Habitat Use of Northern Leopard Frogs in the Front Range

2012 Final Report

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Background

Northern leopard frogs in the western U.S. have undergone population extirpations and reductions in abundance over the past century (Nichols 2006). Based on resurveys of known leopard frog habitat and extensive surveys stratified by land use type, our research group has found that large wetlands that are not surrounded by urban or suburban development are important for leopard frog population persistence in the Front Range (Johnson et al. 2011). Here we expanded on previous work done by our lab and local management agencies by investigating how leopard frogs in persisting populations move within and among water bodies using radiotelemetry. Understanding the movement patterns of leopard frogs will help to identify priority habitat such as overwintering sites and movement corridors, and uncover rates of individual frog movement that can be used to determine the width of protected “buffer zones” around leopard frog habitat.

Project Goals

This year, in collaboration with City of Boulder Open Space and Mountain Parks (OSMP) and Boulder County Parks and Open Space (BCPOS), we sought to: 1) investigate habitat use of northern leopard frogs using radiotelemetry; 2) characterize patterns of individual leopard frog movement; and 3) characterize the movement of individuals among temporary and permanent water bodies to identify overwintering sites and habitat features that facilitate population persistence. Despite an initial interest in using mark-recapture methods to investigate individual survival and source-sink dynamics among populations, prior to the beginning of the study we decided in collaboration with OSMP and BCPOS staff to eliminate the mark-recapture component of the study for two reasons: 1) to reduce the stress imposed on individual animals subject to epidermal identification tags; and 2) to avoid redundancy with the source-sink dynamics that can be partly inferred from radiotelemetry.

Methods

Beginning in July, we visited water bodies on City and County open space with previous leopard frog sightings, and we attempted to capture adult leopard frogs by hand or dipnet during the day and at night using spotlights. In general, capturing adult leopard frogs proved to be quite difficult, and at many sites (Table 1) we were unable to capture leopard frogs due to a mixture of low detectability, habitat features that reduced catchability, and low population densities. The majority of visits involved two to three observers attempting to spot and capture individual frogs. Capturing frogs was easier at night because eyeshine increased detectability. Upon capture, we swabbed the belly, legs, and feet of each individual with a sterile dryswab to test for the presence of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*). Afterwards, we weighed frogs using Pesola spring scales, and recorded snout vent length with adjustable calipers. Adults weighing over 33 grams were outfitted with either 1.34 gram (8 week battery life) or 2 gram (14 week battery life) Holohil BD-2 radiotransmitters depending on frog weight, using one of two attachment methods. Initially transmitters were attached using a lightweight beaded aluminum chain as a belt, which rested in front of the hind legs and behind the belly (Rathbun and Murphey 1996). However, partway through the study we began using embroidery floss threaded through 3.5 mm diameter clear plastic tubing in an attempt to reduce wear on the animals and to allow for more fine-scale adjustment of belt fit. Overall weight of the transmitter plus attachment method never exceeded 10% of frog body weight. We recorded the latitude and longitude in decimal degrees (NAD83) of the locations from which frogs were captured. Processing time per individual did not exceed 15 minutes, and we were careful to ensure that the animal's skin was kept moist throughout. After releasing the animals at their point of capture, we used radiotelemetry to follow their movements and periodically recapture individuals until their transmitters fell off or were removed.

Results

In total, we equipped 13 adult northern leopard frogs with radiotransmitters and collected 227 point location observations spanning the period from August 13 to November 13. Individual frogs outfitted with transmitters were relocated between 4 and 32 times (median = 16, Table 2). The majority of our efforts focused on the three sites where we successfully captured adult leopard frogs, that are located south of OSMP headquarters along Cherryvale Road (Figure 1). Church East Pond is a shallow ephemeral pond located east of the intersection of Cherryvale Rd. and Vale Rd where leopard frogs but not bullfrogs successfully bred this year, and where adult bullfrogs and leopard frogs co-occur. About 400 m NNW is Iron Springs Pond, a shallow, spring-fed pond where leopard frogs and bullfrogs also co-occur. Iron Springs Pond drains into the Goodhue Ditch, which runs East under Cherryvale Rd. We did not observe evidence of leopard frog breeding in Iron Springs Pond or Goodhue Ditch.

