

PROGRESS REPORT – 10 November 2008

Title: Chronology and Rates of Migratory Movements, Migration Corridors, and Habitats Used throughout the Annul Cycle by Female Lesser Scaup Radio-marked on Pool 19 of the Mississippi River.

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Justification:

The continental scaup population (lesser [*Aythya affinis*] and greater scaup [*A. marila*] combined) has declined markedly since 1978 (Austin et al. 1998, Afton and Anderson 2001) and recently may have stabilized at a lower level (see Zimpfer et al. 2008). Annual population estimates of scaup have been below the population goal of the North American Waterfowl Management Plan since 1985 and reached an all-time low in 2006 (Zimpfer et al. 2008). Afton and Anderson (2001) reported that the observed decline in the continental scaup population probably was driven by a decline in the lesser scaup population.

The segment of the lesser scaup population wintering in states bordering the Gulf of Mexico and migrating north along the Mississippi River valley, subsequently through Iowa, Minnesota, South Dakota, and North Dakota (hereafter upper-Midwest), comprises a major component of the continental population and probably experienced the largest decline (Afton and Anderson 2001). Located partially within the upper-Midwest, Region 3 of the U.S. Fish and Wildlife Service (2002) declared lesser scaup a conservation priority citing a need to (1) provide key information to increase understanding of limitations to conservation for this species, (2) acquire biological information to support conservation actions relating to habitat availability and quality, and (3) provide technical assistance to initiate, augment, or redirect conservation actions so that best management practices can be applied. Lesser scaup have high recreational and economic values; high historical abundance established this species as a staple to both hunters and bird-watchers (Chabreck 1964, Jessen 1981, U.S. Fish and Wildlife Service 2002).

Several major factors have been hypothesized as causing the scaup population decline including (Austin et al. 2000, Afton and Anderson 2001): (1) decreased quality and quantity of food resources on winter and spring migration stopover areas, (2) accumulation of contaminants, and (3) climate and habitat changes on boreal forest breeding areas, all of which may be directly or indirectly affecting female survival or recruitment. The first factor listed above has been formalized as the

Spring Condition Hypothesis (Afton and Anderson 2001) and has been most extensively tested to date (Anteau 2002, 2006; Anteau and Afton 2004, 2006, 2008a, 2008b, 2008c).

The Spring Condition Hypothesis states that reproductive success of lesser scaup has declined because females are arriving on breeding areas in poorer body condition than in the past, or not arriving at all, due to a decline in availability and/or quality of forage resources preventing females from acquiring sufficient nutrient reserves (lipid, protein, and mineral) during spring migration (Afton and Anderson 2001). Anteau and Afton (2004) initially documented a decrease, from historical levels, in body mass and lipid reserves of female lesser scaup migrating through northwestern Minnesota and arriving to breed in southwestern Manitoba. Concomitant with the decline in female body condition, Anteau and Afton (2006) also documented a decline, from historical levels, in forage quality of lesser scaup diets at the same locations. Other key findings include: (1) lipid reserves of females migrating throughout the upper-Midwest currently are much lower than are those of females at Pool 19, a major spring stopover to the south (Strand 2005, Anteau 2006), (2) females migrating throughout the upper-Midwest are not storing lipids as expected, but rather are catabolizing lipids (Anteau and Afton 2008c), (3) densities of amphipods, a preferred lesser scaup food, currently are very low throughout the upper-Midwest (Anteau and Afton 2008a), and (4) forage quality and overall mass of foods consumed by females is lower now than that historically within the upper-Midwest, apparently causing the observed decline in lipid reserves of females (Anteau and Afton 2008b). In summary, most findings to date have been consistent with the Spring Condition Hypothesis, and, thus, this hypothesis presently can not be rejected.

Several important questions remain regarding the Spring Condition Hypothesis, one of which is, what is the relative importance of stopover areas in the upper-Midwest for accumulation of nutrient reserves by migrating female lesser scaup? Rates and distances moved during a single migratory flight may be dependent on female body condition; females in superior condition may take longer, more rapid and frequent flights. If so, females in superior condition might have a lower probability of being sampled within the upper-Midwest region. Anteau (2006) attempted to evaluate this question by color-marking lesser scaup at Pool 19, with respect to body mass, and then observing them within the upper-Midwest; however, too few observations of color-marked birds were obtained to draw conclusions (see Appendix E in Anteau 2006:212). Clearly, Anteau's (2006) results indicate that many females migrating through the upper-Midwest in spring are in very poor body condition, but forage conditions could be relatively better in the southern prairies of Canada, perhaps allowing females stopping there to regain body condition before moving on again to more northerly breeding areas. Thus, quantitative estimates, of the proportion of time females spend in each of these regions of North America during spring migration, would be useful for further evaluation of the Spring Condition Hypotheses, and, ultimately, help waterfowl managers prioritize spring migration stopover areas for habitat conservation and management.

Study Goals and Research Objectives:

Following a pilot study (Afton 2007), my collaborators (see Appendix 1) and I initiated a 5-year study in March 2008, with the first major goal of mapping spring migration corridors of females captured and radio-marked on Pool 19 of the Mississippi River. Given the theoretical battery life of the satellite radios (PTTs), we also are documenting fall migration corridors and affiliations of breeding and wintering areas of females. These data should be useful in identifying and prioritizing

regions and areas in North America for habitat conservation and management. Dependent on securing adequate funding, we hope to implant PTTs in a minimum of 25 female lesser scaup each spring for the duration of the 5-year project, with the last group of females to be implanted in March 2012.

Our second major goal is to record migratory flight parameters of radio-marked females, in order to estimate the proportion of time individuals of varying body mass spend on identified wetlands within the upper-Midwest and prairie Canada during spring. These data will be used to: (1) help determine the relative importance of stopover areas in the upper-Midwest, for accumulation of nutrient reserves by breeding females, and (2) to assess the magnitude of bias in scaup population estimates from the May Waterfowl and Habitat Survey.

Our third major goal is to quantitatively describe habitats used by radio-marked females throughout the annual cycle, utilizing remote-sensing and other GIS data (cf. Phillips et al. 2006). Dependent on securing additional funding, we hope to identify a post-doctoral or Ph.D. student to conduct this quantitative habitat analysis. The results from this analysis should provide more specific guidance to managers for acquisition, protection, and management of important habitats within specific regions and areas of North America.

Our fourth major goal is to band a minimum of 2000 lesser scaup at Pool 19 each spring, through March 2012, to allow rigorous estimation of annual survival and to provide opportunity for direct estimates of harvest rates using new band analysis techniques (Nicolai et al. 2006). We plan to estimate annual survival in relation to body mass at capture, and to compare survival estimates using recent and historical spring banding data from Pool 19. Finally, assuming that we are able to obtain funding for a large sample of radio-marked females, this intensive banding effort at Pool 19 should allow for direct estimates of potential radio-effects on survival (cf. Esler 2000).

Finally, our fifth major goal is to provide opportunity for university wildlife students, agency and NGO personnel, and other keenly interested individuals to (1) obtain banding experience, (2) learn techniques for capturing, handling, and marking diving ducks, and (3) interact and discuss current wildlife management issues and needs with a diverse group of waterfowl researchers, biologists and managers working on the project.

Specific Research Objectives

Our specific research objectives are as follows:

- 1) Map migration corridors and affiliations to breeding and wintering areas of female lesser scaup captured during spring stop-over on Pool 19 of the Mississippi River.
- 2) Document chronology and estimate rates of movement (km/day) and flight distances (km) of individual females, and test for relationships among these flight parameters and female body mass at capture.
- 3) Identify specific lakes and wetlands used by migrating females and estimate the proportion of time spent in various regions (e.g., upper-Midwest, prairie Canada) of North America during spring and fall migration.

4) Band a large sample (>2000) of lesser scaup annually to support and encourage future operational bandings on Pool 19 that could provide opportunity for direct estimates of harvest rate and survival, using new band analysis techniques. Analysis of band recoveries from our 5-year study will allow (1) estimation of potential body mass effects on survival, (2) comparison of recent and historical annual survival rates, and (3) estimation of potential radio-effects on female survival, .

Study Area:

We captured lesser scaup during spring migration on Pool 19 of the Mississippi River, between Hamilton and Dallas City, IL and between Keokuk and Fort Madison, IA. Pool 19 is an important middle latitude migration area for lesser scaup, where large numbers stopover prior to migrating through the upper-Midwest in spring (Thompson 1973, Havera 1999, Anteau 2006). Pool 19 has been described in detail by Thompson (1973) and Havera (1999).

Methods:

We trapped, weighed, banded, and released male and female lesser scaup throughout the spring stop-over period, using standard techniques (Haramis et al. 1982, 1987; Pace and Afton 1999). We recorded body mass and estimated the % of the esophagus containing corn for all captured birds. We randomly selected a sub-sample of females, with minimum body mass of 700 g and maximum body mass of 820 g, to be implanted with 38 g, intracoelomic satellite transmitters (PTTs).

We tested PTTs for successful satellite transmission and confirmed that they were transmitting prior to implantation. We used PTTs that were identical to those used successfully in a study of lesser scaup migrating from the Great Lakes region (Badzinski and Petrie 2006a, 2006b) and in our 2007 pilot study (Afton 2007). Furthermore, we implanted PTTs in females within the range of body mass of those successfully radio-marked in the Great Lakes region (Scott Petrie, personal communication) and our pilot study (Afton 2007). Finally, we used a PTT duty cycle that theoretically provides locations every 1.4, 7.2, and 3.3 days during spring migration, on breeding and wintering areas, and during fall migration, respectively. The theoretical battery life allows coverage during 2 spring migration periods for each surviving radio-marked female.

Surgical Implant Procedures

Dr. Mark Mitchell, who is experienced in implanting PTTs in ducks and participated in the pilot study, conducted all implant surgeries at the Kibbe Station, located near the trap sites. Dr. Alan Afton (PI) secured an LSU Institutional Animal Care and Use Committee Protocol (#07-012) and is authorized to capture, band and implant lesser scaup with PTTs under USGS Banding Permit #08810 and IL DNR Scientific Permit W07.0237.

Ducks were anesthetized using isoflurane. Initially, the anesthesia was delivered by facemask (5% isoflurane, 1 liter oxygen flow rate). Once females lost consciousness, they were intubated using a 3-0 to 4-0 endotracheal tube. Ducks were maintained at 2-3% isoflurane at a flow rate 1 liter of oxygen. Birds were positive-pressure ventilated during the procedure every 10 seconds. A stethoscope was used to monitor heart rate.

