

Summary of movements of Colorado lynx in Wyoming



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INTRODUCTION

In an effort to restore a viable population of federally threatened Canada lynx (*Lynx canadensis*) to the southern portion of their former range, 218 individuals were reintroduced into Colorado from 1999–2006 by the Colorado Division of Wildlife (now Colorado Parks and Wildlife, CPW). Most of these animals settled into home ranges within the state as intended, but some made extensive movements into other states (Devineau et al. 2010). Recently the United States Fish and Wildlife Service (USFWS) requested information regarding the number of reintroduced lynx that ventured to Wyoming, where these individuals went once in Wyoming, how long they stayed, whether they reproduced while there, and their ultimate fates. The purpose of this brief report is to fulfill the USFWS request. The information, analysis, and presentation follow the same format as a similar request made in 2013 regarding lynx that travelled from Colorado to Montana.

METHODS

CPW collected location data from reintroduced and Colorado-born lynx (i.e., those born to reintroduced individuals) from 1999–2011 using both traditional VHF telemetry and the Argos satellite system. VHF locations were obtained from daytime flights using fixed-winged aircraft, but these aircraft rarely sampled individuals that left the state. Dual-transmitter satellite/VHF collars were first deployed on reintroduced lynx in April, 2000 and each individual was outfitted with this system for the remainder of the reintroduction project. Satellite collars tracked animal movements irrespective of political boundaries. The data reviewed for this report are almost exclusively (99%) Argos satellite data.

Satellite transmitters were designed to transmit for 12 hours 1 day per week, so it was possible to obtain several satellite locations on a given day. In fact, the data presented here were often clustered with several locations relatively near each other on a given day, followed by another cluster 1 or more weeks later. Note that the precision of Argos data is relatively poor compared to GPS technology. Argos lists the standard deviation of the locational error distribution as 250m, 250–500m, 500–1500m, and >1500m for class 3, 2, 1, and 0 locations, respectively (CLS America 2008). Therefore if a transmitter remains stationary while an Argos satellite passes over multiple times computing numerous class 3 location estimates, 68% of the resultant estimates can be expected to fall within 250 m of the true location of the transmitter; 95% will fall within 2 SD (500 m) of the true location. Similarly, 95% of class 1 locations can be expected to fall within 3000m (1.9 miles) of the true location. Argos systems also produce location estimates of class A, B, and Z, but these locations do not have associated error estimates.

We queried our database for lynx locations that occurred within the state of Wyoming, then used the ‘Points to Lines’ tool in ArcGIS 10.1 to connect locations for each individual. Note that these line segments only serve to connect sequential points – they do not reflect actual movement paths of individuals. We also matched individuals that traveled to Wyoming with mortality and reproduction databases to determine the fates of these individuals and identify known denning attempts. All individuals were indexed by a unique 7-character ID that identified their place of origin, year of release, sex, and count. For example, “QU04M05” is an individual originally trapped in Quebec, released into Colorado in 2004, and was the 5th male released that year.

To be complete and to be consistent with data reported previously, to allow the reader to interpret all data themselves, and because any given Argos location of low precision class may actually be relatively accurate, I included all classes of telemetry data in this exercise. Thus, large, abrupt deviances in lynx “paths” may reflect large, abrupt movements or simply poor precision. Also, due to the manner in which Argos locations are computed, data submitted by Argos to CPW came with 2 estimated locations (usually quite far apart) for each fix. Algorithms were developed to select and store the most likely position, and selections could be overridden manually. However, when lynx made unusual movements, such as to another state, the algorithm, or override, could have selected and stored the wrong location. Any instances (at least 3 in this case) where this might have occurred were noted in Table 1, but these locations were retained on maps for the sake of consistency with previous exercises.

RESULTS

Of the 48,006 locations obtained from lynx reintroduced or born in Colorado during the reintroduction project, 2,094 (4.4%) occurred in Wyoming. These 2,094 locations were collected from 31 adult lynx (16 males, 15 females) that were released into Colorado between 1999 and 2006 and were located in Wyoming between 1999 and 2010. On average, individuals that traveled to Wyoming first did so about 1.5 years (range 0.25 – 5.5) after release. CPW does not have records of Colorado-born lynx traveling to Wyoming.

Lynx that went to Wyoming were there long enough to transmit 4–286 (\bar{x} = 68) locations per individual across approximately 7–634 (\bar{x} = 162) days (Table 1; tally is approximate because we do not know where animals were in between weekly locations). Most of these individuals entered and exited Wyoming via the Medicine Bow Mountains or the Park Range and traveled

no farther into the state than the northern extent of these ranges (Figures 1–31). At least 8 lynx made it to the Greater Yellowstone Area and beyond. A few lynx entered/exited via the Uinta Mountains in Utah (Figures 1–31). Of the 31 individuals that spent time in Wyoming, only 3 were known to have died there. Twelve others were known to have died elsewhere (Colorado, Nebraska, Utah, Montana, Alberta) and the fates of the other 16 were unknown because their collars failed before they died (Table 1).

CPW and Wyoming Game & Fish personnel located the den (3 kittens) of BC00F14 on 6/7/04 on the west side of the Medicine Bow Mountains. No other dens or reproductive activity are known for reintroduced lynx that traveled to Wyoming. However, a male (QU04M04) and female (QU04F02) occupied the same area near Pinnacle Buttes along Highway 287 during the breeding season in 2006. Similarly, a male (QU04M05) and female (QU04F01) occurred together along the east side of the Wyoming Range during the winter of 2004-05. It is not known whether any of these latter individuals bred, denned, and/or produced kittens in these areas.

Note that the data and figures included here represent known movements of lynx from Colorado into Wyoming. There were likely other individuals who made the trip. For instance, one individual was trapped in Alberta in 2008 after having previously travelled to Wyoming then back to Colorado in 2004 (where he spent the next 4 years). His collar had expired by the time he was trapped in Alberta, but he likely traversed Wyoming on his way. Also, CPW stopped monitored collared lynx in April, 2011. Movements into Wyoming may or may not have continued since then, but we have no documentation.

LITERATURE CITED

CLS America. 2008. Argos User's Manual. <http://www.argos-system.org>.

Devineau, O., T. M. Shenk, et al. (2010). Evaluating the Canada lynx reintroduction programme in Colorado: patterns in mortality. *Journal of Applied Ecology* 47: 524-531.

Table 1. Number of locations, dates, duration, and fate of known lynx reintroduced into Colorado that subsequently traveled to Montana, 1999–2010.

Lynx	No. Locations in WY*	Approx. Dates in WY	Approx. Days in WY	Fate	Date	Cause	Location
AK99M06	4	10/8/99 - 10/20/99	12	Died	11/16/1999	Shot	NE
BC00F14	63	8/10/03 - 7/8/04	332	Died	7/28/2004	Probable Predation	West of Centennial, WY
BC00M13	4	3/21/01, 7/8/04 - 10/26/04	111	Unk	N/A	N/A	N/A
BC03F03	26	8/10/04 - 11/2/04	84	Died	5/19/2005	Hit by Vehicle	I-70 east of Eisenhower Tunnel, CO
BC03M02	5	6/4/04 - 6/11/04	7	Died	1/28/2010	Trapped	Nordegg, Alberta
BC03M06	10	8/27/04 - 9/17/04	21	Died	6/6/2008	Unk	Clear Creek, CO
BC03M09	172	8/4/03 - 8/9/04	371	Unk	N/A	N/A	N/A
BC04F02	21	8/19/05 - 9/23/05	35	Unk	N/A	N/A	N/A
BC04F03	27	9/1/09 - 9/22/09	21	Unk	N/A	N/A	N/A
BC04M01	277	6/25/04, 7/18/09 - 8/15/09, 9/12/09 - 3/20/10	218	Unk	N/A	N/A	N/A
BC04M08	15	8/24/04 - 10/5/04, 5/31/05 - 6/21/05, 9/6/05 - 10/25/06, 9/19/06	113	Died	1/4/2008	Shot	Basalt, CO
BC04M13	44	7/29/05 - 11/4/05	98	Unk	N/A	N/A	N/A
BC05M03	25	8/16/05 - 9/27/05, 7/18/06	43	Died	6/28/2013	Hit by Vehicle	Hwy13 N of Rifle, CO
BC05M08	6	7/19/05 - 8/9/05	21	Died	10/11/2005	Plague	Terryall Creek, CO
BC06M13	164	7/15/06 - 5/5/07, 6/2/07 - 6/23/07	315	Died	12/11/2008	Illness	Capitol Reef NP, UT
MB05F01	65	7/18/06 - 9/12/06, 10/3/06 - 11/21/06	105	Unk	N/A	N/A	N/A
MB05F02	17	8/15/06 - 9/12/06, 1/9/07**	29	Died	2/14/2007	Shot	Eastern NE
MB05F03	44	7/18/06 - 10/24/06	98	Unk	N/A	N/A	N/A
QU03M01	9	3/30/04 - 4/20/04	21	Unk	N/A	N/A	N/A
QU04F01	138	6/6/04 - 3/27/05, 4/17/05 - 5/15/05, 7/17/05 - 4/16/06	595	Unk	N/A	N/A	N/A

QU04F02	286	9/12/04 - 3/6/05, 4/3/05**, 6/28/05 - 9/13/05, 10/11/05 - 7/11/06, 10/24/06 - 2/9/07	634	Died	3/14/2007	Unk	NW of Dubois, Wy
QU04F07	20	8/1/04 - 9/19/04	49	Died	9/21/2004	Illness	Gray Rocks Reservoir, WY
QU04M04	150	4/27/05 - 8/5/05, 8/26/05 - 6/25/06	403	Died	3/21/2007	Starvation	Cimarron, CO
QU04M05	85	9/26/04 - 4/10/05, 7/3/05 - 8/14/05, 9/11/05 - 1/15/06	364	Unk	N/A	N/A	N/A
QU05F04	217	9/6/05 - 7/4/06, 8/15/06 - 1/30/07	469	Unk	N/A	N/A	N/A
QU05F05	34	7/5/05 - 8/30/05, 11/22/05, 3/28/06, 4/25/06	59	Unk	N/A	N/A	N/A
QU05F08	71	7/12/05 - 8/16/05, 9/20/05, 11/22/05**, 3/7/06 - 5/9/06, 12/26/06 - 2/13/07	147	Unk	N/A	N/A	N/A
QU05M08	49	9/13/05 - 11/22/05, 7/8/06 - 8/5/06, 9/9/06	99	Died	10/13/2006	Unk	Lyman, NE
YK00F11	32	8/2/06 - 9/20/06, 10/4/06 - 11/15/06	91	Unk	N/A	N/A	N/A
YK05M03	10	6/21/05 - 8/2/05	42	Died	11/16/2005	Unk	Stevensille, MT
YK06M02	4	6/4/07 - 6/18/07	14	Unk	N/A	N/A	N/A

*Collected mostly (99%) from ARGOS satellite collars. 51% of locations were assigned location codes of '0', 'A', 'B', or 'Z' by ARGOS indicating no estimate of precision was attainable. The remaining 49% were LC 3, 2, or 1 indicating that the SD of the error distribution was 250m, 250–500m, 500–1500m, respectively.

**Of the 2 locations submitted to CPW by Argos for this day, CPW likely stored the wrong location.

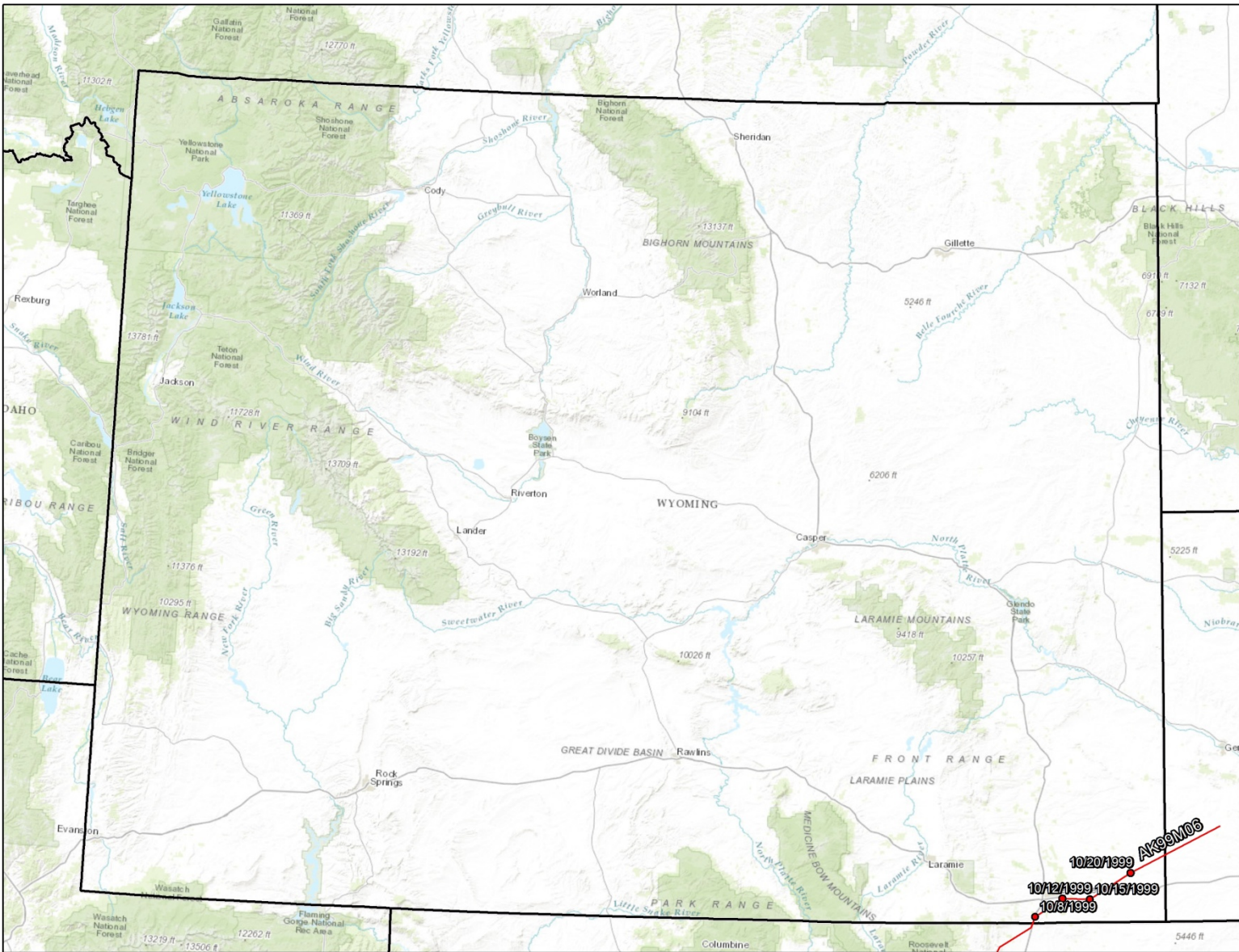


Figure 1. Known locations of lynx AK99M06 in Wyoming.

