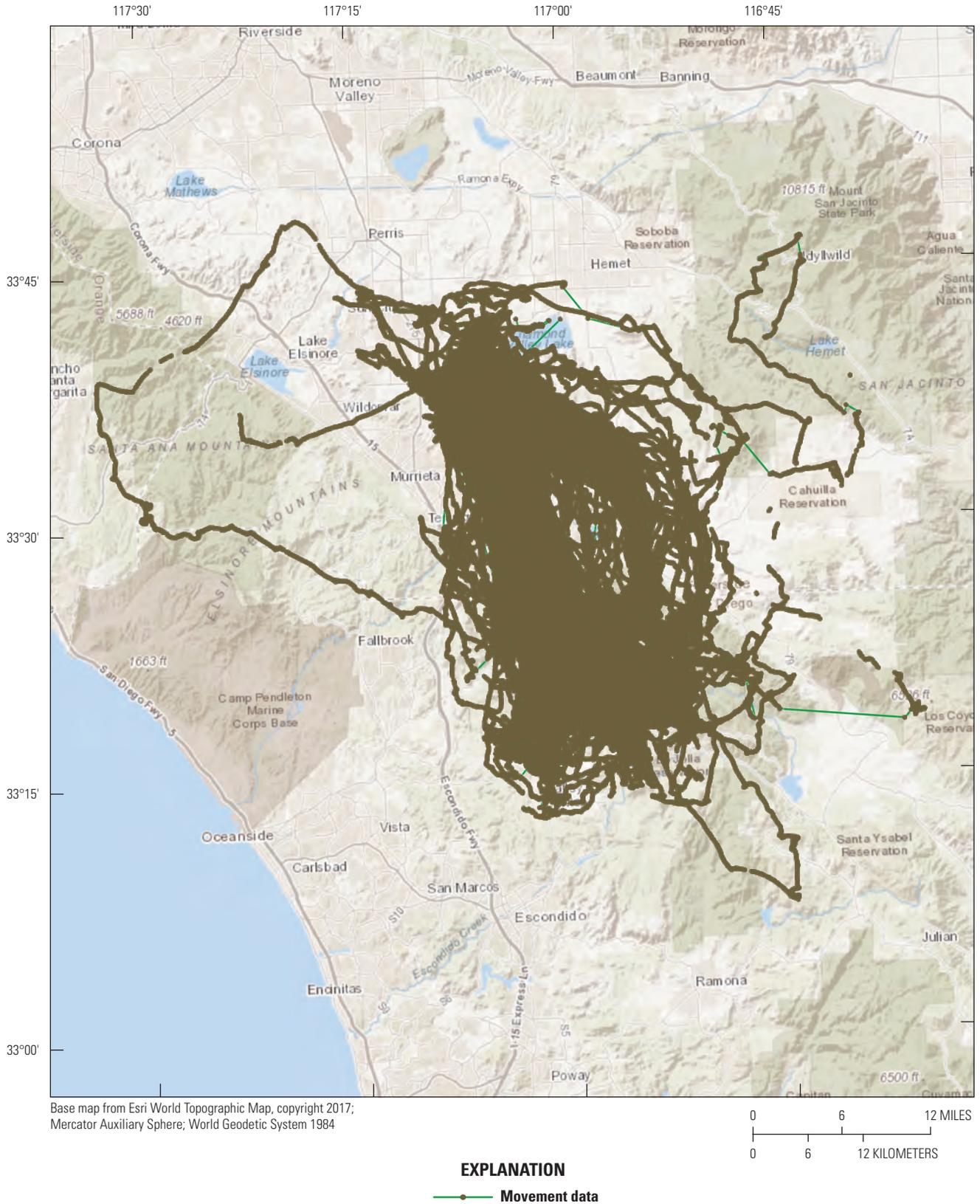


Figure 25. Location data for eagle GOEA-SD-M013 captured at Boucher Hill, San Diego County, California, November 20, 2016.