Ducks were surgically prepped at two sites: the dorsal synsacrum at the junction of the spine and pubis and the ventral abdominal muscles. The dorsal site was done first. The sterile surgical preparation was done using a 1% betadine solution and sterile saline. Once prepped, the surgical site was covered with a sterile 2 x 2 gauze pad. The duck was then placed in dorsal recumbency to prep the abdomen; the same sterile technique was then used. A clear surgical drape was placed after the surgical prep was completed. The ventral abdominal incision was made through the skin and rectus abdominis using a #15 scalpel blade. Once the coelomic cavity was opened, the right abdominal airsac was manually deflated.

The PTT antenna was placed into a blunt trochar and digitally guided through the incision (around the viscera) to the point of the pubic/spinal juncture. Using gentle pressure, the trochar was advanced through the skin and out the dorsum of the bird. The entire trochar and antennae was extracted sterilely out of the body cavity, by manipulating it through the clear drape.

The PTT was then digitally manipulated into place along the right body wall. The incision in the body wall was closed with 4-0 PDS using a simple continuous pattern. The skin also was closed with 4-0 PDS using a simple continuous pattern. A single 4-0 PDS suture was used to anchor the antennae to the skin on the dorsum of the bird. Birds were recovered on room air using an ambubag. Once females regained their righting reflex and were extubated, they were held in a warm, quiet area for 2 hours prior to release at original capture sites.

Analysis of satellite location data

We estimated the minimum number of migration stopover sites between Pool 19 and the inferred breeding site of each female, based on single or clustered locations (≥ 1 day) that varied ≤ 0.5 degrees of latitude or longitude. Potential breeding sites were inferred based on terminal clustered locations within the known breeding range of the species and date. We estimated straight-line distances between stopover sites, and between Pool 19 and the inferred breeding site for each female, using the great circle distance equation. We inferred mortalities based on temperature and activity sensor data provided by ARGOS. We classified a PTT as failed when transmissions stopped, but temperature and activity sensor data for the last transmissions indicated that the bird was alive.

2008 Preliminary Results:

Satellite Radios

We captured and implanted PTTs in 26 female lesser scaup on Pool 19 of the Mississippi River during the period of 17 to 19 March 2008 (Table 1). Body mass at capture for the implanted females ranged from 700 to 810 g and averaged 745.8 ± 6.7 g (\pm SE).

Twenty-one of the 26 implanted females subsequently migrated from Pool 19. Three females died shortly after release on Pool 19, and another female moved downriver near Canton, MO, where she died on 20 April 2008 (33 days after release). The PTT of another female failed on Pool 19, on the day following release.

The 21 females that migrated spent, on average, a minimum of 26.4 ± 2.8 days (\pm SE) on Pool 19 before migrating, with a range of 5 to 53 days (Table 1). The mean departure date was 14 April 2008; the earliest and latest departure dates were 24 March and 10 May 2008, respectively.

Nineteen females (90%) took a westerly or northwesterly overland tract when leaving Pool 19, whereas 2 females (10%; Females 80881 and 80898) initially took a northerly tract, stopping again on the Mississippi River near La Crosse, WI, before taking a northwesterly overland tract (Figures 1-21). Interestingly, Female 80885 made a southeast move to the Illinois River near Meredosia, IL, before initiating a northwesterly overland tract (Figure 10).

The 21 females made, on average, a minimum of 7.2 ± 0.5 (\pm SE) stops (Range = 2 to 10 stops) between Pool 19 and their inferred breeding sites (Table 2). Straight-line distances, between Pool 19 and inferred breeding sites, ranged from 1269 to 4541 km and averaged 2715.2 ± 193.5 km (\pm SE). The mean time between departure from Pool 19 and arrival on the inferred breeding sites averaged 39.0 ± 3.5 days (\pm SE), with a minimum and maximum of 7 and 63 days, respectively. Mean overall rate of movement from Pool 19 to inferred breeding sites was 80.3 ± 8.2 km/day (\pm SE), with a range of 36.3 to 181.3 km/day.

Arrival dates on inferred breeding sites for 21 females ranged from 22 April to 16 June 2008, with a mean arrival of 23 May 2008 (Table 2). Arrival dates were positively correlated with straight-line distances from Pool 19 ($r = 0.7575$, $P = 0.0001$) and minimum number of stops between Pool 19 and inferred breeding sites ($r = 0.8092$, $P < 0.0001$), but were not correlated with overall movement rates (km/day) of individual females ($r = -0.2848$, $P = 0.2108$). Moreover, overall movement rates (km/day) were not significantly correlated with minimum number of stops between Pool 19 and inferred breeding sites ($r = -0.3867$, $P = 0.0834$). Finally, body mass at capture was inversely related to date of departure from Pool 19 ($r = -0.4367$, $P = 0.0478$) and to minimum number of days spent on Pool 19 after release ($r = -0.4354$, $P = 0.0485$), but was not correlated with any other migratory flight parameter (all P s > 0.11).

Two females died on their breeding sites; 1 in Saskatchewan (97 days after release; Female 72900) and 1 in the NWT (81 days after release; Female 80895). PTTs of 2 other females failed after arrival on their breeding sites (Females 80881 and 80890). Seventeen females remained alive with functioning PTTs at the start of the 2008 fall migration.

Banding

We captured, weighed, banded and released a total of 4426 lesser scaup on Pool 19 during the period of 14 to 26 March 2008 (Table 3). This total included 521 AHY females and 3905 AHY males. Twenty-six of the females were implanted with PTTs (see above), and 8 of the males previously had been banded and nasal-marked in March 2005 on Pool 19 in our previous research project there (see Anteau 2006).

Discussion:

We chose not to implant females in 2008 with body mass >820 g because the heaviest females implanted in the 2007 pilot study appeared to have low survival, perhaps due to effects of excessive

wing-loading. We recorded 3 mortalities soon after release on Pool 19, and locations for 2 of these dead females were in known bald eagle (*Haliaeetus leucocephalus*) roost sites, located short distances away from Pool 19. These females could have died due to complications of surgery and then were scavenged by eagles, or alternately the behavior of implanted birds soon after release may make them highly vulnerable to eagle predation. Concentrations of eagles were very high on Pool 19 in springs 2007 and 2008; thus, we will try to select release sites next spring that have lower concentrations of eagles in order to help reduce the potential vulnerability of implanted females during the immediate post-release period.

In contrast to the 2007 pilot study, we did not record any mortality during the 2008 spring migration; however, 2 mortalities occurred after arrival inferred breeding areas. We received 5 locations of 1 of these females (Female 80895) in vegetative cover along a pond margin, at first alive and then dead, over a 4.4 hr period. The date and consistency of locations on this day and several preceding days were suggestive of predation on a nesting female.

We chose to implant females as early as possible in spring 2008 to help ensure the marking of high quality individuals. Accordingly, the period during which females were implanted was 9 days earlier in 2008 than in 2007 (Table 1). We subsequently observed that the minimum number of days spent on Pool 19 following release was similar, on average, between years (about 26 days), whereas the mean departure date was 8 days earlier in 2008 (Table 1). Interestingly, 1 of 2 females (Female 72886), implanted in March 2007 and alive with a functioning PTT, returned to Pool 19 on 21 March 2008 and stayed 26 days before moving on to southwestern Minnesota. All of these data suggest that female lesser scaup spend a lengthy stopover period on Pool 19 before migrating on to their breeding areas.

We found that migration flight parameters generally did not vary greatly between years, despite the relatively earlier mean departure in 2008 (Table 2). Interestingly, we found that, in spring 2008, heavier females departed from Pool 19 relatively sooner and, thus, spent fewer days on Pool 19 after release. However, body mass was not significantly correlated with any other migratory flight parameter.

We recorded 3 PTT failures (12%) in 2008, which was lower than that during the same period of the 2007 pilot study (24%). One PTT failed soon after the female was released on Pool 19, and the other 2 failures occurred after females arrived on their inferred breeding sites. We will request replacements for these failed PTTs from the manufacturer.

Conclusion:

Given the 3 PTT failures and 6 mortalities recorded to date (4 on or near Pool 19, 2 on breeding sites), 17 females remain alive with functioning PTTs for the 2008 fall migration. The PTT failure rate was lower and female survival generally was higher in 2008 as compared to the 2007 pilot study. We believe that continued radio-marking of females at Pool 19 will provide useful information as per our study objectives.

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Table 1. Numbers of female lesser scaup implanted with PTTs, ranges of dates that females were implanted and released, body mass of implanted females, minimum days that implanted females spent on Pool 19 before migrating north, and departure dates of females by year. Note that estimates of minimum days spent on Pool 19 and departure dates were based on 14 and 21 marked females in 2007 and 2008, respectively

Variables	2007	2008
Females implanted	17	26
Dates implanted	26-28 MAR	17-19 MAR
Body mass (g)		
Mean \pm SE	763.5 \pm 22.4	745.8 \pm 6.7
Range	630-930	700-810
Minimum days on Pool 19		
Mean \pm SE	25.6 \pm 1.8	26.4 \pm 2.8
Range	13-40	5-53
Departure dates		
Mean	22 APR	14 APR
Range	9 APR-5 MAY	24 MAR-10 MAY

Table 2. Number of migration stops between Pool 19 and inferred breeding sites, straight-line distance between Pool 19 and breeding sites, time females spent migrating and rate of movement from Pool 19 to breeding sites, and date of arrival on breeding sites by year. Note that these estimates were based on 11 and 21 marked females in 2007 and 2008, respectively.

Variables	2007	2008
Stops		
Mean \pm SE	6.3 \pm 1.1	7.2 \pm 0.5
Range	1-11	2-10
Distance (km)		
Mean \pm SE	3020.1 \pm 243.1	2715.2 \pm 193.5
Range	1860-4342	1269-4541
Time (days)		
Mean \pm SE	34.2 \pm 2.8	39.0 \pm 3.5
Range	24-51	7-63
Movement rate (km/day)		
Mean \pm SE	89.2 \pm 4.4	80.3 \pm 8.2
Range	68.6-112.0	36.3-181.3
Arrival date		
Mean	25 MAY	23 MAY
Range	13 MAY-9 JUN	22 APR-16 JUN

Table 3. Numbers of lesser scaup captured, weighed, banded, and released at Pool 19 by sex and year. Note that banding dates ranged from 18-30 March 2007 and 14-26 March 2008.

Year	Females	Males	Total
2007	309	2173	2482
2008	521	3905	4426
Combined	830	6078	6908

Figure 1. Migration tract of Lesser Scaup female 72885B from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and was alive as of 26 October 2008.

