University of Illinois
Institute of Natural Resource Sustainability
William Shilts, Executive Director

ILLINOIS NATURAL HISTORY SURVEY
Brian D. Anderson Director
1816 South Oak Street
Champaign, IL 61820-6964
217-333-6830

Strategies for recovery of an amphibian and a reptile inhabiting sand areas in Mason and Tazewell Counties

Final Report

Andrew J. Berger, Ellen A. Schneider , and Christopher A. Phillips

Prepared for:

Illinois Department of Natural Resources
One Natural Resource Way
Springfield, Illinois 62702-1271

UI Grant Code: D8015, Sponsor # T-42-R-1

Restricted Access T&E Species Locations

INHS Technical Report 2010 (08)
Date of issue: 3 February 2010

ILLINOIS NATURAL HISTORY SURVEY

FINAL REPORT

PROJECT TITLE: Strategies for recovery of an amphibian and a reptile inhabiting sand areas in Mason and Tazewell Counties

PROJECT NUMBER: T-42-R-1

NEED: Illinois has a number of unique habitat types including the cypress swamps of southern Illinois, the northwestern driftless area, hill prairies, and sand prairies. Of all these habitats, sand prairies are unique in having species of reptiles and amphibians restricted to the sandy habitats. In fact, two of these species occur only on sand prairies in Illinois and a few neighboring states. The Illinois Sand Areas were identified in the Farmland & Prairie Campaign of Section III.E of the Illinois Wildlife Action Plan as a Priority Location for Conserving Illinois' Species in Greatest Need of Conservation Concern. Specifically, Farmland and Prairie Action item number 3e (p. 75 of Version 1.0) states "restore and manage at least 6 areas (of 300-500 acres each) of ephemeral wetlands and accompanying upland sand prairie habitat in the inland sand areas."

Species restricted to sand prairies are declining or listed in Illinois. These include the Illinois chorus frog (*Pseudacris streckeri illinoensis*) and the Illinois mud turtle (*Kinosternon flavescens spooneri*), both of which are listed as threatened or endangered species in Illinois and Species in Need of Greatest Conservation in the Wildlife Action Plan (Version 1.0, p. 306, Appendix I, Amphibians and Reptiles). These subspecies are unique elements of the herpetofauna of North America and have the majority of their ranges restricted to Illinois (Smith 1951). The Illinois mud turtle requires sand ponds for foraging and adjacent loose sand dunes and sand blowouts for nesting, aestivation and hibernation (Tuma 2006). The Illinois chorus frog inhabits sand ponds as well, but does not coexist with predatory fish, which eat frog eggs and tadpoles (Phillips et al. 1999). The Illinois chorus frog also requires loose sand for aestivation and hibernation (Brown and Rose 1988).

The distribution of the Illinois chorus frog has been studied at several locations in the Illinois River sand areas (Brown 1986; Brown and Rose 1988; Tucker 1999), including Mason County. Most of these investigations have detected Illinois chorus frogs at several locations using Roadside Calling Surveys. However, no explicit linkage exists between the results of the calling surveys and anuran abundance or reproductive success (Stevens and Stevens and Paszkowski 2004; Weir et al. 2005). Intensive field surveys are required to document these parameters which are critical to the success of conservation efforts. The best study approach is to conduct mark and recapture studies. The Illinois chorus frog is an early spring breeder and after breeding (March-April) it retreats to subterranean refugia. Thus, frog surveys need to be conducted during those months.

The Illinois mud turtle has been under investigation in Illinois since 1979, with Department of Natural Resources field trapping at the three main core areas in Illinois, including Mason and Tazewell counties. This trapping data, plus similar data from Iowa and Missouri were recently collated and show declines at all core areas in Illinois as well as Iowa and Missouri (Christiansen et al. unpubl.). However, no pond or group of ponds in Illinois has been monitored intensively (at least 3 consecutive years) in over ten years. This level of effort is required to assemble demographic data and assess the threats facing these turtles. In addition, nest predation has been identified as a primary cause of declines in most freshwater turtles (Burke et al. 1998). However, to date, there has been very little quantitative data concerning nest predation rates for the Illinois mud turtle (but see Tuma 2006). Thus, there is a need for estimation of predation rates and formulation of potential management to counter it. The Illinois mud turtle usually does not become active until late April with activity continuing into late June. Thus it will be possible to conduct needed studies for both species without much seasonal overlap.

There is also a need for data on the geographic distribution of genetic variation for both species, so that informed management decisions can be made. There is currently data on the mtDNA variation of the Illinois mud turtle in Illinois and Iowa and for the nominate subspecies, *K. f. flavescens* (Serb et al. 2001). Researchers at Arkansas State University are analyzing Illinois chorus frogs from Illinois, Missouri, and Arkansas for mtDNA variation. These studies will provide the “broad picture” data on the relationship of the Mason and Tazewell populations to the surrounding populations in Illinois and the neighboring states. In addition to mtDNA, a more rapidly evolving marker is needed to provide finer resolution. First, the overall level of genetic variation within versus among ponds can shed light on the degree of inbreeding that may be occurring, and contributing to declines. If variation is low within ponds, there may be a need to increase genetic variation via translocation of individuals. Second, the translocation of individuals into newly restored areas can be evaluated only in the light of data on genetic variation (see below). Third, levels of genetic variation can provide estimates of migration rates among populations, which are extremely difficult to obtain using direct field measures.

Fortunately, past conservation of sandy habitats has produced a number of protected areas with habitat suitable for these sand restricted species with many located in Mason and Tazewell Counties. In addition, Illinois' Wildlife Action Plan calls for a net increase of 21,000 acres of grassland in the Illinois River and Mississippi River Sand Areas (Version 1.0; Section IV. Natural Division Assessments; C. The Illinois and Mississippi River Sand Areas; Management Guidelines; p. 142). This will provide benefits for many species of wildlife, especially those that are mobile and can exploit improvements far from areas where they live. Unfortunately, this approach will have limited benefits for species that are comparatively immobile and suffer from fragmentation, such as amphibians and reptiles. Our project will provide a purposeful approach to the implementation of The Plan habitat goals in part of this Natural Division by using habitat needs and demographic characteristics of two critical species (Illinois mud turtle, Illinois chorus frog) to identify core areas for conservation efforts. It will also provide a sound rationale for expanding efforts from core areas based on distances these creatures are able to travel among parcels, thereby creating optimum conditions for sustaining viable metapopulations. Mason and Tazewell counties are instrumental to the success of any plan because so much of the best quality habitats are located there.

One solution to the absence of natural recolonization is to begin a program of reintroductions of the two target species (Illinois chorus frog and Illinois mud turtle) into conserved but unoccupied habitats. Although seemingly simple, a program to reintroduce sand prairie species requires considerable information before it could be implemented. Without sufficient information on current demographic status of populations, on demographic patterns of extant populations, on suitability of possible reintroduction sites, and on genetic variability the possibility of successful conservation projects are greatly reduced (Kleiman 1989). Thus there is great need to gather these data and determine the genetic and demographic structure for these species.

OBJECTIVES

Job 1. Create habitat suitability models for both species using existing data from previous trapping surveys conducted by IDNR staff and previous contractors. Time frame: 1 May to 30 June 2007. Estimated cost: $8,000.

Job 2. Map suitable habitat in both counties using models and available GIS layers. Time frame: 1 May to 30 June 2007. Estimated cost: $5,000. Estimated number of sites and acreage: There are more than 35 individual sand ponds in approximately 250 km^2 in Mason and Tazewell counties. Within this area there are two main sub-clusters, one near Forest City and one near Green Valley, each approximately 1,000 ha. Because these two areas are found on disjunct sand areas separated by approximately 9 km of non-sandy soils, it is doubtful that migration occurs among the clusters.

Job 3. Survey sites with suitable habitat as determined in Job 2 and collect demographic data. Estimated cost: $112,000.

3.1 Begin occupancy surveys at all sites identified in Job 2. Time frame: 1 May 2007 to 30 March 2008.

3.2 Collect tissue samples for genetic analysis. Time frame: 1 May 2007 to 30 June 2009.

3.3 Choose occupied sites for in-depth demographic and habitat analyses and begin surveys at those sites. Time frame: 1 March 2008 to 30 June 2009.

Job 4. Revise habitat models using data from occupied sites and additional GIS layers (fine-scale habitat) collected during field surveys. Time-frame: 1 March 2008 to 30 June 2009. Estimated cost: $5,000.

Job 5. Model impact of management strategies at unoccupied but conserved potentially suitable sites. Time frame: 1 March 2008 to 30 June 2009. Estimated cost: $46,000.

5.1. Evaluate current habitat management practices such as burning frequency

5.2. Examine needs for predator control, mainly the raccoon, in turtle habitats

5.3. Examine hydrologic management practices at selected suitable but unoccupied habitats

5.4. Acquire necessary permits for head starting turtle hatchlings.

Job 6. Genetic analysis.

6.1 Determine how many microsatellite markers are currently available for both species. Time frame: 1 March 2008 to 30 June 2008. Estimated cost: $2,000.
6.2 Screen individuals of both species for microsatellite variation. Time frame: 1 July 2008 to 31 December 2008. Estimated cost: $19,000.
6.3 Estimate genetic variability within and among populations for both species. Timeframe: 1 May 2008 to 30 June 200. Estimated cost: $26,000.

Job 7. Demographic analysis. Survivorship and population demographics will be modeled using appropriate computer analysis tools such as MARK or similar methods for both turtle and frog populations. Timeframe: 1 February 2009 to 30 June 2009. Estimated cost: $39,000.

Job 8. Viability and sensitivity analysis. Timeframe: 1 July 2009 to 30 October 2009. Estimated cost: $9,000.

Job 9. Prepare final report. Timeframe: 1 November 2009 to 30 January 2010. Estimated cost: $6,000.

ACCOMPLISHMENTS

Job 1

IMT

An explicit habitat suitability model has not been created because the low capture rates for IMTs and the small numbers of turtles encountered in occupied ponds suggests that the species is very near extirpation. In this situation it is likely that the factors affecting the current distribution of IMTs are not necessarily related to habitat, but rather the result of stochastic factors. Although an explicit model of habitat suitability is not warranted, we have developed a series of GIS layers that provide representations of the landscape features that we believe are necessary for occupancy by IMTs. By locating and mapping suitable landscapes for IMT populations we will be able to focus restoration efforts for this species as well as identify areas that harbor as yet undetected populations of IMTs.