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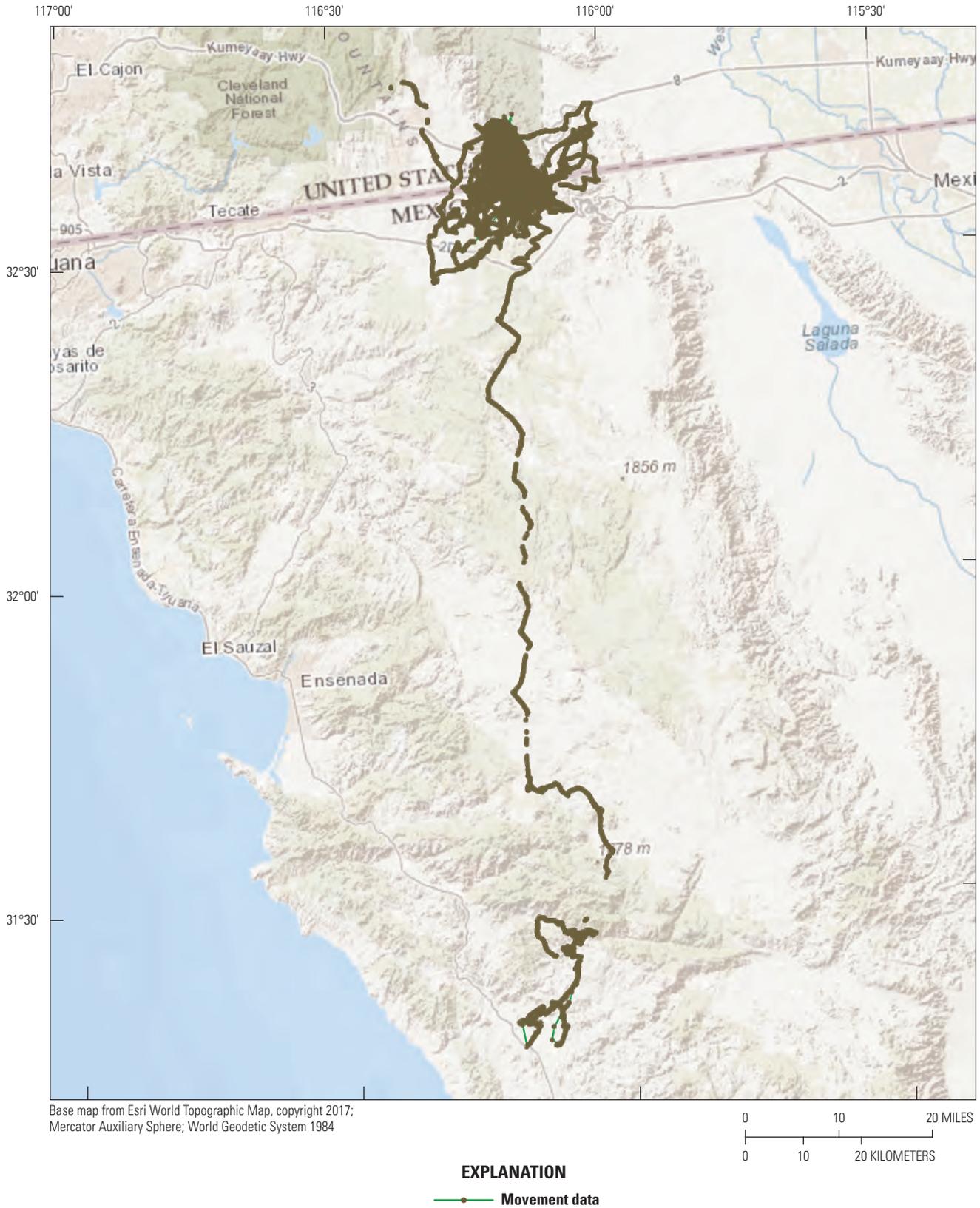


Figure 26. Location data for eagle GOEA-SD-M015 captured at Table Mountain, San Diego County, California, January 28, 2017.

