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Biotelemetry Data for Golden Eagles (*Aquila chrysaetos*) Captured in Coastal Southern California, November 2014–February 2016

Data Series 994

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

Cover: Photograph showing eagle (GOEA-SD-M001) taking flight after release on Otay Mountain, San Diego County, California. Photograph by Jeremy Sebes, U.S. Geological Survey, December 5, 2014.

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U.S. Department of the Interior
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SALLY JEWELL, Secretary

U.S. Geological Survey
Suzette M. Kimball, Director

U.S. Geological Survey, Reston, Virginia: 2016

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Conversion Factors

International System of Units to Inch/Pound

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

Biotelemetry Data for Golden Eagles (*Aquila chrysaetos*) Captured in Coastal Southern California, November 2014–February 2016

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

The status of golden eagles (*Aquila chrysaetos*) in coastal southern California is unclear. To address this knowledge gap, the U.S. Geological Survey (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 October 2014 and continued until early March 2015. During the first trapping season that focused on San Diego County, we captured 13 golden eagles (8 females and 5 males). During the second trapping season that began in November 2015, we focused on trapping sites in San Diego, Orange, and western Riverside Counties. By February 23, 2016, we captured an additional 14 golden eagles (7 females and 7 males). In this report, biotelemetry data were collected between November 22, 2014, and February 23, 2016. The location data for eagles ranged as far north as San Luis Obispo, California, 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). Populations of golden eagles in California are typically comprised of resident or migratory breeders, resident or migratory non-breeders (for example, adult floaters or subadults), and seasonal itinerants. 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. The U.S. Geological Survey (USGS) in collaboration with U.S. Fish and Wildlife Service (USFWS), the California Department of Fish and Wildlife (CDFW), and the 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 biotelemetry data associated with the capture of 26 golden eagles from November 22, 2014 through February 23, 2016.

Methods

Biotelemetry

Since October 2014, we have been trapping eagles at targeted sites across San Diego County, California. We began the second season of eagle trapping in November 2015, and included trapping sites in San Diego, Orange, and western Riverside Counties.

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 GPS transmitter that sends data over the mobile phone network (a GPS-GSM transmitter; Dunstan, 1972; Kenward, 1985; 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.

[1]U.S. Geological Survey.

[2]Bloom Biological, Inc.

Standard morphological measurements and samples were taken from each captured eagle. Measurements included (1) weight, (2) wingspan, (3) hallux and culmen, and (4) 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) 2–4 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 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. 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." The Teflon™ ribbon is non-abrasive and the standard method for attaching telemetry units to eagles. If the eagle had other markings or telemetry devices, other than 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 5,
3. Vertical dilution of precision (VDOP), if available, had to be less than or equal to 5,
4. Longitudes 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 25 seconds apart (based on discussion with engineers at CTT™).

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

1. Location had to be within UTM zones 10, 11, or 12, and
2. Rate of displacement had to be realistic (≤ 89.4 m/s horizontal or ≤ 20.0 m/s vertical).

Biotelemetry Data for Captured Golden Eagles

As of February 23, 2016, we captured 27 golden eagles at 16 trapping locations (table 1, fig. 1). Currently, we have 15 eagles with active transmitters, 5 eagles with transmitters of unknown status, 3 eagles with inactive transmitters, and 4 eagles known to have died. An active transmitter is one from which we have received a download within the past 10 days. A transmitter with unknown status is one from which we have received data 11 to 60 days ago, an inactive transmitter is one from which we have not received a download in more than 60 days, and a mortality indicates that we have recovered the eagle's remains. Location data for 26 of the 27 captured golden eagles with transmitters are shown in figures 2–27. The transmitter attached to golden eagle GOEA-OC-F012 malfunctioned and no data were received. Thus, there is not a location map for this golden eagle.

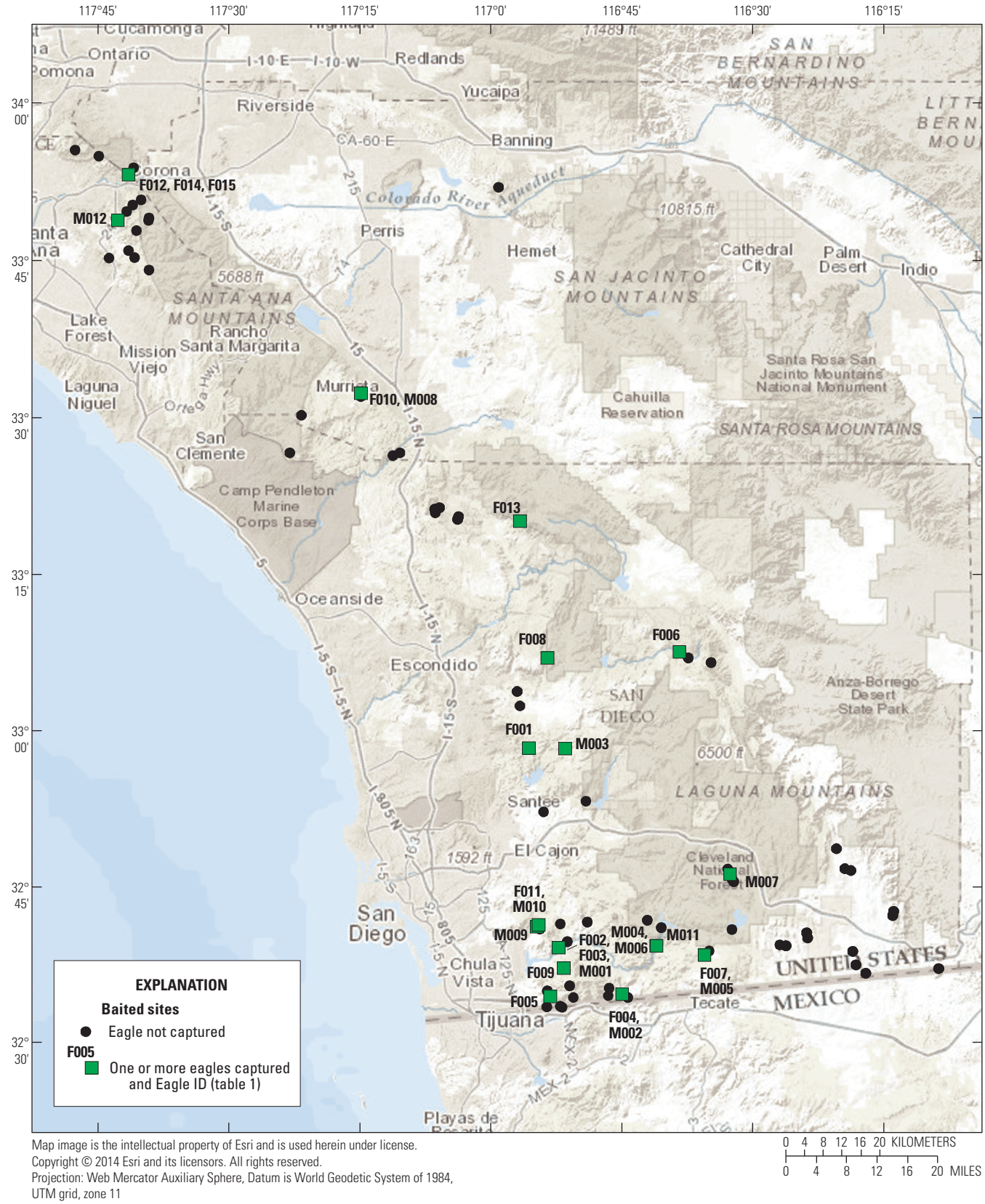
A view of the location data over the entire extent of the area used by the golden eagles is shown in figure 28. Note that a lack of eagle data for a particular area does not necessarily imply that it is not used by eagles we are not tracking.

Table 1. Summary of golden eagles captured in southern California, November 2014–February 2016.

[**Sex:** F, female; M, male. **Age:** HY, hatch year; TY, third year; FY, fourth year; AFY, after fourth year; AFFY, after fifth year]

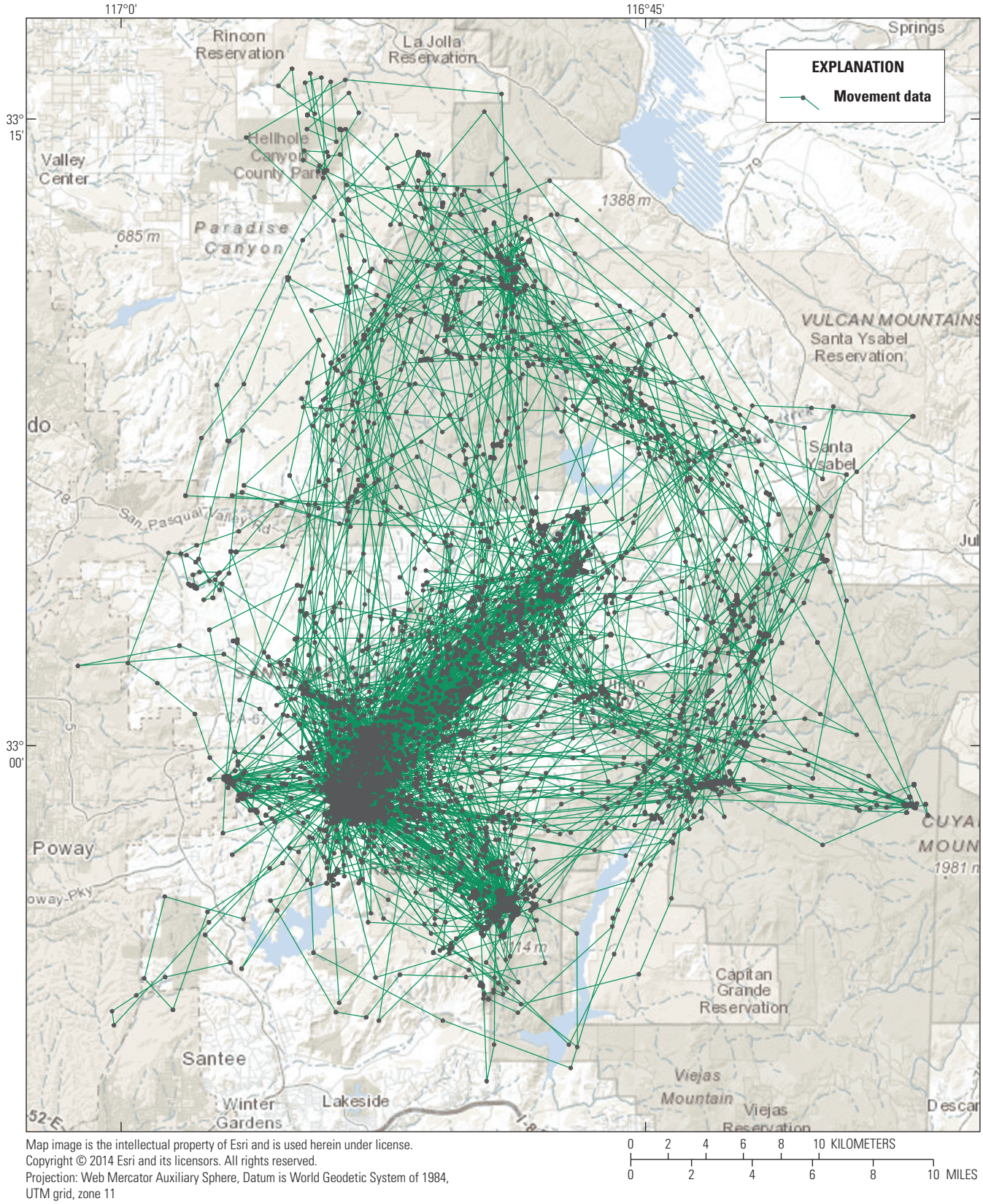
EagleID	Date	Location	Sex	Age	Status
GOEA-SD-F001	11-22-14	Boulder Oaks	F	AFY	Active
GOEA-SD-F002	11-28-14	Cedar Canyon	F	AFY	Active
GOEA-SD-F003	12-05-14	Cedar Canyon	F	AFY	Mortality
GOEA-SD-F004	12-27-14	Marron Valley	F	TY	Unknown
GOEA-SD-F005	01-03-15	O'Neal Canyon	F	AFY	Inactive
GOEA-SD-F006	02-02-15	Santa Ysabel	F	AFY	Inactive
GOEA-SD-F007	02-23-15	Long Potrero	F	AFFY	Active
GOEA-SD-F008	03-14-15	Pamo Valley	F	TY	Mortality
GOEA-SD-F009	11-23-15	Rancho Jamul Ecological Reserve	F	AFY	Mortality
GOEA-RV-F010	12-12-15	Santa Rosa Plateau	F	AFY	Active
GOEA-SD-F011	12-20-15	Proctor Valley	F	TY	Active
GOEA-OC-F012[1]	02-10-16	Fremont Canyon	F	AFFY	Unknown
GOEA-SD-F013	02-11-16	Gregory Mountain	F	AFFY	Active
GOEA-OC-F014	02-12-16	Fremont Canyon	F	AFFY	Active
GOEA-OC-F015	02-12-16	Fremont Canyon	F	AFFY	Active
GOEA-SD-M001	12-05-14	Cedar Canyon	M	AFY	Active
GOEA-SD-M002	01-08-15	Marron Valley	M	AFY	Unknown
GOEA-SD-M003	02-03-15	Rancho Canada	M	AFFY	Active
GOEA-SD-M004	02-07-15	Barrett Lake	M	AFFY	Inactive
GOEA-SD-M005	02-23-15	Long Potrero	M	AFFY	Active
GOEA-SD-M006	12-01-15	Barrett Lake	M	AFY	Unknown
GOEA-SD-M007	12-09-15	Long Valley	M	AFY	Active
GOEA-RV-M008	12-11-15	Santa Rosa Plateau	M	HY	Mortality
GOEA-SD-M009	12-13-15	Proctor Valley	M	TY	Unknown
GOEA-SD-M010	12-17-15	Proctor Valley	M	HY	Active
GOEA-SD-M011	12-21-15	Barrett Lake	M	AFY	Active
GOEA-OC-M012	12-27-15	Brush Canyon	M	FY	Active

[1]The transmitter attached to golden eagle GOEA-OC-F012 malfunctioned and no data were received. Thus, there is not a location map for this eagle.