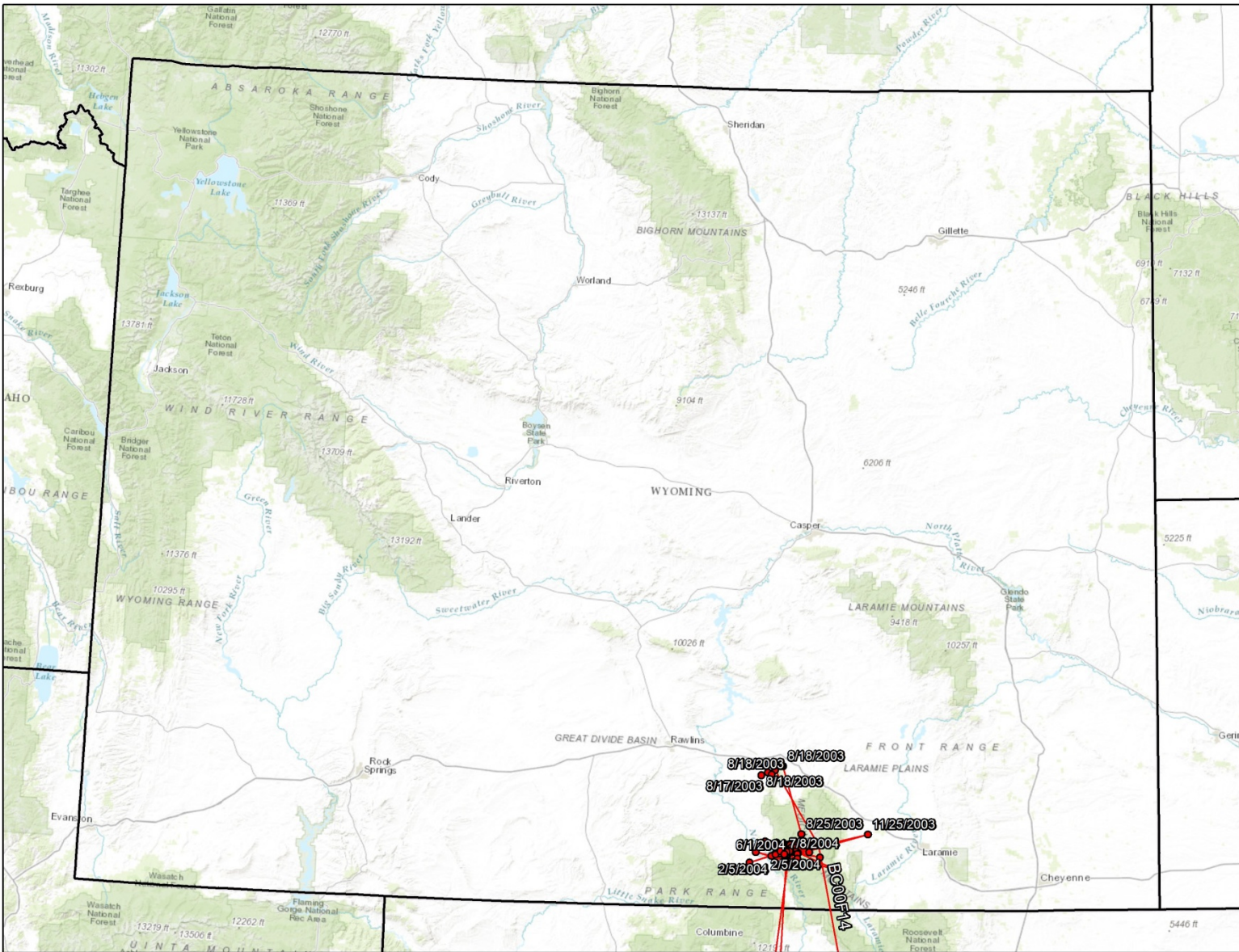


Figure 2. Known locations of lynx BC00F14 in Wyoming.

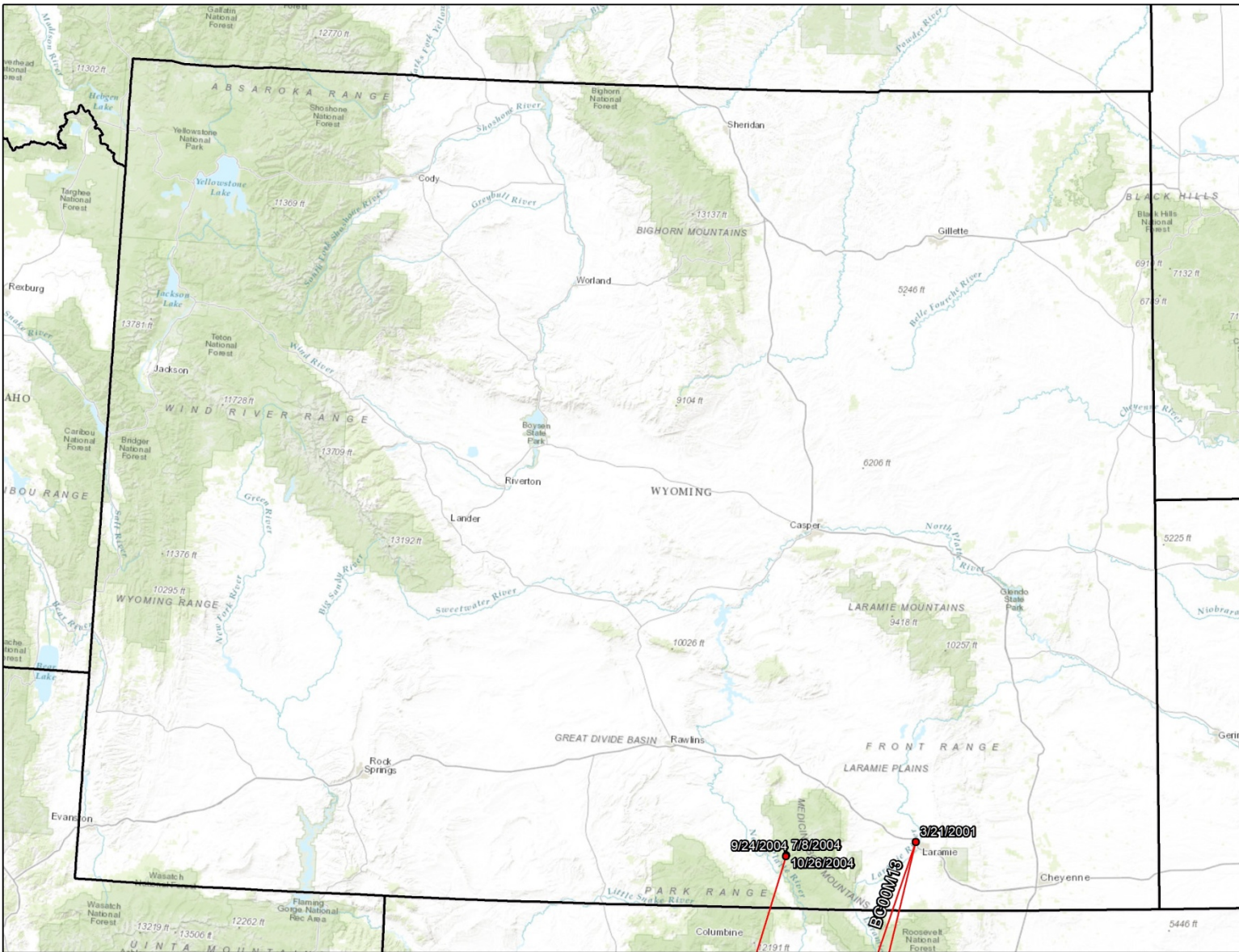


Figure 3. Known locations of lynx BC00M13 in Wyoming.

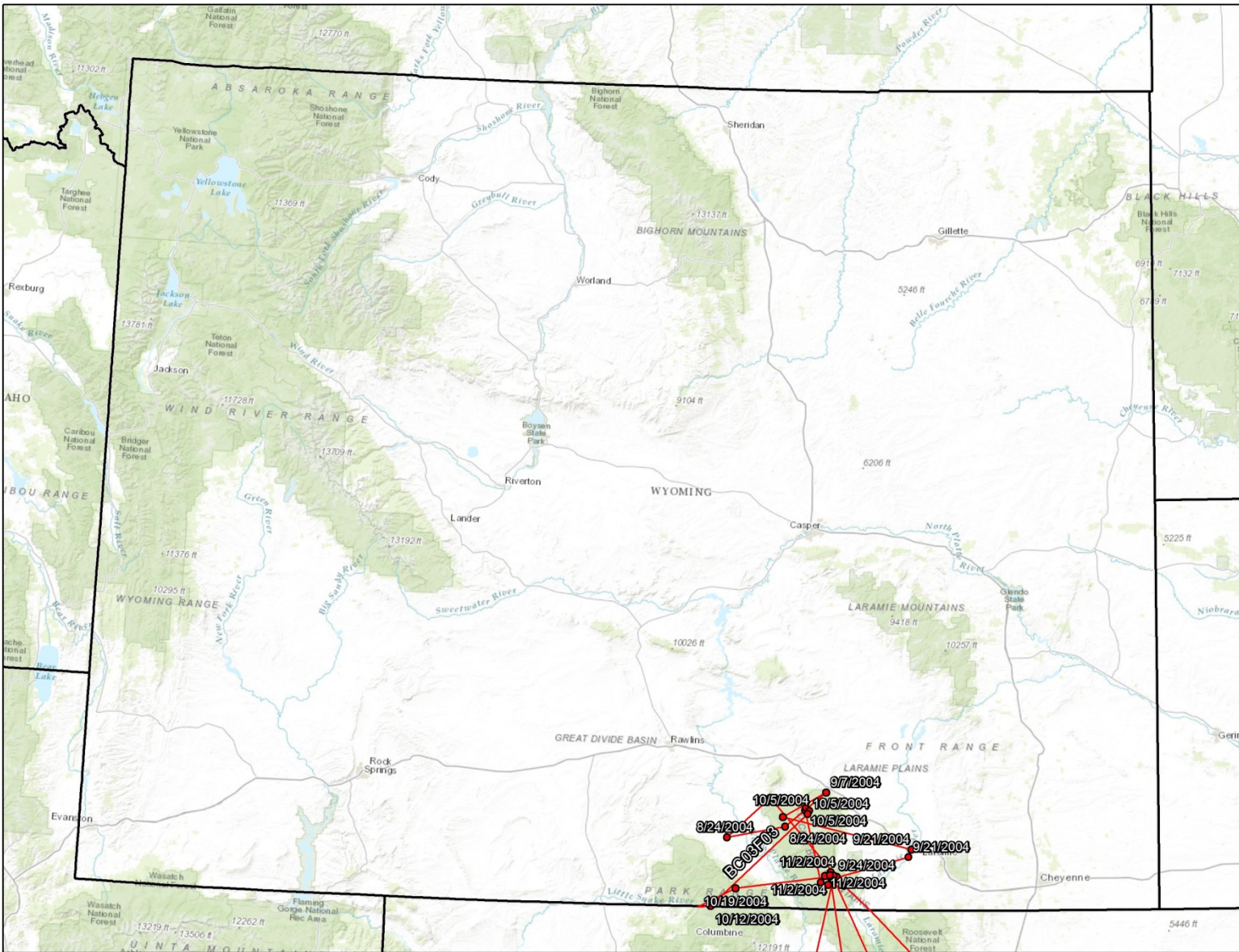


Figure 4. Known locations of lynx BC03F03 in Wyoming.

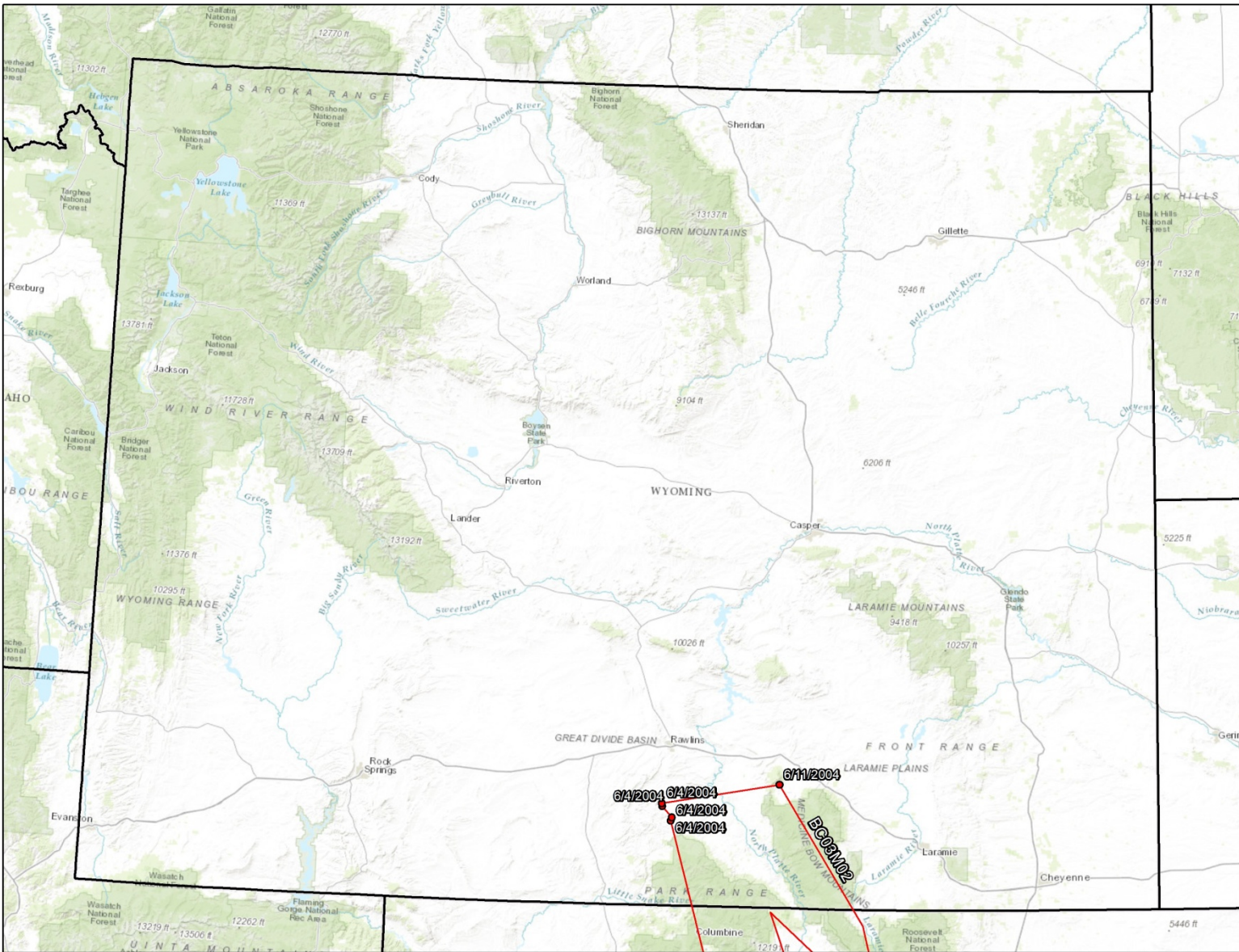


Figure 5. Known locations of lynx BC03M02 in Wyoming.