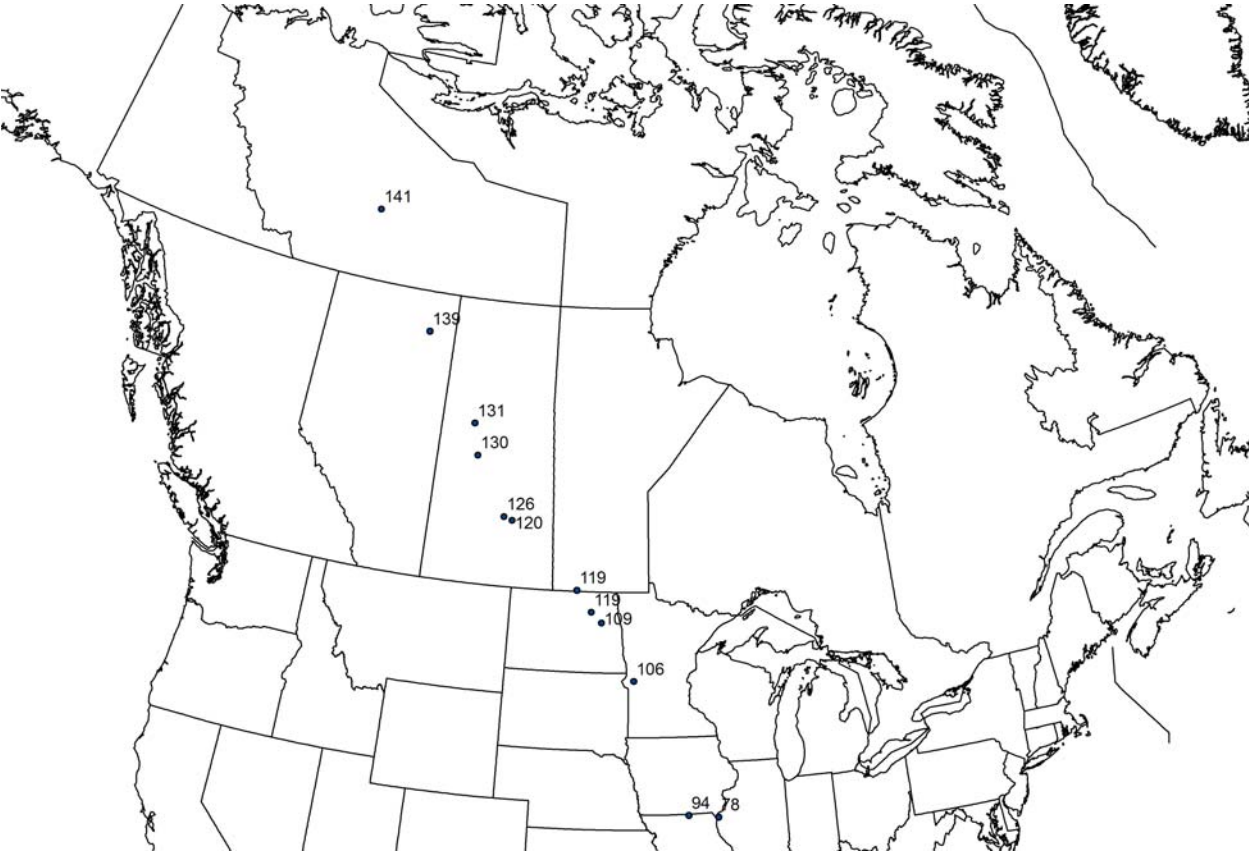


Figure 2. Migration tract of Lesser Scaup female 72899 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and was alive as of 8 November 2008.

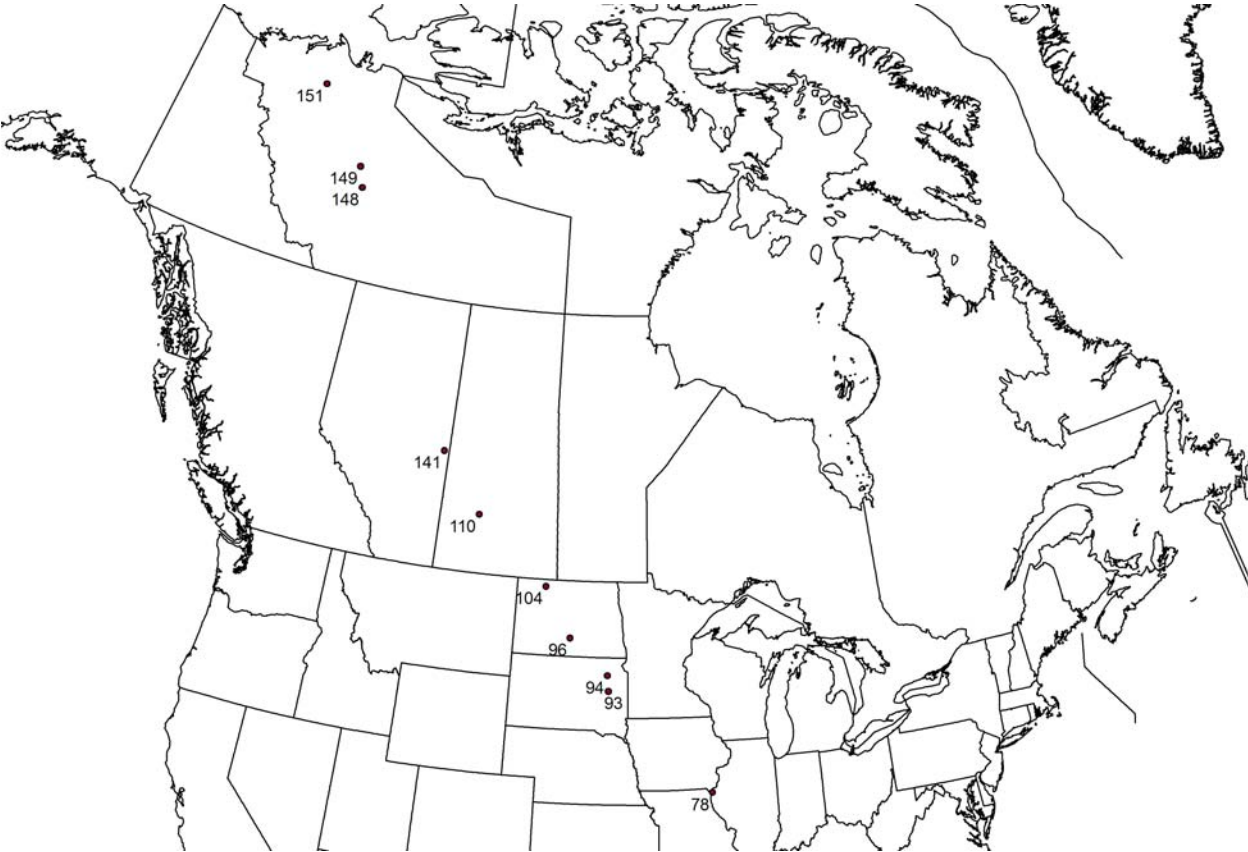


Figure 3. Migration tract of Lesser Scaup female 72900 from Pool 19 to her inferred breeding site in Saskatchewan. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 17 March 2008 (Julian date = 76) and was noted dead on 22 June 2008.

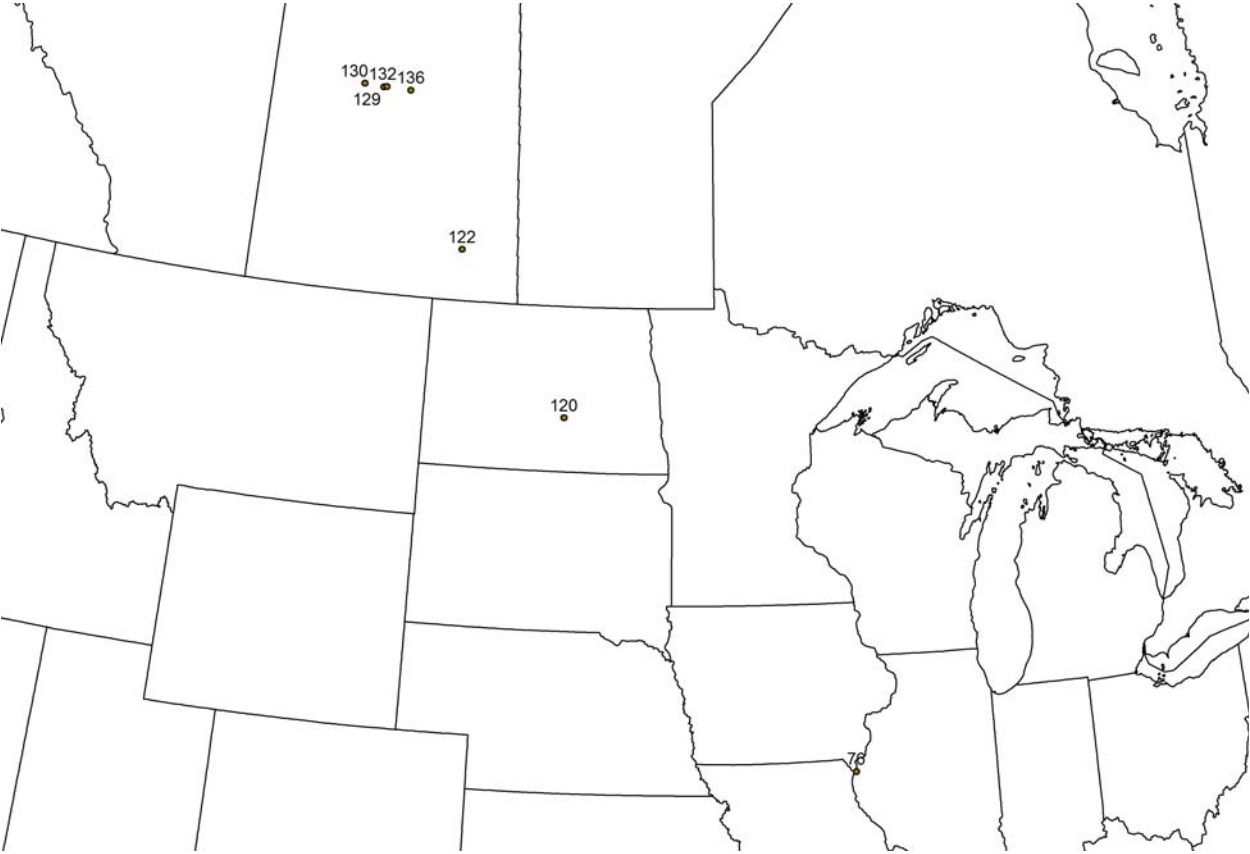


Figure 4. Migration tract of Lesser Scaup female 72901 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and was alive as of 10 November 2008.