We documented animals moving from Church East to the Goodhue Ditch (Figure 2), and from the Goodhue Ditch to Iron Springs Pond (Figure 3). No frogs equipped with radiotransmitters at Iron Springs Pond (n=5) dispersed from Iron Springs Pond during the study period, but we did see movement within Iron Springs Pond (Figure 4). Long distance movement of adult frogs from Church East was synchronous and abrupt as Fall approached. These movements began in the second week of September after the first major rain event of the summer which was coupled with a three-day drop in daily maximum temperatures into the 70 °F range, a contrast from the drier, warmer conditions of August and the first week of September. We observed animals moving north from Church East, passing under Cherryvale Road through a culvert in the Goodhue Ditch, and then continuing west to Iron Springs Pond, a likely overwintering site. We observed one individual (151.110) spend at least 6 weeks in and around the Goodhue Ditch culvert under Cherryvale Road before we removed its transmitter (Figure 2). Two other radiotransmitters fell off in the same culvert. One frog that dispersed from Church East to Iron Springs Pond showed the highest observed rate of movement in this study, traveling at least 350 meters over the course of three days (Figure 5). Finally, this project provided incidental data on sources of mortality for leopard frogs in the study region – one adult leopard frog with a radiotransmitter was eaten by a garter snake (*Thamnophis* sp.) at Iron Springs Pond (Figure 6).

Discussion and future directions

Our data indicate that leopard frogs are capable of moving hundreds of meters between sites over short timescales. Most work citing the habitat use patterns of leopard frogs asserts that adults primarily use upland foraging habitat subsequent to breeding. However, we found that adults were primarily aquatic, and primarily occurred in upland habitat while dispersing between aquatic habitats. Whether this is generally the case in this region, or due to a relatively dry summer remains to be seen. Total rainfall from January to November in 2012 was 80% of the rainfall for the same interval averaged over the past five years (NOAA 2012). While frogs were dispersing between Church East and Goodhue Ditch, they were nearly undetectable visually in the hayfield North of Church East even with the assistance of telemetry, which narrowed our search area down to a meter square. The combination of low detectability and infrequent use of upland habitats may indicate that survey efforts to determine whether leopard frogs are present at a site are best directed towards ponds, lakes, ditches, and wetlands.

In this study area, it seems that the connectivity provided by the undeveloped hayfields and Goodhue Ditch between Church East (where leopard frogs bred in 2012) and Iron Springs Pond (where they are likely overwintering) contribute to leopard frog persistence. From a management perspective, population persistence may be more likely when maintaining habitat connectivity in addition to site quality, particularly where one site does not support both breeding and overwintering. The hydrological regime in the Goodhue Ditch and the culvert under Cherryvale Road stand out as possible management foci to maintain connectivity in this area. If the ditch is dry in the summer, or if the culvert becomes blocked, movement between sites may become more difficult.

The synchronicity of adult dispersal from Church East following a period of rain and cool temperatures is suggestive of environmental and possibly social cues to long distance dispersal. Previous work has shown that leopard frog adults may travel hundreds of meters during nocturnal summer rains, consistent with our findings, and may even migrate up to two miles in the Fall, although we did not observe such long range dispersal (Dole 1965, Merrell 1970). Expanding this project to include more sites will help to generalize our findings in terms of average distance covered, and the weather conditions that correspond to long range movements.

In addition to learning about habitat use and movement of frogs on this study area, in Spring 2013 we will be processing skin swabs collected throughout the study area to evaluate the presence and intensity of the amphibian chytrid fungus, *Batrachochytrium dendrobatidis*. These data will inform us as to whether there may be chytrid fungus "hotspots" in the study area, or seasonal trends in infection status. Finally, we hope to build on the knowledge gained this year to continue this project next year, broadening our scope to include multiple study areas on both OSMP and BCPOS land, and to include observations of movement earlier in the season when breeding activity occurs which will help to generalize our findings and reveal additional patterns of dispersal and habitat use that can be used to inform conservation management decisions.