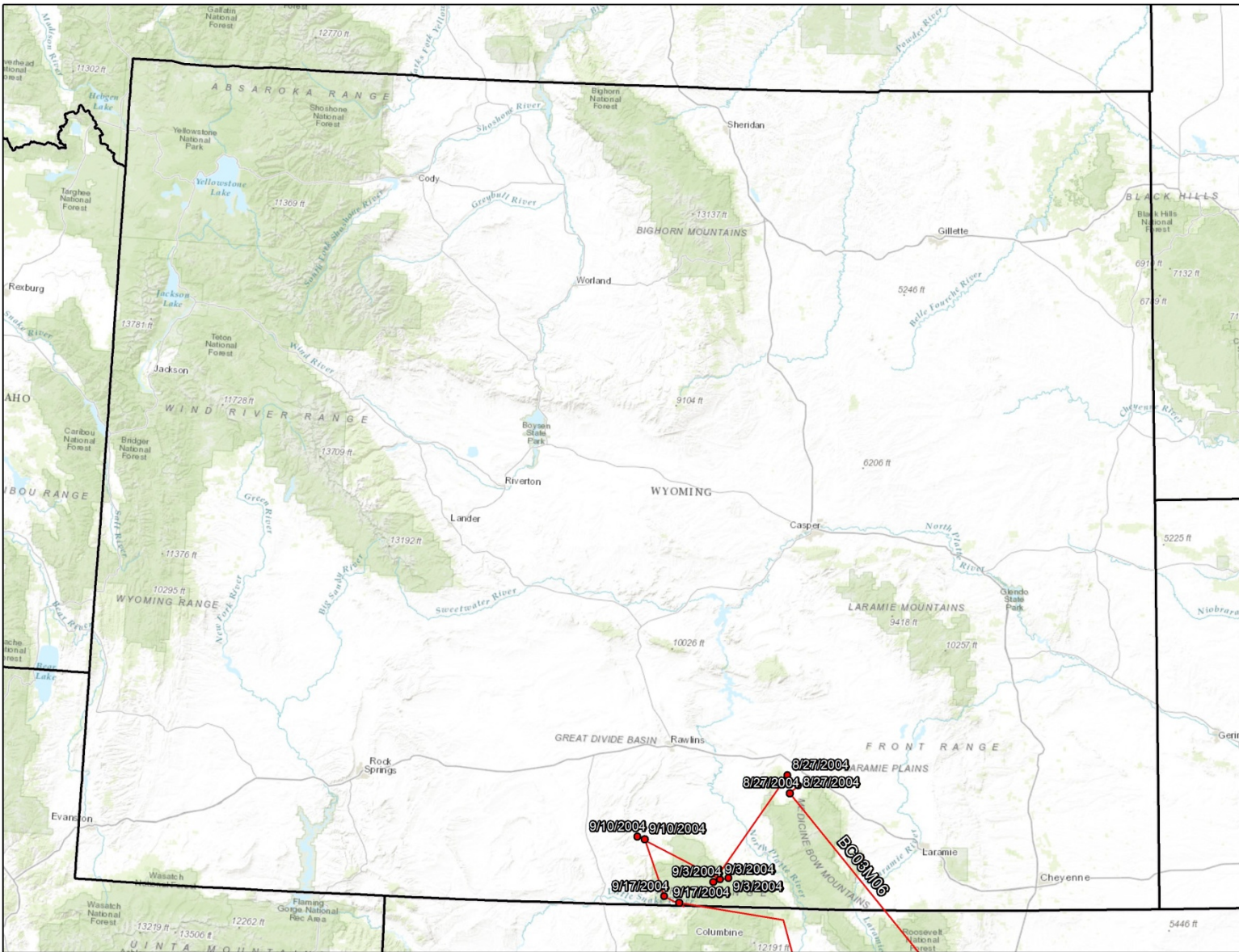


Figure 6. Known locations of lynx BC03M06 in Wyoming.

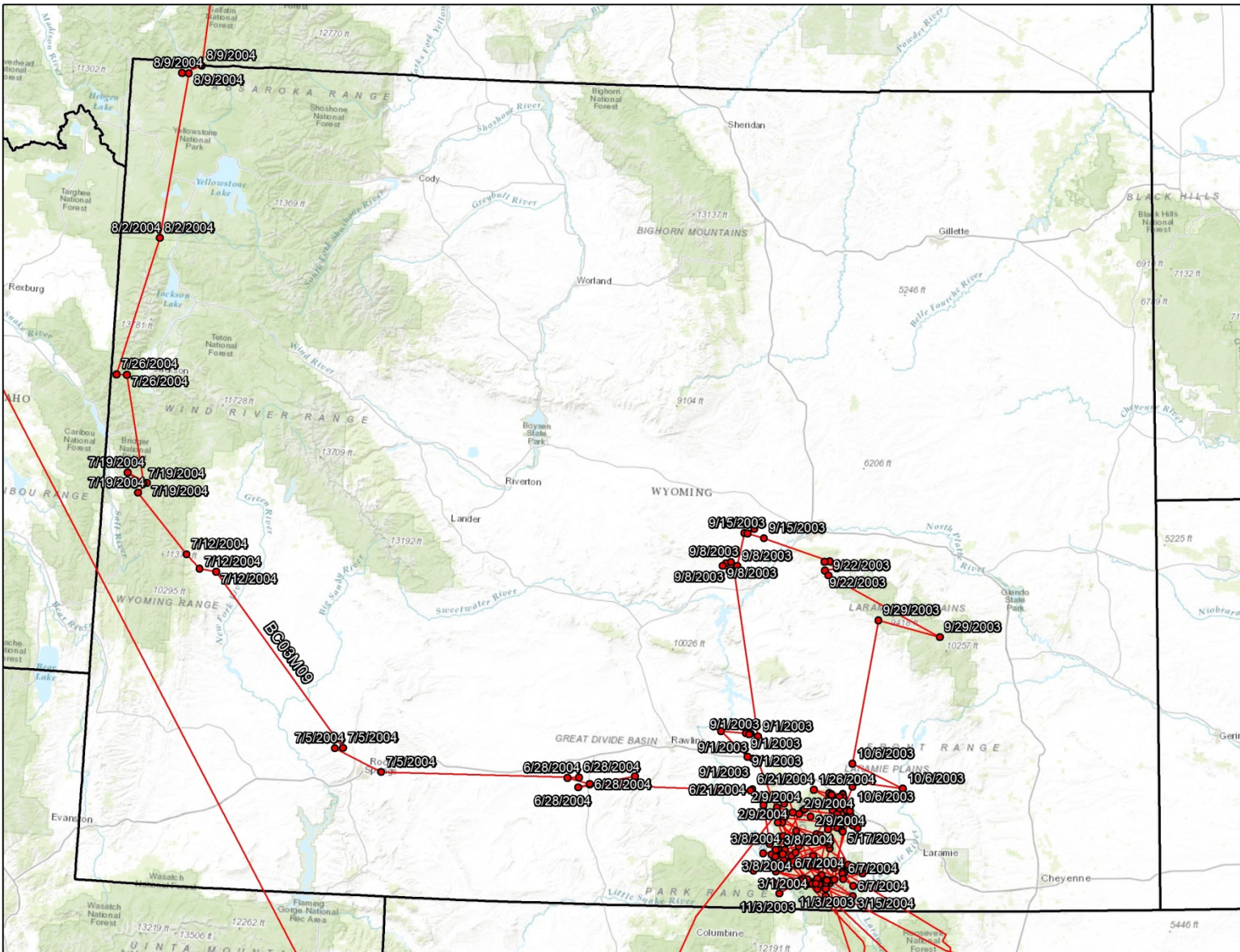


Figure 7. Known locations of lynx BC03M09 in Wyoming.

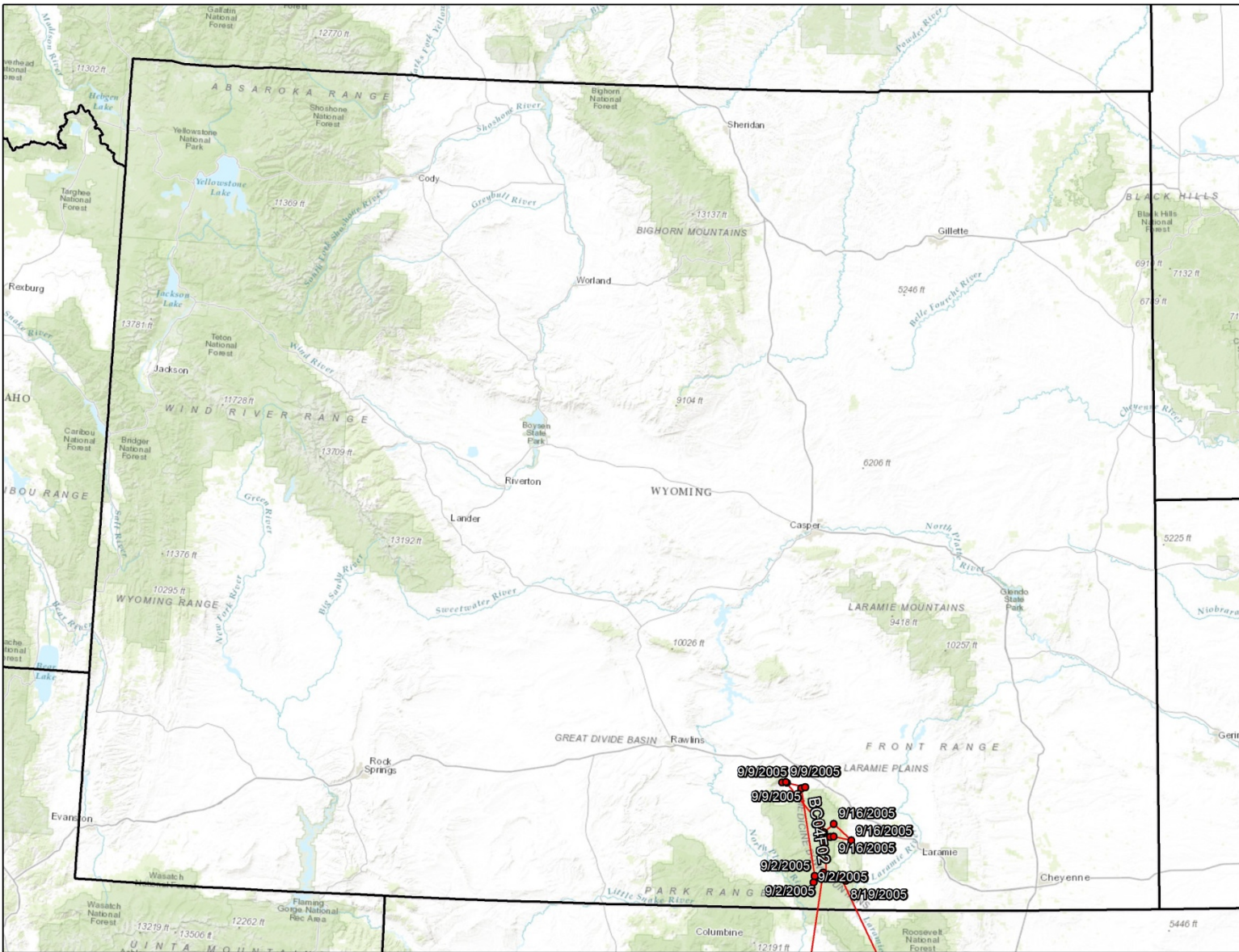


Figure 8. Known locations of lynx BC04F02 in Wyoming.

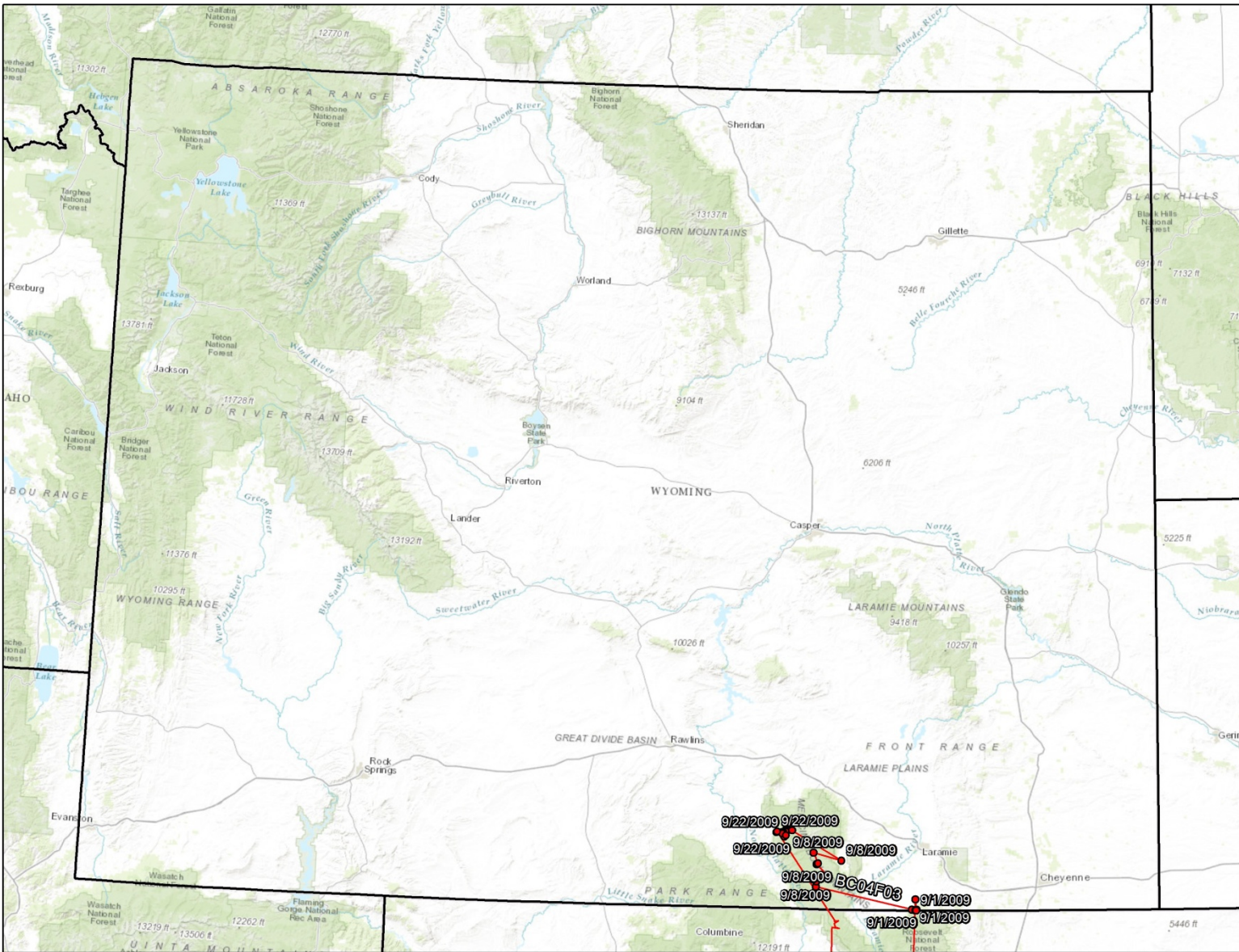


Figure 9. Known locations of lynx BC04F03 in Wyoming.