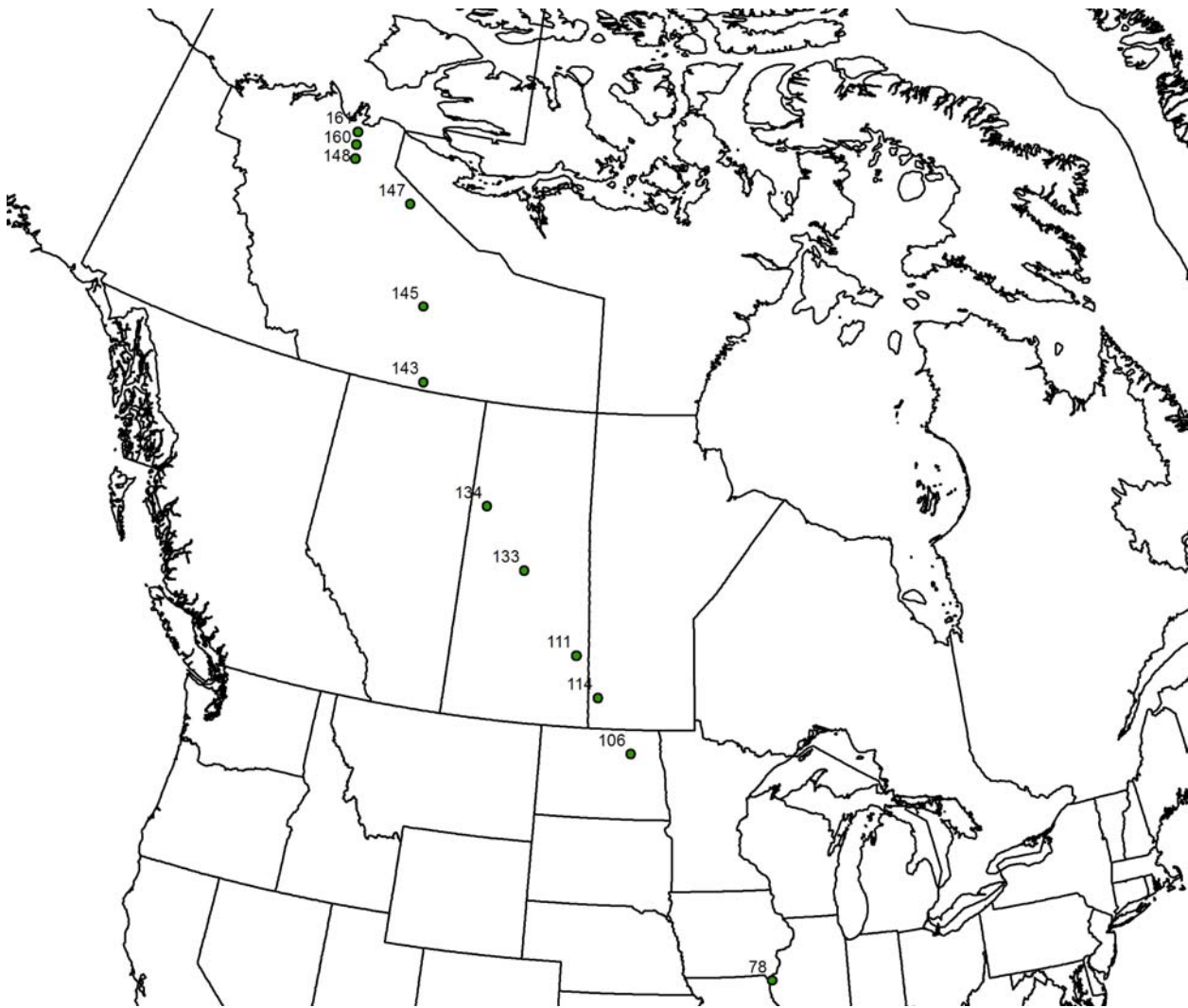


Figure 5. Migration tract of Lesser Scaup female 80877 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 18 March 2008 (Julian date = 77) and was alive as of 9 November 2008.



Figure 6. Migration tract of Lesser Scaup female 80879 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and was alive as of 8 November 2008.

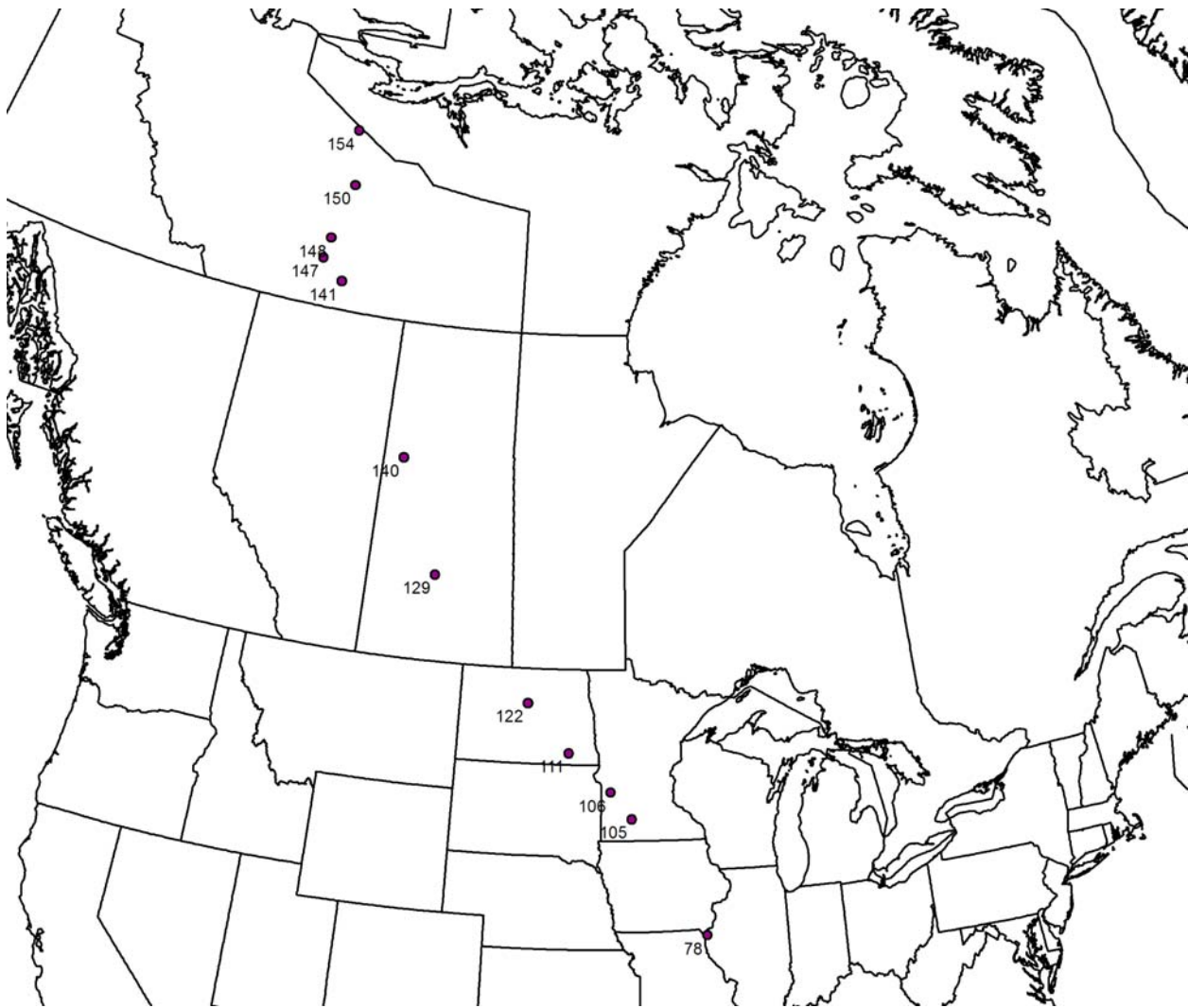


Figure 7. Migration tract of Lesser Scaup female 80880 from Pool 19 to her inferred breeding site in Manitoba. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 18 March 2008 (Julian date = 77) and was alive as of 7 November 2008.



Figure 8. Migration tract of Lesser Scaup female 80881 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and her PTT failed after 30 June 2008.