Acknowledgements

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Table 1

Site	Ownership	Number of visits
Buffalo Gulch	BCPOS	5
Middle Mayhoffer	BCPOS	3
Hodgeson Harris Reservoir	BCPOS	3
Slake	OSMP	3
Transformer Pond	OSMP	1
ERTL	OSMP	1
South Boulder Creek	OSMP	1
Bush Pond	BCPOS	1

Table 1 Number of visits to sites where we were unable to capture frogs.

Table 2

ID	# of Locations	First capture	Capture date	Final location	Final date	Distance moved (m)	Sex	Weight (g)	SVL
151.190	9	Church East	8/13/2012	Church East	8/22/2012	90	F	39	72.3
151.050	32	Iron Springs Pond	8/13/2012	Iron Springs Pond	10/11/2012	170	F	40	67.8
151.448	22	Church East	8/14/2012	Church East	9/16/2012	580	F	48	71.4
151.250	27	Goodhue Ditch	8/14/2012	Iron Springs Pond	10/30/2012	210	F	41	69.3
151.709	14	Goodhue Ditch	8/28/2012	Iron Springs Pond	9/25/2012	250	F	56	77
151.930	29	Iron Springs Pond	8/28/2012	Iron Springs Pond	11/1/2012	240	F	47.5	72.3
151.350	22	Iron Springs Pond	8/28/2012	Iron Springs Pond	10/15/2012	150	F	44.5	71.3
151.150	16	Iron Springs Pond	8/28/2012	Iron Springs Pond	10/3/2012	190	F	31.5	63.5
151.610	15	Church East	9/6/2012	Iron Springs Pond	10/17/2012	590	M	43	71.8
151.369	7	Church East	9/6/2012	Goodhue Ditch	11/13/2012	530	M	55.5	78.1
151.310	12	Church East	9/6/2012	Goodhue Ditch	11/13/2012	640	M	39	68.3
151.270	4	Church East	9/6/2012	Goodhue Ditch	9/16/2012	50	M	39.5	68.5
151.110	18	Church East	9/6/2012	Goodhue Ditch	10/28/2012	690	F	41	69.2

Table 2 Results for each individual northern leopard frog across all sites are summarized. Animals were relocated until transmitters were either removed or fell off. Frog ID is coded by transmitter frequency. Distance moved is an estimate of the total distance covered while the transmitter was attached, accounting for GPS measurement error.

Figure 1 Overview of study area and leopard frog movement (double click to enlarge)