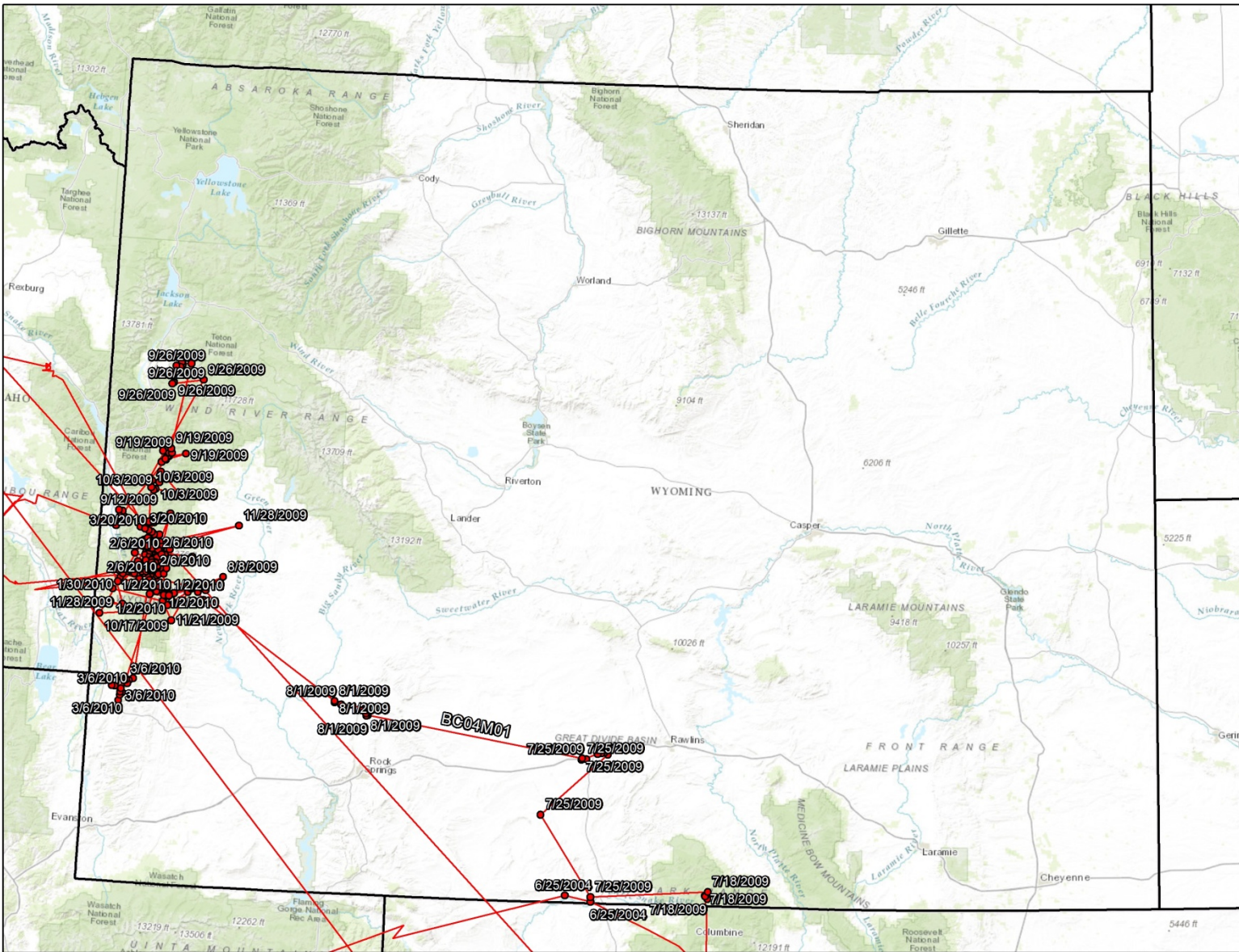


Figure 10. Known locations of lynx BC04M01 in Wyoming.

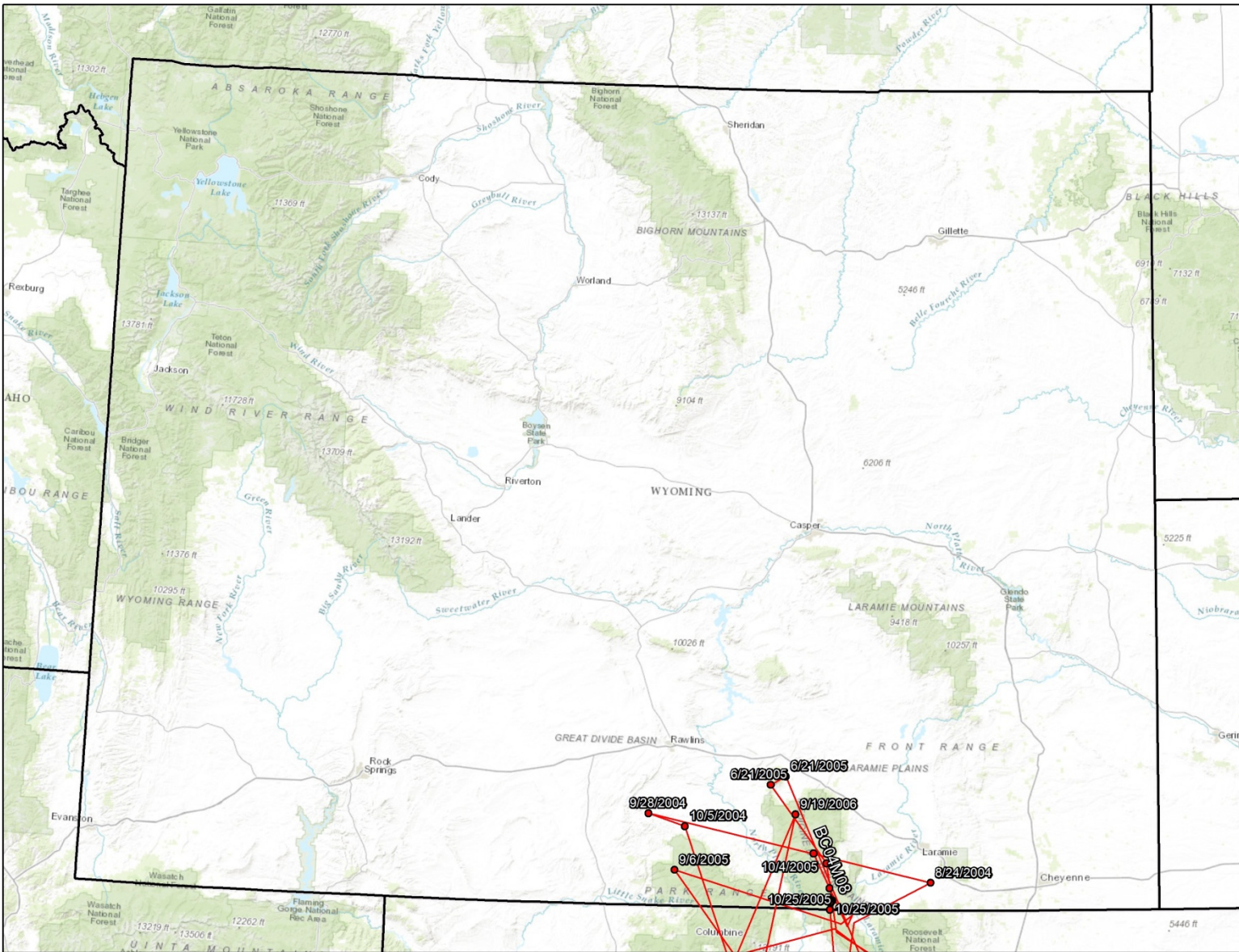


Figure 11. Known locations of lynx BC04M08 in Wyoming.

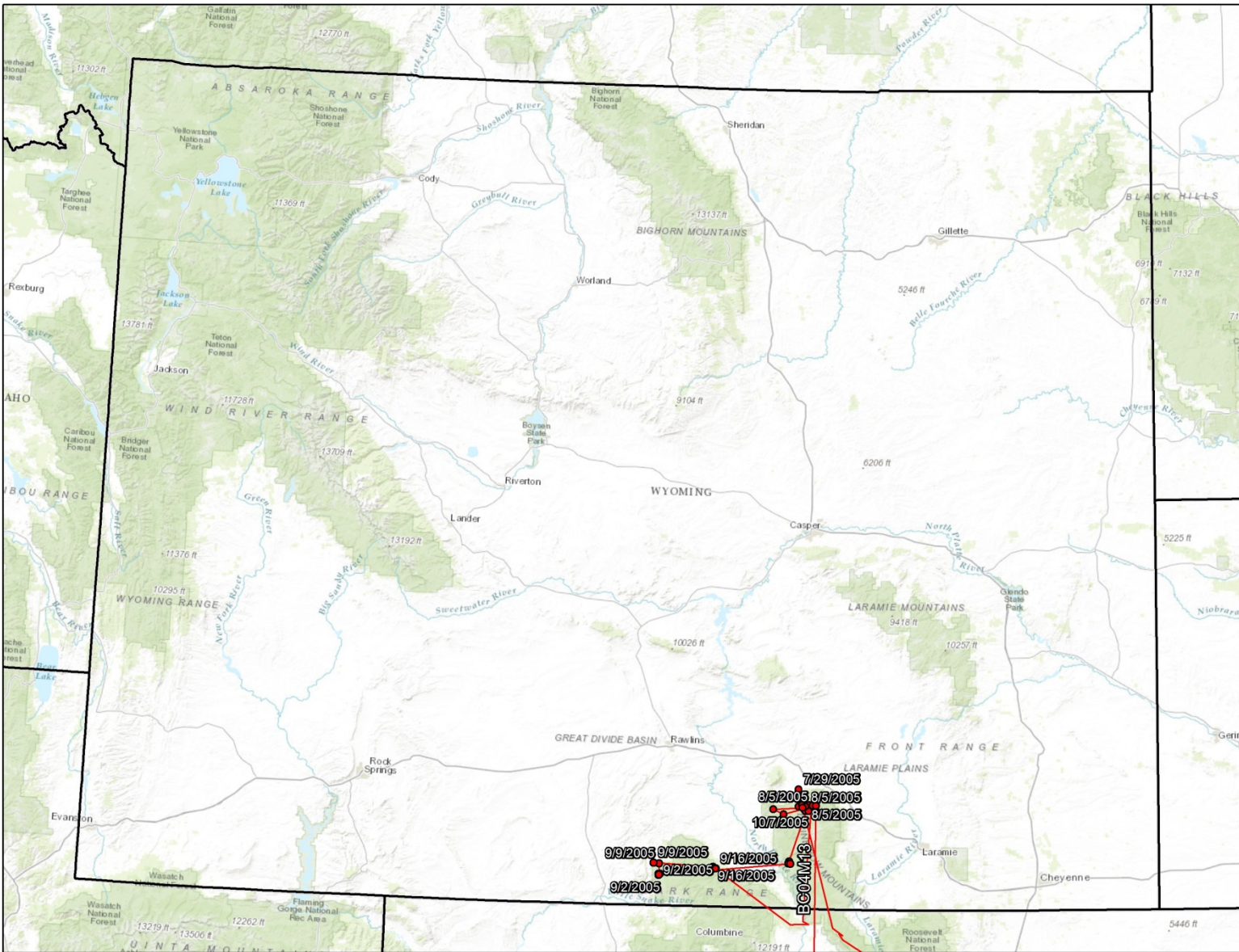


Figure 12. Known locations of lynx BC04M13 in Wyoming.

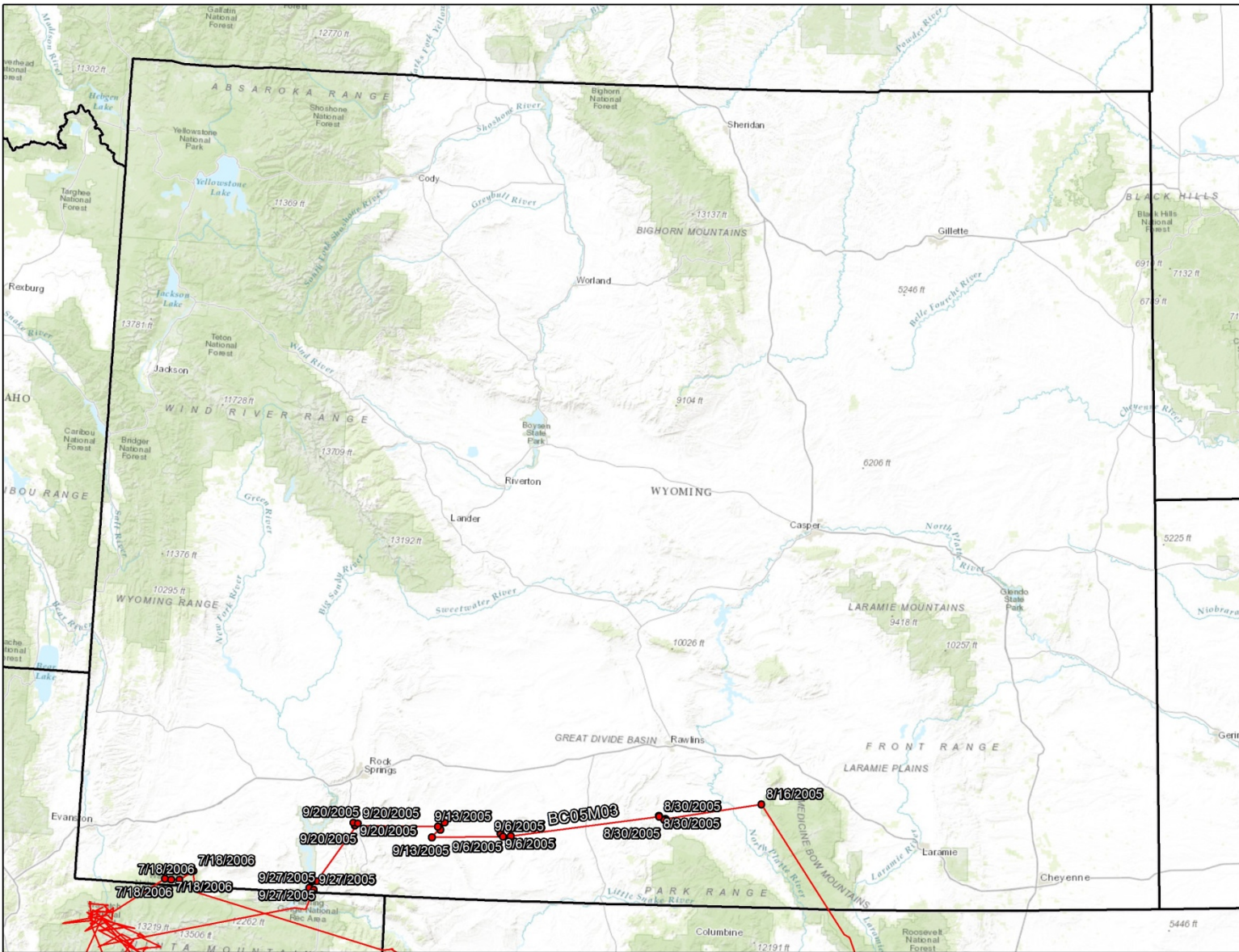


Figure 13. Known locations of lynx BC05M03 in Wyoming.