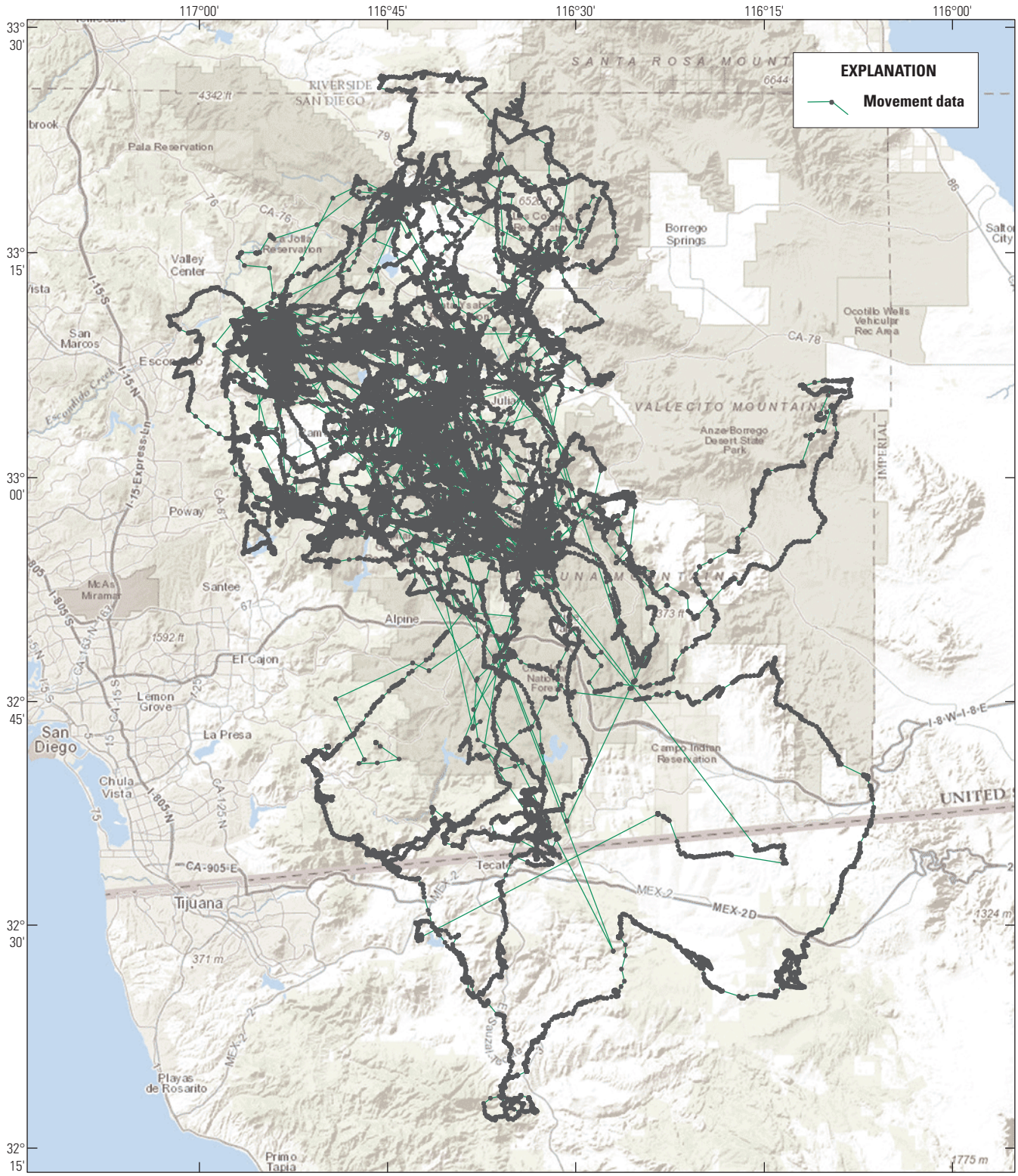
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 1. Golden eagle trapping locations, southern California.



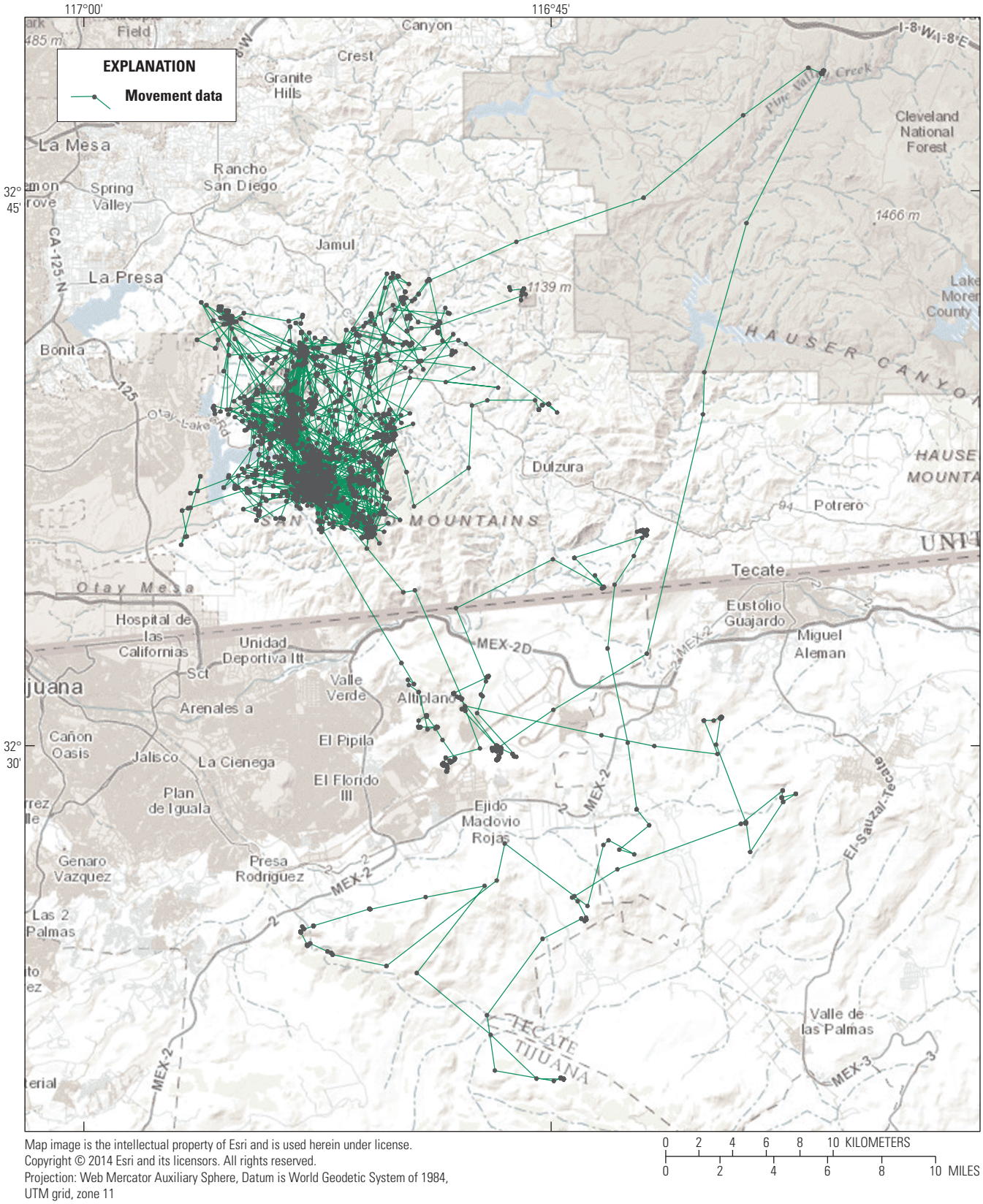
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 2. Location data for eagle GOEA-SD-F001 captured at Boulder Oaks, San Diego County, California, November 22, 2014.



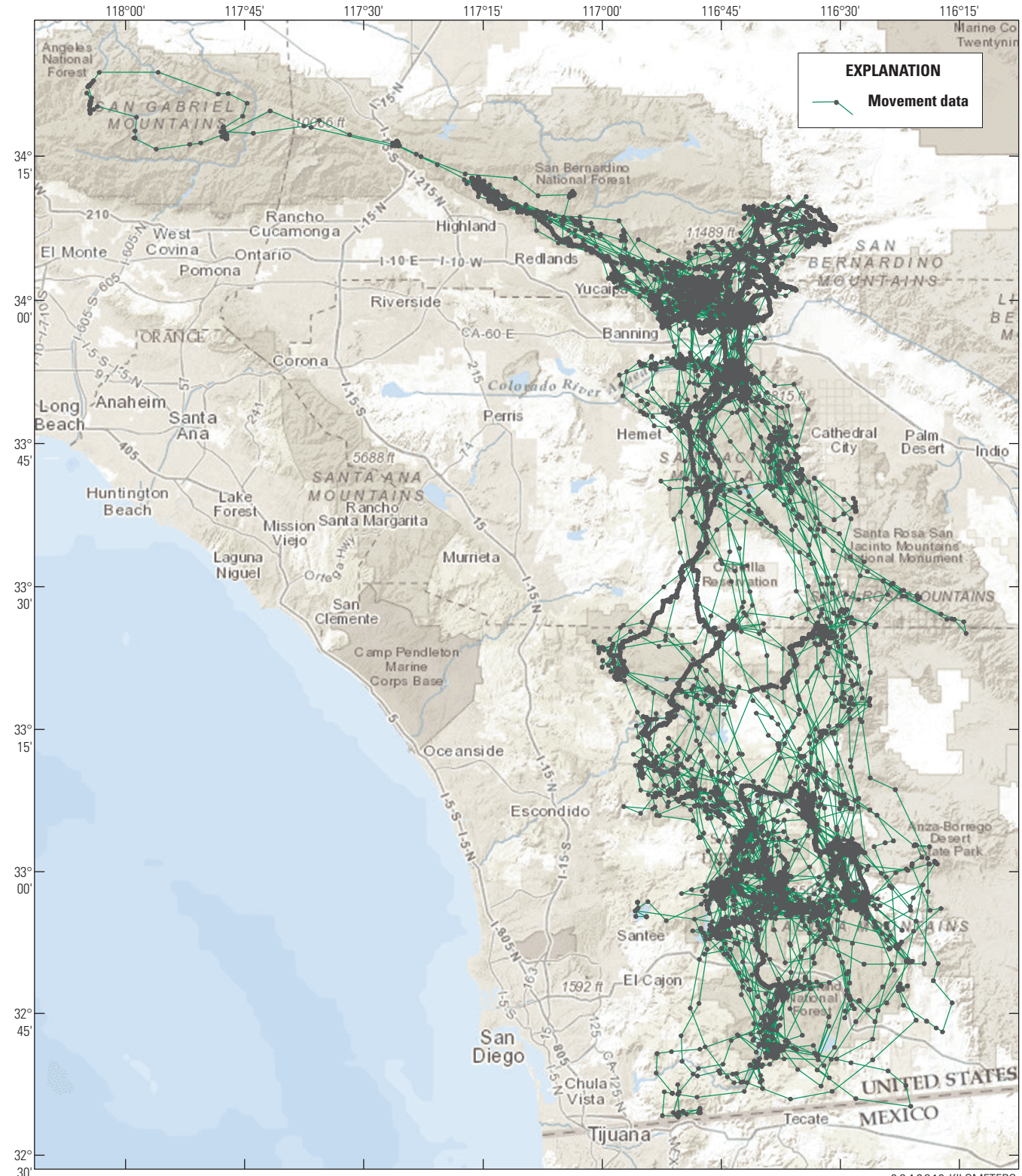
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 3. Location data for eagle GOEA-SD-F002 captured at Cedar Canyon, San Diego County, California, November 28, 2014.