It is well known that IMTs require a matrix habitat of ephemeral to semi-permanent wetlands for foraging and sand prairie for nesting and aestivation (Christiansen 1985, Iverson 1991, Tuma 2006); however the spatial relationships of these two habitat types and their distributions across Illinois have never been explicitly described. We have determined that the IMT has three large scale habitat requirements that restrict its range in Illinois, first they require a cluster of ephemeral to semi-permanent wetlands for their activity periods, secondly these wetlands must occur on or near areas with sandy soil allowing them to bury into the soil for aestivation/hibernation and nesting and finally, IMTs only utilize sandy areas for aestivation/hibernation and nesting that have open sand prairie vegetation cover.

To determine the potential distribution of IMTs in Illinois a series of ArcGIS layers was compiled. Initial mapping of the known localities of IMTs and Illinois soil associations from the NRCS showed that known populations of the IMT were highly correlated with the soil associations 1222 and 1250. A soil association consists of two, two-digit codes; the first represents the parent material of the soils while the second code indicates the group of soil series that make up the majority of the soils within the soil association. In the case of these two soil associations the parent material is coded as 12 and is described as 'Thick, sandy Wisconsonian outwash and Aeolian materials' (Soil Associations Metadata). For the first soil association 1222, the 22 code indicates that the soils are mostly made up of the soils series Sparta, Dickinson and Onarga which are considered to be prairie soils. The second soil association 1250 is made up of soil series named as Oakville, Lamont and Alvin which are primarily associated with forest vegetation. The soil association map was not specific enough to use for more in-depth analysis, but it was used as a starting point for collecting additional data. A soil series map that contains much more specific and accurate information on the distribution of soil types was obtained for Mason and Tazewell counties. The soil series layers were then refined to include only the soil series that were labeled as 'sand' within the soil series name. Using this layer provides an even better correlation with known sites of IMT populations. Additionally all of the aestivation sites of radio-tracked IMTs were located within soil types labeled as sand, specifically Bloomfield and Plainfield sands which are extremely prevalent in the survey area.

A polygon layer of wetlands from the National Wetland Inventory (NWI) was also obtained for the same counties as the soil series data. This provided a polygon layer of wetlands across the survey area as well as a general wetland classification broken into the categories Freshwater Emergent Wetland (FEW), Freshwater Forested/Shrub Wetland (FFSW), Freshwater Pond (FP), Riverine and Lake. For the purposes of the IMT we were only concerned with the FEW, FFSW and FP types. These categories describe the type of vegetation within the wetland and do not necessarily represent the vegetation around the pond, which is why we also included the FFSW category.

As part of a study on the connectivity between wetlands used by the IMT, appropriate wetlands within the survey area in Mason and Tazewell counties were analyzed using a network analysis technique. This technique allows for an analysis of the importance of each wetland with respect to the overall 'network' or cluster using three criteria; articulation, centrality and size. The measurements articulation and centrality were calculated using a software program called Pajek. Articulation serves as a measure of the importance of a wetland in connecting groups of other wetlands. The centrality measure quantifies how connected a wetland is to the rest of the wetlands within a network. The third criteria used the size of the wetland as an indicator of that wetland's importance as a habitat patch for the IMT. The network measurements were calculated based on an 800m network, a hypothetical maximum distance that IMTs are capable of moving between wetlands. This distance was selected because it served as the best approximation of between pond movements observed from the radio-telemetry data. Networks based on 400m and 600m were also calculated but not used for in-depth network analysis. Although the network analysis is not yet fully developed, the preliminary results give some good indications of how to manage wetland clusters to achieve a landscape that allows IMTs to more easily move between wetlands and overcome the geographic isolation currently faced by the IMT in the study area. The final results of the network analysis study are part of a M.S. thesis and will be made available once completed.

ICF

Using GIS layers of soil series and wetland availability we have designed a general map of ICF sites where calls and/or tissues were collected during this project. We believe that the ICF is probably able to use a wider variety of soil series and is not as restricted as the IMT to the use of highly sandy soil series. We believe that the ICF still requires concentrations of sandy soils, but may be able to use soil series classified as loamy sands and sandy loams as well.

<u>Job 2</u>

IMT

Figure 1 shows the distribution of soil associations with parent material '12' across Illinois and the location of known IMT populations. A more specific map of the sandy soil series and the distribution of known IMT populations within the study area can be seen in Figure 2. Maps displaying the results of the network analysis used on the Manito and Green Valley networks can be seen in Figures 3 and 4. Appendix 1 includes the GPS coordinates of all wetlands surveyed for IMTs from 2007 through 2009. This table includes each wetland's site name and numerical ID and where applicable the Network ID used in the network analysis study. Figures 7 – 12 depict the movements and aestivation locations of turtles observed using radio-telemetry. All the locations used by turtles for aestivation and nesting occurred within the sandy soil series.

ICF

The distribution of historical ICF sites across Illinois along with the distribution of soil associations that occur near these ICF sites can be seen in Figure 5. Figure 6 shows the distribution of sites that we surveyed for the ICF as well as soil series labeled as sand, loamy sand and sandy loam. Appendix 2 provides the GPS coordinates for all sites that were surveyed for the ICF in 2008 and 2009.

<u>Job 3.1</u>

IMT

Trapping surveys for IMTs were performed during spring and summer in 2007 from 10 May through 28 June, in 2008 from 19 May through 23 July and in 2009 from 30 April through 5 August. We trapped a total of 26 ponds over the course of the three field seasons, 15 near Manito, six in the area near Green Valley and five ponds north of the Manito pond cluster, between Spring Lake State Park and the Manito Blacktop Rd. These northern ponds have been grouped together as the 'North' group in tables reporting trap effort and captures. Trap effort and number of mud turtles captured can be seen in Tables 1 (2007), 2 (2008), 3 (2009) and 4 (cumulative). In 2007, 1406 trap-nights yielded a total of nine IMTs from six ponds. In 2008, 2225 trap-nights yielded a total of 22 IMTs from six ponds. In 2009, 2424 trap-nights yielded a total of 34 IMTs from eight ponds. Catch per unit effort was calculated to be 0.0064 in 2007, 0.0099 in 2008 and 0.014 in 2009. Alternatively it took 156, 101 and 71 trap nights to capture one mud turtle for 2007, 2008 and 2009 respectively. Of the ponds that produced IMTs in 2007 the Becker Pond (69) was the only pond that was not surveyed again in 2008 or 2009 because of difficulties in obtaining landowner permission.

Over the three year study a cumulative trap effort of 6055 trap nights resulted in the capture of 50 individual mud turtles, of which three are known to have died during the course of the study. The mortality of all three of these turtles was discovered while collecting radio-telemetry data and will be discussed in the radio-telemetry and movements section. In addition to the trap captures, two dead IMTs were collected during the course of the project. The first individual, an adult male was a recapture from previous surveys and found dead on the road between the Rollo (6) and Fornoff (39) ponds during the 2007 field season. During the 2009 field season an unmarked juvenile was found floating dead in the water near one of the traps set in the Fornoff (39A) pond.

Trapping surveys during this project have resulted in the discovery of IMTs at two new sites. Ponds that were not previously numbered during Ed Moll's previous surveys were sequentially numbered starting with 80 for the Nehmelman pond. The first new pond, Nehmelman (80), was initially surveyed during the 2007 field season, but mud turtles were only captured during the 2008 and 2009 field seasons. This pond is located just north of the Burnsmier ponds and movement between these two properties was observed in 2009 using radio-telemetry. A second new pond, VanHies (86), was discovered during the 2009 season and is located 0.44 mi south of the Talbot subdivision. While this pond is not located near any previously known ponds, the area consists of two permanent ponds with nearby ephemeral wetlands providing a high density of water bodies within suitable soil types. A total of six female IMTs have been captured from this site. The observation of six females over a period of 28 trap nights is encouraging and further surveys at this site should be performed to determine the status of this population. The lack of encounters with males at this population is of some concern, however this pond was not trapped until relatively late in the season and it is possible that males had already aestivated by this time. Morphological data for IMTs captured from 2007 through 2009 are given in Table 5.

ICF

Calling surveys of accessible sites identified in Jobs 1 and 2 began in 2008 from 13 March through 22 April. In 2008 surveys were conducted at 42 sites in Mason and Tazewell counties while an additional ten sites were surveyed in Menard, Cass, and Logan counties. Table 6 lists the sites at which ICFs were heard as well as the observed calling index according to the North American Amphibian Monitoring Program (NAAMP) protocol. Out of eleven sites surveyed in Tazewell County only five had choruses of ICFs while 15 of 31 sites surveyed in Mason County had ICF choruses. The frogs were frequently skittish and difficult to approach because of lower than average air temperatures during the surveys. In some instances it took over 30 minutes for ICFs to resume calling after being approached.

On 5 March 2009 calling surveys of accessible sites identified in Jobs 1 and 2 began and continued until 1 April 2009. The observed calling index according to the (NAAMP) protocol where ICFs were heard is listed in Table 7. Only ten sites in Mason and

Tazewell counties were surveyed in 2009. Of the four sites surveyed in Tazewell County only one site had a chorus of ICFs, while all six sites surveyed in Mason County had ICF choruses at least once during the survey period. Calls were also heard at List Ditch, Montgomery S., Bluhm, Cherry Grove North, Wetland 267, and Woodard sites. Because the NAAMP calling data was not recorded these sites have not been included in the Table 7 results.

A total of 67 wetlands have been surveyed for ICFs in the 2008 and 2009 field seasons using a combination of calling, visual and dip netting surveys. Appendix 2 lists the results of these sampling efforts at all sites surveyed in Mason and Tazewell counties.

Job 3.2

IMT

Blood samples were taken from the majority of turtles captured from 2007 through 2009. Samples were not taken from most of the juveniles because of their small size. The low numbers of IMT tissues collected prevents effective utilization of microsatellite primers for analyzing the population genetics of the IMT within the study area.