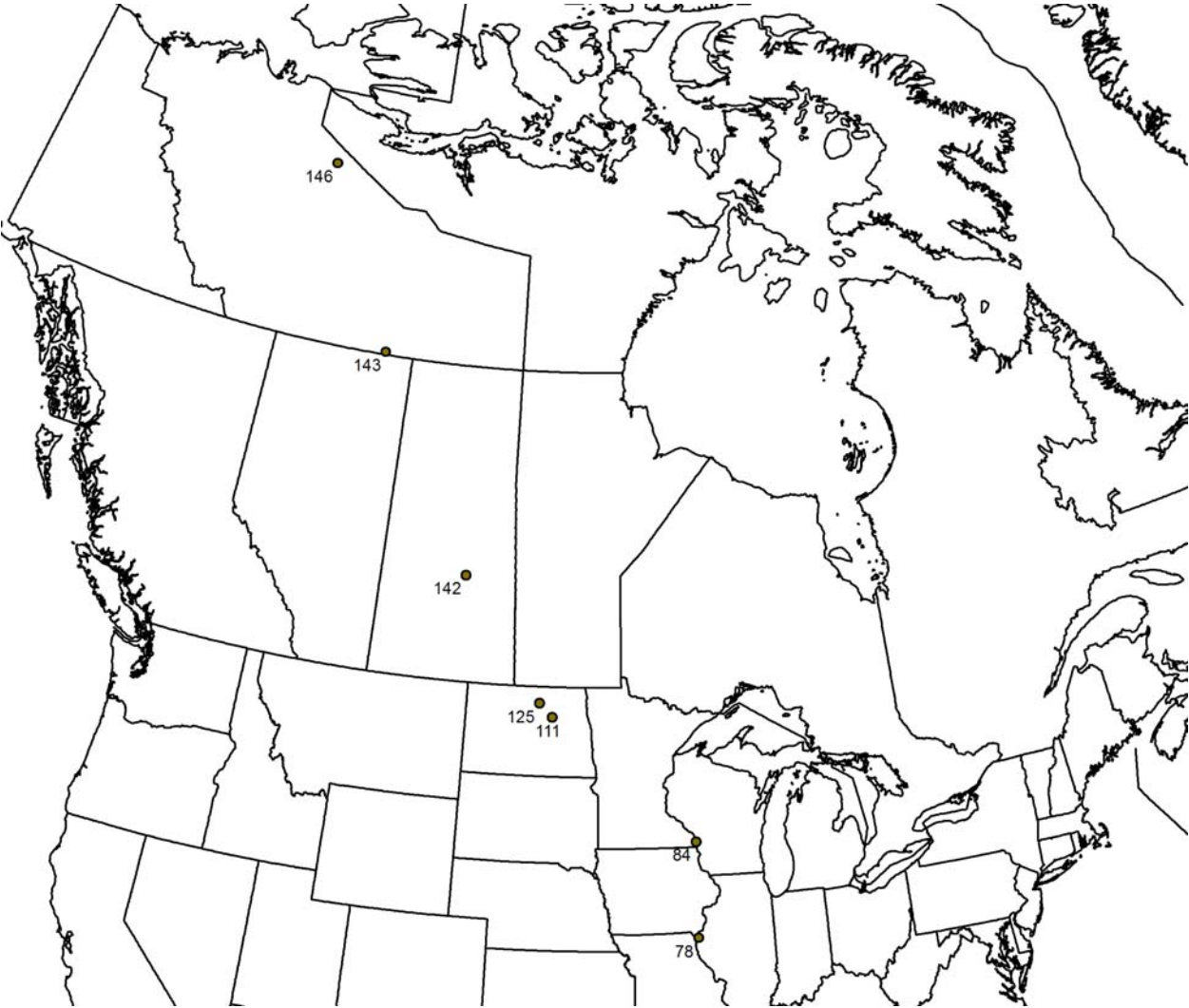


Figure 9. Migration tract of Lesser Scaup female 80884 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and was alive as of 8 November 2008.

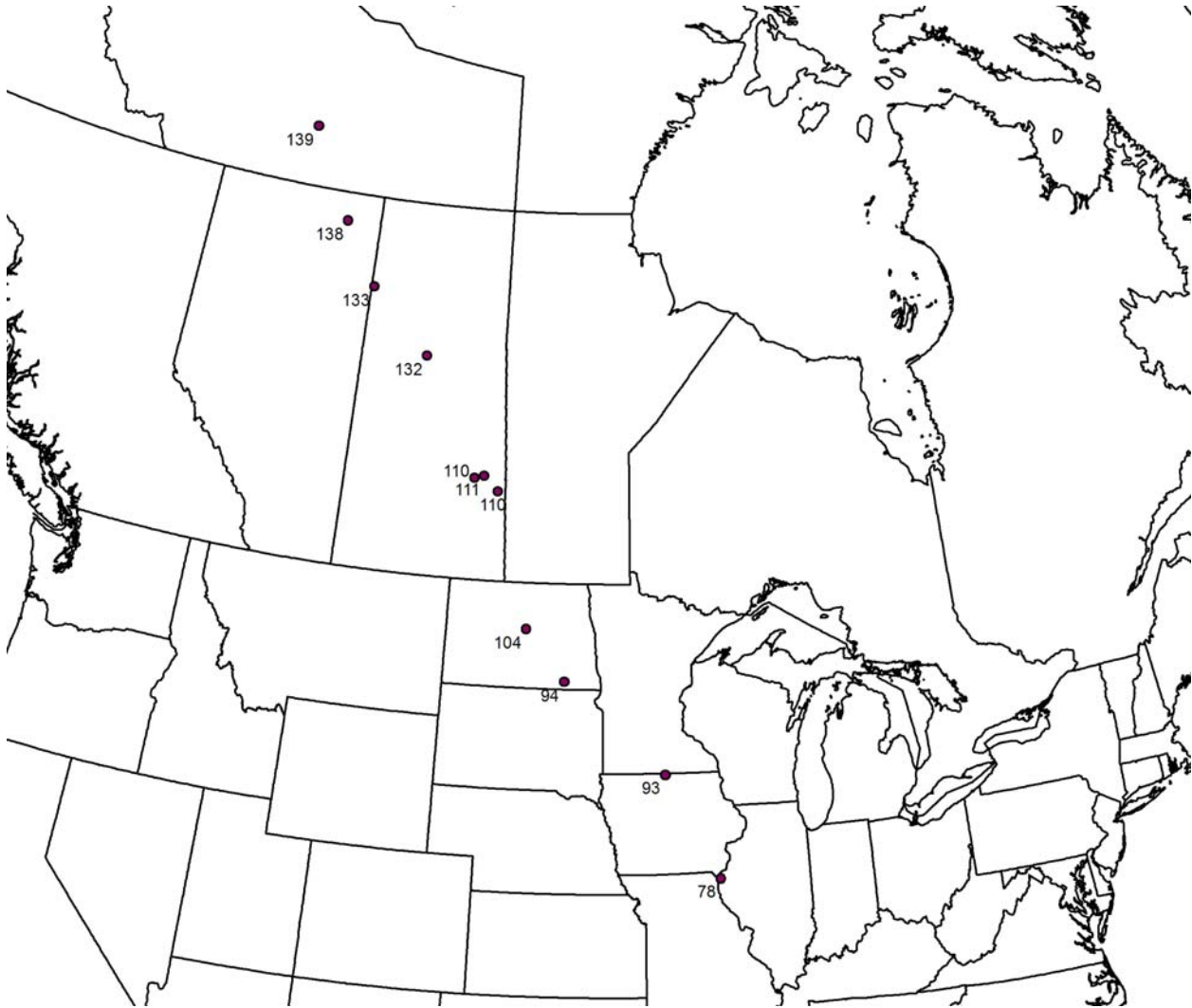


Figure 10. Migration tract of Lesser Scaup female 80885 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 18 March 2008 (Julian date = 77) and was alive as of 7 November 2008.

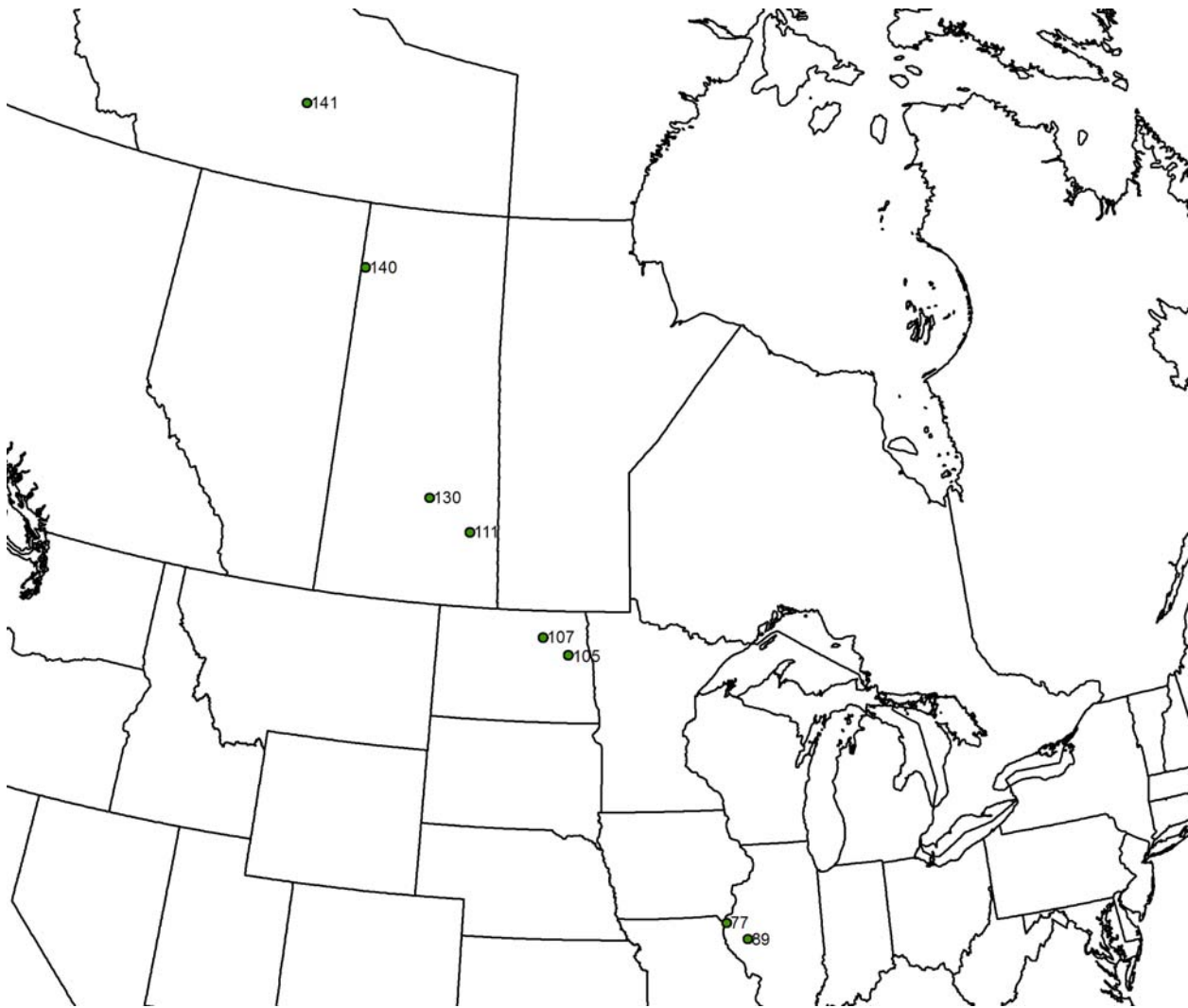


Figure 11. Migration tract of Lesser Scaup female 80886 from Pool 19 to her inferred breeding site in Saskatchewan. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and was alive as of 8 November 2008.