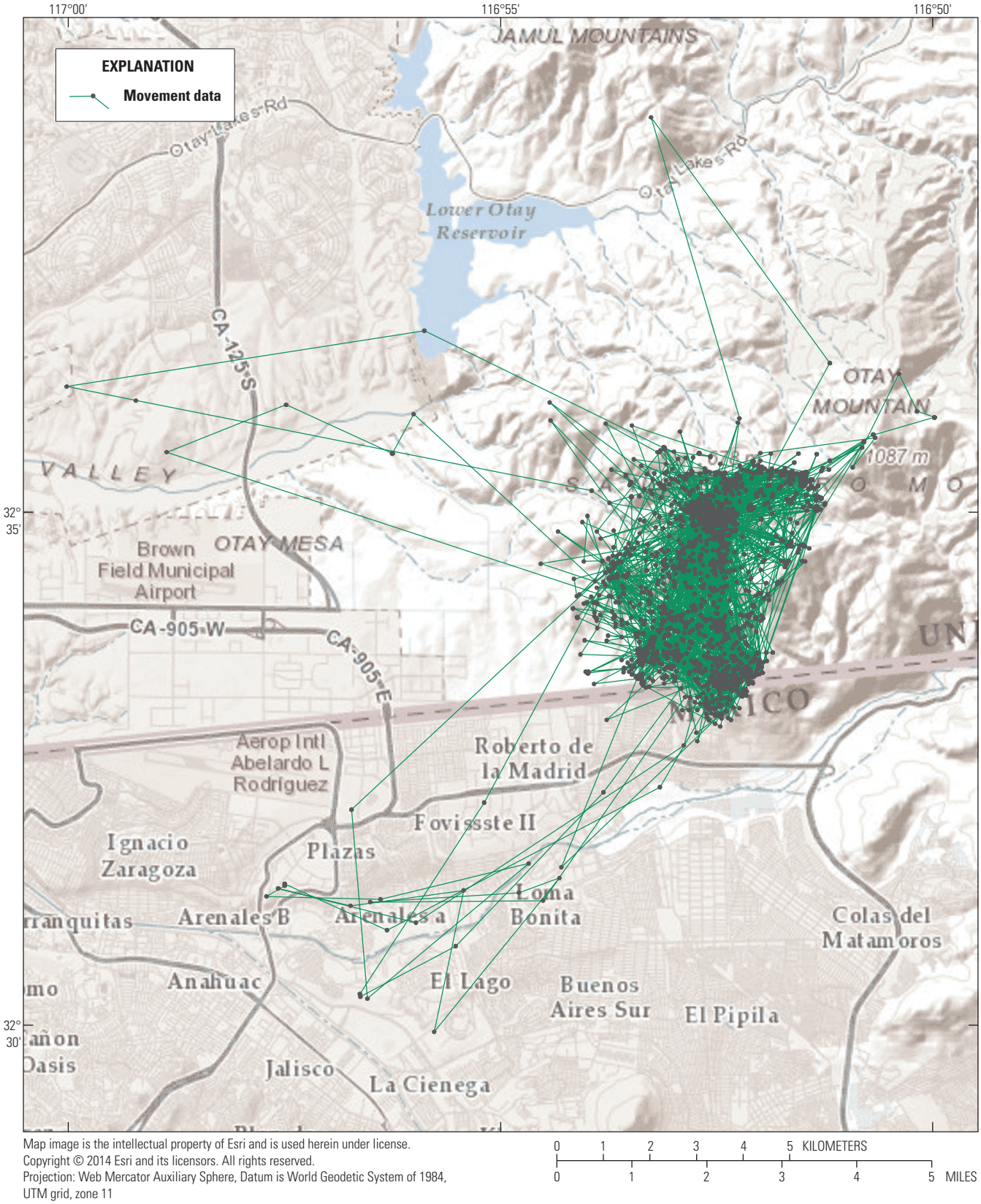
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 4. Location data for eagle GOEA-SD-F003 captured at Cedar Canyon, San Diego County, California, December 5, 2014.



Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 5. Location data for eagle GOEA-SD-F004 captured at Marron Valley, San Diego County, California, December 27, 2014.



Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 6. Location data for eagle GOEA-SD-F005 captured at O'Neal Canyon, San Diego, California, January 3, 2015.

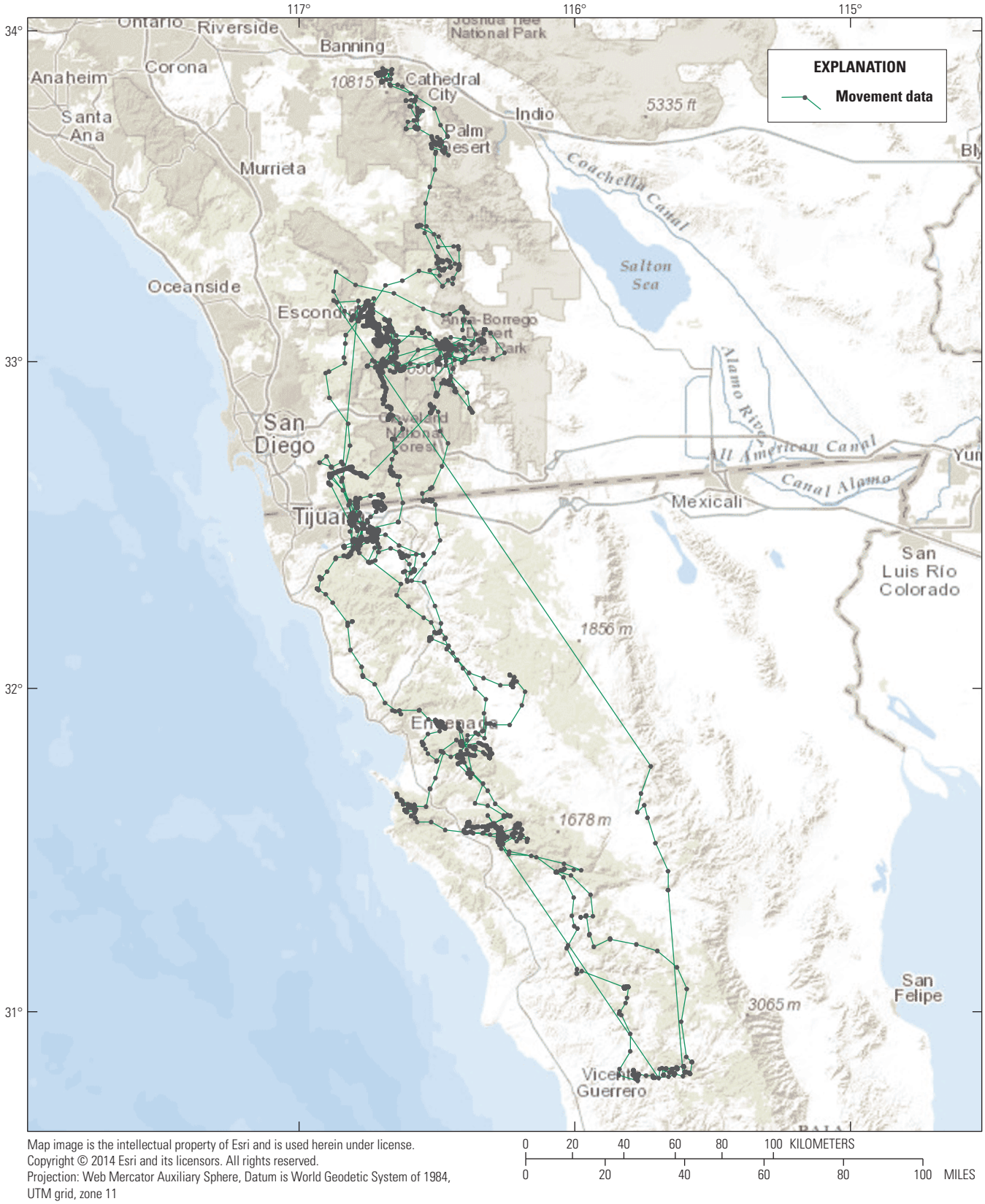
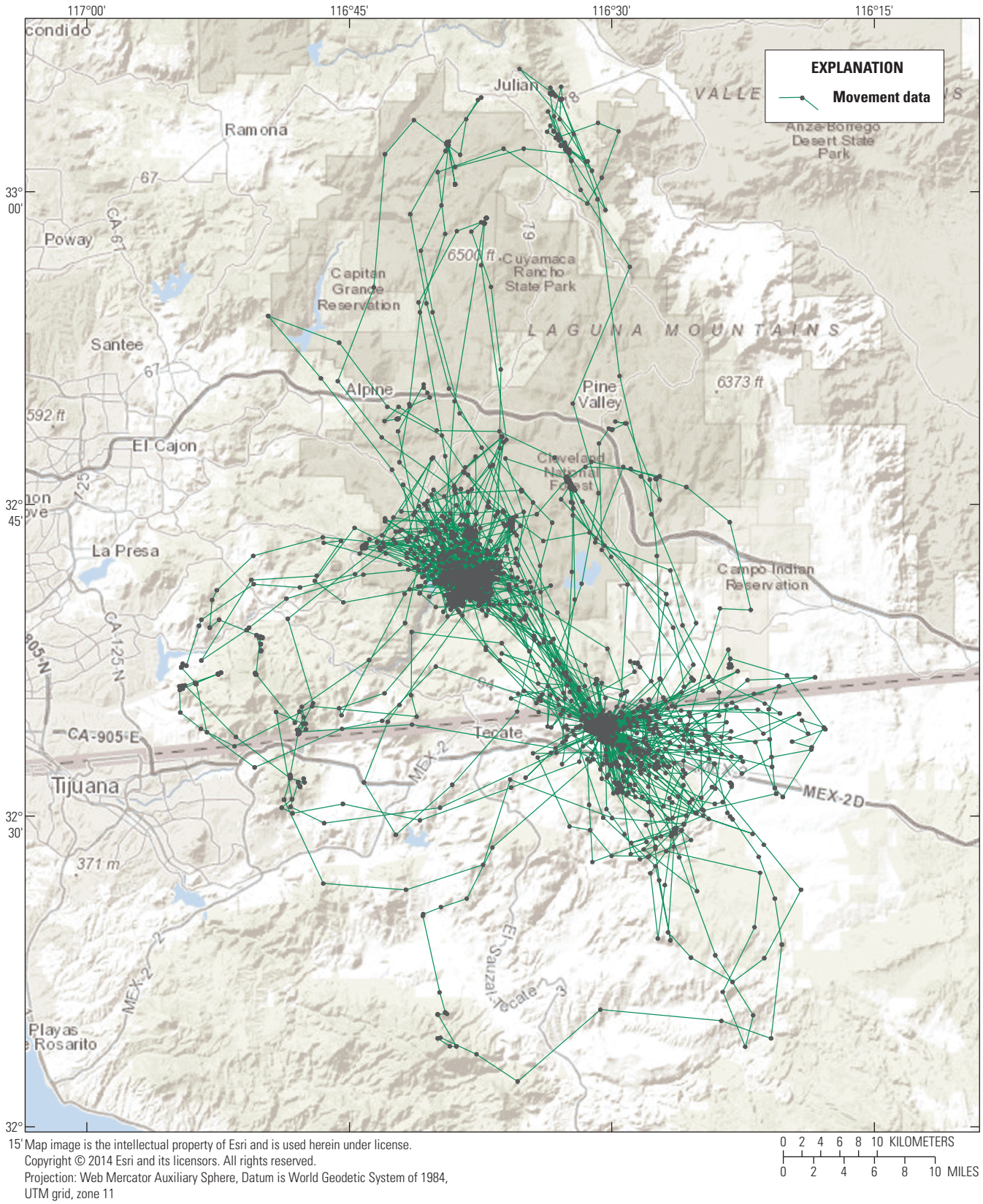
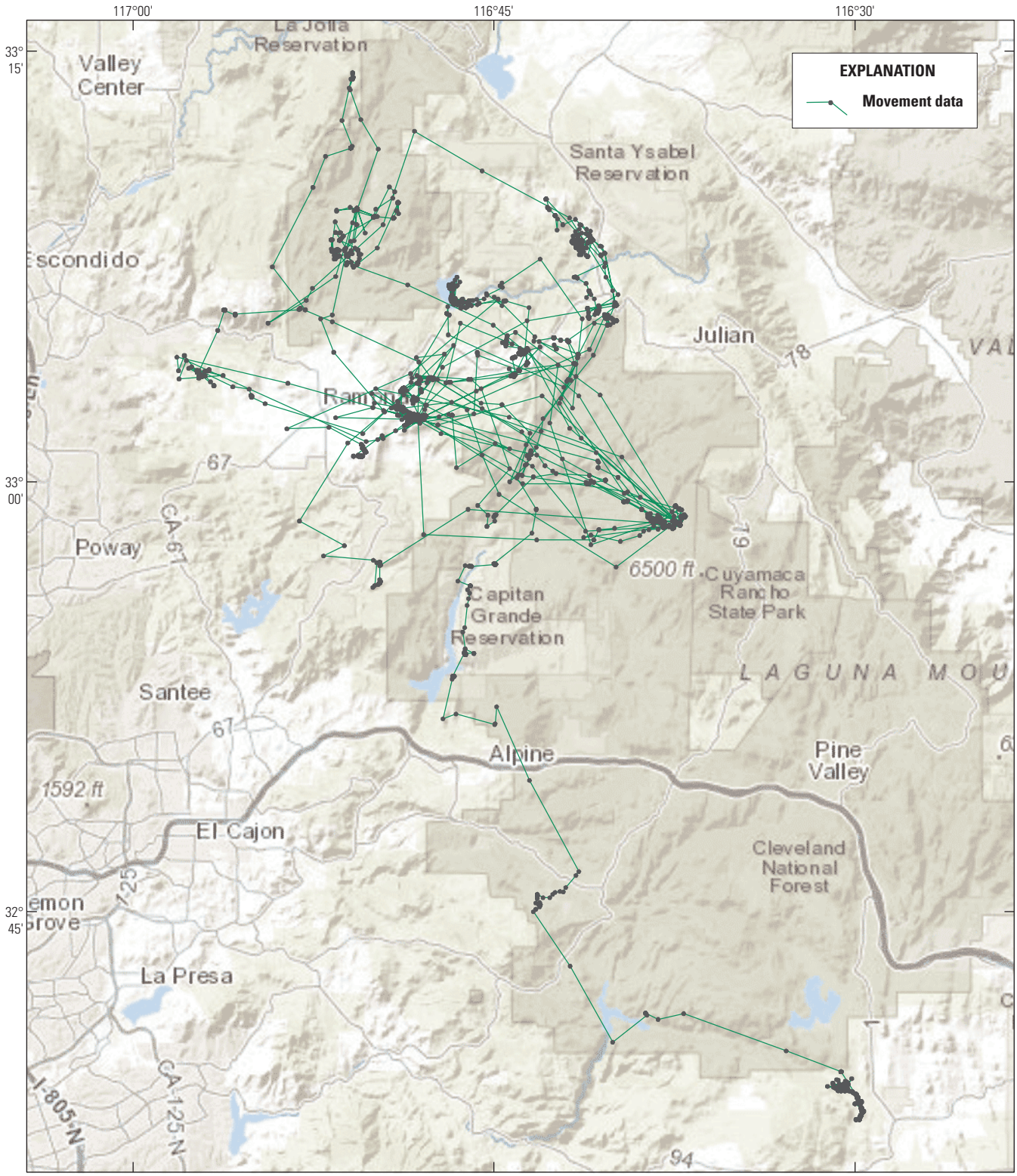


Figure 7. Location data for eagle GOEA-SD-F006 captured at Santa Ysabel, San Diego County, California, February 2, 2015.