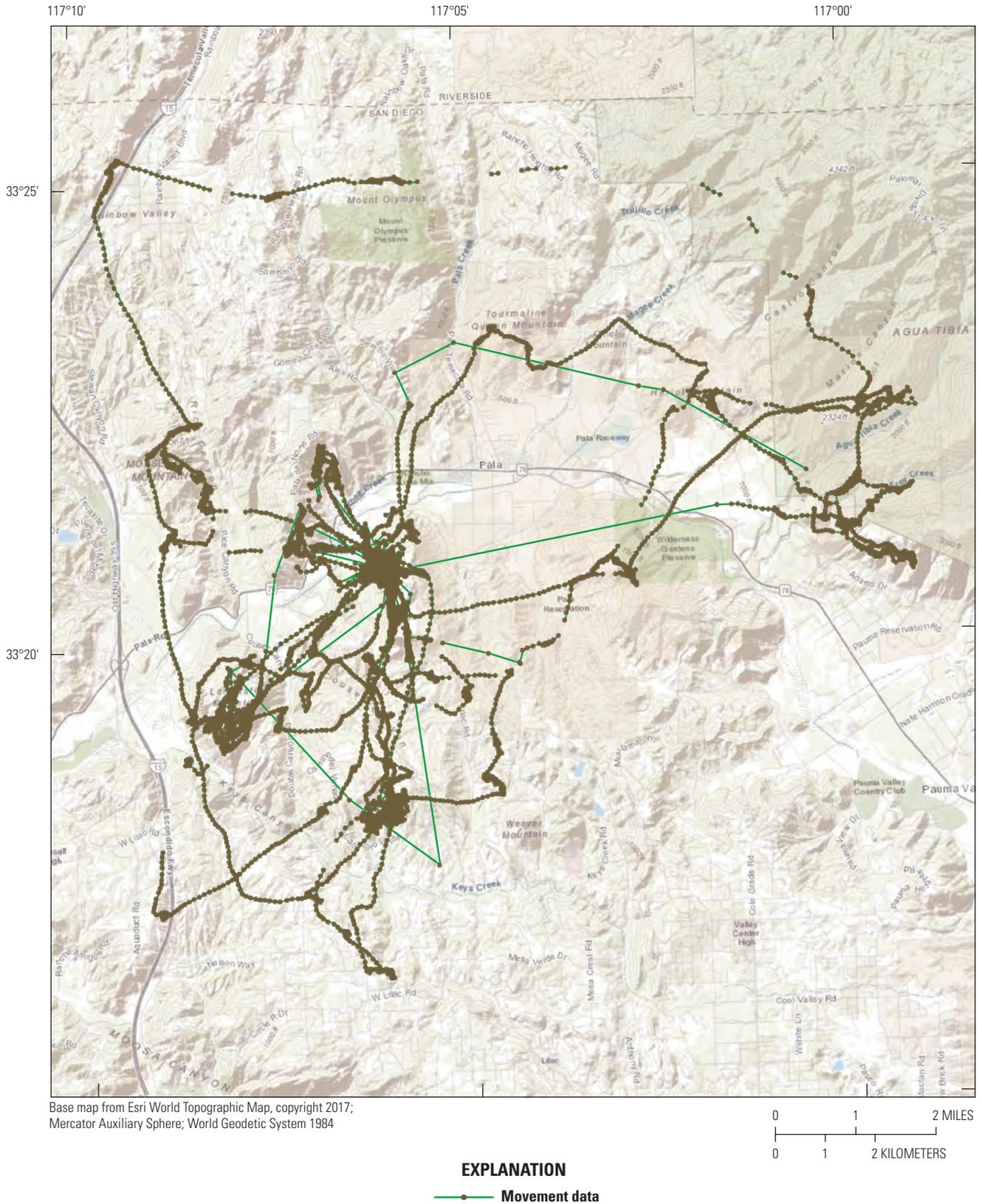


Figure 27. Location data for eagle GOEA-SD-M019 captured at Gregory Mountain, San Diego County, California, January 30, 2018.