ICF

Over the course of the 2008 field season we were able to collect 61 ICF tissue samples using visual surveys in addition to the dip net site survey protocol described under Job 3.3. Dip netting was conducted from 3 June through 16 June 2008. Table 8 lists sites at which tissues were collected as well as the type of tissue collected. Tissues were collected from eight out of 38 total sites sampled from both counties.

Two potential sources of *Pseudacris* microsatellite primers have been identified as of this report. We have begun to use these primers to analyze tissues collected from our surveys and the preliminary results of these analyses are described in Job 6.1.

During the 2009 field season we collected approximately 367 ICF tissues using a modified version of the dip net survey protocol described under Job 3.3. As this season was the last field season the focus of work shifted to collect the maximum number of samples possible. This was facilitated by modifying the protocol to exclude the analysis of invertebrates and salamander larvae. Dip netting was conducted in 2009 from 5 May through 24 May. Table 9 lists sites at which both vouchered and unvouchered tissues were collected from Mason and Tazewell counties. Tadpoles were collected and brought back to the lab to ease identification and insure an adequate genetic sample for analysis. The numbers at certain sites represent estimates because of the difficulties in identifying tadpoles. As of this writing the processing and identification of collected tadpoles is still in progress.

Job 3.3

IMT

In-depth demographic analyses are not possible given the low number of IMTs encountered. Instead, we have shifted our focus to include radio-telemetry of IMTs to characterize timing of movements and terrestrial habitat used by the IMT. The distances moved to and from ponds were calculated from the center of the pond the turtle moved into or was last known to have occupied.

In 2007, we tracked four IMTs, one juvenile male, two adult males and one adult female from three ponds; Jibben Pasture (16), Armbrust (53), and Hilst North (13). The average total terrestrial distance moved was 315m, but varied from 39m to 704m. A summary of our telemetry observations can be seen in Table 10. The only female turtle in the telemetry study moved back to the pond on 28 June after spending 17 days in aestivation. She remained in Pond 53 for 37 days and then moved to within 8m of her initial aestivation site. Depth of aestivation for all turtles varied from 9cm to 30cm, but the female could not be located at the end of the study. We dug to a depth of 1m and a diameter of 0.8m centered on her radio-location, but could not find her, even though the transmitter signal was strong.

In 2008, 13 IMTs were tracked at four ponds; the results can be seen in Table 11. Transmitters fell off of two turtles after they had moved out of the ponds. Because final aestivation sites could not be determined for these two individuals they have not been included in the analysis of terrestrial distances moved. The average total overland distance moved was 224m and ranged from 63m to 579m. Depth of aestivation observed for the turtles during the summer June/July varied from 7cm to 24cm, similar to the 2007 results of 9cm to 30cm.

Turtle 03L-10L-02R did not appear to aestivate at anytime, despite traveling 450m overland. The turtle was initially trapped in Hilst South (14) then left the pond two days after being released with a transmitter. The turtle was observed actively walking on land for two days during the daily checks and ultimately moved into Hilst North (13) on 1 June. The turtle was discovered floating dead in Hilst North (13) on 6 June.

A second IMT mortality was narrowly avoided on 15 June. After checking traps the turtle 03L-11L-02R was located directly underneath one of the hoop net traps, the turtle had apparently gotten stuck attempting to crawl under the trap. Fortunately the turtle recovered after being brought out of the water. The turtle was radio-tracked through the winter and for a short time during the spring of 2009.

Three turtles from the 2008 field season were fitted with 12 month Holohil transmitters to determine timing of return to ponds the following spring. Turtles 03L-09L-09R (Hilst) and 03L-11L-02R (Armbrust) were found to have resumed aquatic activity on 25 April 2009. Turtle 02L-08L-11R (Hilst) did not leave its hibernation location and was dug up on 29 May 2009 and found to have died over the winter. The turtle had not moved deeper into the ground since its last telemetry check in the fall of 2008 and presumably froze. On 14 May 2009 turtle 03L-09L-09R was found floating dead in the water of Hilst North (13). Its head had been chewed off and we were unable to determine the responsible predator. The turtle was behaving oddly so it is likely that it was ill, which could have contributed to its vulnerability to predators.

A total of eighteen IMTs were tracked in the 2009 field season. Table 12 gives a summary of the results of our tracking efforts. In 2009 we observed an increase in the total overland distances moved by IMTs and many instances of movement between wetlands. The average total terrestrial distance moved by IMTs in 2009 ranged from 81m to 2311m with an average distance of 607m. While this average is not drastically different from those for 2007 and 2008, the maximum distances observed were higher, primarily because of the movements of a few turtles. We suspect that the drastic increase in terrestrial movements was because of the extremely wet field season of 2009, as this allowed IMTs to take advantage of a much longer field season and wetlands that were much fuller than normal.

During the 2009 field season nesting was observed for two of the radio-tracked females, one captured from Fornoff (39A) and the other from Armbrust (53B). A HOBO data-logger was placed near each nest at approximately the same depth as the eggs to monitor the incubation temperature. We were unable to locate any hatchlings at the end of the field season.

ICF
A dip net protocol was used to assess the community structure of probable ICF ponds as well as the development stage of the ICF population in each pond. Dip net samples were collected in 15 minute intervals per researcher. The contents of each net were collected in a bucket that was carefully examined for tadpoles, invertebrates, and tiger salamander larvae. The goal was to collect 15 ICF tissue samples and 10 tiger salamander larvae at each of 34 sites. Tiger salamander larvae were collected to assess the potential for predation on ICFs. A sample of the invertebrate community netted at each site was also collected for later analysis. Table 13 lists the results of the dip net protocol in Mason and Tazewell county ponds during the 2008 season.

During the 2009 season emphasis was placed upon collecting adequate numbers of ICF tissues from ponds to insure that analysis of population genetic structure using microsatellites would be robust. Rather than collecting and analyzing invertebrates, only ICF tadpoles and metamorphs were collected. Notes were taken on the presence/absence of potential predatory invertebrates as well as potential vertebrate predators such as fish, bullfrogs and tiger salamander larvae.

<u>Job 4</u>
IMT
Vegetation cover data was taken at terrestrial locations used by radio-tracked IMTs for aestivation/hibernation and nesting. To compare microhabitat at locations used by IMTs for aestivation to habitat that is available, similar measurements were taken at random locations surrounding wetlands where IMT surveys were conducted. A multivariate analysis of the terrestrial habitat surrounding these wetlands will be performed to characterize the habitat available to IMTs for aestivation. These data will be incorporated in a M.S. Thesis and will be made available when completed.

ICF
While conducting surveys for ICFs the presence or absence of vegetative cover and approximate water level was recorded. Although our observations are insufficient to

perform a modeling analysis, we believe that the presence of emergent vegetation within wetlands is an important factor for successful ICF recruitment and warrants further investigation.

Job 5.1

The study area can be sub-divided into two main population clusters, the eastern population occurs near the town of Green Valley while the western population is located near the town of Manito. With respect to management of these populations each cluster can be treated as a separate population. Appendix 1 provides both the Network ID numbers used in this section along with the Site Names used elsewhere in the report. We used the Network IDs because these include wetlands that are currently unsuitable for IMTs but could potentially be restored. The network analysis was used to describe the potential connectivity of the landscape as a means of directing future restoration efforts.

Within the Green Valley cluster a core network at a distance of 400m can be identified between points 4, 10, 19, 12, 11 and 24. These wetlands are also indicated as being quite important with respect to the overall network on the basis of centrality (4, 10, 19, 12, and 11) and size (4, 10, 19 and 11). With the addition of node 22, which becomes connected at the 600m level, these wetlands include all of the sites within the network with known populations of IMTs. Node 22 serves as an extremely important patch with respect to this network because it received a rank of 4 in all three network measurements. This wetland is also important with respect to the conservation of IMTs because of the relatively high numbers of IMTs that have been captured in trapping surveys at this site. While there are several other wetlands within this network that received ranks of importance with respect to several of the metrics we believe that initial conservation efforts should focus on the 'backbone' of this network consisting of nodes 22, 4, 10, 19, 12, 11 and 24. Not only do these wetlands comprise the known populations of IMTs within the network, but they also represent wetlands that are important in maintaining the connectivity of the network overall. By focusing on this central portion of the network and working outwards, initial efforts will hopefully result in increased populations at the core wetlands while future efforts of restoring the peripheral wetlands will give the expanding populations suitable habitat to disperse to.

For the Manito network we see two main core networks at 400m that include sites of known populations of IMT, one dense cluster between ponds 13, 6, 3 and 4 and a larger more linear network from ponds 10, 11, 9, 16, 2, 14, 8 and 15. These separate core networks do become connected at the 600m level and even more so at the 800m level. The 800m network also includes node 12, which provides some of the best available aestivation habitat and seems to be the main wetland used by IMTs in this network. The two wetlands represented by nodes 8 and 15 are demonstrated to be very important to the overall network because of their large size, centrality and in the case of node 15, articulation as well. Recent surveys for IMTs in the area suggest that the historic populations at these sites have been extirpated. This is likely because of the unsuitability of the vegetation at these sites as the terrestrial habitat has seceded to shrubland and forest which is unusable for aestivation by the IMT. Conservation efforts within the Manito cluster should initially focus on the restoration of prairie habitat surrounding ponds 8 and 15. Restoration of these large ponds will provide enough wetland habitat to support large populations of IMT and provide the additional benefit of providing central habitat patches that will facilitate the movement of turtles between the currently known populations of IMT that are currently isolated from one another by unsuitable habitat.

The DNR currently owns two properties within the study area, both of these properties are located within the western cluster near the town of Manito; these properties are named Sparks Pond State Natural Area and Rollo Prairie State Natural Area. Both of these properties were purchased as habitat for the IMT and ICF. Our recent surveys at Sparks Pond indicate that both the IMT and ICF are no longer present. Surveys at Rollo Prairie indicate that the ICF is still present and sustains numbers similar to those of other sites in the study area, while the IMT has experienced a drastic decline in numbers compared to surveys performed by Ed Moll (Moll 1980). Both of these properties are in need of a more active management regime to create and maintain the prairie habitat required by both of these species.