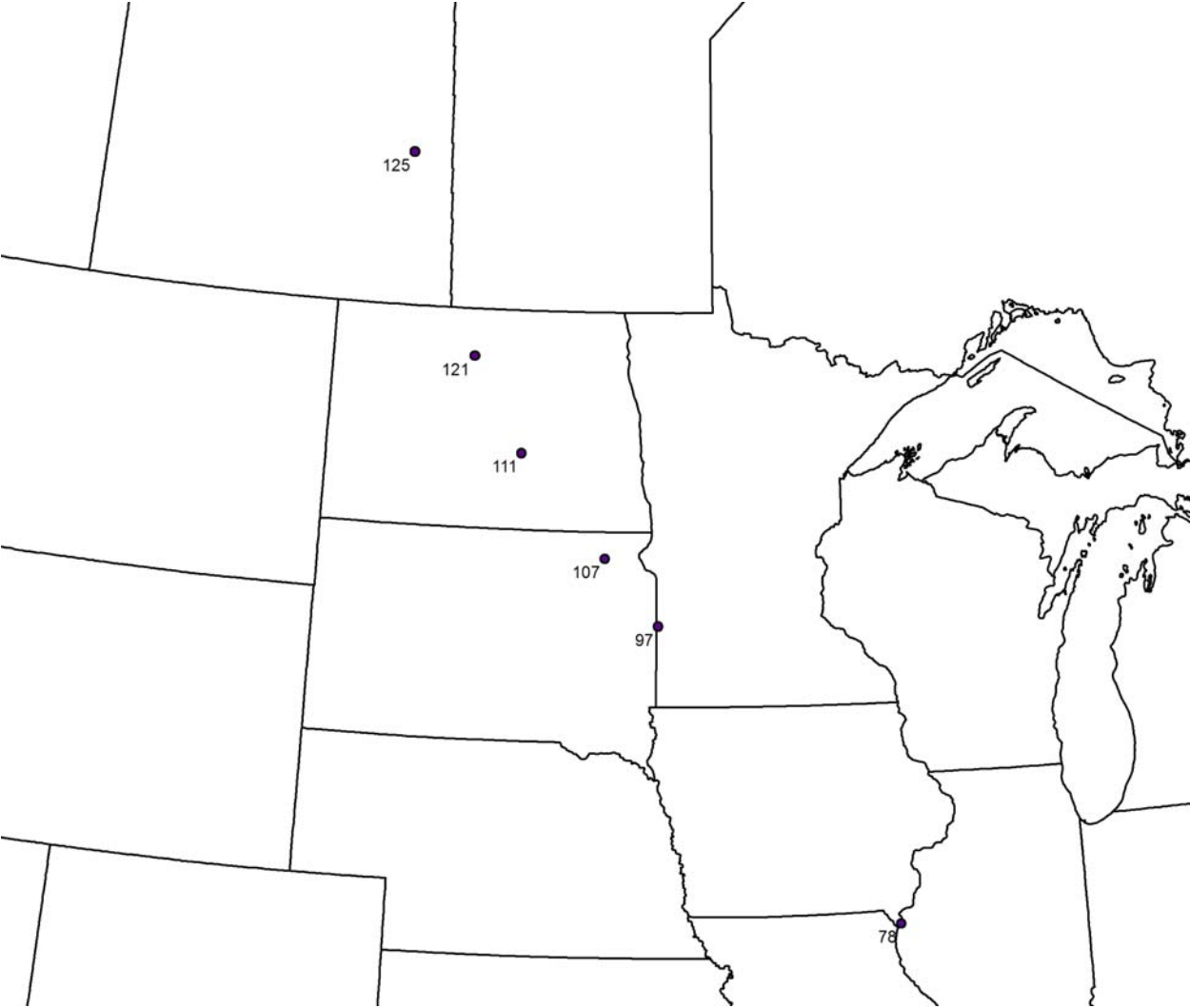


Figure 12. Migration tract of Lesser Scaup female 80888 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and was alive as of 8 November 2008.

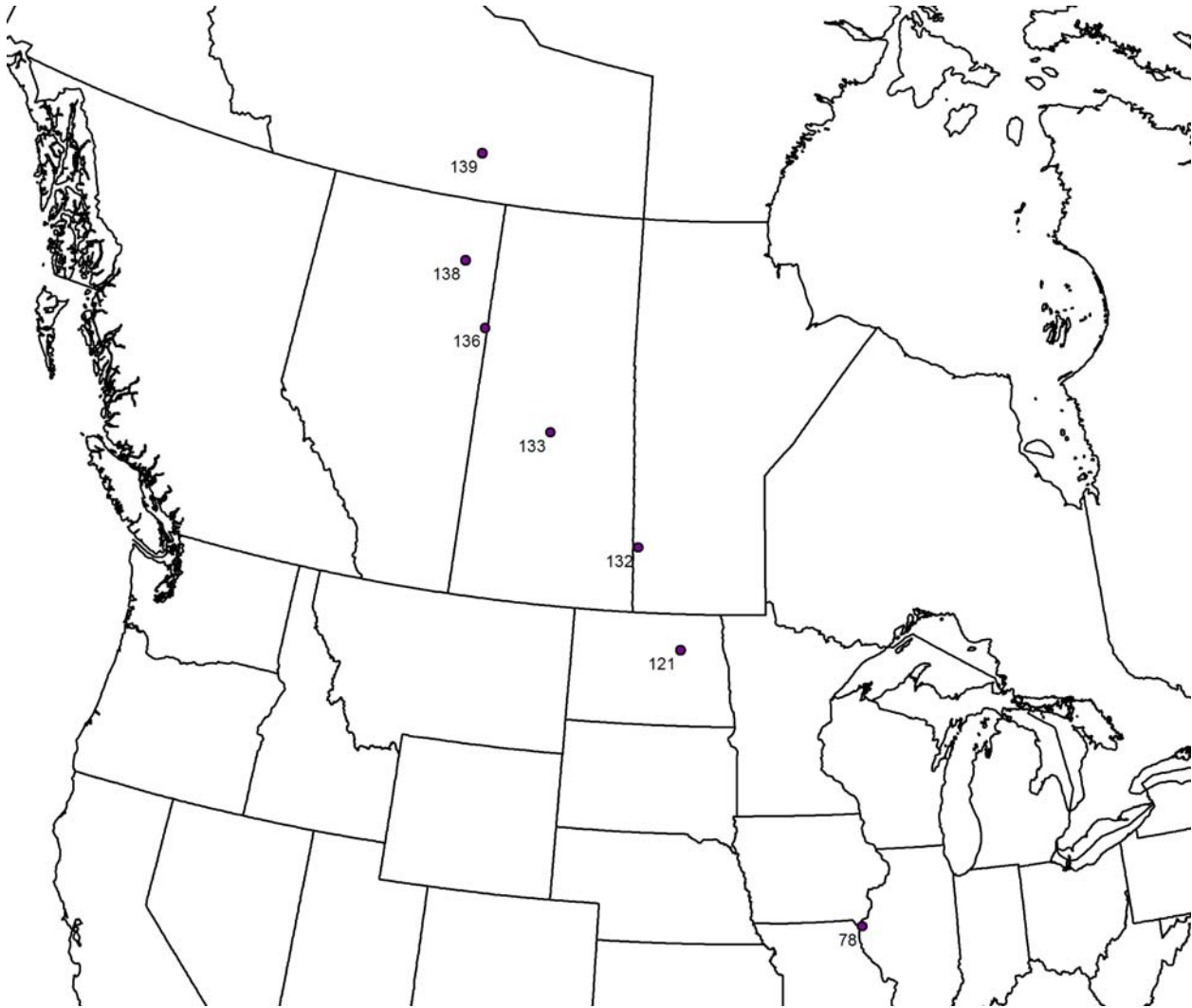


Figure 13. Migration tract of Lesser Scaup female 80889 from Pool 19 to her inferred breeding site in Saskatchewan. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and was alive as of 9 November 2008.

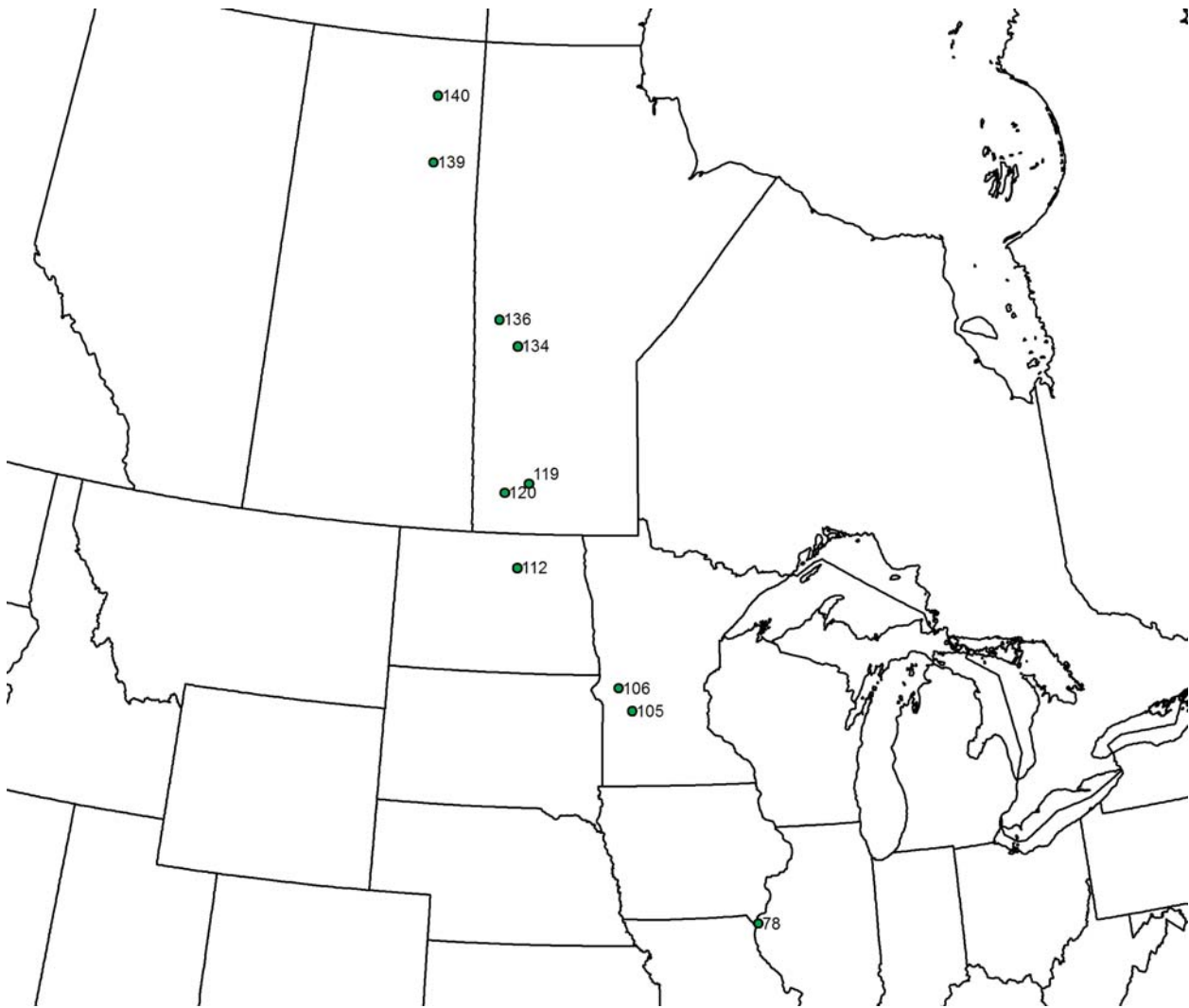


Figure 14. Migration tract of Lesser Scaup female 80890 from Pool 19 to her inferred breeding site in the Yukon. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and her PTT failed after 23 June 2008.