32 Biotelemetry Data for Golden Eagles Captured in Coastal Southern California

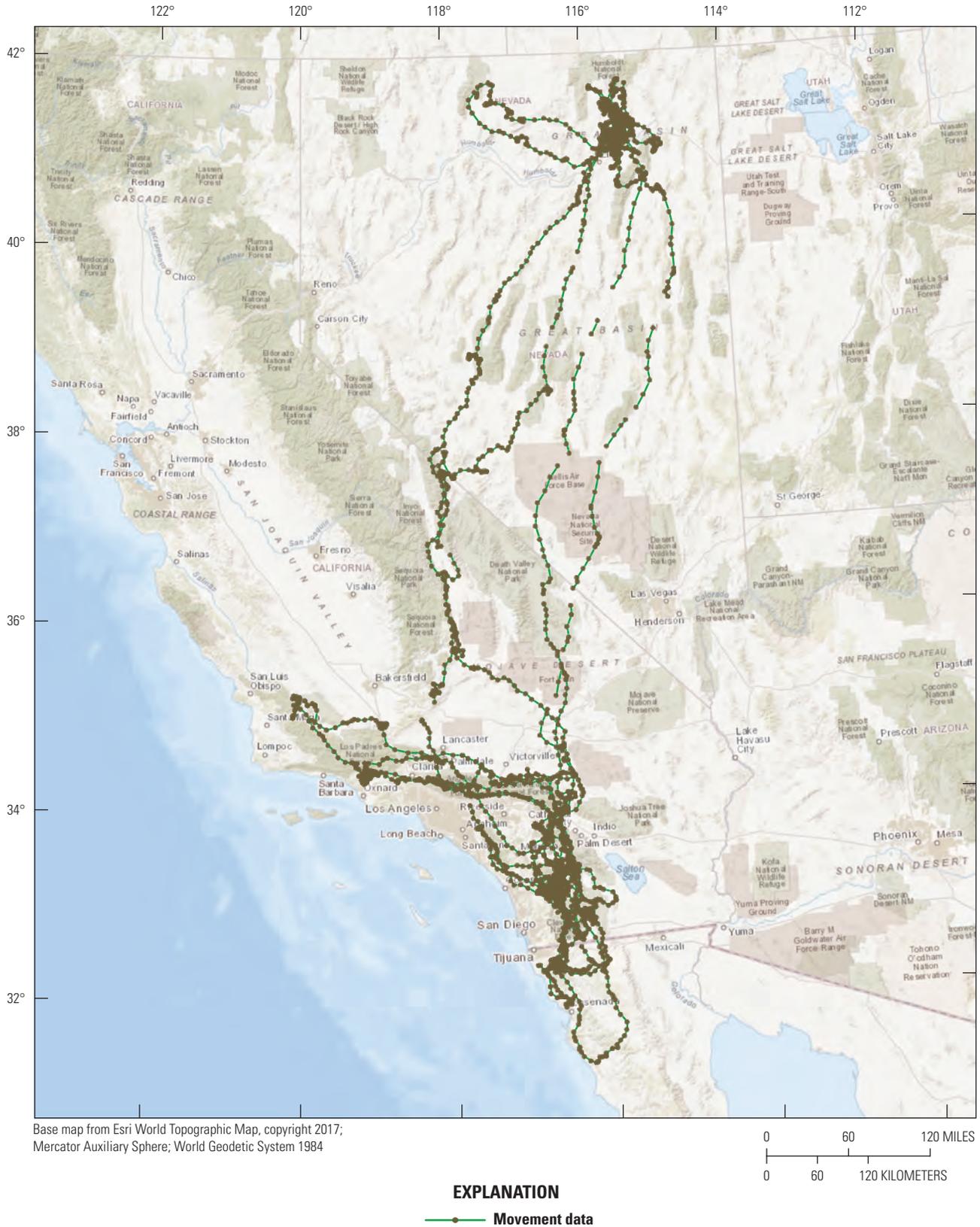


Figure 28. Location data for eagle GOEA-SD-M020 captured at Pamo Valley, San Diego County, California, January 31, 2018.



Figure 29. Location data for eagle GOEA-SD-M021 captured at McCain Valley, San Diego County, California, February 23, 2018.

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