Suitable aestivation habitat on privately owned properties appears to be maintained primarily by late summer and early fall mowing of grassland areas. As long as mowing takes place after mid-August IMTs should be out of the ponds and buried in their aestivation/hibernation locations. Although some of the IMTs tracked made terrestrial moves after they left the ponds, most of these movements took place after periods of moderate to heavy rainfall. As long as mowing is performed during dry periods it is unlikely that IMTs will be affected. Another viable management strategy would be to conduct fall burns to maintain prairie habitat and exclude woody species. Fall burns conducted after August should avoid any negative impacts to IMTs as this will occur during their period of inactivity when the turtles are buried well beneath the soil surface. Although conducting burns in the early spring would not affect the IMT as long as they took place before April, the ICF becomes active much earlier in the year with calling taking place as early as late February. Because ICFs become active so early in the year any spring burns could potentially harm adult ICFs as they migrate to wetlands for their annual breeding. This makes spring burns a poor choice for habitat management within the study area. Additionally care should be taken to maintain emergent vegetation within wetlands used by ICFs for breeding. In our surveys we have noticed that wetlands lacking emergent vegetation are not utilized by ICFs, probably because the vegetation provides perches for calling males and attachment points for eggs.

Conservation efforts for the IMT and ICF on DNR owned properties should focus on creating and maintaining sand prairie habitat surrounding available wetlands. Efforts should also be made to work with landowners in the area to set aside more habitat and conduct mowing and other management around wetlands to promote open sand prairie habitat suitable for the IMT, ICF and other species restricted to sand prairie habitats within Illinois.

<u>Job 5.2</u>

We have not conducted any surveys to determine the density of the raccoon population at these sites. Although we did not observe any predation or disturbance of radio-tracked turtles by meso-predators, we did have problems with raccoons tampering with aquatic traps at some sites particularly at the Jibben (16), Rollo (6) and Fornoff (39) ponds. Meso-predators such as raccoons may pose a significant source of mortality for IMTs within the study area; however we do not have any specific evidence to indicate the magnitude of the problem within the study area.

Job 5.3

The IMT and ICF both require ephemeral to semi-permanent wetlands for their life cycles; consequently management of water levels at these wetlands will be very important to their conservation. For the ICF water level is critical to successful recruitment, if wetlands used by ICFs dry out before the tadpoles can metamorphose there will be no annual recruitment at that wetland. Where management of a wetland's water level is possible, we recommend that the hydroperiod be maintained until the end of June. Through radio-telemetry we have observed that a few IMTs have remained active within wetlands until mid-August, though this was likely caused by the unusually rainy seasons in 2008 and 2009. Despite the presence of water in wetlands used by the IMT, most of our radio-tracked individuals left their ponds and entered aestivation by mid July. Where possible water levels should be maintained through July, this will ensure a reasonable availability of aquatic habitat for IMT foraging.

We would like to point out that an important aspect of the IMT and ICF natural history is that they both take advantage of ephemeral wetlands in their life cycle. Because these wetlands dry out periodically the establishment of many predators, such as fish and bullfrogs that would prey on ICFs, is prevented. This lack of predators also benefits the IMT because they are the top predators in ephemeral wetland communities and benefit from the lack of competition for prey. At sites where water level management is possible, wetlands should be allowed or even encouraged to dry after July to prevent the establishment of fish and bullfrogs. We have observed that wetlands colonized by bullfrogs no longer support ICF reproduction. Whether this is because of competition between the tadpoles or the active predation of adult bullfrogs on ICFs is unknown, but warrants further investigation. We also recommend that any man-made wetlands that are created within the study area be designed so that they are shallow enough to dry out during the late summer of a typical year, preventing such wetlands from being colonized by bullfrogs and other predators.

Job 5.4

Because of the high degree of aestivation site fidelity exhibited by adult IMTs, translocating adults should not be attempted. Relocation of eggs or hatchlings is likely the only viable way to re-introduce or augment populations of IMTs. The first step of a captive breeding program will be to identify suitable facilities for maintaining a captive population of adults and incubating and raising young IMTs. In the meantime, surveys at historically known and potential IMT wetlands outside of the focal area of this study should be conducted to identify extant populations. At this time that is likely limited to the Henry County population at Mineral Marsh. Initial efforts should be made to augment the numbers of IMTs at sites that currently support relatively large populations. Within the study area we would recommend that augmentation efforts initially focus on Jibben and Nehmelman Pond in the Green Valley cluster and at the Armbrust ponds in the Manito cluster. The dramatic decline in IMTs at the Rollo and Fornoff properties would make re-introductions inadvisable because the mortality of IMTs caused by the nearby road is difficult to remedy. Re-introduction of IMTs at the Sparks ponds will not be possible until after the upland habitat has been restored to sand prairie habitat suitable for IMT aestivation. It is also very likely that natural re-colonization will occur because of the proximity of the Sparks ponds to the Armbrust property once IMT populations at Armbrust have increased.

Job 6.1

ICF

As of this report, thirteen available *Pseudacris* microsatellite primers have been obtained and tested for cross-amplification in the ICF. Preliminary tests used three ICF individuals, two *Pseudacris triseriata* individuals (positive control), two *Pseudacris crucifer* individuals (positive control), and a negative control. The results from these tests are represented in Table 14. Contamination was never a problem; a clear negative control lane was observed in all tests. Five of the primers were cross-amplified in the three ICF individuals.

Job 6.2 and 6.3

ICF

We have not yet completed the genetic analysis of ICF tissues collected. However the analysis of microsatellite markers and genetic variability within these populations will be performed as part of a M.S. thesis and will be made available once completed.

Job 7

In-depth demographic analysis of IMT and ICF populations within the study area was not pursued because of the low population numbers of IMTs and the difficulty of performing such surveys for the ICF. Because of the low capture rates for the IMT we were unable to perform a mark/recapture study to determine accurate population demographics. For the ICF we decided to use genetic analysis to examine the genetic health of the populations within the study area. The results of the genetic analysis will allow us to determine the degree of inbreeding within the wetlands and across the study area. Once we are able to determine the degree of genetic variation within the study area we will have a better idea of how healthy these ICF populations are and where future conservation efforts should be focused.

Job 8

Our surveys within the study area for the IMT and ICF indicate that both of these species occur in low numbers and are vulnerable to extirpation. Within the study area conservation efforts should focus on the restoration and maintenance of high quality sand prairies and ephemeral wetlands. The viability of these species will require the creation of a matrix of prairie and wetland habitats to provide a landscape that will meet the needs of both the IMT and ICF. Because the habitat needs for both of these species are very similar we have focused our management recommendations on conservation of the IMT.

Any management directed at conserving the IMT within the study area will result in similar benefits for the ICF.

The results of our surveys indicate that even though the IMT is persisting in many of the ponds in which it has been historically known, populations have been reduced to extremely low numbers. The low numbers and isolation of these populations makes it extremely likely that remaining IMT populations will go extinct because of stochastic factors (drought, contamination by agricultural chemicals, disease). Conservation of this species within the study area will require a dramatic overhaul of current management practices. Initial efforts should focus on increasing the amount and quality of aestivation habitat near wetlands that are currently used by IMTs. This can be accomplished by working with landowners to enroll appropriate properties in conservation programs and purchasing property from willing landowners. The purchase of property within the study area should only be pursued if the DNR is willing and able to commit the resources necessary to conserve and maintain that land as prairie habitat suitable for IMT aestivation.

Figures 13, 14 and 15 display our suggestions for conservation areas. Polygons marked in red identify areas that are the highest priority for IMT conservation. These areas include wetlands with the highest numbers of known IMT individuals and the adjacent upland habitat that radio-tracked IMTs have used for aestivation/hibernation. Within the Green Valley cluster this would represent an area of 112 acres surrounding ponds 80 (50 acres), 13 (33 acres) and 16 (29 acres). Within the Manito cluster we recommend the highest conservation priority be placed on 49 acres surrounding pond 53. We also recommend conservation efforts surrounding the newly discovered IMT population at pond 86. Because IMTs have only recently been documented at this pond we recommend further surveys to determine if IMTs are using nearby wetlands in addition to pond 86. Until further information is available we recommend conservation efforts focus on 155 acres surrounding the pond and nearby wetlands.

The areas we have marked in orange indicate areas that we believe are important to the IMT, but do not represent currently stable sub-populations within the Manito and Green Valley clusters. We recommend that conservation efforts focus on maintaining the suitability of the wetlands within these areas to provide IMT populations with additional foraging habitat. These areas include the area surrounding ponds 53A, B, C, D and E, 39A and B and pond 84 in the Manito cluster and ponds 55A, B and C in the Green Valley cluster. Despite being surrounded by agriculture as long as these wetlands remain intact nearby populations of IMT should be able to travel to and from these wetlands to forage. We also know that these areas are heavily used by the ICF as breeding ponds. While any conservation of upland habitat adjacent to the wetlands within these areas would greatly benefit both the IMT and ICF, we believe that conserving the wetlands and adding buffers of prairie vegetation of at least 50 meters around these wetlands would be a significant step in conserving these species.

The areas we have marked with green are areas that represent high concentrations of sandy soils suitable for IMT aestivation. The conservation of these areas would provide additional aestivation habitat for the IMT at nearby wetlands, but should not be a top priority for initial conservation efforts. Restoration of prairie habitat within these areas would also remove forest stands, particularly the stand east of pond 53 that may inhibit the dispersal of IMTs between wetlands.

Because the Manito cluster already has two large areas of DNR owned property (Sparks Pond and Rollo Prairie) we recommend that restoration efforts at these sites be made a top priority. The restoration of the upland habitat at these sites to high quality prairie would greatly benefit the IMT and ICF.

Efforts should be made to create a landscape that allows for greater movement of IMTs between wetlands. From our radio-telemetry data we have seen that IMTs are quite capable of moving through crop land. While land in row crops does not provide suitable aestivation habitat for the IMT it does not seem to serve as a barrier for movement between wetlands. However the results of our radio-telemetry also indicate that IMTs do not move in or through heavily forested habitats. The presence of roads also serves as a barrier between wetlands, although IMTs are capable of walking across a road they like many other wildlife species suffer from drastically increased mortality when crossing roads. Within the study area management should focus on areas where roads are not present or on mitigating the impact of roads on IMT populations. Efforts should also be made to remove forest areas between wetlands that may serve as a barrier to IMT movements through the landscape. Increasing movement between wetlands will allow gene flow between populations and will increase the colonization of restored wetlands.