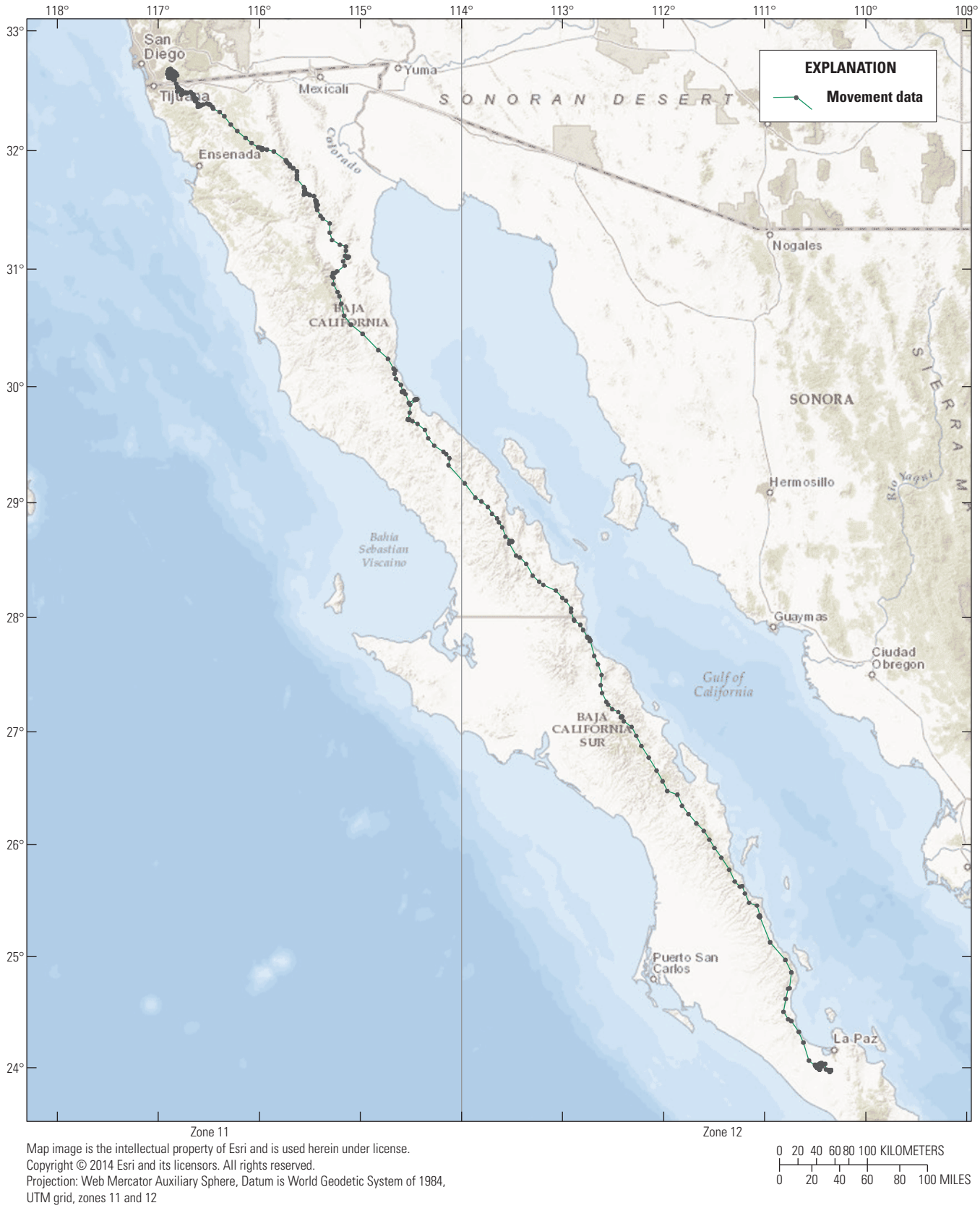
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 8. Location data for eagle GOEA-SD-F007 captured at Long Potrero, San Diego County, California, February 23, 2015.



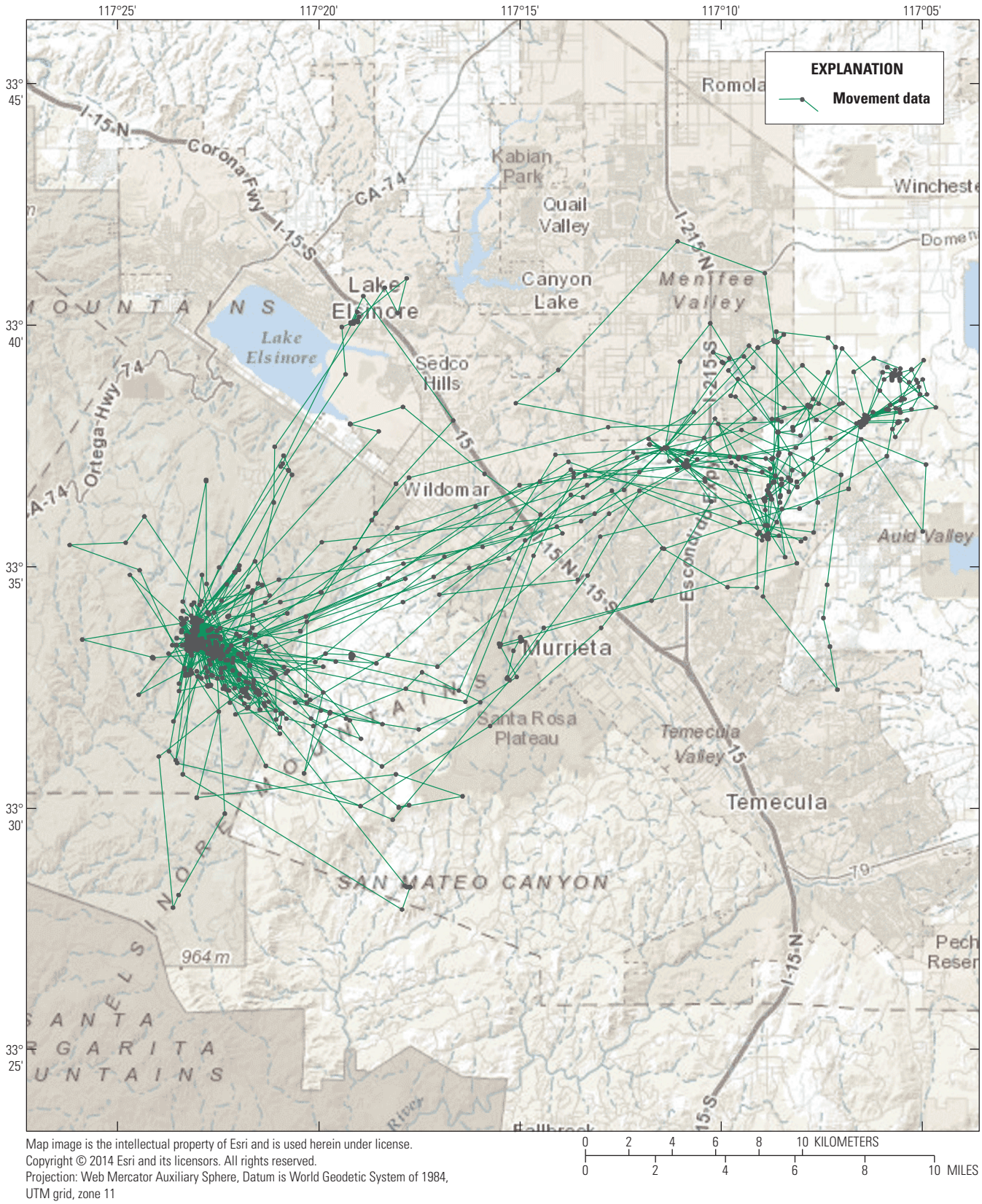
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 9. Location data for eagle GOEA-SD-F008 captured at Pamo Valley, San Diego County, California, March 14, 2015.



Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zones 11 and 12

Figure 10. Location data for eagle GOEA-SD-F009 captured at Rancho Jamul Ecological Reserve, San Diego County, California, November 23, 2015.



Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 11. Location data for eagle GOEA-RV-F010 captured at Santa Rosa Plateau, Riverside County, California, December 12, 2015.

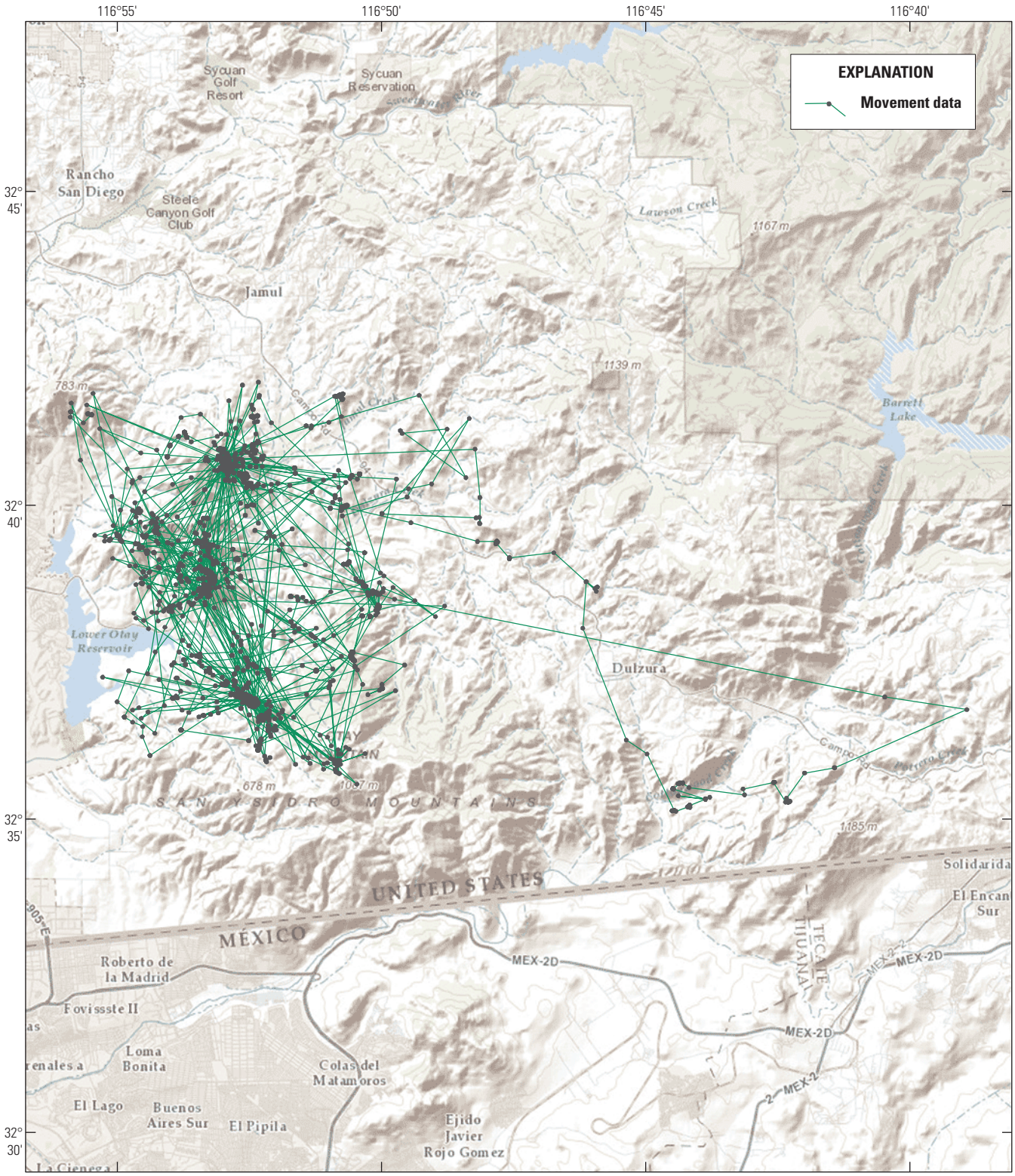
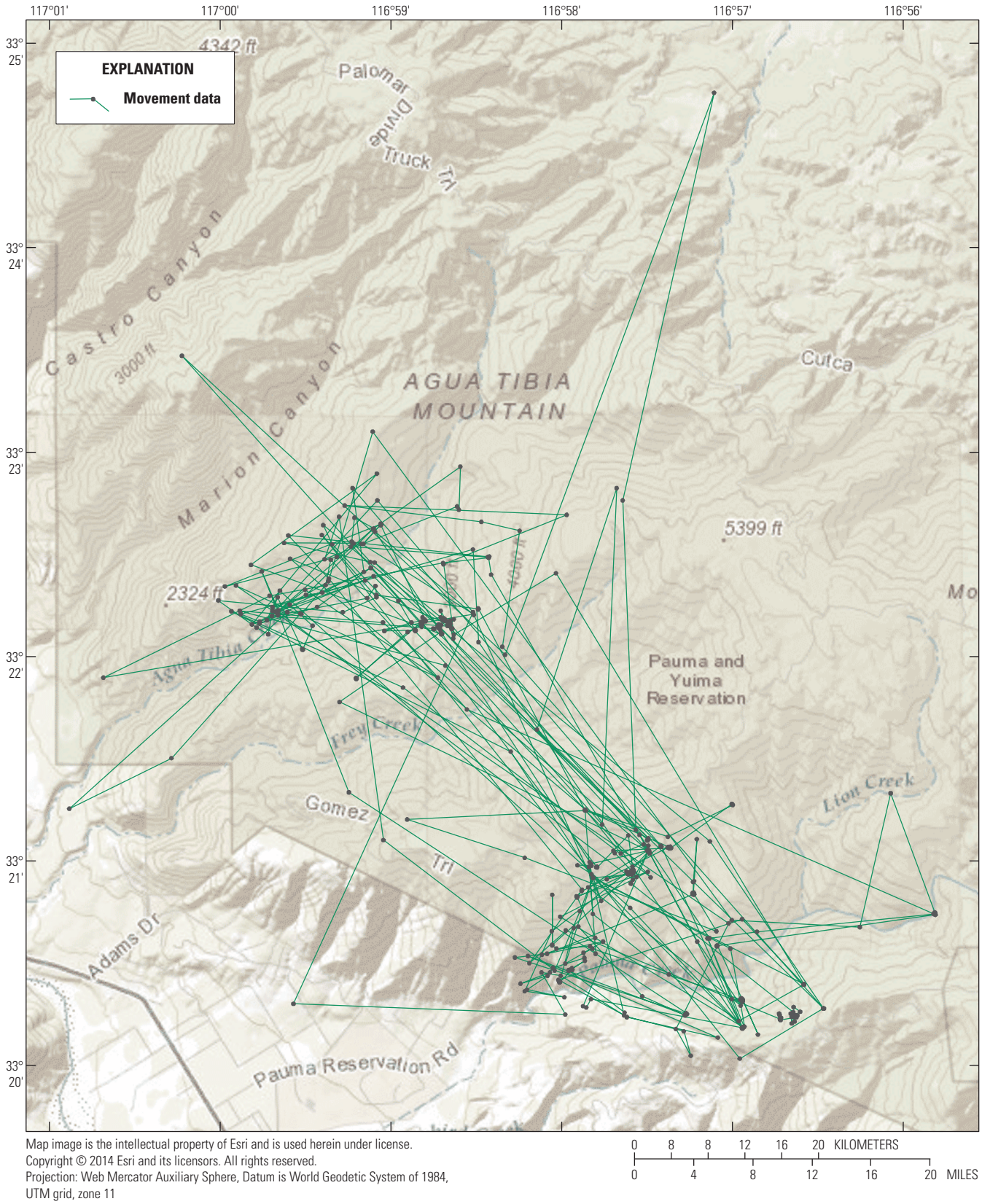