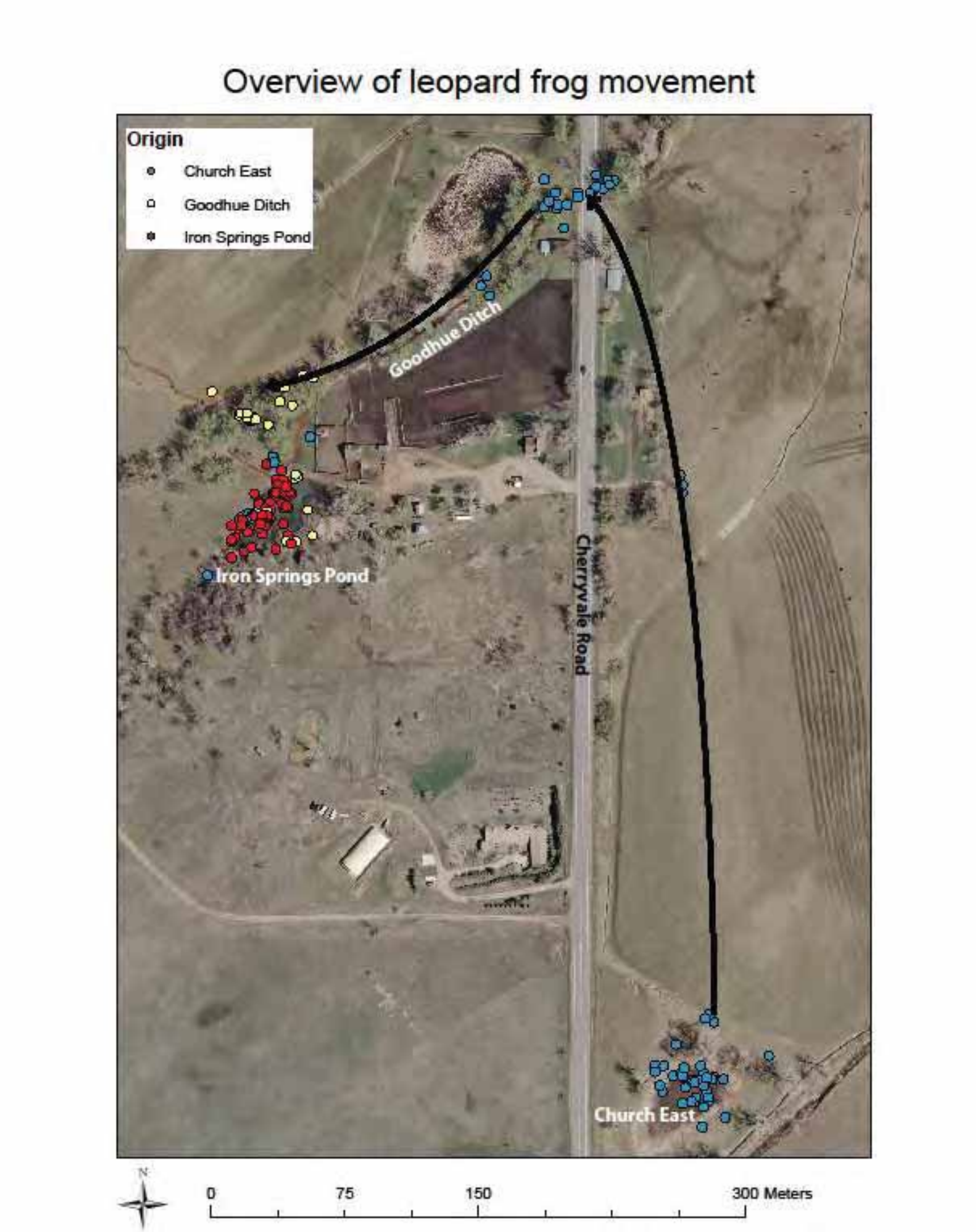


Figure 1: Frog locations over the course of the field season, color coded by origin (site where transmitters were deployed). Black arrows indicate likely routes taken between points.

Figure 2 Individual movement map: 151.110 (double click to enlarge)

Figure 2: Point locations and dates for frog 151.110. Transmitter fate is in bold white font.

Figure 3 Individual movement map: 151.709 (double click to enlarge)

Figure 3: Point locations and dates for individual 151.709. Transmitter fate is in bold white font.

Figure 4 Individual movement map: 151.350 (double click to enlarge)

Figure 4: Point locations and dates for individual 151.350. Transmitter fate is in bold white font.

Figure 5 Individual movement map: 151.610 (double click to enlarge)