The Illinois Wildlife Action plan has called for at least 6 areas of 300-500 acres of ephemeral wetlands and upland sand prairie within the inland sand areas. For the IMT the Manito and Green Valley clusters represent the highest numbers of remaining populations within the state. Unless other extant populations of IMTs are located, conservation efforts will have to focus on the Manito and Green Valley wetland clusters. If the area encompassing all of our management recommendations was totaled we would have three conservation areas; 1014 acres within the Manito cluster (including Sparks Pond and Rollo Prairie), 448 acres within the Green Valley cluster and 155 acres encompassing pond 86. Much of the area included in these estimates is currently being farmed and it is unlikely that the current landowners will be willing to remove the entire property from production. However, if we focus on the most important wetlands and upland habitats and perform restorations where it will most benefit the connectivity of the landscape we don’t need to remove the entire area from agricultural production.

Because appropriately detailed demographic studies were not feasible, the viability of the ICF population in Mason and Tazewell counties is unknown at this time. Therefore it would be premature to propose specific criteria for changes in status. The most important question remaining is how far ICF move from breeding ponds for foraging, i.e, how much buffer around breeding ponds do they require? In addition, it is important to establish how far ICFs can move through the landscape. The genetic analysis can begin to answer these questions, but only direct measurements of movements of tagged individuals will guarantee the answers.

<u>Literature Cited</u>

Bickham, J. W., M. D. Springer and B. J. Gallaway.1984. Distributional survey of the yellow mud turtle (*Kinosternon flavescens*) in Iowa, Illinois and Missouri: A proposed endangered species. The Southwestern Naturalist 29:123-132.

Brown, L.E. 1986. Field survey for the Illinois chorus frog in the study area for the IL 97/Pecan Creek bridge (FAP 34), Mason County, Illinois. Unpublished Report to the Illinois Department of Transportation. 9 pp.

Brown, L.E. and G.B. Rose. 1988. Distribution, habitat, and calling season of the Illinois chorus frog (*Pseuadacris streckeri illinoensis*) along the lower Illinois River. Illinois Natural History Survey Biological Notes 132:. 13 pp.

Burke, V.J., S.L. Rathbun, J.R. Bodie, and J.W. Gibbons. 1998. Effect of density on predation rate for turtle nests in a complex landscape. Oikos 83:3-11.

Christiansen, J. L. and B. J. Gallaway. 1984. Raccoon removal, nesting success and hatchling emergence in Iowa turtles with special reference to *Kinosternon flavescens* (Kinosternidae). The Southwestern Naturalist 29:343-348.

Christiansen, J. L., J. A. Cooper, J. W. Bickham, B. J. Gallaway, M. D. Springer. 1985. Aspects of the natural history of the yellow mud turtle *Kinosternon flavescens* (Kinosternidae) in Iowa: A proposed endangered species. The Southwestern Naturalist 30:413-425.

Christiansen, J.L., C.A. Phillips, J. Briggler, and D. Kangas. In prep. Declining Illinois mud turtles in Iowa, Illinois, and Missouri. Unpublished manuscript.

Dodd, C. K. Jr. 1983. A review of the status of the Illinois mud turtle *Kinosternon flavescens spooneri* Smith. Biological Conservation 27:141-156.

Iverson, J. B. 1991. Life history and demography of the yellow mud turtle, *Kinosternon flavescens*. Herpetologica 47:373-395.

Kleiman, D. G. 1989. Reintroduction of captive mammals for conservation. BioScience. 39:152-162.

Moll, E. O. 1980. Ecology and Management of the Illinois mud turtle at Sand Ridge State Forest. Springfield, Ill., Preliminary report to Illinois Department of Conservation. Unpublished Technical Report.

Phillips, C.A., R.A. Brandon, and E.O. Moll. 1999. Field guide to amphibians and reptiles of Illinois. Illinois Natural History Survey Manual 8. 300 pp.

Serb, J.M., C.A. Phillips, and J.B. Iverson. 2001. Molecular phylogeny and biogeography of *Kinosternon flavescens* based on complete mitochondrial control region sequences. Molecular Phylogeny and Evolution 18(1): 149-162.

Smith, P.W. 1951. A new frog and a new turtle from the western Illinois sand prairies. Bull. Chicago Acad. Sciences. 9(10):189-199.

Stevens, C.E. and C.A. Paszkowski. 2004. Using chorus size ranks from call surveys to estimate reproductive activity of the wood frog (*Rana sylvatica*). J. Herpetology 38(3):404-410.

Tuma, M.W. 2006. Range, habitat use, and seasonal activity of the Yellow Mud Turtle (*Kinosternon flavescens*) in northwestern Illinois: Implications for site-specific conservation and management. Chelonian Conservation and Biology 5(1)108-120.

Weir, L.A., A. Royale, P. Nanjappa, and R.E. Jung. 2005. Modeling anuran detection and site occupancy on North American Amphibian Monitoring Program (NAAMP) routes in Maryland. J. Herpetology 39(4):627-639.

Tables and Figures

Table 1. 2007 Trap effort and IMTs captured 21 May 2007 through 28 June 2007.

Site Name	Date	Trap Nights	Traps Set	Trap Effort	IMTs Captured	
Manito					**Trapped**	**Deceased**
Rollo(6)	5/21/2007	38	5	190	1M	1M-DOA
Fornoff(39)	5/24/2007	35	5	175	0	
Armbrust(53)	5/24/2007	35	6	210	1M, 1F	
Armbrust(53A)	6/4/2007	24	3	72	0	
Sparks(9)	5/21/2007	18	3	54	0	
Blacktop(7)	5/22/2007	17	3	51	0	
Sand Ridge(1)	6/4/07	14	3	42	0	
Sand Ridge(2)	6/4/07	14	3	42	0	
Green Valley						
Nehmelman (80)	6/12/2007	16	3	48	0	
Hilst N(13)	5/22/2007	37	6	222	1M, 1F	
Hilst S(14)	5/22/2007	24	3	72	1F	
Jibben(16)	5/22/2007	24	5	120	1M, 1F	
North					0	
Becker(69)	5/22/2007	27	4	108	1M	
Total				**1406**	**5M, 4F**	**10****

*site not previously trapped
**Including DOA and KIA

Table 2. 2008 Trap effort and IMTs captured 19 May 2008 through 23 July 2008.

Site Name	Date	Trap Nights	Traps Set	Trap Effort	IMTs Captured	
Manito					**Trapped**	**Deceased**
Rollo(6)	5/19/2008	45	4	180	0	
Fornoff(39)	5/23/2008	41	4	164	0	
Armbrust(53)	5/19/2008	45	4	180	1M, 4J	
Armbrust(53)	7/7/2008	3	4	12	2J	
Armbrust(53)	7/21/2008	2	4	8	1J	
Armbrust(53)	9/18/2008	3	3	9	0	
Armbrust(53A)	5/19/2008	45	4	180	0	
Armbrust(53C)	6/4/2008	29	4	116	1M	
Sparks(9)	5/19/2008	44	4	176	0	
Sparks(9A)	5/19/2008	44	4	176	0	
Blacktop(7)	5/19/2008	44	4	176	0	
Green Valley						
Nehmelman(80)	5/20/2008	44	4	176	1F, 2J	
Nehmelman(80)	6/7/2008	26	2	52	0	
Hilst N(13)	5/20/2008	44	4	176	3M, 1F	
Hilst N(13)	7/7/2008	3	4	12	0	
Hilst S(14)	5/20/2008	44	4	176	1F	1F-KIA
Jibben(16)	5/20/2008	35	4	140	3M, 2F	
Jibben(16)	9/18/2008	3	4	12	0	
North						
Cupi(11)	6/6/2008	26	4	104	0	
Total				**2225**	**8M, 5F, 9J**	**22****

**Including DOA and KIA

Table 3. 2009 Trap effort and IMTs captured 30 April 2009 through 5 August 2009.

Site Name	Date	Trap Nights	Traps Set	Trap Effort	IMTs Captured	
					Trapped	Deceased
Manito						
Rollo(6)	5/6/2009	3	4	12	0	
Rollo(6)	5/18/2009	12	4	48	0	
Rollo(6)	6/23/2009	10	4	40	0	
Rollo(6)	7/7/2009	4	4	16	0	
Fornoff(39)	5/6/2009	3	4	12	0	
Fornoff(39)	6/11/2009	22	4	88	0	
Fornoff(39A)	5/18/2009	36	4	144	1M, 2F	1J-DOA
Fornoff(39B)	5/27/2009	5	3	15	0	
Armbrust(53)	4/30/2009	3	4	12	1M	
Armbrust(53)	5/6/2009	3	4	12	0	
Armbrust(53)	5/18/2009	46	4	184	3M, 1F, 1J	
Armbrust(53)	7/7/2009	4	4	16	0	
Armbrust(53)	7/14/2009	10	4	40	1J	
Armbrust(53A)	6/11/2009	21	4	84	0	
Armbrust(53B)	5/6/2009	3	3	9	1F	
Armbrust(53B)	5/18/2009	9	3	27	0	
Armbrust(53C)	5/6/2009	3	4	12	0	
Armbrust(53C)	6/1/2009	10	4	40	0	
Armbrust(53D)	5/18/2009	9	3	27	0	
Armbrust(53E)*	4/30/2009	3	3	9	0	
Armbrust(53E)*	5/6/2009	3	4	12	0	
Armbrust(53E)*	5/18/2009	9	3	27	0	
Childers(84)*	6/11/2009	21	4	84	0	
Sparks(9B)	5/27/2009	6	3	18	0	
Renick(85)*	6/11/2009	12	4	48	0	
Green Valley						
Nehmelman(80)	5/21/2009	30	3	90	2M	
Nehmelman(80)	6/20/2009	13	6	78	1F	
Nehmelman(80)	7/7/2009	4	6	24	1M	
Nehmelman(80)	7/14/2009	10	6	60	0	
Nehmelman(80)	8/3/2009	2	4	8	0	
Burnsmier(55A)	5/14/2009	49	4	196	1M	
Burnsmier(55B)	5/14/2009	37	4	148	1M	
Hilst N(13)	4/30/2009	3	4	12	0	1M-KIA, 1F-KIA
Hilst N(13)	5/7/2009	2	4	8		
Hilst N(13)	5/14/2009	49	4	196		
Hilst S(14)	5/18/2009	15	2	30	0	
Jacobs(81)*	5/7/2009	2	4	8	0	
Jacobs(81)*	5/14/2009	7	4	28	0	
Jacobs(81)*	6/2/2009	18	4	72	0	
Jibben(16)	4/30/2009	3	4	12	1F, 1J	
Jibben(16)	5/7/2009	2	4	8	1J	
Jibben(16)	5/14/2009	50	4	200	1M, 2F, 3J	
Jibben(16)	7/7/2009	4	4	16	2J	
Jibben(16)	7/21/2009	3	4	12	0	
Jibben(16)	8/3/2009	2	4	8	0	
North						
VanHies(86)*	6/21/2009	12	4	48	3F	
VanHies(86)*	7/7/2009	4	4	16	1F	
VanHies(86)*	7/14/2009	10	4	40	2F	
VanHies(86)*	8/3/2009	2	4	8	0	
Herrman(82)	5/31/2009	11	4	44	0	
Desutter(83)	5/31/2009	6	3	18	0	
Total				**2424**	**11M, 14F, 9J**	**37****