Figure 12. Location data for eagle GOEA-SD-F011 captured at Proctor Valley, San Diego County, California, December 20, 2015.

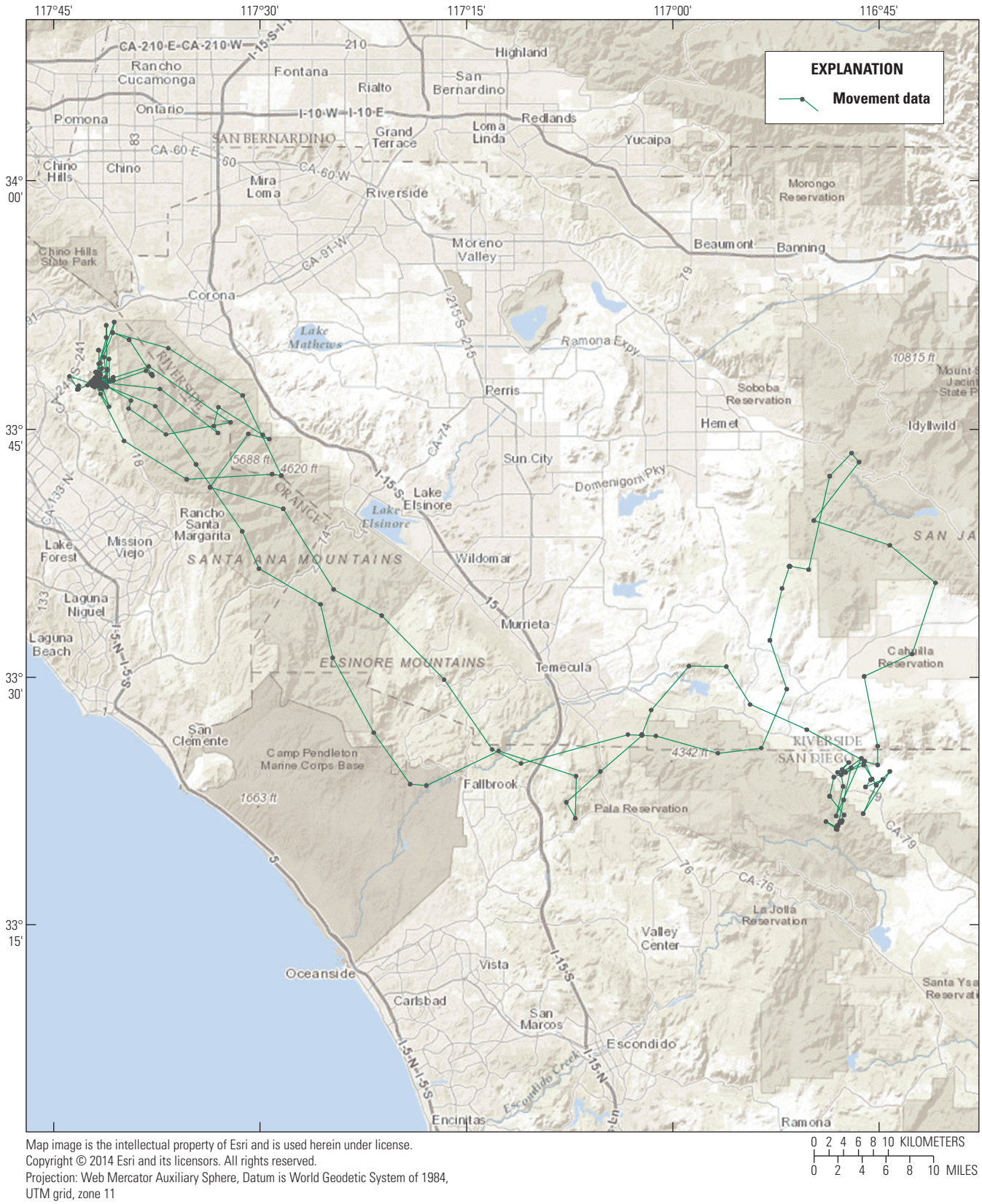


Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 13. Location data for eagle GOEA-SD-F013 captured at Gregory Mountain, San Diego County, California, February 11, 2016.

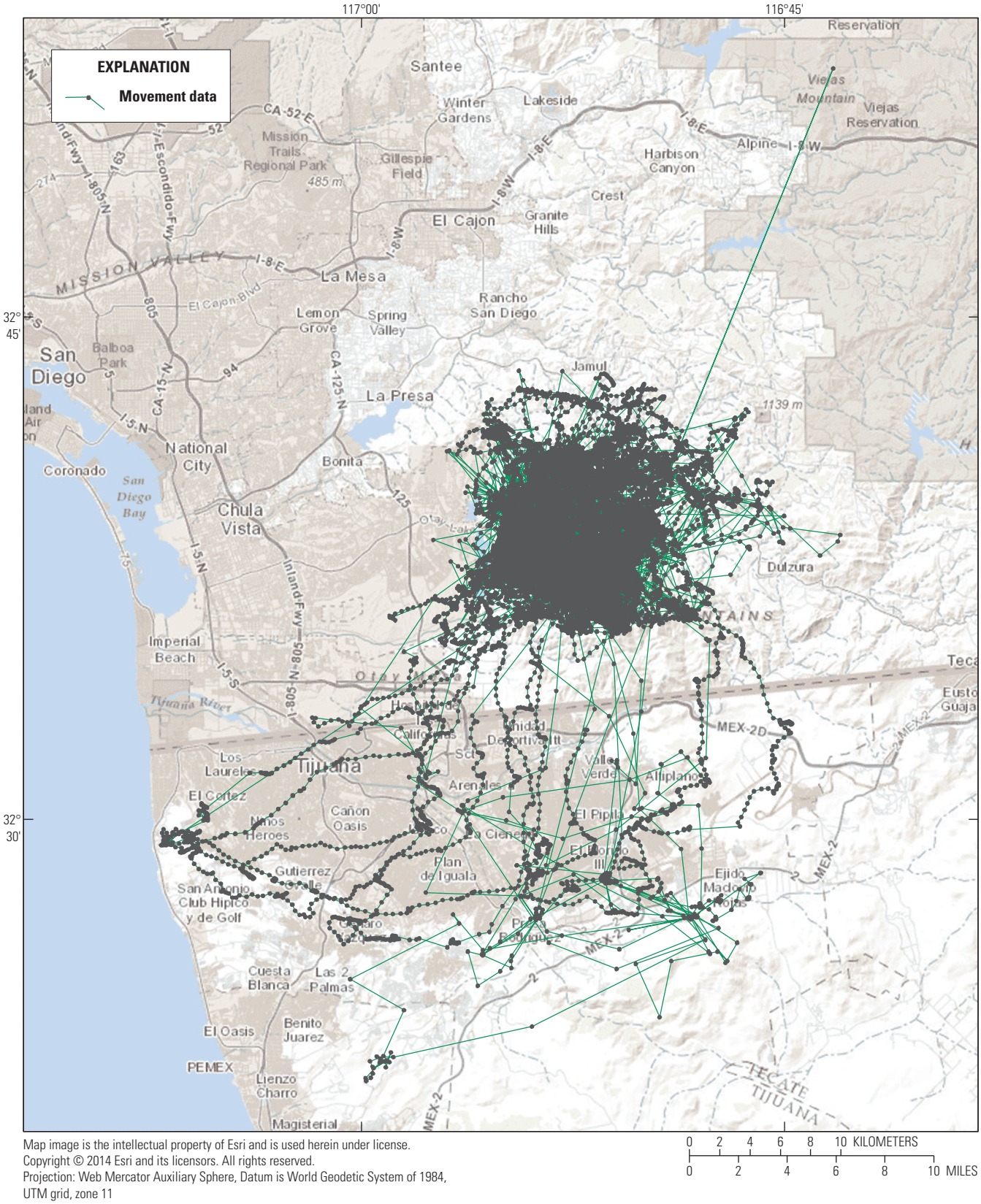
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zones 10 and 11

Figure 14. Location data for eagle GOEA-OC-F014 captured at Fremont Canyon, Orange County, California, February 12, 2016.



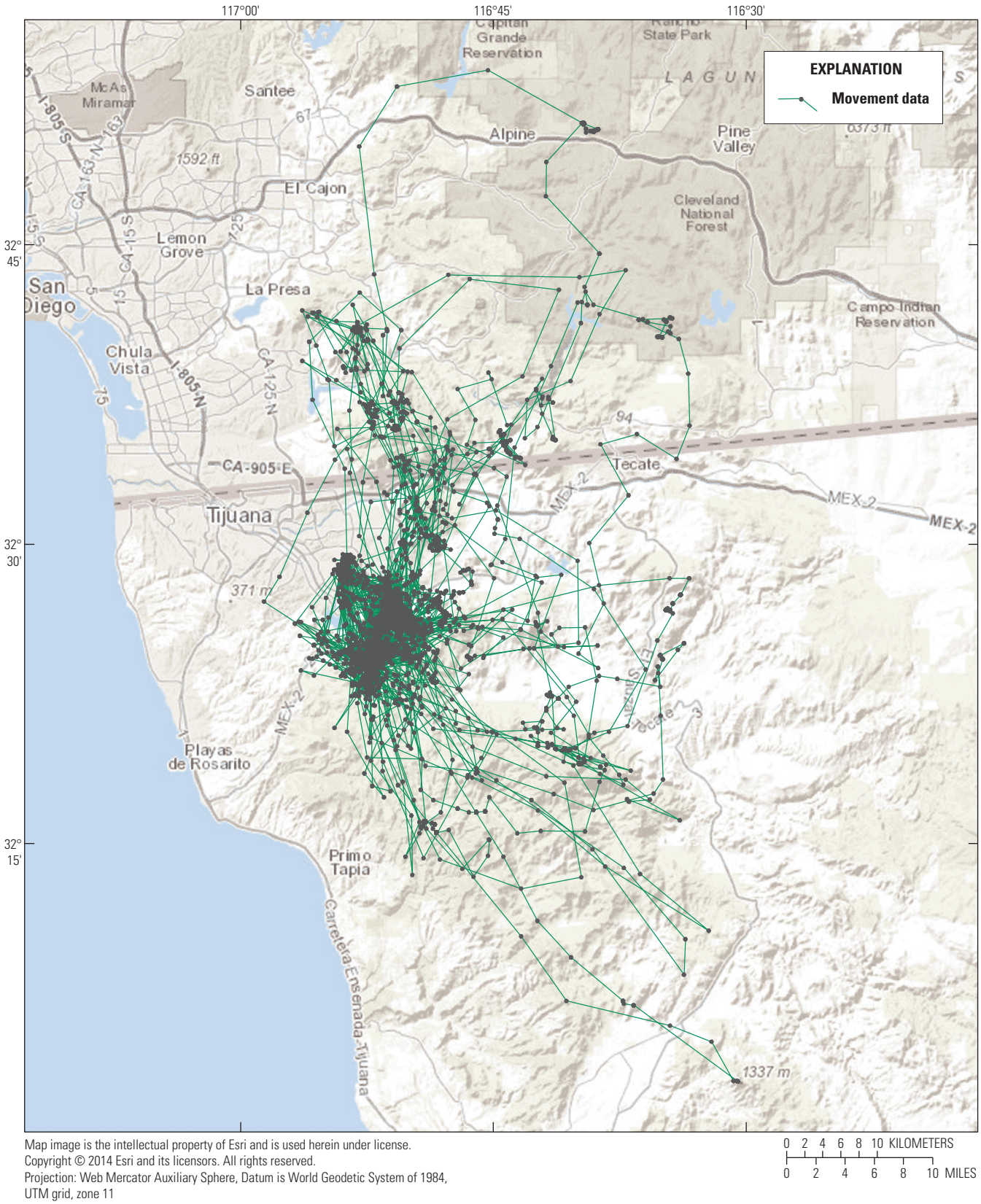
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 15. Location data for eagle GOEA-OC-F015 captured at Fremont Canyon, Orange County, California, February 12, 2016.



Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 16. Location data for eagle GOEA-SD-M001 captured at Cedar Canyon, San Diego County, California, December 5, 2014.



Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 17. Location data for eagle GOEA-SD-M002 captured at Marron Valley, San Diego County, California, January 8, 2015.

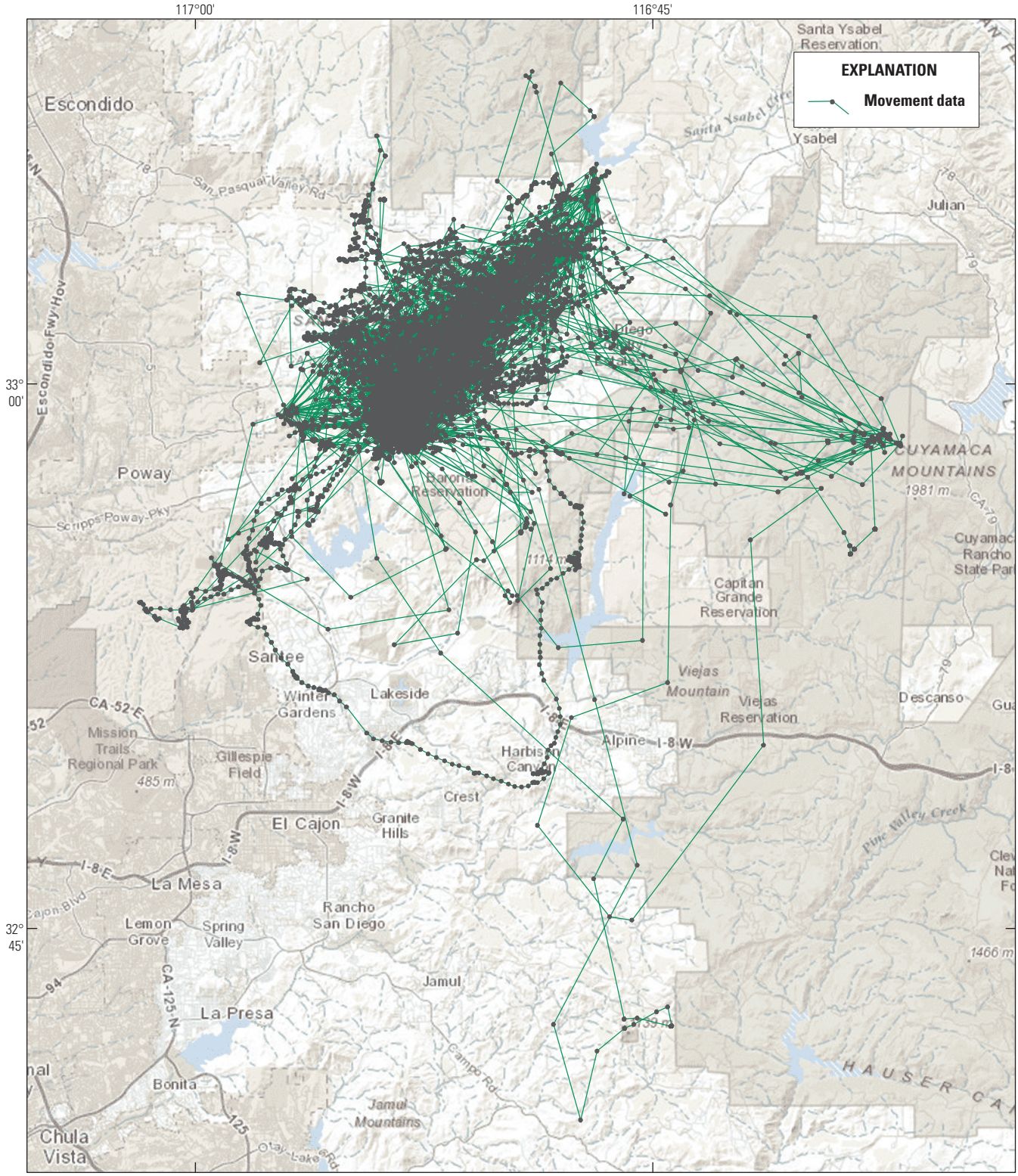
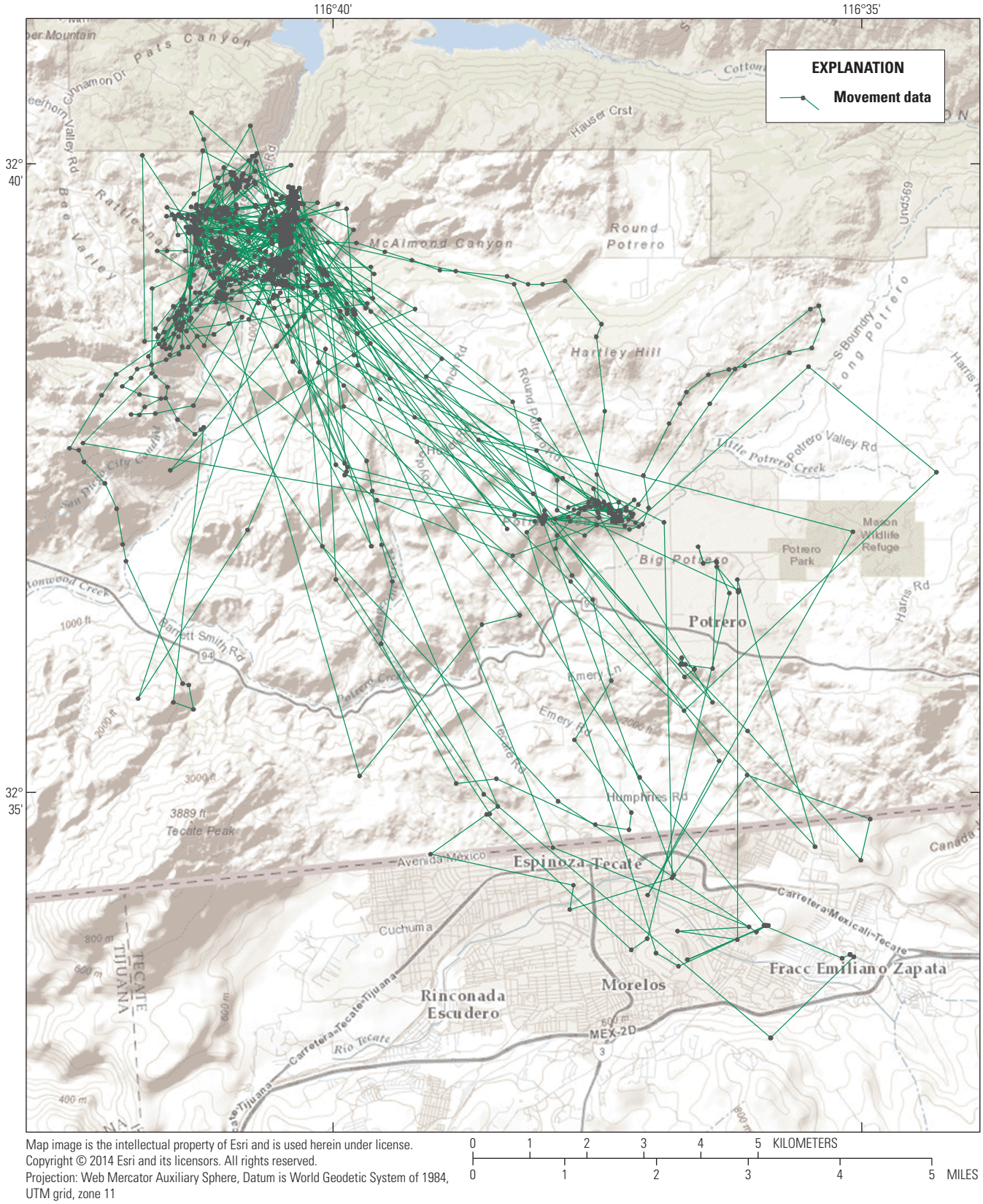
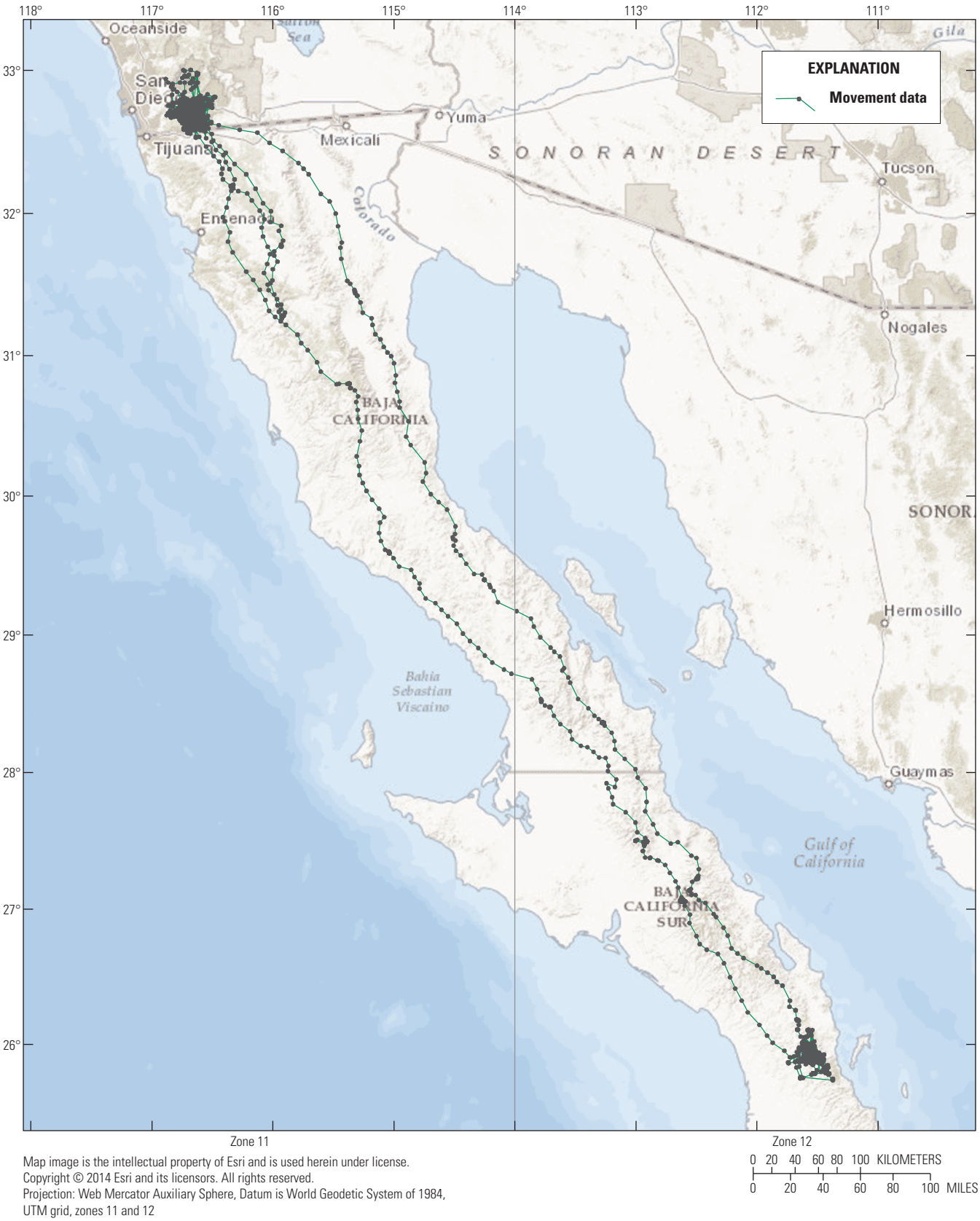


Figure 18. Location data for eagle GOEA-SD-M003 captured at Rancho Canada, San Diego County, California, February 3, 2015.