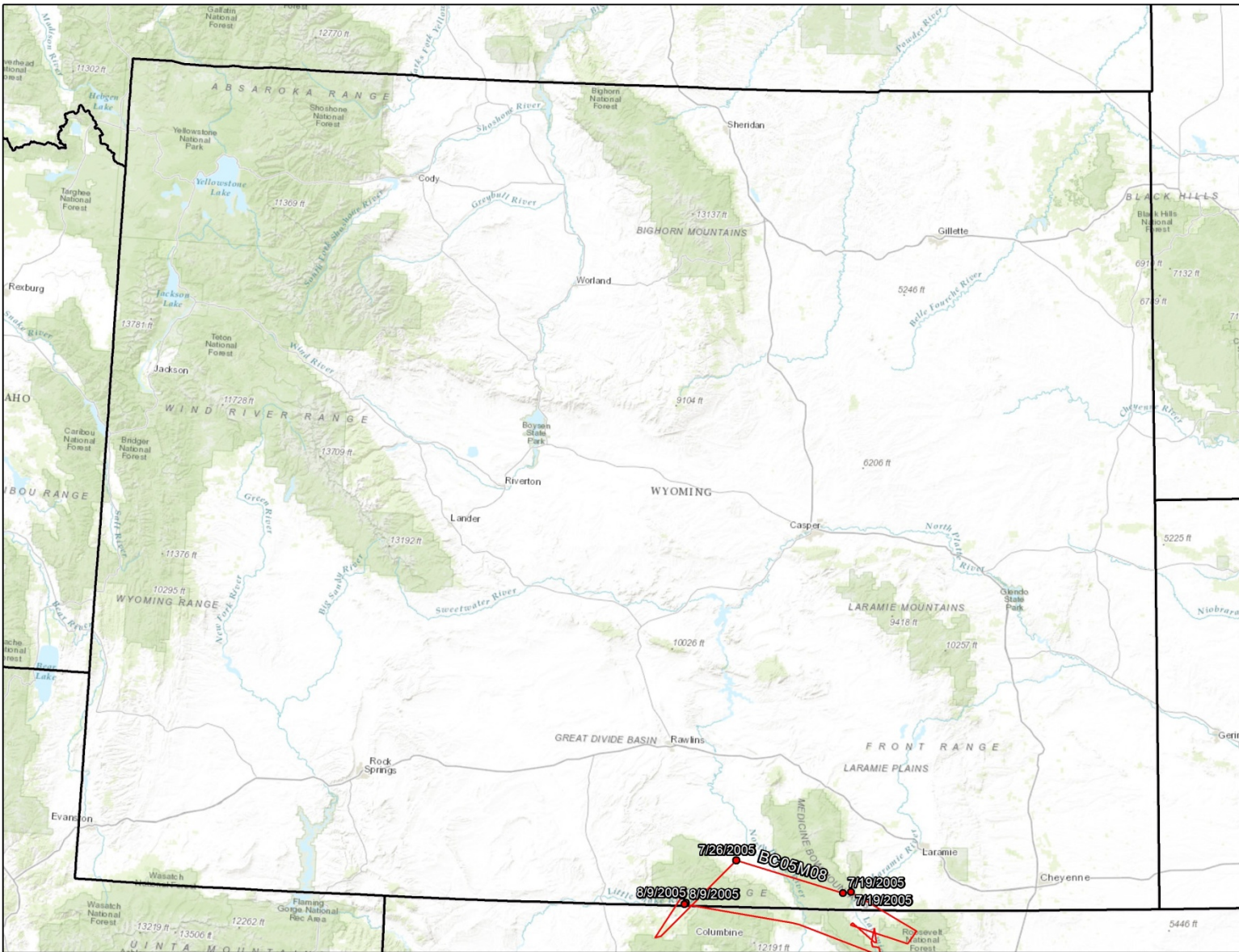


Figure 14. Known locations of lynx BC05M08 in Wyoming.

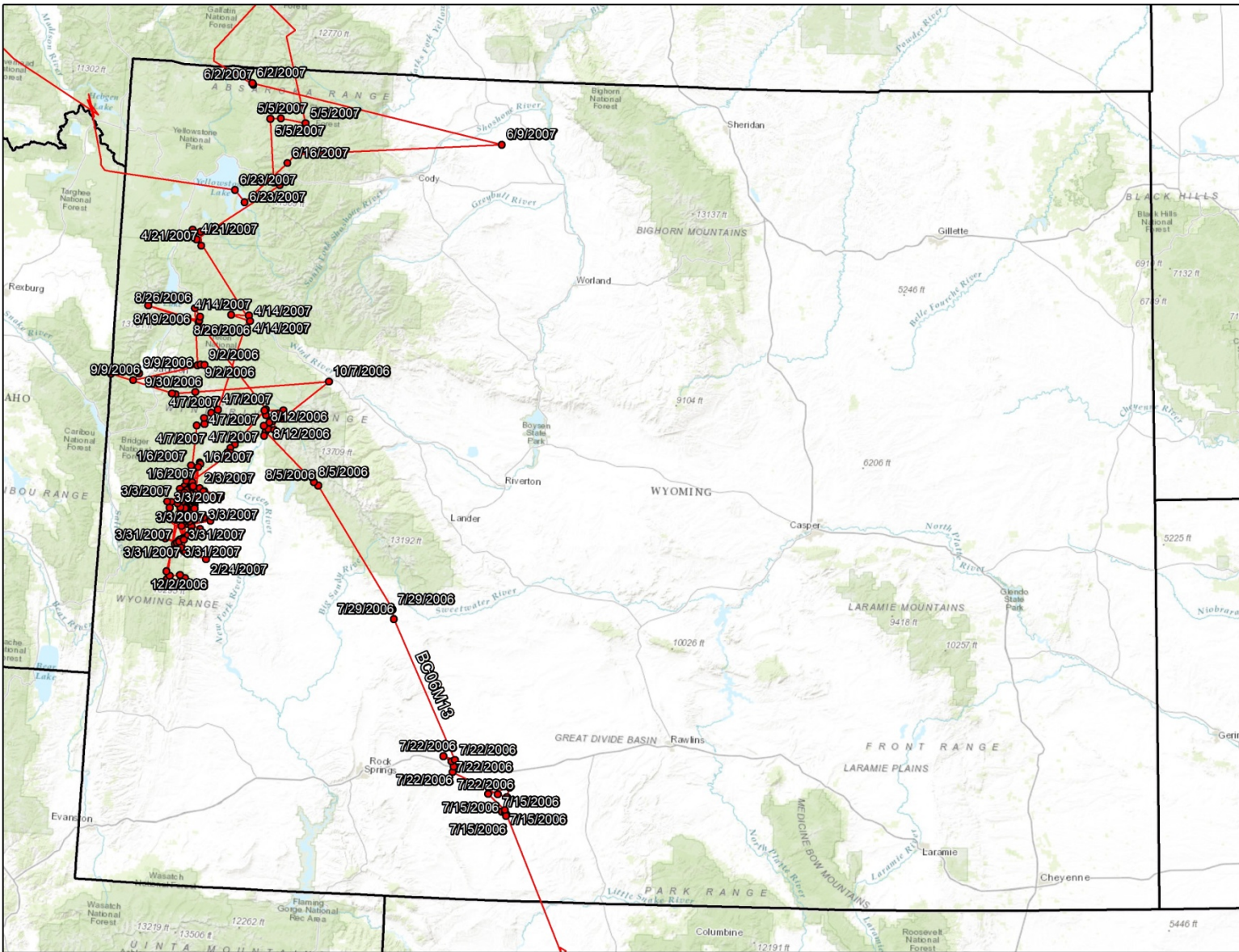


Figure 15. Known locations of lynx BC06M13 in Wyoming.

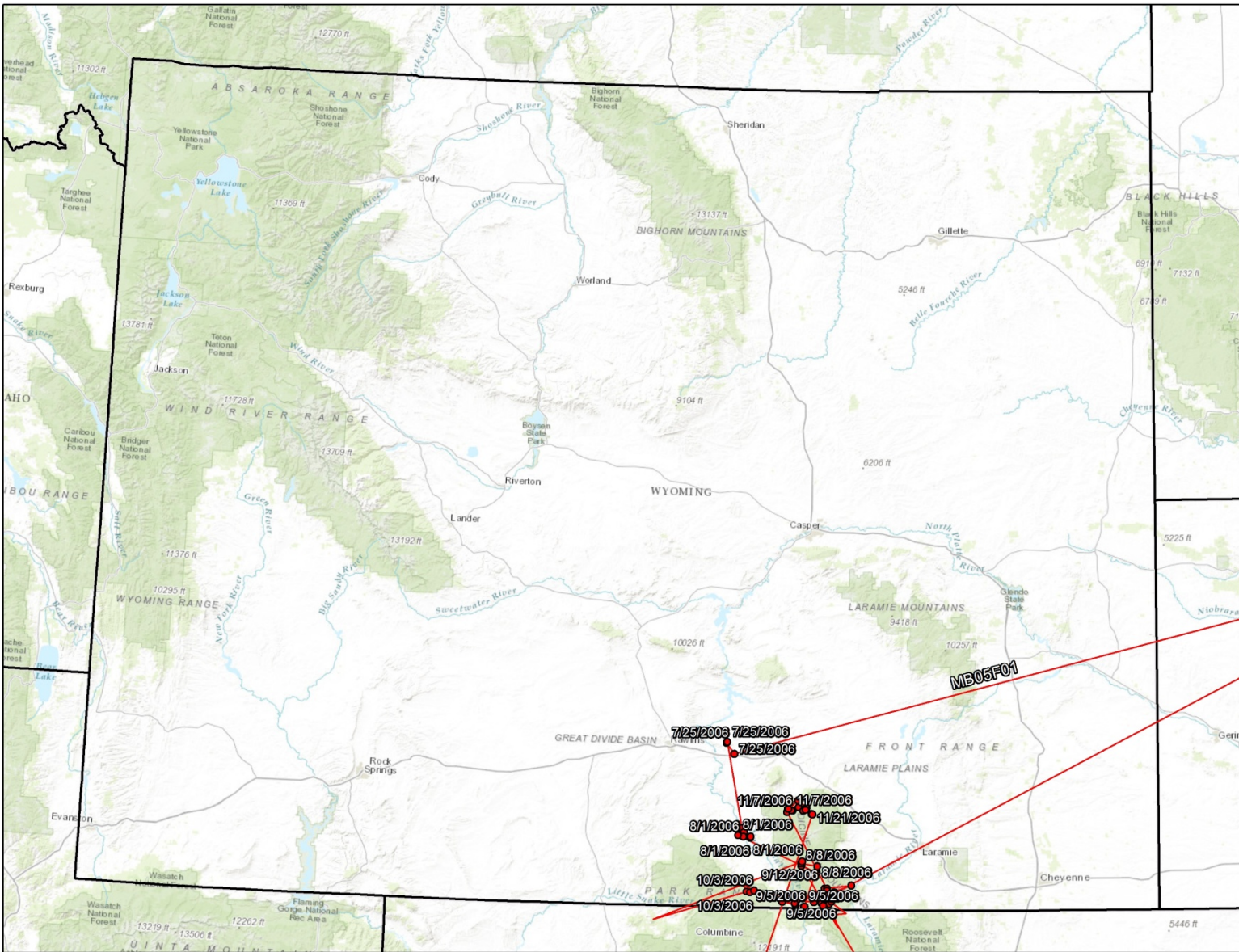


Figure 16. Known locations of lynx MB05F01 in Wyoming.

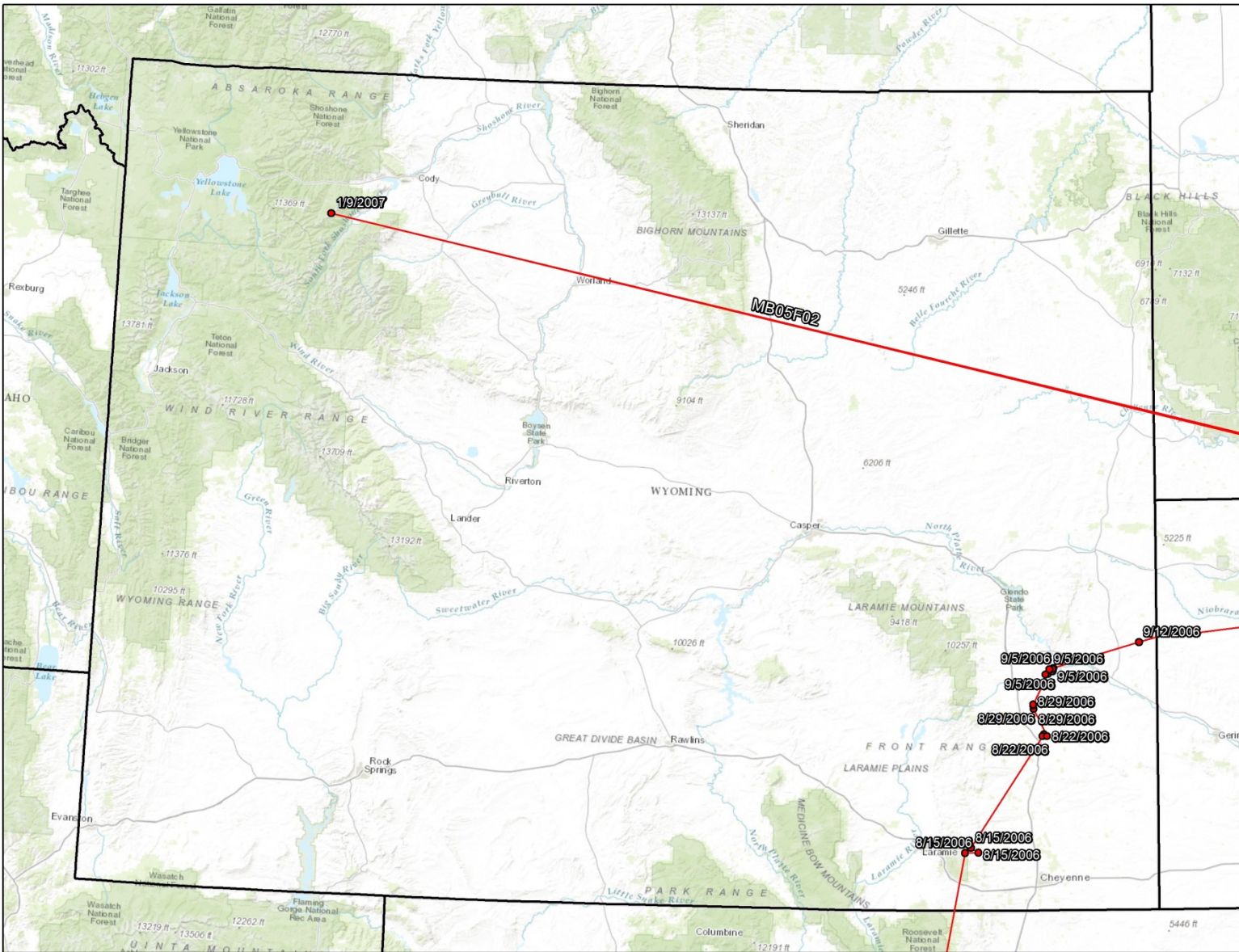


Figure 17. Known locations of lynx MB05F02 in Wyoming.