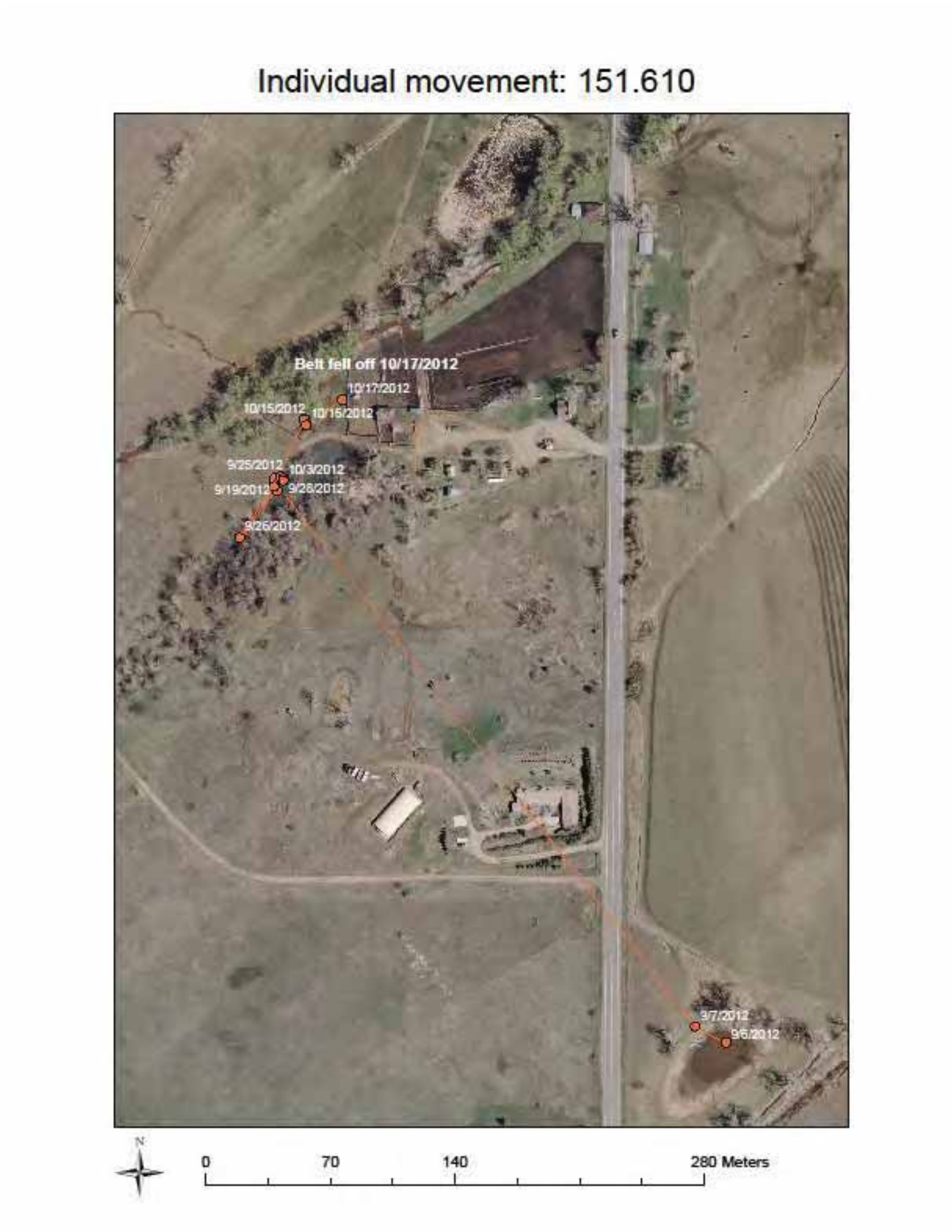