Figure 15. Migration tract of Lesser Scaup female 80891 from Pool 19 to her inferred breeding site in Alberta. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 17 March 2008 (Julian date = 76) and was alive as of 10 November 2008.

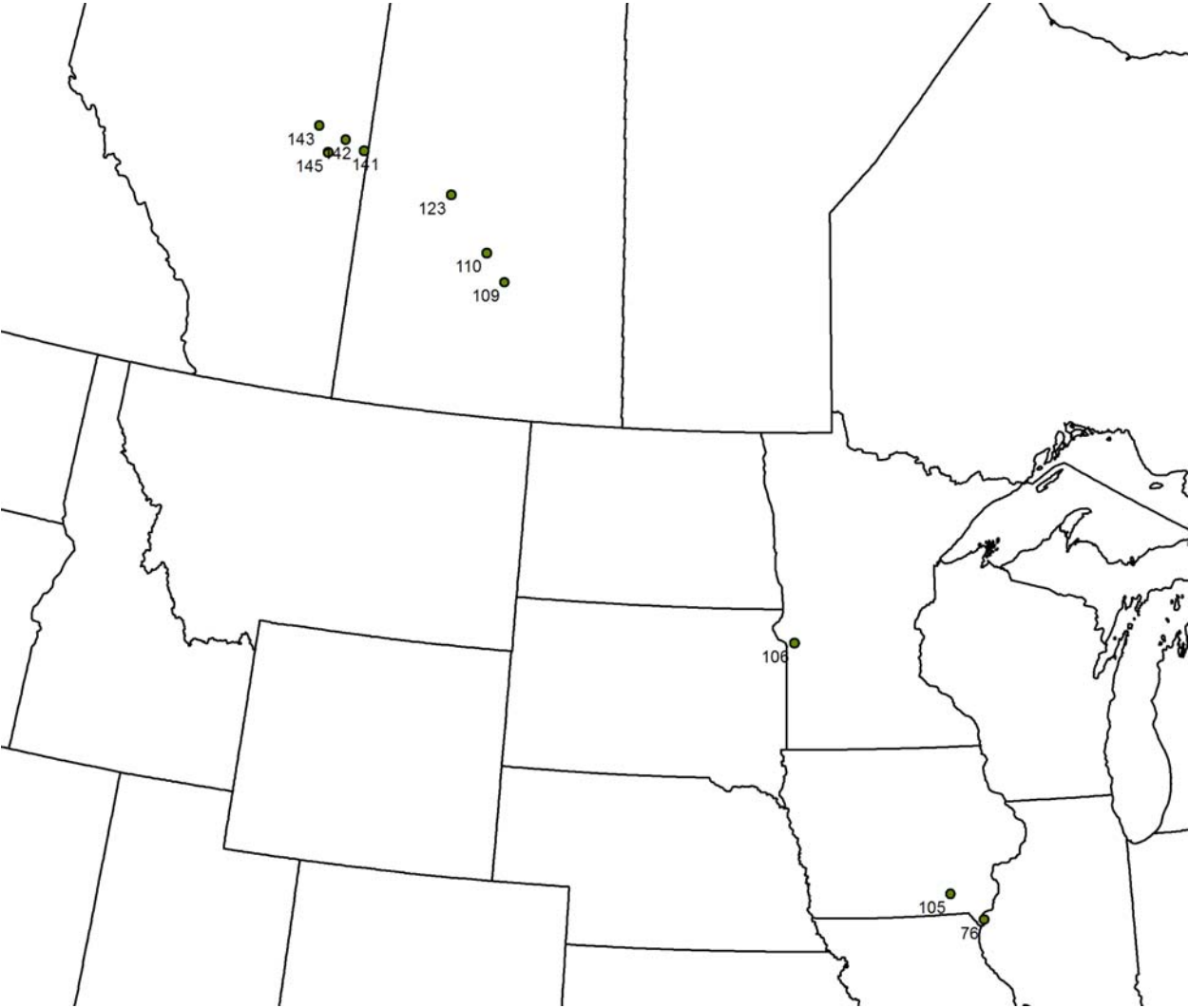


Figure 16. Migration tract of Lesser Scaup female 80892 from Pool 19 to her inferred breeding site in Alaska. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 19 March 2008 (Julian date = 78) and was alive as of 7 November 2008.

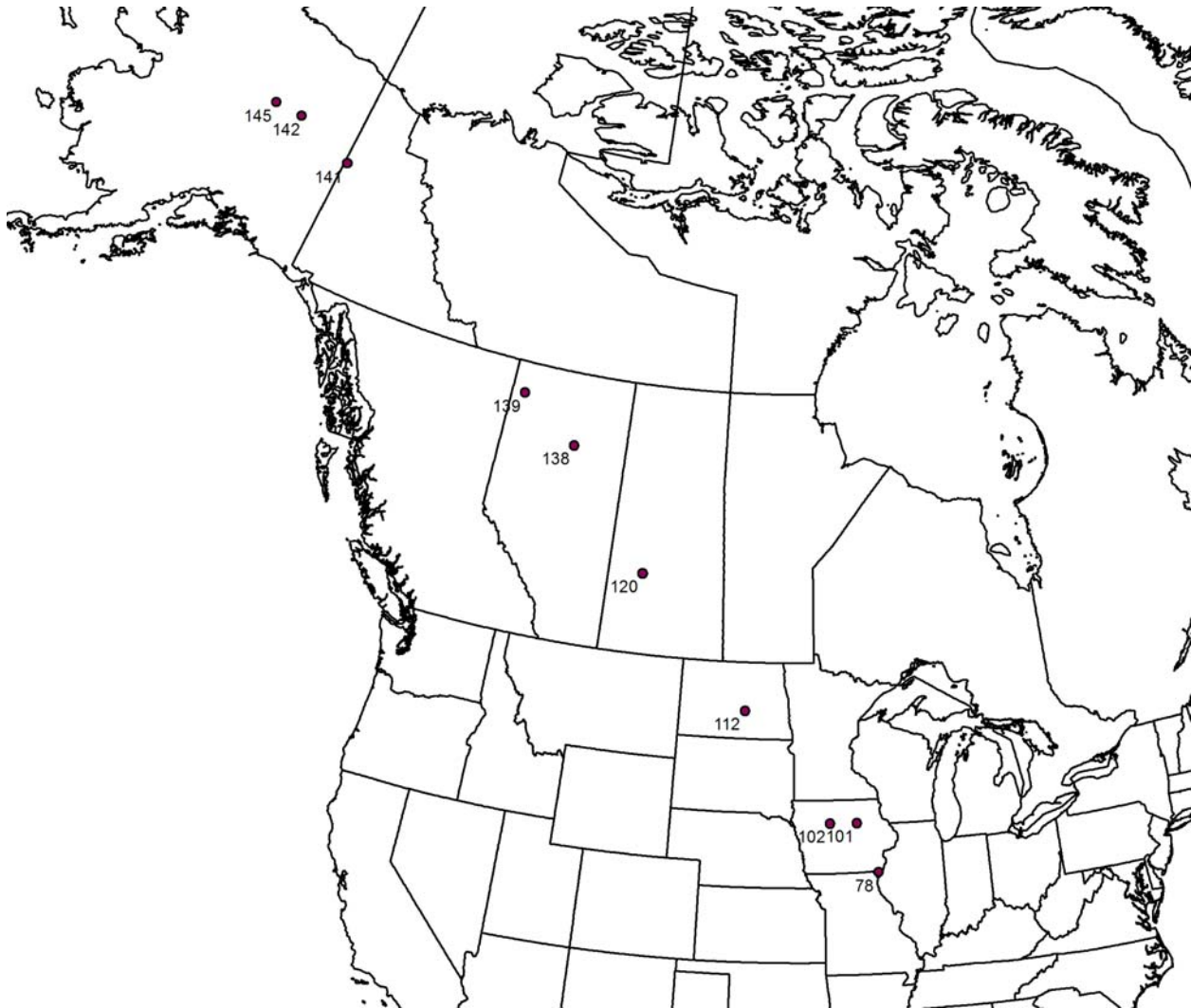


Figure 17. Migration tract of Lesser Scaup female 80894 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 18 March 2008 (Julian date = 77) and was alive as of 10 November 2008.