*site not previously trapped

**Including DOA and KIA

Table 4. 2007-2009 Total IMT individuals captured

Site Name	Total IMTs Captured	
Manito	**Trapped**	**Deceased**
Rollo(6)	1M	1M-DOA
Fornoff(39)	0	
Fornoff(39A)	1M, 2F	1J-DOA
Fornoff(39B)	0	
Armbrust(53)	3M, 2F, 6J	
Armbrust(53A)	0	
Armbrust(53B)	1F	
Armbrust(53C)	1M	
Armbrust(53D)	0	
Armbrust(53E)	0	
Childers(84)	0	
Sparks(9)	0	
Sparks(9A)	0	
Sparks(9C)	0	
Blacktop(7)	0	
Renick(85)	0	
Green Valley		
Nehmelman(80)	3M, 1F, 2J	
Burnsmier(55A)	1M	
Burnsmier(55B)	1M	
Hilst N(13)	3M, 2F	1M-KIA, 1F-KIA
Hilst S(14)	1F	1F-KIA
Jibben(16)	3M, 4F, 7J	
North		
Becker(69)	1M	
Cupi(11)	0	
VanHies(86)	6F	
Herrman(82)	0	
Desutter(83)	0	
Total	**18M, 19F, 15J**	**2M, 2F, 1J**
	49 Still Alive	**54***

*Including DOA and KIA

Table 5. 2006 – 2009 Morphological measurements of IMTs captured

Site Name	Turtle ID	Date Captured	Recapture	Sex	CL	SH	PL	CW	Mass
Manito									
Armbrust(53)	02L	6/3/2008	no	J	65.0	27.0	62.0	53.0	58
Armbrust(53)	02L	7/24/2009	yes	M	92.0	40.0	92.0	73.0	148
Armbrust(53)	02L-10L-08R	6/19/2009	yes	F	114.0	47.0	108.0	85.0	274
Armbrust(53)	03L	6/3/2008	no	J	55.0	23.0	51.0	44.0	31
Armbrust(53)	03L	6/20/2009	yes	J	75.0	30.5	72.0	61.0	71
Armbrust(53)	03L-01R-02R	5/1/2009	no	M	119.5	46.0	106.0	87.0	274
Armbrust(53)	03L-09L-03R*	5/25/2007	yes	F	107.0	45.0	104.0	86.0	270
Armbrust(53)	03L-11L-02R	5/21/2009	yes	M	130.0	50.0	114.0	93.0	339
Armbrust(53)	03L-11L-10R	5/25/2007	yes	M	111.0	45.0	106.0	84.0	270
Armbrust(53)	03L-11L-10R	6/15/2008	yes	M	118.0	46.0	110.0	88.0	273
Armbrust(53)	03L-11L-10R	6/19/2009	yes	M	122.0	50.0	112.0	89.0	299
Armbrust(53)	03R*	6/28/2008	no	J	56.4	24.1	54.1	47.4	37
Armbrust(53)	08L	7/2/2008	no	J	42.4	19.5	39.9	36.9	17
Armbrust(53)	08L	5/20/2009	yes	J	49.6	24.0	48.8	43.3	24
Armbrust(53)	08L-10L	7/22/2008	no	J	45.1	20.3	40.1	38.0	19
Armbrust(53)	09L	7/9/2008	no	J	41.5	17.9	37.0	36.2	14
Armbrust(53)	09L-10L	7/10/2008	no	J	44.3	19.8	40.6	37.7	18
Armbrust(53B)	03L-11L-09R	5/8/2009	yes	F	109.5	47.0	106.0	87.0	268
Armbrust(53C)	03L-11L-02R	6/7/2008	yes	M	128.0	45.0	112.0	92.0	322
Rollo(6)	01L-10L-01R	5/29/2007	yes	M	NT	NT	NT	NT	NT
Rollo(6)	03L-09L-11R	5/26/2007	yes	M	102.0	42.0	100.0	80.0	220
Fornoff(39A)	01L-08L	6/20/2009	no	F	111.5	50.0	109.0	88.5	294
Fornoff(39A)	02L-10L-01R	5/24/2009	no	M	120.5	48.0	108.5	88.0	301
Fornoff(39A)	02L-10L-02R	5/24/2009	no	F	114.5	48.0	111.0	89.0	310
Green Valley									
Nehmelman(80)	01L	5/30/2008	no	J	71.0	28.0	69.0	57.0	69
Nehmelman(80)	01L-02L-01R	6/20/2008	no	F	98.0	41.0	96.0	80.0	191
Nehmelman(80)	01L-02L-01R	6/28/2009	yes	F	101.5	46.5	101.0	82.0	222
Nehmelman(80)	01L-02R	7/11/2009	no	M	94.0	49.0	93.0	75.0	153
Nehmelman(80)	01L-03L	6/18/2009	no	M	109.0	42.0	101.0	83.0	223
Nehmelman(80)	02R	6/28/2008	no	J	48.7	20.8	43.8	41.8	22
Nehmelman(80)	03L-11L-03R	5/27/2009	no	M	120.0	47.0	104.0	89.5	271
Burnsmier(55A)	03L-09L-10R	5/23/2009	yes	M	114.0	47.0	102.0	86.0	254
Burnsmier(55B)	01L-09L-08R	5/27/2009	no	M	118.0	47.0	106.0	89.5	266
Hilst(13)	02L-08L-11R	6/15/2006	yes	M	124.0	49.0	111.0	88.0	332
Hilst(13)	02L-08L-11R	6/13/2008	yes	M	125.0	51.0	112.0	89.0	339
Hilst(13)	03L-09L-03R*	5/23/2007	yes	F	113.0	48.0	116.0	84.0	290
Hilst(13)	03L-09L-09R	6/7/2008	no	F	106.0	43.0	99.0	81.0	209
Hilst(13)	03L-09L-10R	6/23/2008	no	M	113.0	44.0	102.0	85.0	244
Hilst(13)	03L-11L-01R	6/13/2008	yes	M	129.0	46.0	111.0	90.0	336
Hilst(13)	03R*	6/14/2007	no	U	111.0	43.0	106.0	87.0	260
Hilst(14)	03L-10L-02R	5/23/2007	yes	F	117.0	44.0	107.0	90.0	270
Hilst(14)	03L-10L-02R	5/27/2008	yes	F	116.0	43.0	105.0	90.0	261
Jibben(16)	01L-02L	6/2/2009	no	J	50.1	22.8	46.3	43.4	27
Jibben(16)	01L-03R-10R	7/11/2009	no	J	45.7	20.1	41.6	39.8	20
Jibben(16)	01L-10L	6/28/2009	no	J	44.0	19.2	40.2	38.0	18
Jibben(16)	01R	5/24/2007	no	M	83.0	33.0	78.0	71.0	100
Jibben(16)	01R	5/31/2008	yes	M	83.0	35.0	79.0	71.0	109
Jibben(16)	01R	5/30/2009	yes	M	85.5	36.0	81.4	70.8	136
Jibben(16)	02L-08R	5/23/2007	yes	F	111.0	46.0	109.0	86.0	280
Jibben(16)	02L-08R	5/30/2008	yes	F	112.0	48.0	108.0	87.0	286
Jibben(16)	02L-09L-09R	5/30/2008	yes	F	114.0	46.0	106.0	89.0	298
Jibben(16)	02L-09L-09R	4/30/2009	yes	F	114.0	46.0	105.5	89.5	268
Jibben(16)	03L-09L-01R	6/15/2009	yes	F	119.0	48.0	113.0	94.5	319
Jibben(16)	03L-09L-08R	5/30/2008	no	M	106.0	49.0	98.0	84.0	201
Jibben(16)	03L-11L-08R	5/31/2008	yes	M	133.0	44.0	113.0	96.0	348
Jibben(16)	03L-11L-09R-10R	5/28/2009	no	F	104.9	41.1	103.4	84.4	212
Jibben(16)	10L-11R	5/8/2009	no	J	53.4	23.3	50.6	45.5	31
Jibben(16)	10R	5/18/2009	no	J	46.5	22.0	43.7	41.5	24
Jibben(16)	11L	6/2/2009	no	J	46.8	21.0	43.9	41.3	23
Jibben(16)	11R	5/2/2009	no	J	45.8	21.2	42.7	39.7	20
North									
Becker(69)	10L	5/25/2007	no	M	118.0	49.0	113.0	94.0	340
VanHies(86)	01L-01R	6/28/2009	no	F	114.0	47.5	109.5	88.0	289
VanHies(86)	01L-03R	7/9/2009	no	F	115.0	45.0	109.0	88.0	282

VanHies(86)	01L-08R	7/15/2009	no	F	110.0	46.0	105.0	83.0	269
VanHies(86)	01L-09L	6/23/2009	no	F	111.0	45.0	109.0	84.0	264
VanHies(86)	01L-09R	7/19/2009	no	F	113.0	46.0	110.0	88.0	262
VanHies(86)	01L-11L	6/28/2009	no	F	90.0	48.5	90.0	72.0	143
Means					**90.6**	**36.9**	**84.4**	**70.7**	**178.58**

*Multiple turtles with same notch code

Table 6. 2008 Calling survey results for sites in Mason and Tazewell counties C.I. = NAAMP chorus index.