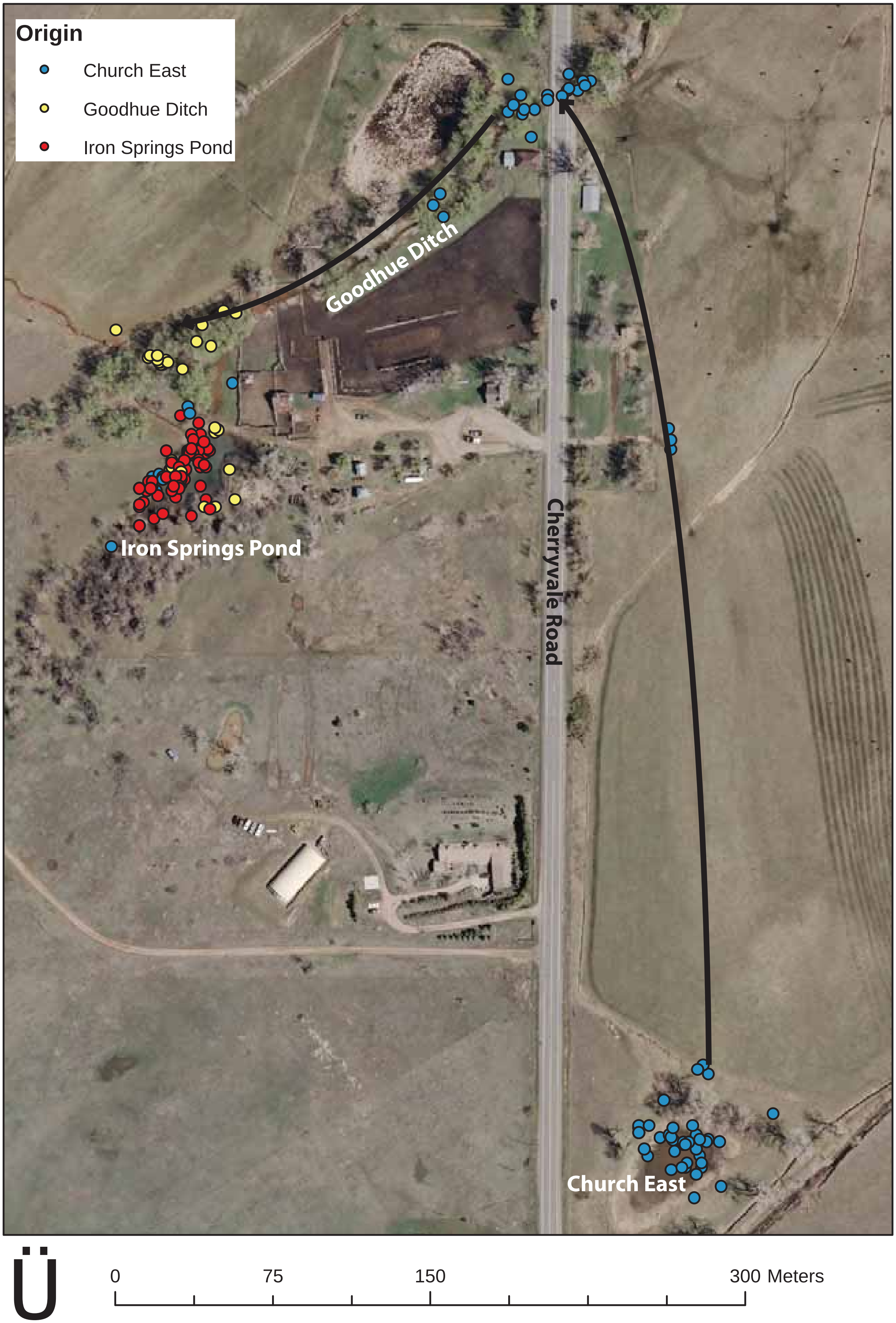