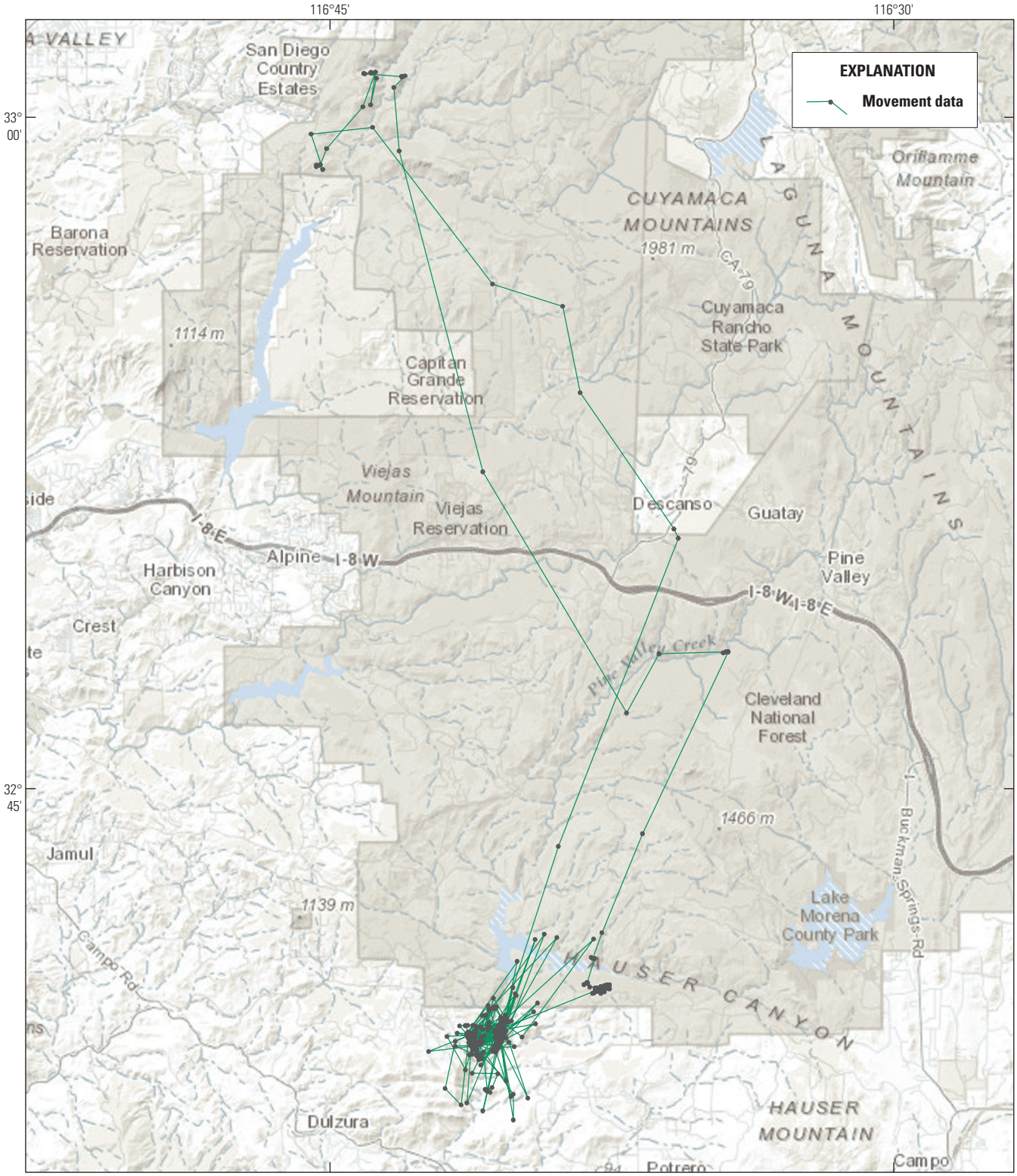
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 19. Location data for eagle GOEA-SD-M004 captured at Barrett Lake, San Diego County, California, February 7, 2015.



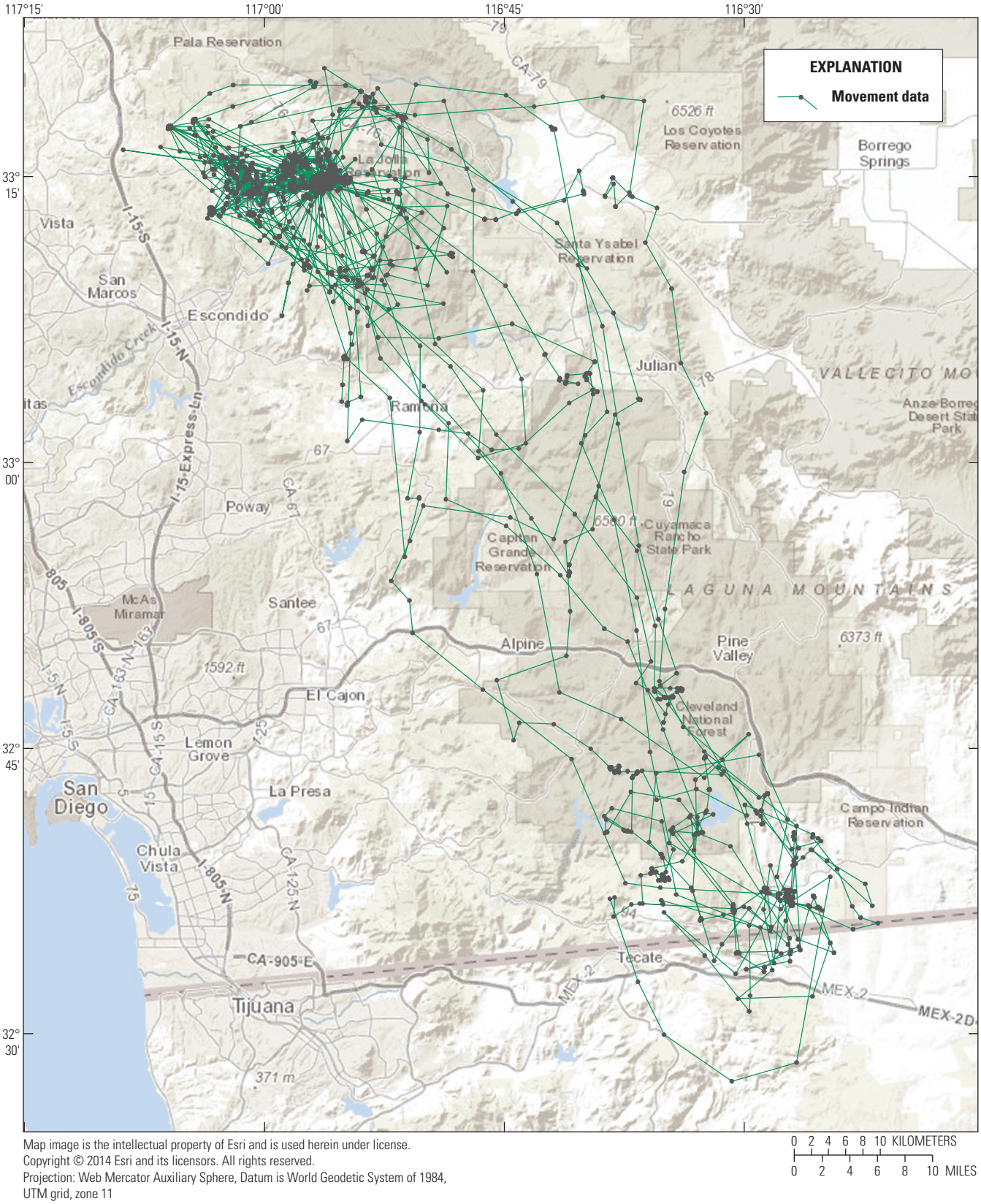
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zones 11 and 12

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



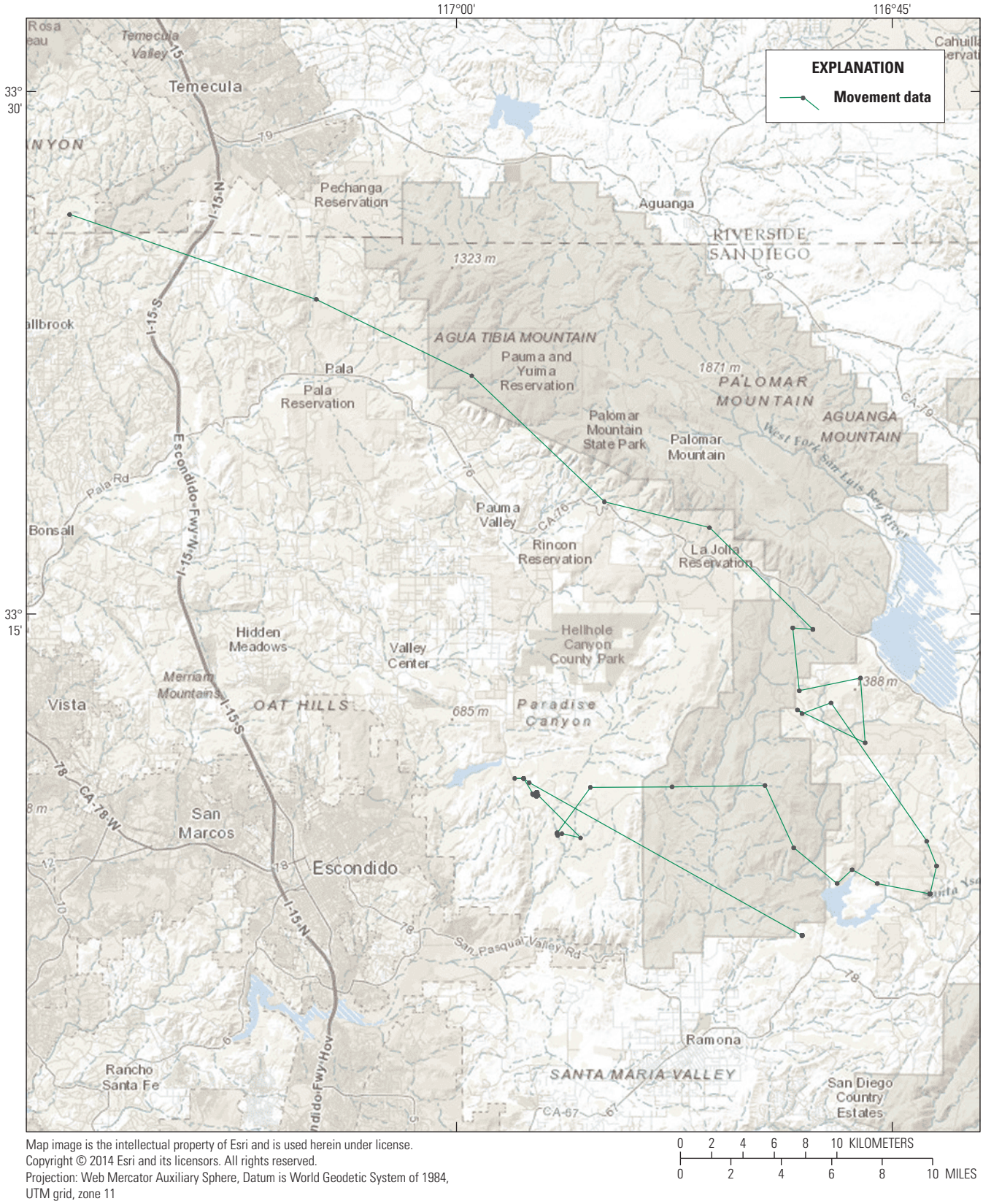
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

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



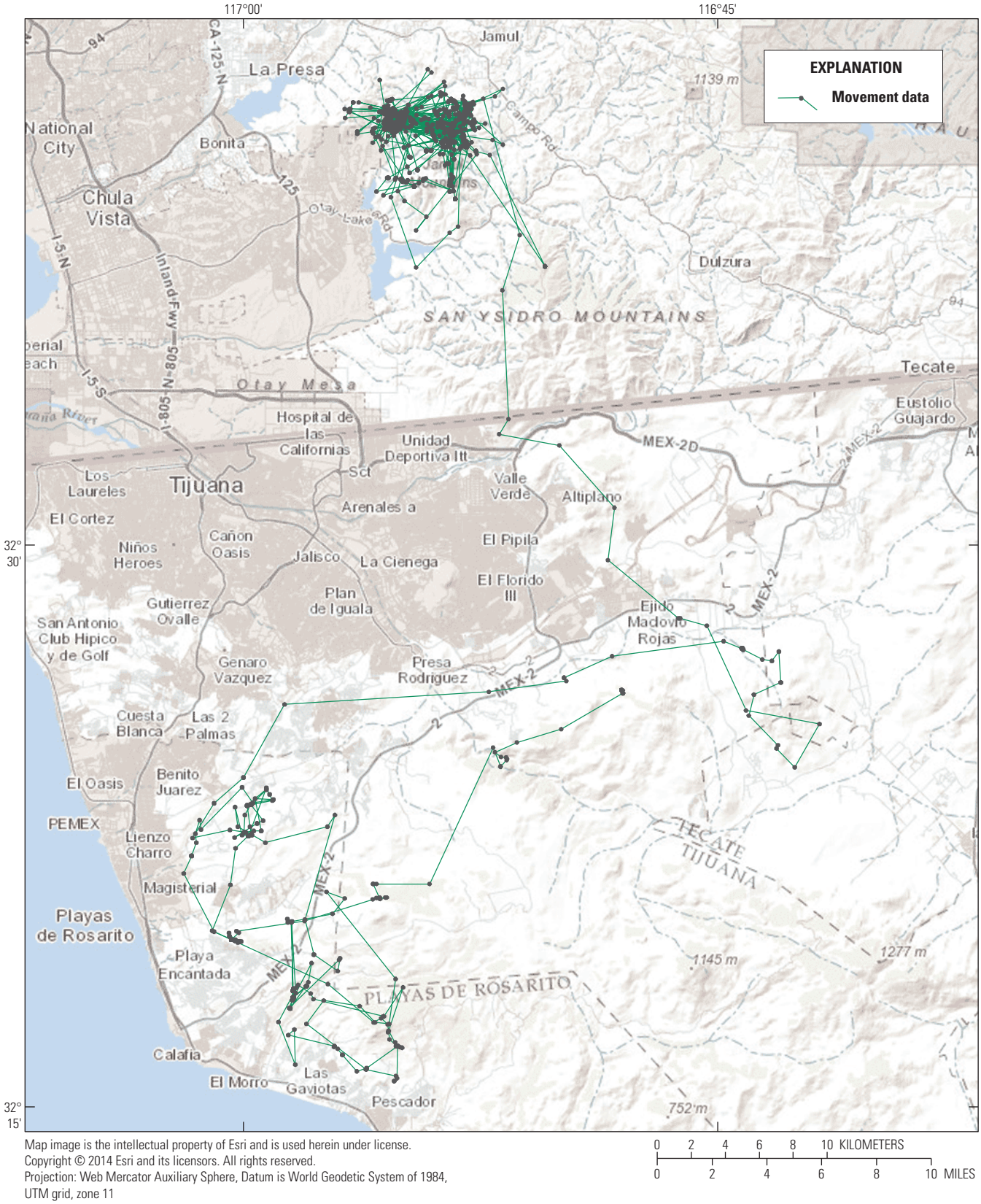
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