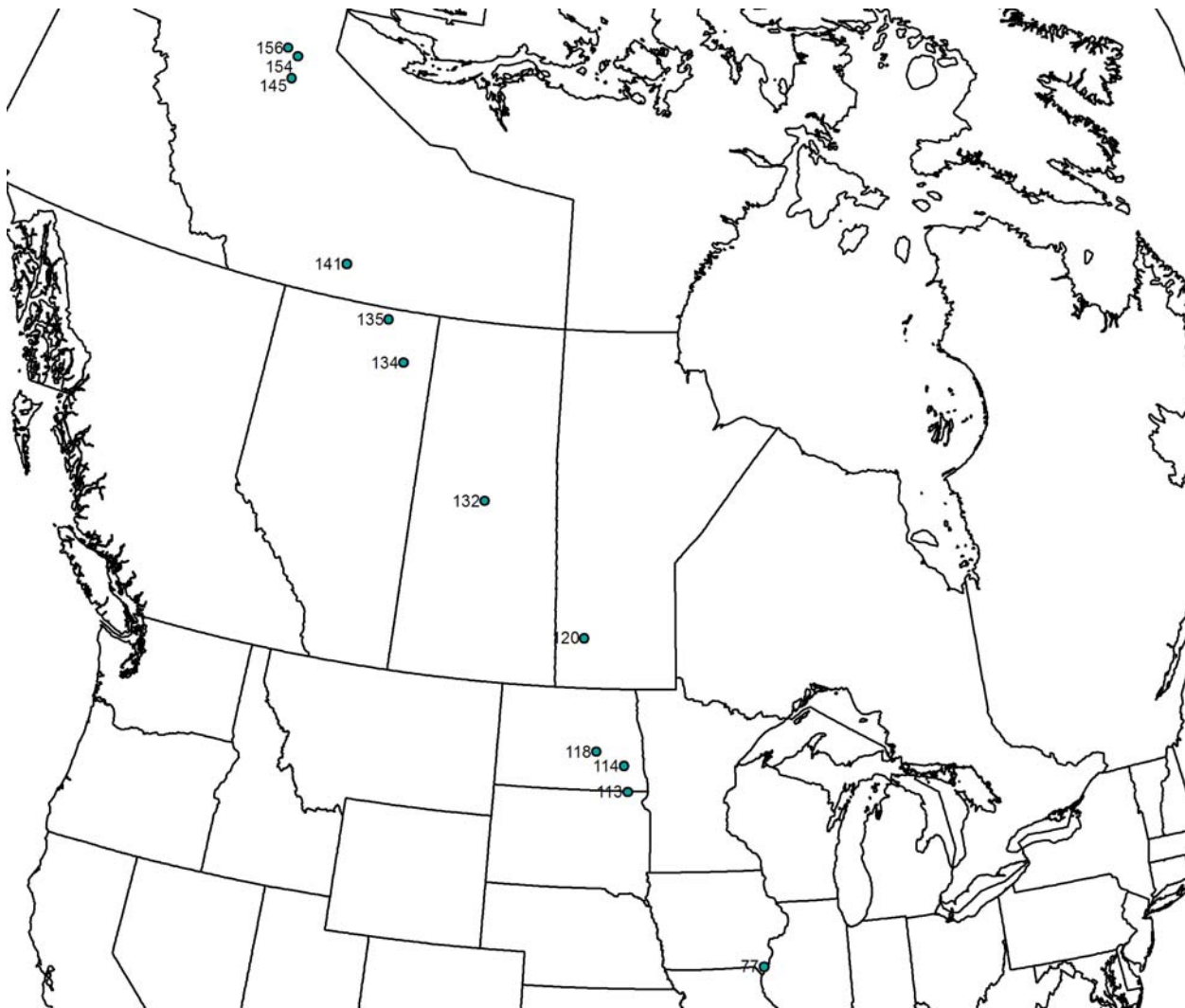


Figure 18. Migration tract of Lesser Scaup female 80895 from Pool 19 to her inferred breeding site in the Northwest Territories. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 18 March 2008 (Julian date = 77) and was noted dead on 7 June 2008.

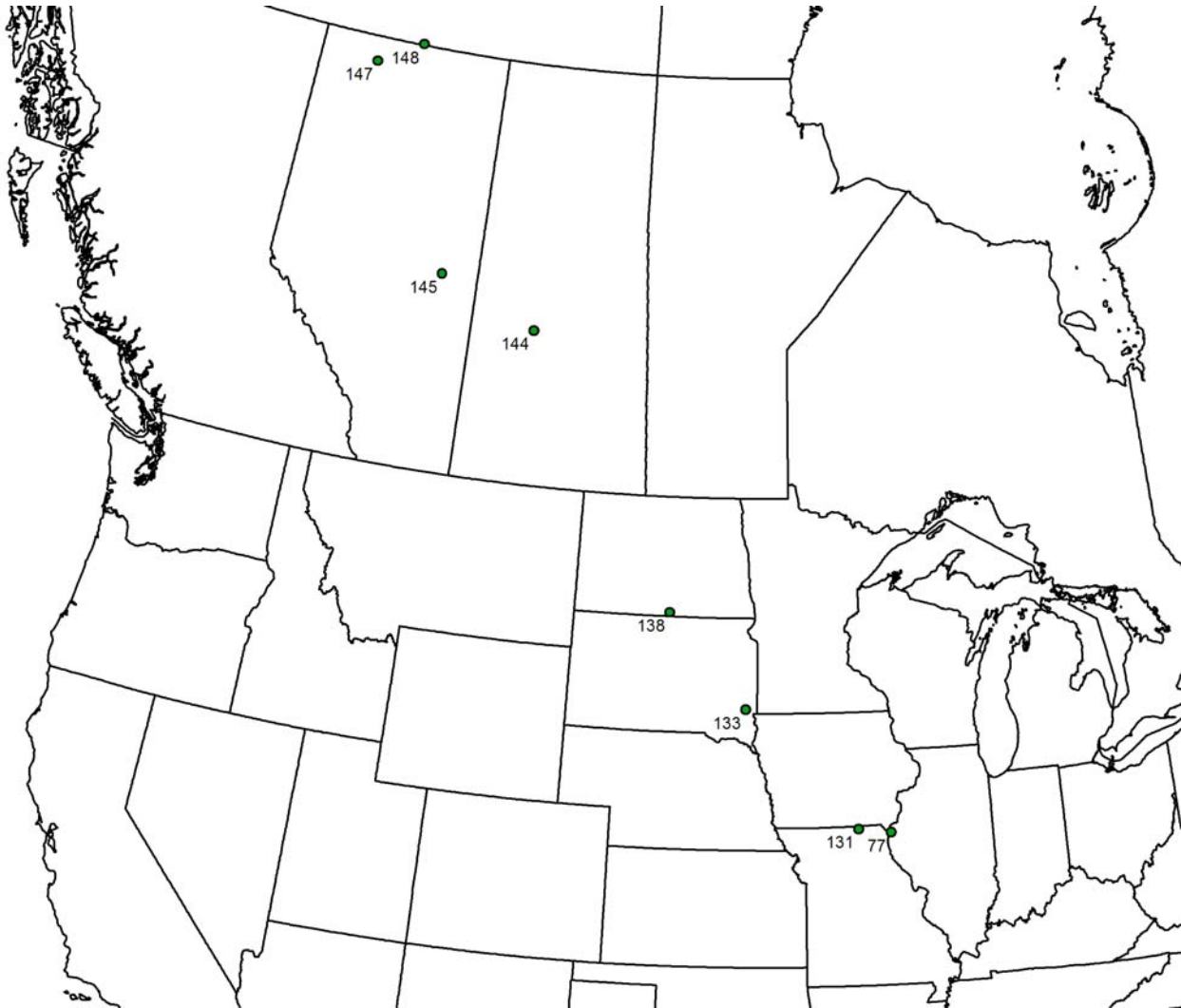


Figure 19. Migration tract of Lesser Scaup female 80896 from Pool 19 to her inferred breeding site in Saskatchewan. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 18 March 2008 (Julian date = 77) and was alive as of 9 November 2008.



Figure 20. Migration tract of Lesser Scaup female 80897 from Pool 19 to her inferred breeding site in Saskatchewan. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 18 March 2008 (Julian date = 77) and was alive as of 7 November 2008.

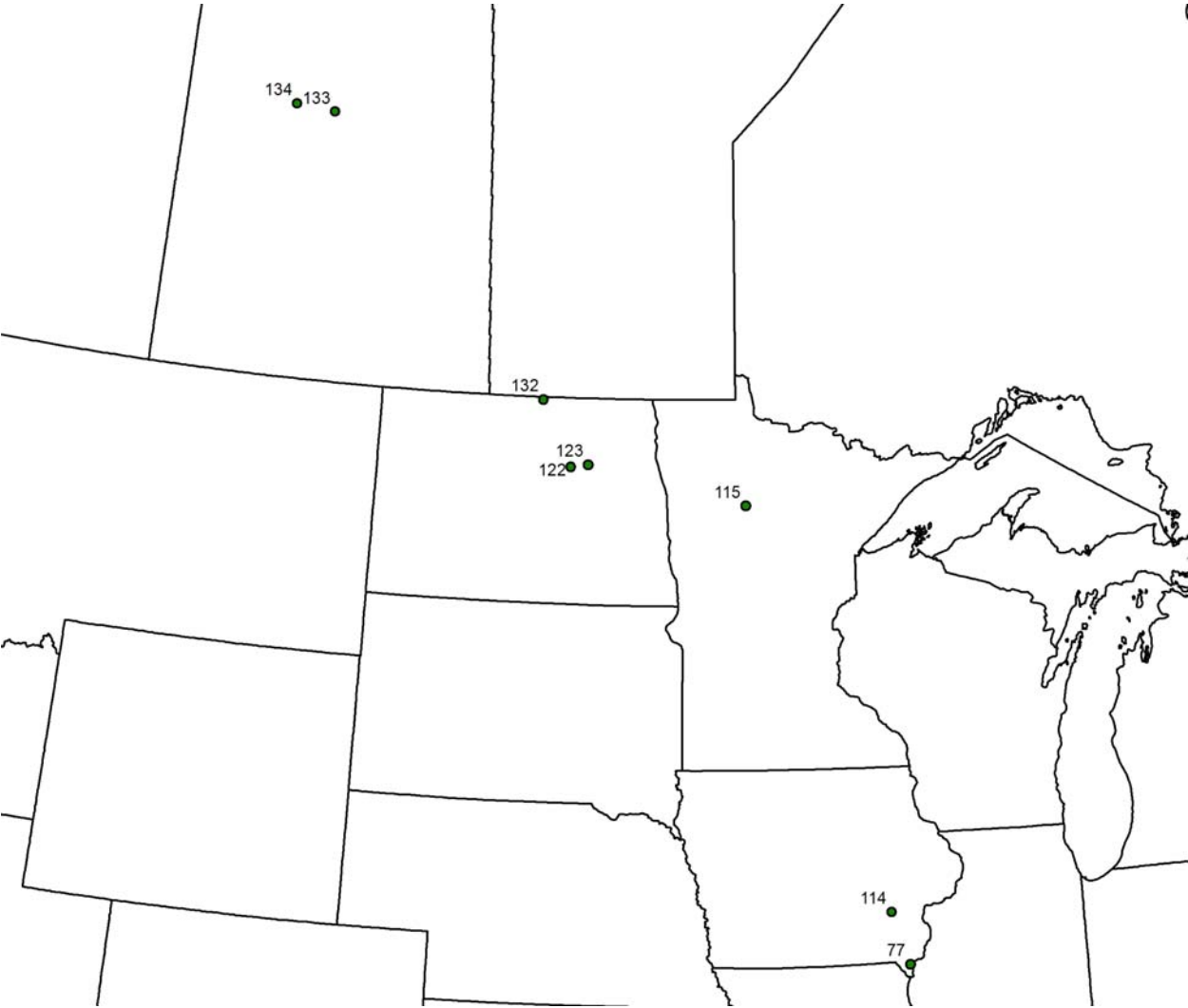


Figure 21. Migration tract of Lesser Scaup female 80898 from Pool 19 to her inferred breeding site in Alberta. Numbers associated with each migration stop and the inferred breeding site (solid circles) represent the first day (Julian date) the female was known to be at that location. This female was implanted and released on 17 March 2008 (Julian date = 76) and was alive as of 7 November 2008.