Figure 5: Point locations and dates for individual 151.610. Transmitter fate is in bold white font.

Figure 6 Individual movement map: 151.250 (double click to enlarge)

Figure 6: Point locations and dates for individual 151.250, with transmitter fate written in bold white font. Movement after 9/4/2012 represents snake movement.

Overview of leopard frog movement

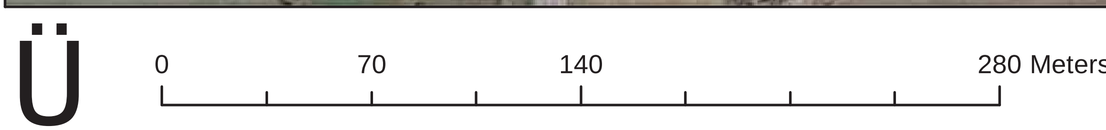


Individual movement: 151.050

Individual movement: 151.709

Individual movement: 151.610

Individual movement: 151.448



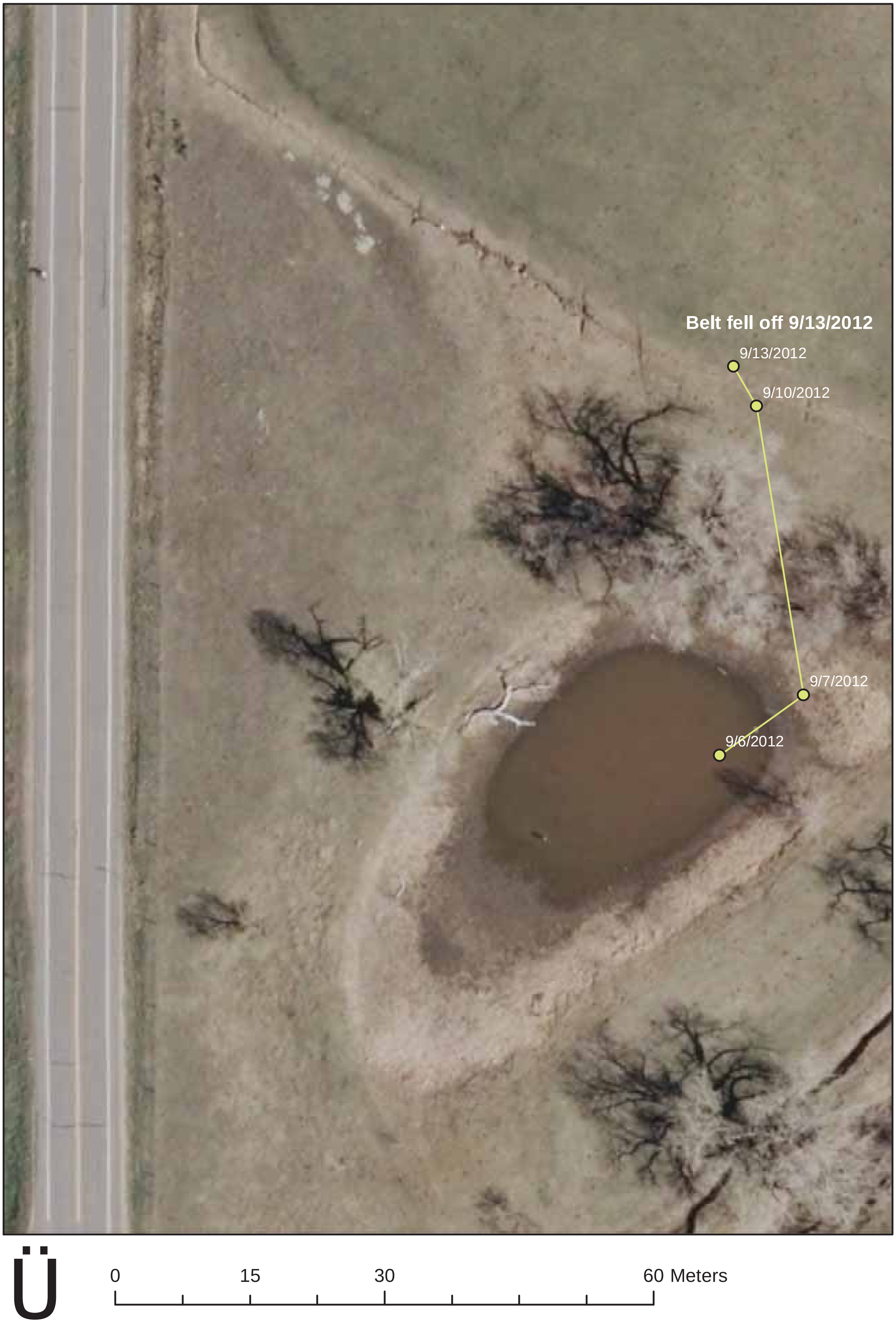
Individual movement: 151.369

Individual movement: 151.350

0 15 30 60 Meters

Individual movement: 151.310

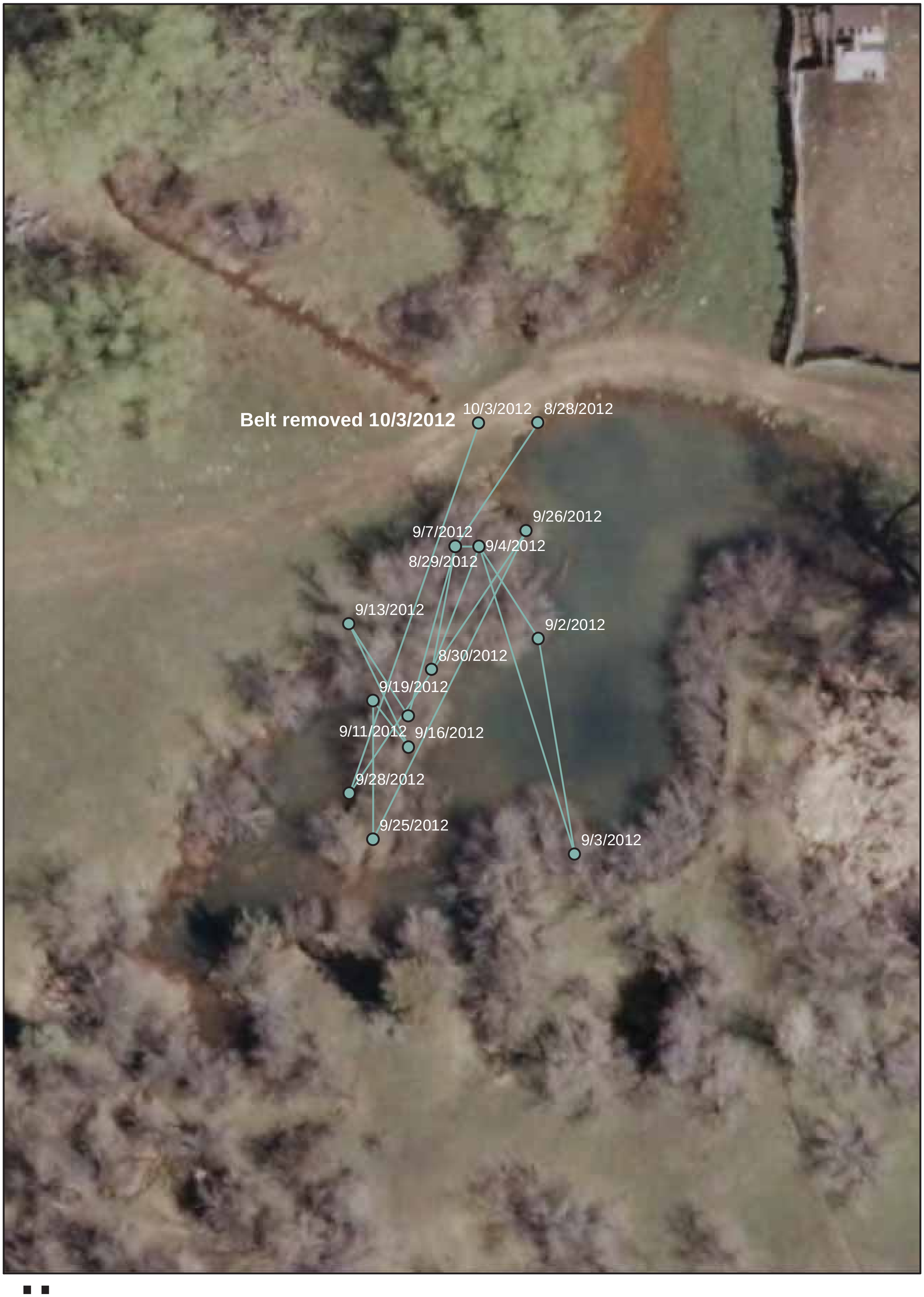
Individual movement: 151.270

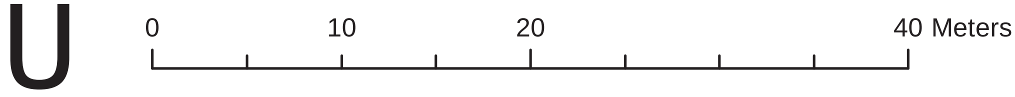


Individual movement: 151.250

Individual movement: 151.190

Individual movement: 151.150





Individual movement: 151.110

Individual movement: 151.930