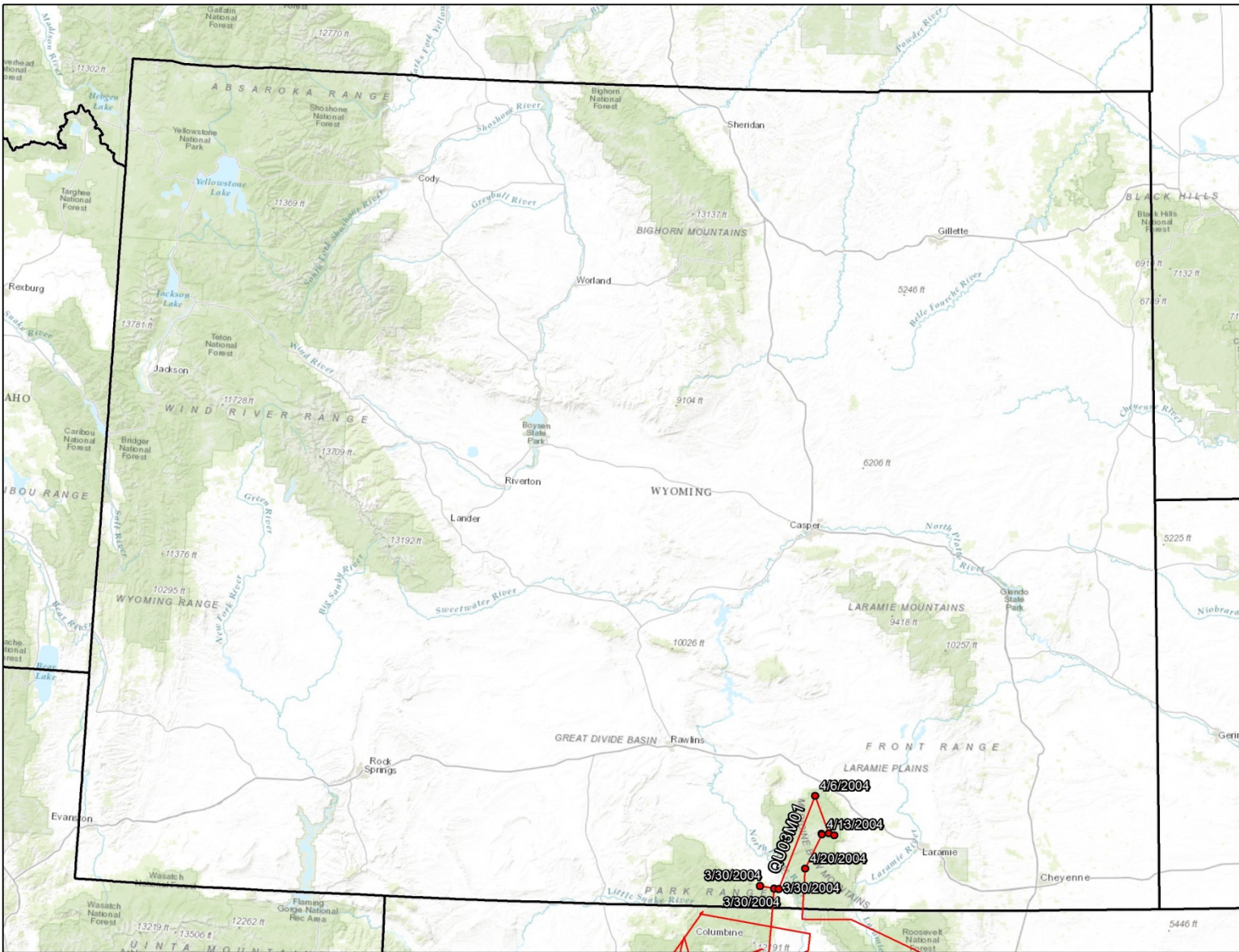


Figure 19. Known locations of lynx QU03M01 in Wyoming.

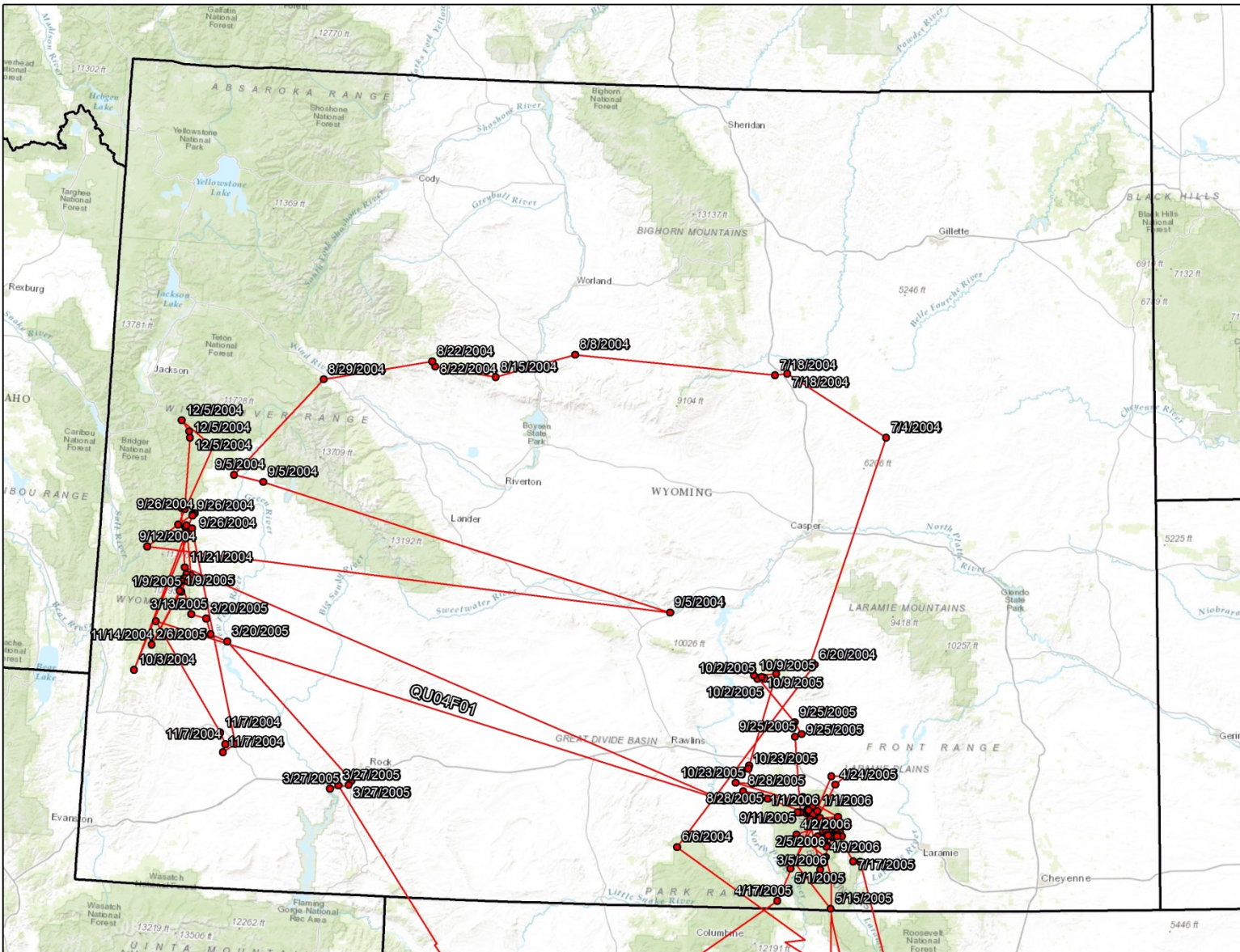


Figure 20. Known locations of lynx QU04F01 in Wyoming.

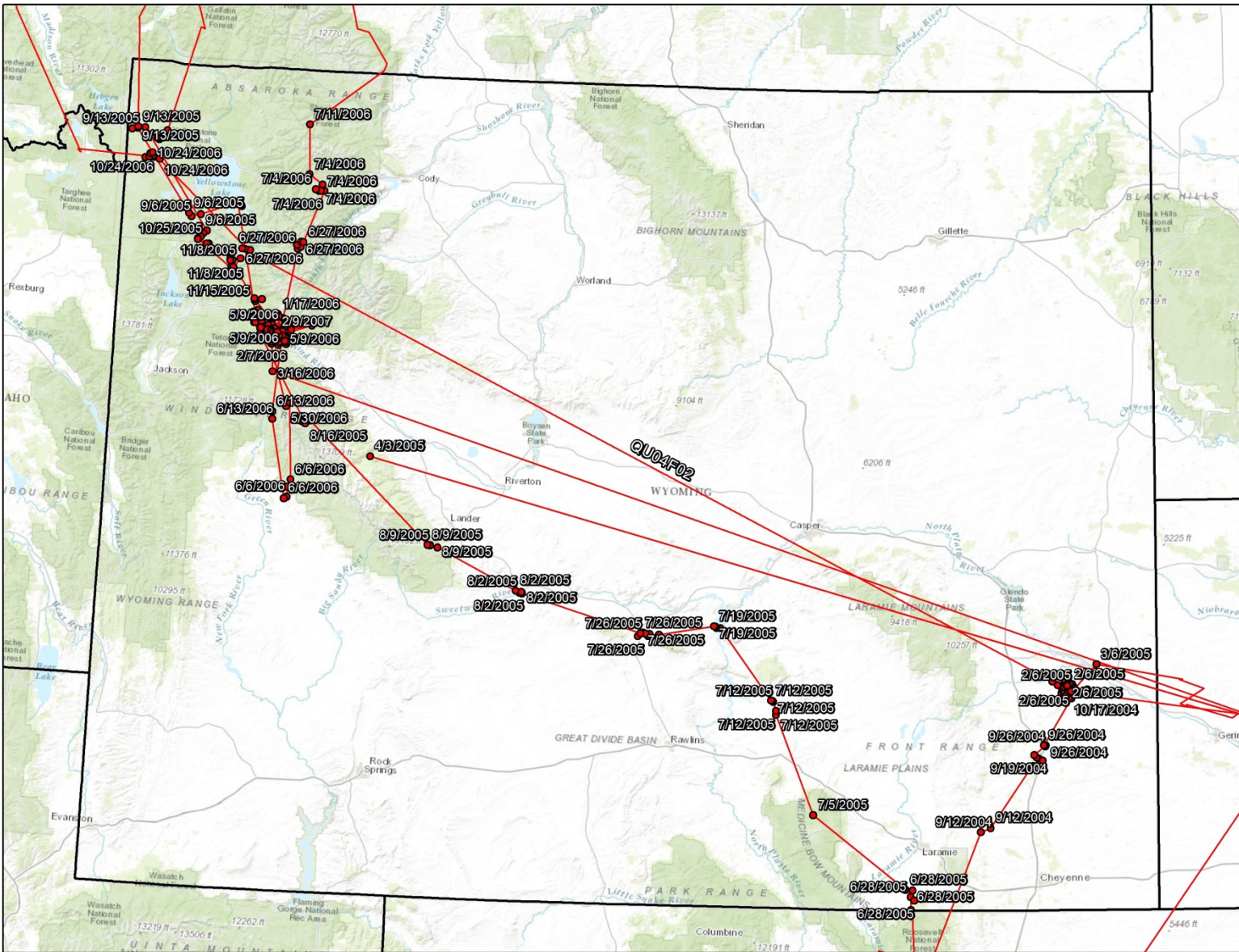


Figure 21. Known locations of lynx QU04F02 in Wyoming.

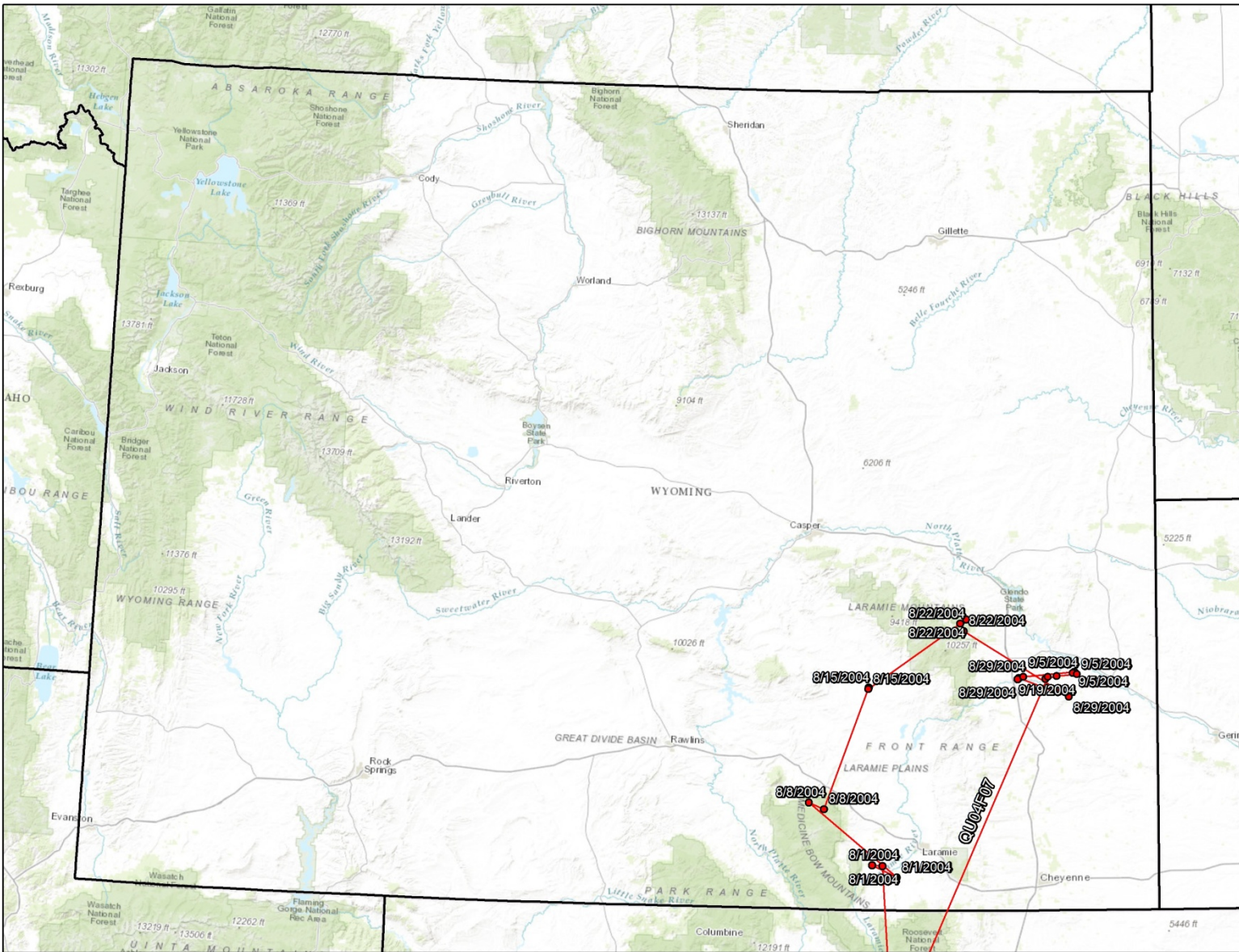


Figure 22. Known locations of lynx QU04F07 in Wyoming.