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



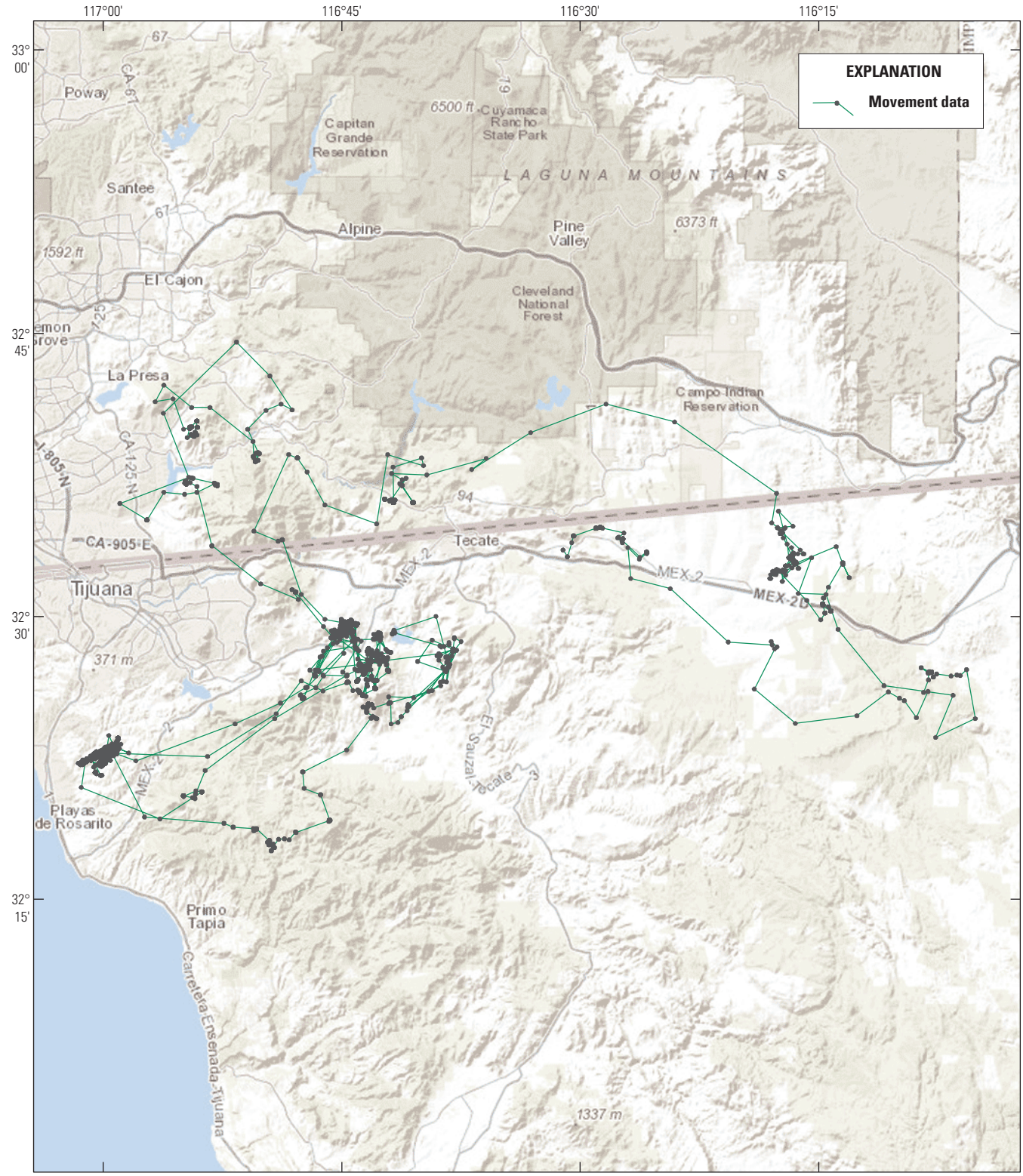
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 23. Location data for eagle GOEA-RV-M008 captured at Santa Rosa Plateau, Riverside County, California, December 11, 2015.



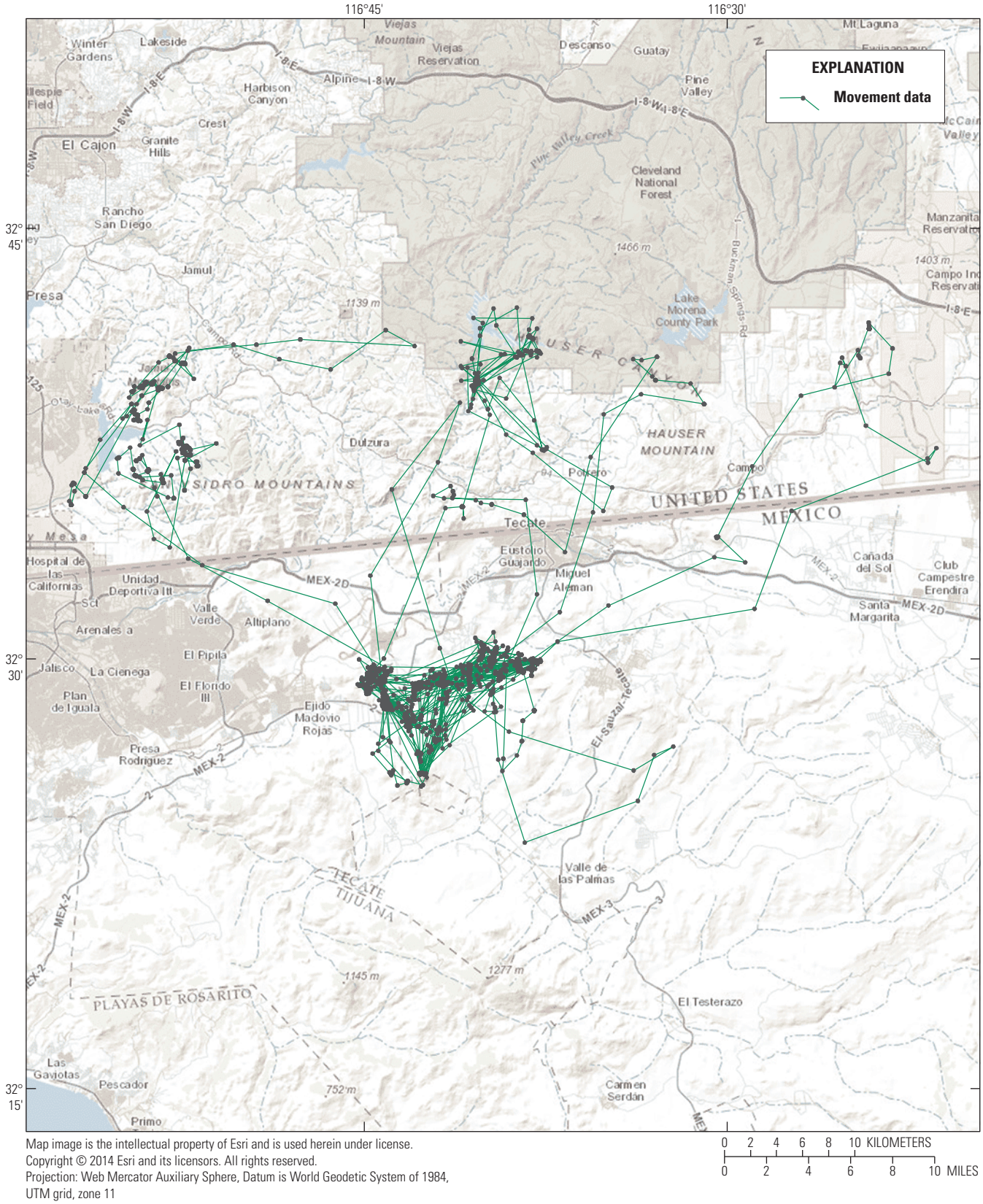
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 24. Location data for eagle GOEA-SD-M009 captured at Proctor Valley, San Diego County, California, December 13, 2015.



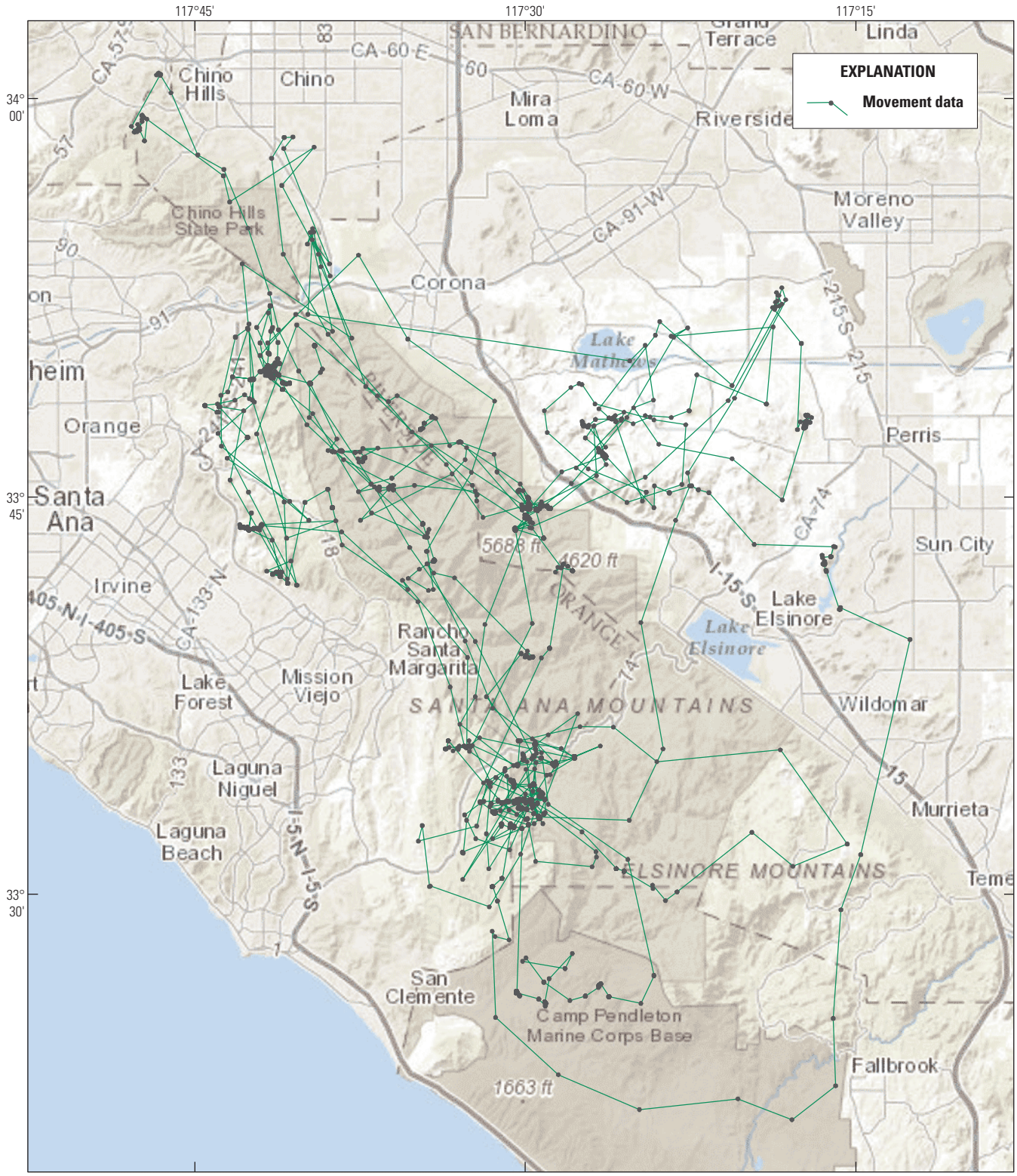
Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 25. lLocation data for eagle GOEA-SD-M010 captured at Proctor Valley, San Diego County, California, December 17, 2015.



Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

Figure 26. Location data for eagle GOEA-SD-M011 captured at Barrett Lake, San Diego County, California, December 21, 2015.



Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zone 11

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

Projection: Web Mercator Auxiliary Sphere, Datum is World Geodetic System of 1984, UTM grid, zones 10, 11, and 12

Figure 28. Location data for all eagles since time of capture, southern California.

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