Site Name	Date	C.I.
Mason County		
Mas 10	3/20/2008	2
Mas 10	4/16/2008	2
Rollo(6)	3/13/2008	2
Powerline Pond	4/16/2008	2
Wimpyville Ditch E.	4/22/2008	2
Wimpyville Ditch W.	4/22/2008	2
Robertson	3/25/2008	3
Bitner	3/25/2008	3
Behrens	3/25/2008	3
Tracy 1	3/25/2008	2
Tracy 2	3/25/2008	2
Tracy Homestead	3/25/2008	3
Biessman	3/25/2008	1
Fleener	3/25/2008	3
Ruth Becker	3/13/2008	1
Ruth Becker	3/21/2008	3
Ruth Becker	3/25/2008	3
Ainsworth	3/25/2008	1
Tazewell County		
Burnsmier(55A)	3/26/2008	2
Burnsmier(55C)	3/26/2008	1
Burnsmier(55B)	3/26/2008	1
Short Pond	3/26/2008	1
Becker(69)	3/20/2008	1
Becker(69)	4/17/2008	1

Table 7. 2009 Calling survey results for sites in Mason and Tazewell counties C.I. = NAAMP chorus index.

Site Name	Date	C.I.
Mason County		
Mas 10	3/16/2009	1
Rollo(6)	3/5/2009	0
Rollo(6)	3/16/2009	2
Rollo(6)	3/22/2009	0
Rollo(6)	4/1/2009	0
Powerline Pond	3/16/2009	2
Powerline Pond	3/21/2009	1
Powerline Pond	4/1/2009	0
Blacktop(7)	3/16/2009	2
Blacktop(7)	3/21/2009	1
Blacktop(7)	4/1/2009	0
Fornoff(39A)	3/20/2009	1
Fornoff(39A)	3/21/2009	1
Fornoff(39A)	4/1/2009	1
Fornoff(39B)	3/21/2009	1
Fornoff(39B)	4/1/2009	1
Tazewell County		
Jibben(16)	3/16/2009	1

Table 8. 2008 ICF tissue samples collected from sites in Mason and Tazewell counties

Site Name	Vouchered	Unvouchered	Combined
Mason County			
Armbrust(53)	1	6	7
Armbrust(53D)	0	4	4
Rollo(6)	5	6	11
Powerline Pond	10	0	10
Wimpyville Ditch W.	1	0	1
Mason Totals	**17**	**16**	**33**
Tazewell County			
Burnsmier(55C)	3	15	18
Jibben(16)	0	7	7
Becker(69)	3	0	3
Tazewell Totals	**6**	**23**	**28**
Grand Total			**61**

Table 9. 2009 ICF tissue samples collected from sites in Mason and Tazewell counties

Site Name	Vouchered	Unvouchered	Combined
Mason County			
Armbrust(53)	20 *	0	20
Armbrust(53A)	3	0	3
Armbrust(53D)	28*	0	28
Armbrust(53E)	6	15	21
Powerline Pond	31*	11	42
Rollo(6)	31*	0	31
Fornoff(39A)	23	5	28
Fornoff(39B)	28	1	29
Mas 14	17	0	17
Mas 11	22	0	22
Sparks(9B)	29	0	29
Montgomery S.	1	15	16
List Ditch	1	0	1
Bluhm	1	0	1
Cherry Grove North	1	3	4
Wetland 267	0	11	11
Woodard	1	9	10
Blacktop(7)	20*	0	20
Mason Totals	**263**	**70**	**333**
Tazewell County			
Burnsmier(55B)	4	0	4
Burnsmier(55C)	16*	0	16
Nehmelman(80)	6	2	8
Taz 2	20*	0	20
Jibben(16)	29*	0	29
Tazewell Totals	**75**	**2**	**77**
Grand Total			**410**

*Sites where identification and tabulating of samples remains in progress. The number in the table represents a conservative estimate of ICF tissues based upon the samples being examined.

Table 10. 2007 Telemetry data for four IMTs

ID	Date First	Date Last	Distance (m)	Notes
Armbrust				
03L-11L-10R	6/5/2007	6/22/2007		First trap capture 5/25/07
03L-11L-10R	6/23/2007	8/11/2007	238	Transmitter removed 8/11/07
Total			**238**	
03L-09L-03R	6/7/2007	6/9/2007		First trap capture 5/25/07
03L-09L-03R	6/10/2007	6/27/2007	90	
03L-09L-03R	6/28/2007	7/30/2007	90	Moved back into pond, last check on 7/30/07
03L-09L-03R	8/4/2007	8/11/2007	98	Unable to locate
Total			**277**	
Hilst				
03R	6/16/2007	6/26/2007		First trap capture 6/14/07
03R	6/27/2007	8/11/2007	704	Transmitter removed 8/11/07
Total			**704**	
Jibben				
01R	6/5/2007	6/5/2007		First trap capture 5/24/07
01R	6/6/2007	6/15/2007	39	Transmitter removed 6/15/07
Total			**39**	
Ave			**315**	
St. Dev			**280**	

*not included in average distance moved

Table 11. 2008 Telemetry data for thirteen IMTs

ID	Date First	Date Last	Distance (m)	Notes
Armbrust				
03L-11L-10R	6/16/2008	6/29/2008		First trap capture 6/15/08
03L-11L-10R	6/30/2008	8/21/2008	227	
03L-11L-10R	8/22/2008	9/20/2008	31	Transmitter removed 9/20/08
Total			**258**	
03L-11L-02R	6/8/2008	7/7/2008		First trap capture 6/7/08
03L-11L-02R	7/8/2008	7/8/2008	480	Found at surface
03L-11L-02R	7/9/2008	8/22/2008	49	Last checked on 8/22/08
03L-11L-02R	8/31/2008	9/21/2008	45	Last checked on 9/21/08
03L-11L-02R	9/30/2008	12/31/2008	4	Transmitter left on through 2009
Total			**579**	
Hilst				
03L-10L-02R	5/28/2008	5/29/2008		First trap capture 5/27/08
03L-10L-02R	5/30/2008	5/30/2008	167	At surface, in form
03L-10L-02R	5/31/2008	5/31/2008	154	At surface, walking in sand lane
03L-10L-02R	6/1/2008	6/6/2008	129	Moved into pond 13, KIA 6/6/08
Total			**450**	
03L-09L-09R	6/8/2008	7/7/2008		First trap capture 6/7/08
03L-09L-09R	7/8/2008	7/31/2008	155	Last checked on 7/31/08
03L-09L-09R	8/11/2008	8/11/2008	20	Last checked on 8/11/08
03L-09L-09R	8/22/2008	8/22/2008	36	
03L-09L-09R	8/23/2008	9/21/2008	11	Last checked on 9/21/08
03L-09L-09R	9/30/2008	12/31/2008	46	Transmitter left on through 2009
Total			**269**	
02L-08L-11R	6/14/2008	6/24/2008		First trap capture 6/13/08
02L-08L-11R	6/25/2008	6/25/2008	44	At surface, in form
02L-08L-11R	6/26/2008	6/26/2008	15	At surface, in form
02L-08L-11R	6/27/2008	6/27/2008	11	At surface, in form
02L-08L-11R	6/28/2008	6/28/2008	100	At surface, in form
02L-08L-11R	6/29/2008	12/31/2008	20	Last Check on 10/30/08, did not survive winter
Total			**190**	
03L-11L-01R	6/14/2008	6/24/2008		First trap capture 6/13/08
03L-11L-01R	6/25/2008	6/25/2008	27	At surface, in form
03L-11L-01R	6/26/2008	8/22/2008	132	Last checked on 8/22/08
03L-11L-01R	8/31/2008	9/20/2008	9	Transmitter removed 9/20/08
Total			**168**	
03L-09L-10R	6/24/2008	6/24/2008		First trap capture 6/23/08
03L-09L-10R	6/25/2008	6/25/2008	22	Transmitter fell off
Total*			**22**	
Nehmelman				
01L-02L-01R	6/21/2008	6/30/2008		First trap capture 6/20/08
01L-02L-01R	7/1/2008	9/12/2008	126	Last checked on 9/12/08
01L-02L-01R	9/18/2008	9/21/2008	17	Transmitter removed 9/21/08
Total			**142**	
Jibben				
01R	6/1/2008	6/15/2008		First trap capture 5/31/08
01R	6/16/2008	6/19/2008	32	
01R	6/20/2008	6/21/2008	30	
01R	6/22/2008	6/23/2008	45	Transmitter removed 6/23/08
Total			**107**	
02L-08R	5/31/2008	6/11/2008		First trap capture 5/30/08
02L-08R	6/12/2008	6/12/2008	92	
02L-08R	6/13/2008	6/15/2008	15	Transmitter removed 6/15/08
Total			**107**	
02L-09L-09R	5/31/2008	6/6/2008		First trap capture 5/30/08
02L-09L-09R	6/7/2008	6/16/2008	63	Transmitter removed 6/16/08
Total			**63**	
03L-09L-08R	5/31/2008	6/19/2008		First trap capture 5/30/08
03L-09L-08R	6/20/2008	6/20/2008	36	Transmitter fell off
Total*			**36**	
03L-11L-08R	6/7/2008	6/9/2008		First trap capture 5/31/08
03L-11L-08R	6/10/2008	6/13/2008	133	Transmitter removed 6/13/08
Total			**133**	
Ave			**224**	
St. Dev			**159**	