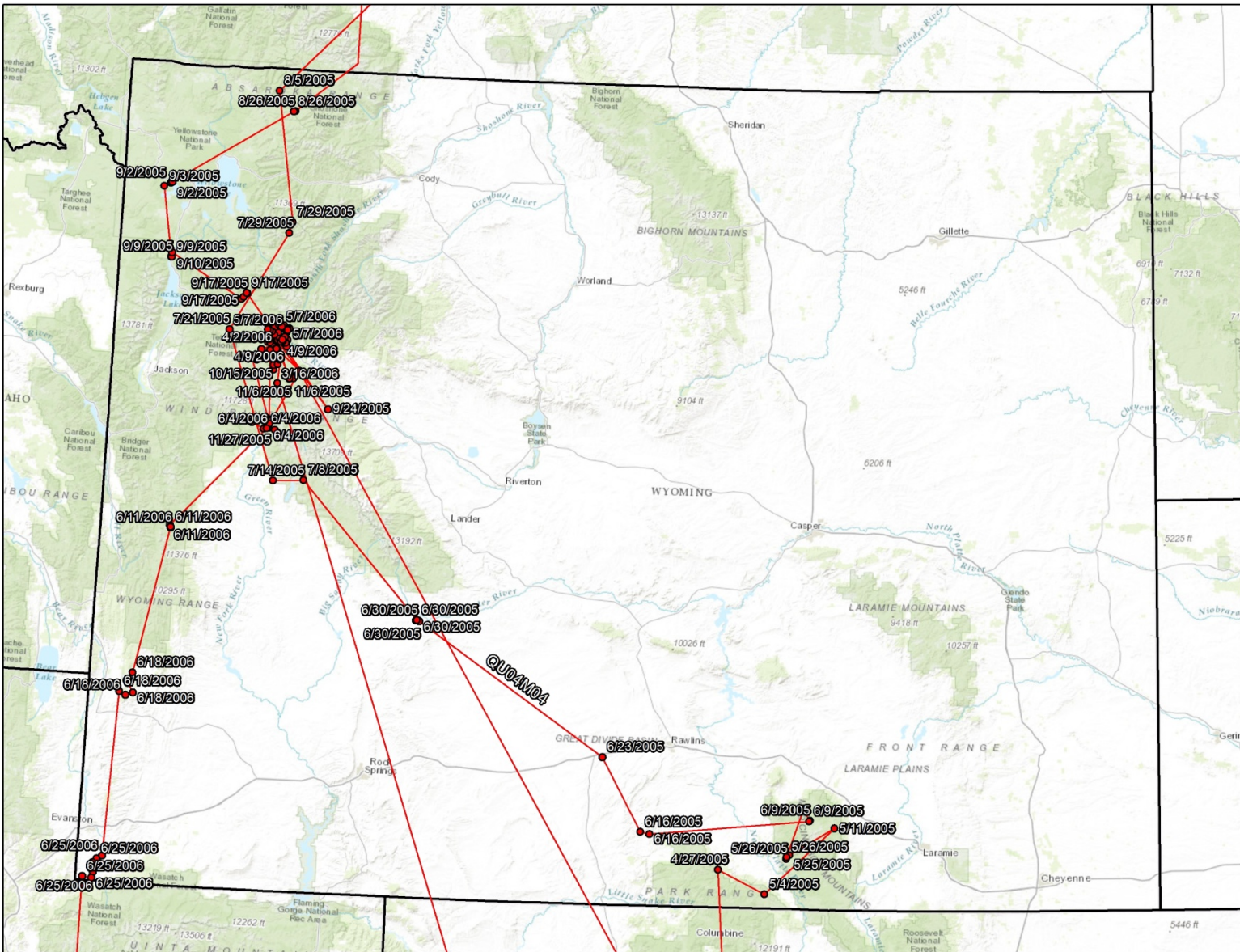


Figure 23. Known locations of lynx QU04M04 in Wyoming.

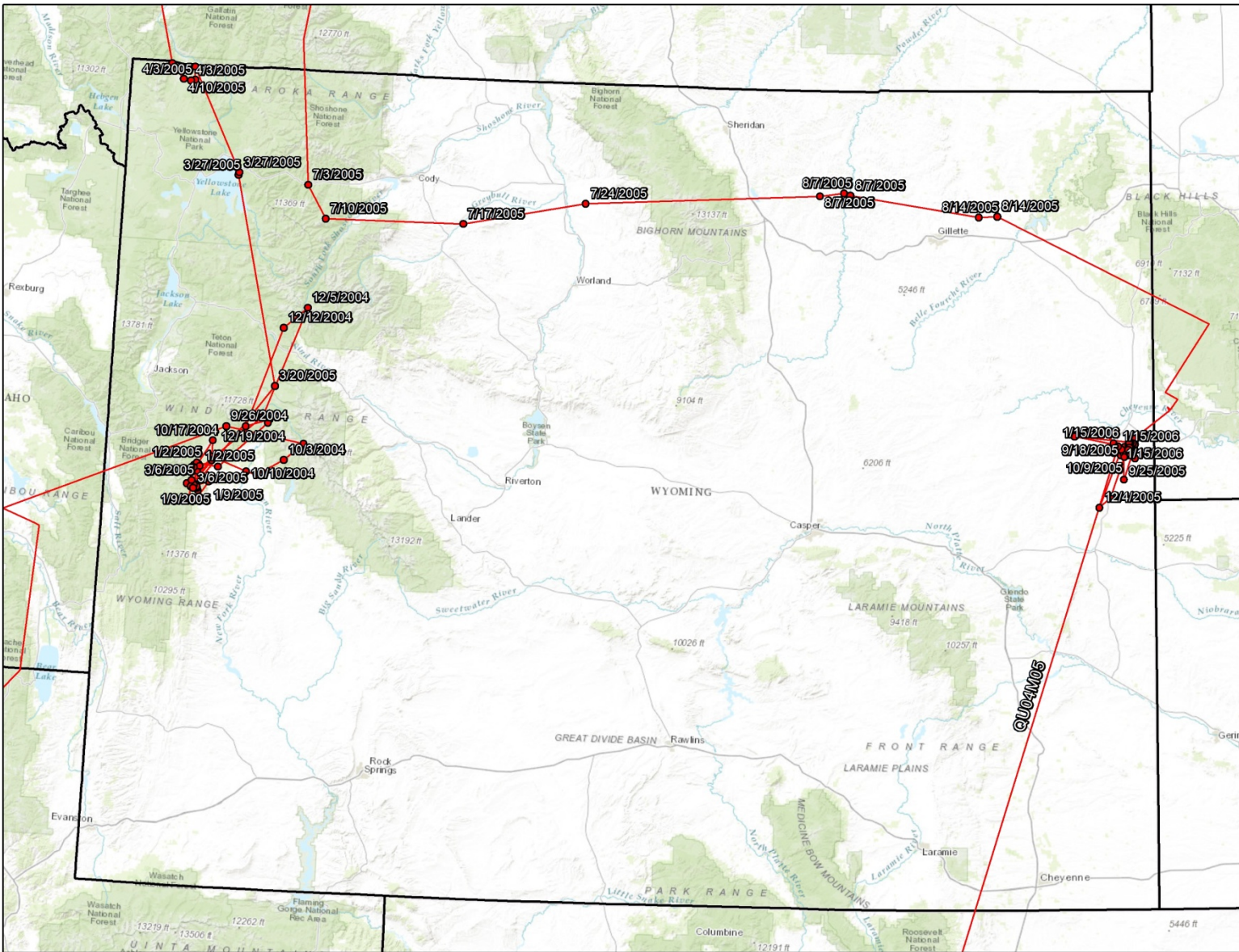


Figure 24. Known locations of lynx QU04M05 in Wyoming.

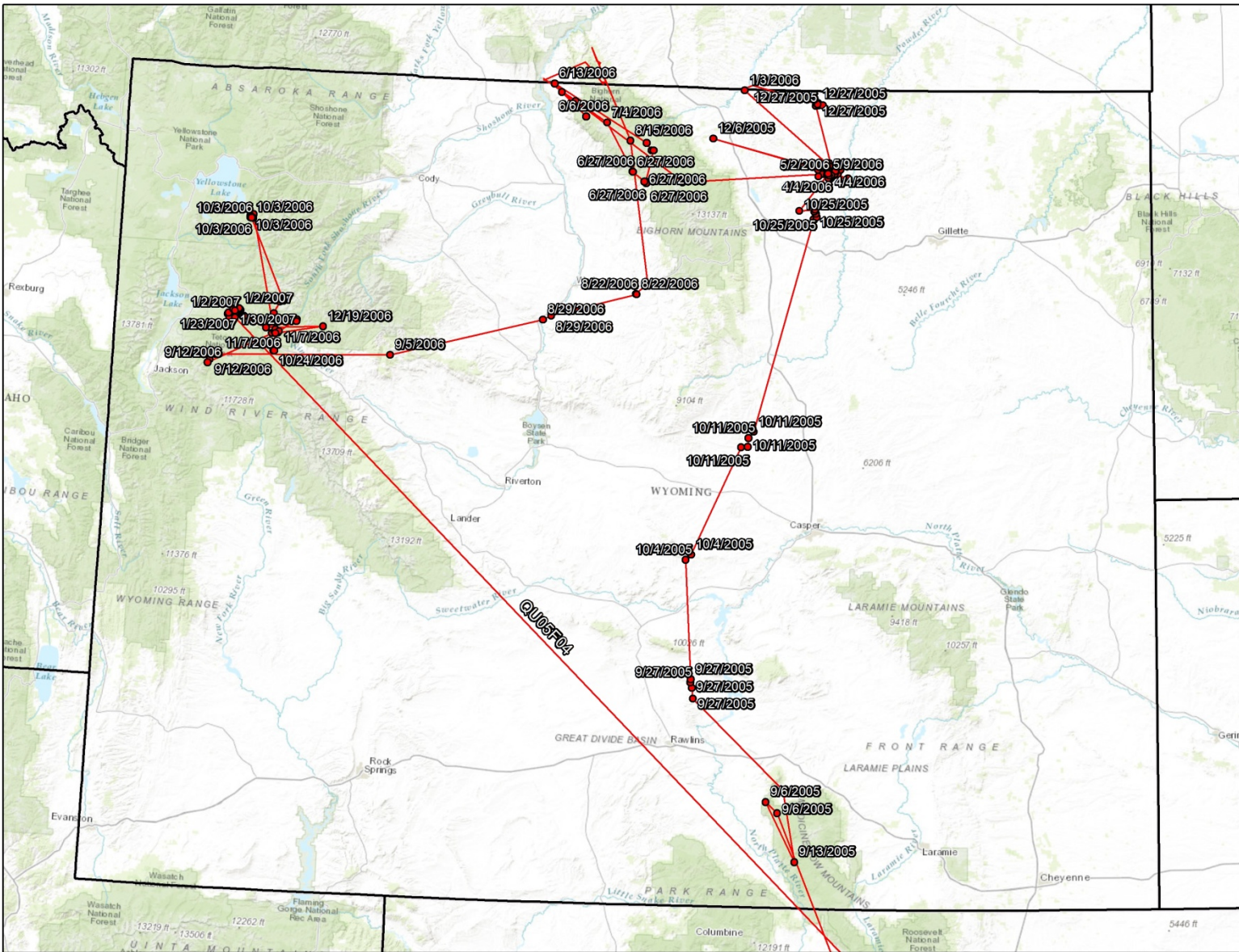


Figure 25. Known locations of lynx QU05F04 in Wyoming.

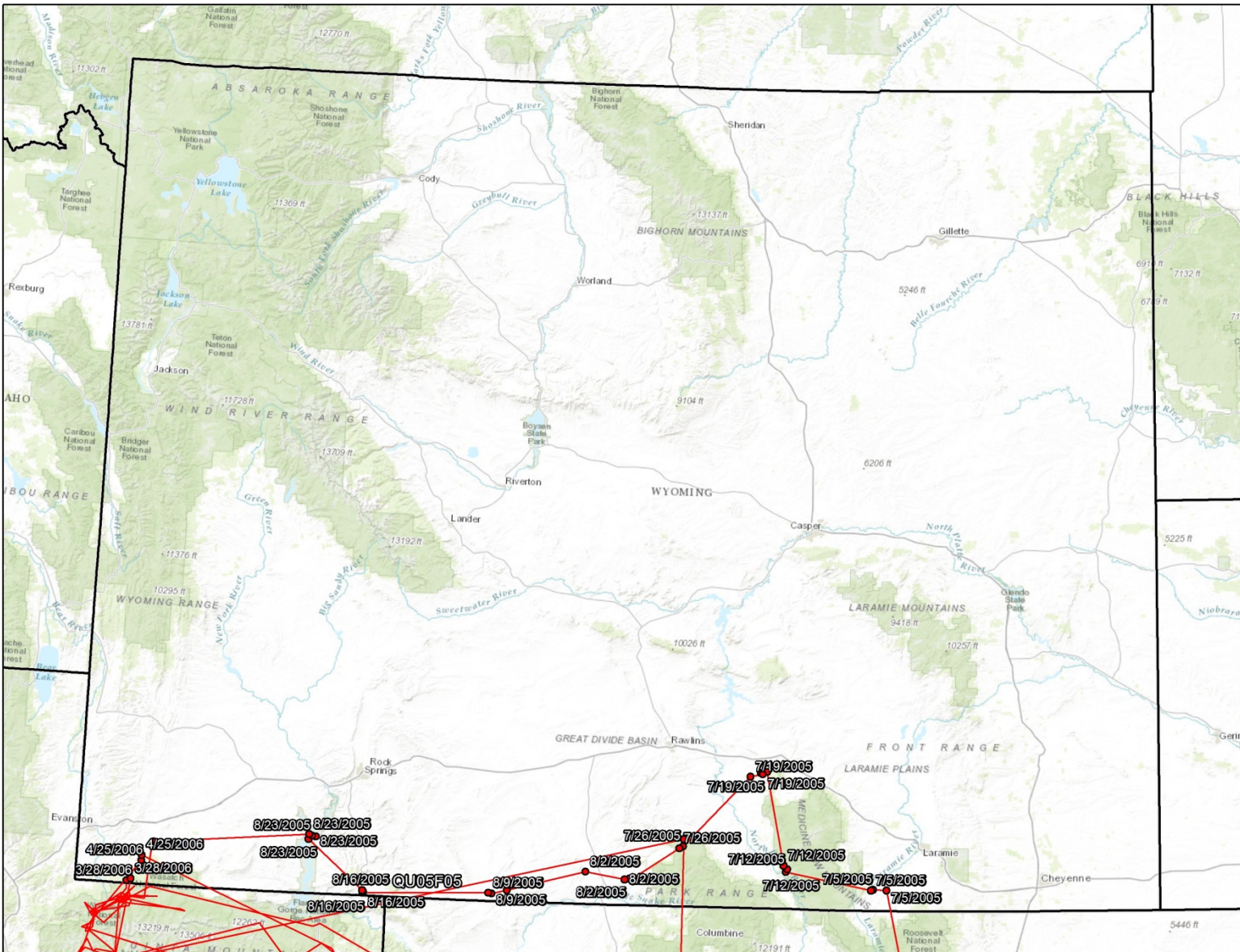


Figure 26. Known locations of lynx QU05F05 in Wyoming.

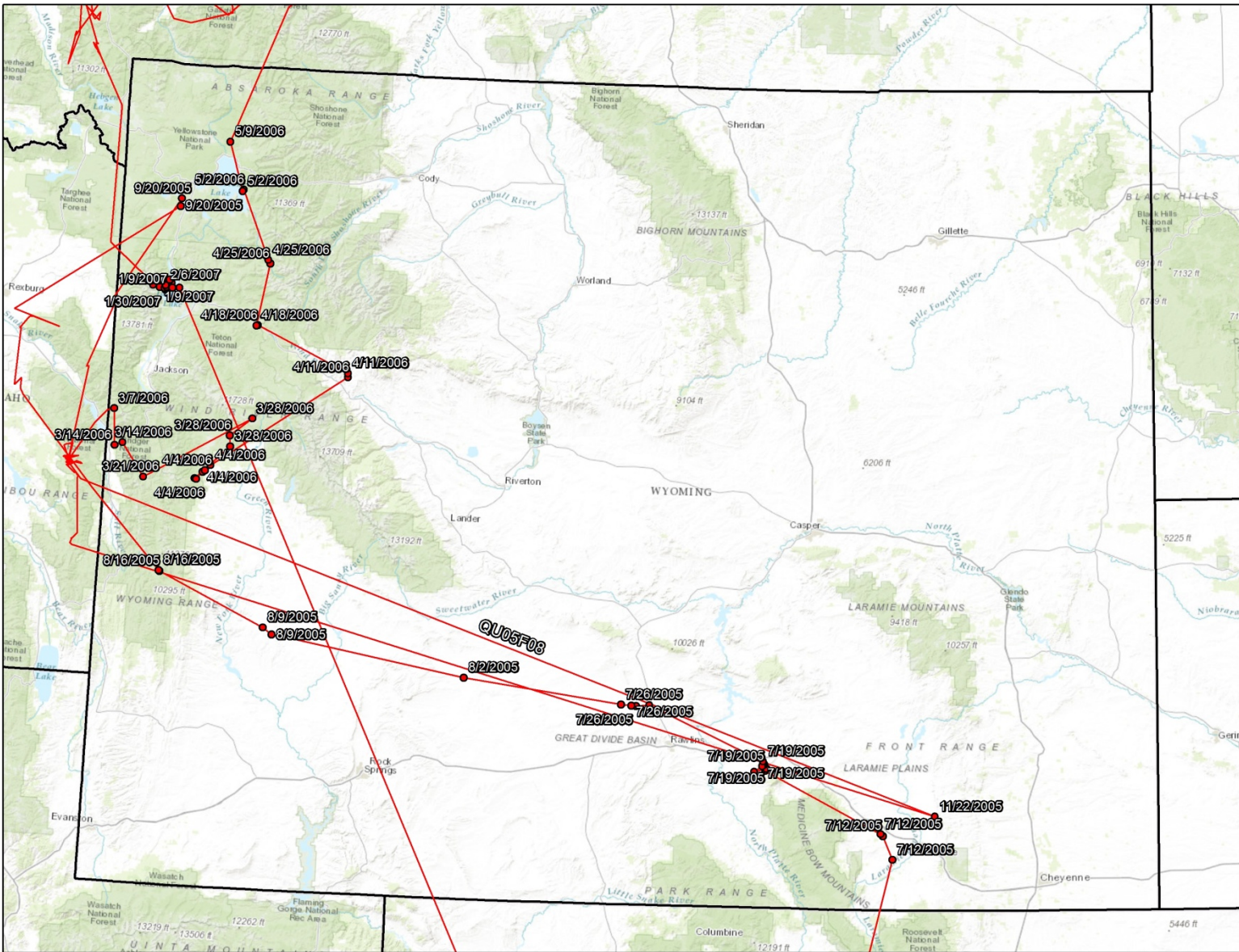


Figure 27. Known locations of lynx QU05F08 in Wyoming.

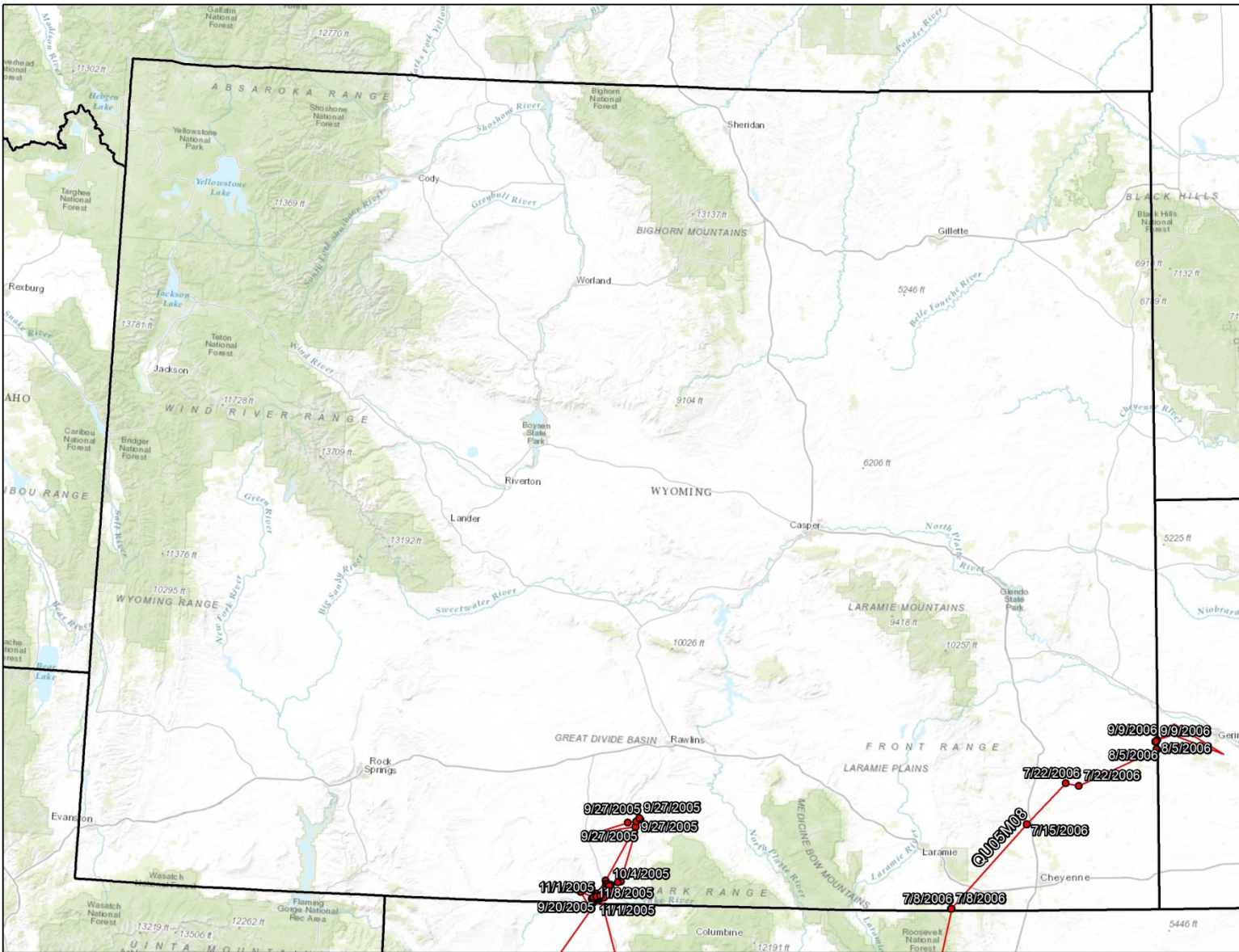


Figure 28. Known locations of lynx QU05M08 in Wyoming.

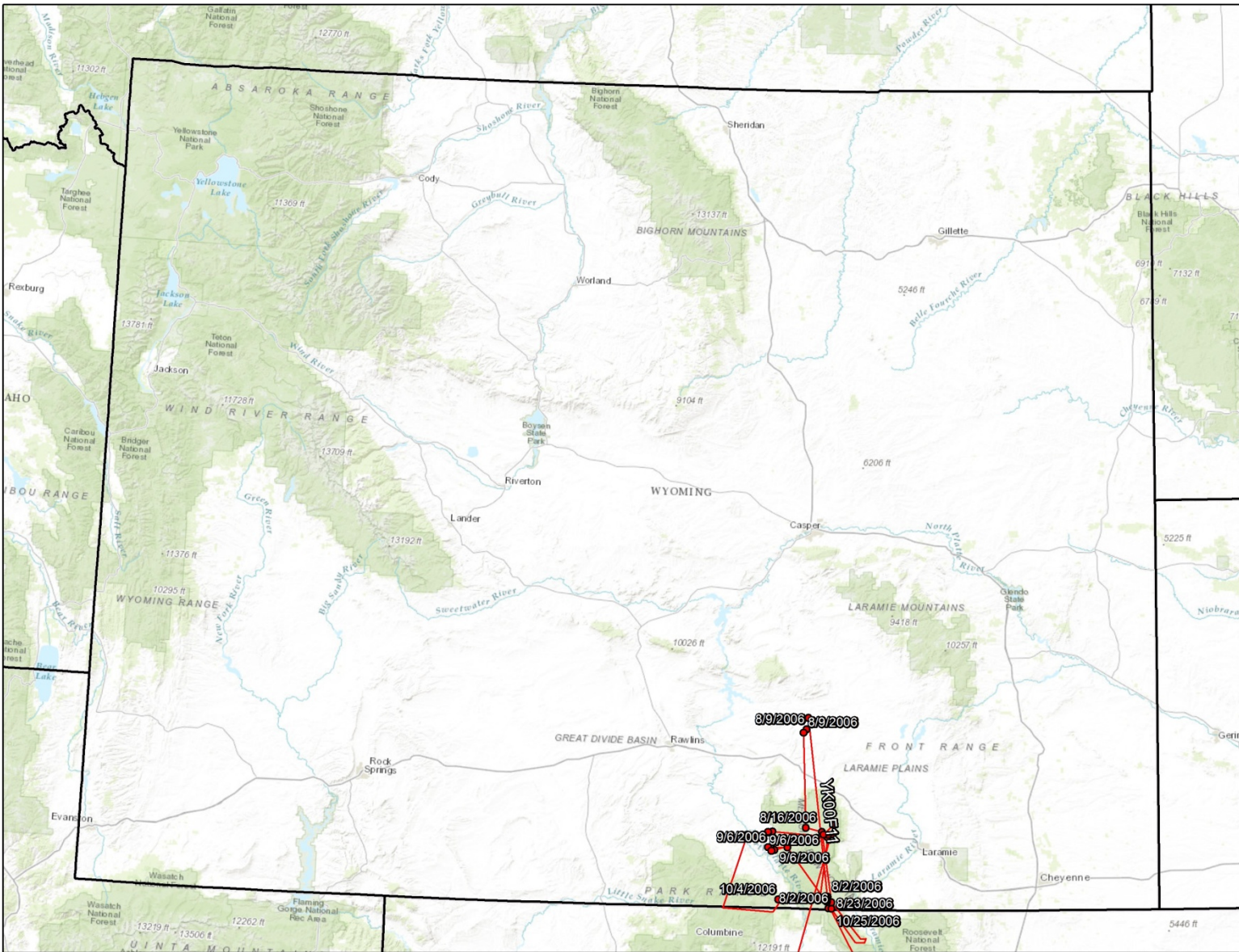


Figure 29. Known locations of lynx YK00F11 in Wyoming.

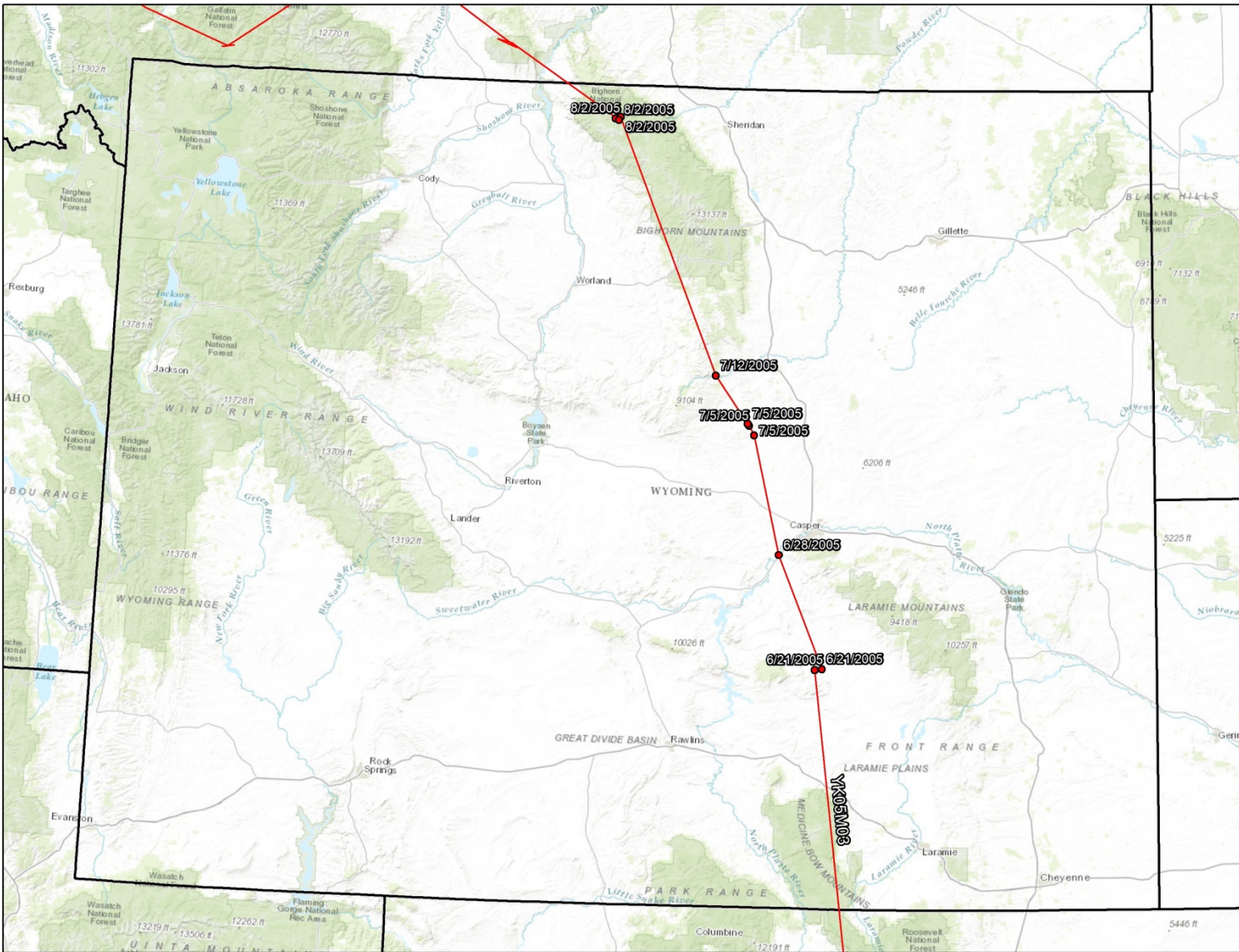


Figure 30. Known locations of lynx YK05M03 in Wyoming.



Figure 31. Known locations of lynx YK06M02 in Wyoming.