*not included in average distance moved

Table 12. 2009 Telemetry data for eighteen IMTs

ID	Date First	Date Last	Distance (m)	Notes
Armbrust				
02L	7/25/2009	8/3/2009		First trap capture 7/24/09
02L	8/4/2009	8/4/2009	108	
02L	8/5/2009	8/5/2009	14	Last tracked on 8/5/09
02L	8/25/2009	8/29/2009	22	Transmitter removed 8/29/09
Total			**144**	
03L-01R-02R	5/2/2009	5/27/2009		First trap capture 5/1/09
03L-01R-02R	5/28/2009	5/29/2009	36	
03L-01R-02R	5/30/2009	5/30/2009	37	Transmitter removed 5/30/09
03L-01R-02R	6/30/2009	6/30/2009		Incidental capture on land, walking
Total*				
03L-11L-02R	1/1/2009	4/18/2009		Hibernation location, last checked 4/18/09
03L-11L-02R	4/25/2009	4/25/2009	489	First move to pond 53C, last checked 4/25/09
03L-11L-02R	5/1/2009	5/3/2009	178	Moved to pond 53E, last checked on 5/3/09
03L-11L-02R	5/7/2009	5/7/2009	178	Moved to pond 53C
03L-11L-02R	5/8/2009	5/22/2009	702	Moved to pond 53
Total			**1547**	
03L-11L-09R	5/9/2009	5/19/2009		First trap capture 5/8/09
03L-11L-09R	5/20/2009	5/22/2009	246	Moved to pond 53E
03L-11L-09R	5/23/2009	6/1/2009	178	Moved to pond 53C
03L-11L-09R	6/2/2009	6/2/2009	564	
03L-11L-09R	6/3/2009	6/3/2009	115	
03L-11L-09R	6/4/2009	6/20/2009	82	Nest location, transmitter removed 6/20/09
Total			**1184**	
Fornoff				
01L-08L	6/22/2009	7/6/2009		First trap capture 6/20/09
01L-08L	7/7/2009	10/13/2009	156	Unable to locate
Total			**156**	
02L-10L-01R	5/25/2009	6/30/2009		First trap capture 5/24/09
02L-10L-01R	7/1/2009	7/2/2009	100	
02L-10L-01R	7/3/2009	7/3/2009	7	Last tracked on 7/3/09
02L-10L-01R	7/7/2009	7/11/2009	71	Transmitter removed 7/11/09
Total			**178**	
02L-10L-02R	5/25/2009	5/26/2009		First trap capture 5/24/09
02L-10L-02R	5/27/2009	5/28/2009	279	
02L-10L-02R	5/29/2009	5/30/2009	115	
02L-10L-02R	5/31/2009	6/1/2009	69	Moved to pond 39
02L-10L-02R	6/2/2009	6/18/2009	116	Nest location
02L-10L-02R	6/19/2009	7/6/2009	91	Moved to pond 6
02L-10L-02R	7/7/2009	10/13/2009	12	Unable to locate
Total			**681**	
Nehmelman, Burnsmier, Hilst				
01L-09L-08R	5/31/2009	6/9/2009		First trap capture 5/27/09
01L-09L-08R	6/10/2009	6/12/2009	112	
01L-09L-08R	6/13/2009	6/15/2009	49	
01L-09L-08R	6/16/2009	6/17/2009	275	
01L-09L-08R	6/18/2009	7/6/2009	363	Moved to Nehmelman pond
01L-09L-08R	7/7/2009	7/7/2009	130	
01L-09L-08R	7/8/2009	7/10/2009	130	Moved back into Nehmelman pond
01L-09L-08R	7/11/2009	7/13/2009	324	
01L-09L-08R	7/14/2009	9/22/2009	63	Transmitter removed 9/22/09
Total			**1446**	
03L-09L-10R	5/24/2009	6/7/2009		First trap capture 5/23/09
03L-09L-10R	6/8/2009	6/8/2009	45	
03L-09L-10R	6/9/2009	6/9/2009	384	
03L-09L-10R	6/10/2009	6/10/2009	34	
03L-09L-10R	6/11/2009	6/11/2009	86	Moved to Nehmelman pond
03L-09L-10R	6/12/2009	6/12/2009	290	
03L-09L-10R	6/13/2009	6/15/2009	88	Lost signal, picked up again on 8/3/09
03L-09L-10R	8/3/2009	8/4/2009	1378	Resumed tracking
03L-09L-10R	8/5/2009	9/22/2009	7	Transmitter removed 9/22/09
Total			**2311**	
02L-08L-11R	1/1/2009	4/25/2009		Never exited hibernation, dug up on 4/25/09
Total*			**0**	
03L-09L-09R	1/1/2009	4/18/2009		Hibernation location, last checked 4/18/09
03L-09L-09R	4/25/2009	4/25/2009	148	First move to pond 13, last check on 4/25/09
03L-09L-09R	4/30/2009	4/30/2009	48	

03L-09L-09R	5/1/2009	5/1/2009	48	Moved back to pond 13
03L-09L-09R	5/2/2009	5/2/2009	51	
03L-09L-09R	5/3/2009	5/3/2009	0	Slight move, only a few feet
03L-09L-09R	5/7/2009	5/14/2009	51	Found dead along shore of pond 13
Total			**345**	
01L-02L-01R	7/7/2009	7/22/2009		First trap capture 6/28/09
01L-02L-01R	7/23/2009	8/25/2009	148	Transmitter found at surface
Total*			**148**	
01L-02R	7/14/2009	7/15/2009		First trap capture 7/11/09
01L-02R	7/16/2009	8/3/2009	160	Checked on 8/25/09 but transmitter had failed
Total			**160**	
Jibben				
02L-09L-09R	5/1/2009	5/15/2009		First trap capture 4/30/09
02L-09L-09R	5/16/2009	5/20/2009	116	
02L-09L-09R	5/21/2009	6/1/2009	19	
02L-09L-09R	6/2/2009	6/15/2009	9	
02L-09L-09R	6/16/2009	6/16/2009	58	
02L-09L-09R	6/17/2009	6/18/2009	84	Moved back to pond, transmitter failed
Total			**286**	
03L-09L-01R	6/16/2009	6/16/2009		First trap capture 6/15/09
03L-09L-01R	6/17/2009	6/17/2009	51	
03L-09L-01R	6/18/2009	6/18/2009	14	
03L-09L-01R	6/19/2009	6/29/2009	14	
03L-09L-01R	6/30/2009	7/3/2009	37	Last checked on 7/3/09
03L-09L-01R	7/7/2009	9/22/2009	6	Transmitter removed 9/22/09
Total			**122**	
11L	7/2/2009	7/7/2009		First trap capture 6/2/09
11L	7/8/2009	7/9/2009	50	
11L	7/10/2009	8/3/2009	14	Last checked on 8/3/09
11L	8/25/2009	8/25/2009	17	Transmitter removed 8/25/09
Total			**81**	
VanHies				
01L-01R	6/29/2009	7/10/2009		First trap capture 6/28/09
01L-01R	7/11/2009	8/29/2009	173	Transmitter removed 8/29/09
Total			**173**	
01L-11L	6/29/2009	7/14/2009		First trap capture 6/28/09
01L-11L	7/15/2009	7/15/2009	219	
01L-11L	7/16/2009	8/25/2009	74	Transmitter removed 8/25/09
Total			**294**	
Ave			**607**	
St. Dev			**687**	

*not included in average distance moved

Table 13. 2008 Results of dip netting protocol at sites in Mason and Tazewell counties

Site	Date	# Samples	Meta-morphs	Tadpoles	Tissues	*A. tigrinum*	Vouchers	Inverts
Mason County								
Armbrust(53)	6/4/2008	1	1	5	6	2	0	Y
Armbrust(53)	6/11/2008	*	0	0	0	0	1**	N
Armbrust(53A)	6/4/2008	1	0	0	1 Dead Frog	0	1 Dead Frog	Y
Armbrust(53D)	6/4/2008	1	0	4	4	0	0	Y
Armbrust(53D)	6/11/2008	*	0	0	0	0	0	N
Bitner	6/16/2008	2	0	0	0	10	0	Y
Blacktop(7)	6/12/2008	1	0	0	0	0	0	Y
Duewer 2	6/16/2008	2	0	0	0	5	0	Y
Duewer 3	6/16/2008	2	0	0	0	1	0	Y
Duewer 4	6/16/2008	2	0	0	0	0	0	N
Fleener	6/16/2008	2	0	0	0	0	0	Y
Fornoff(39)	6/4/2008	1	0	0	0	0	0	Y
Mas 17	6/12/2008	1	0	0	0	0	Several Tadpoles	Y
Montgomery S.	6/16/2008	2	0	0	0	3	0	Y
Mt Zion	6/10/2008	3	0	0	0	0	Several Tadpoles	Y
Rollo(6)	6/4/2008	1	1	5	6	1	0	Y
Rollo(6)	6/11/2008	*	5	6	4	1	6 Tadpoles	N
Ruth Becker	6/16/2008	2	0	0	0	0	0	N
Strolle&Wilker 4	6/17/2008	2	0	0	0	0	0	Y
Tracy 1	6/17/2008	2	0	0	0	0	0	Y
Tazewell County								
Becker(69)	6/12/2008	3	1	2	3	0	2 Tad. 1 Metamorph	Y
Burnsmier(55A)	6/3/2008	2	0	0	0	0	4 P. triseriata	Y
Burnsmier(55B)	6/3/2008	2	0	0	0	0	0	Y
Burnsmier(55C)	6/3/2008	2.5	0	~20	15 Tail Clips	1	4 ICF	Y
Cupi(11)	6/11/2008	1	0	0	0	0	0	Y
Hilst N(13)	6/11/2008	1	0	0	0	0	0	Y
Hilst S(14)	6/11/2008	1	0	0	0	0	1**	Y
Jibben(16)	6/4/2008	1	0	7	7 Tail Clips	8	0	Y
Jibben(16)	6/11/2008	*	0	0	0	0	0	N
Nehmelman(80)	6/11/2008	1	0	0	0	0	3**	Y

*time not restricted

**unidentified tadpoles

Table 14. Preliminary results from tests of microsatellite primers developed for *Pseudacris ornata* (Po), *Pseudacris crucifer* (Pc), and *Pseudacris triseriata* (Pt).

Primers	Po1	Po2	Po3	Po7	Po8	Pc1	Pc2	Pt1	Po4	Po5	Po6	Pc3	Pc4
ICF 3	-	+	-	+	-	+	-	-	-	-	-	+??	-
ICF 4	-	+	-	-	-	+	-	-	-	-	-	+	+
ICF 5	-	+	-	+	-	+	-	-	-	-	-	+	-
P1	-	-	+	-	-	+	+	+	-?	-	-	+	+
P2	-	-	+	+?	-	+	+	-	-	-	-	+	+
W1	-	-	-	-	-	+?	-	+	-	-	-	+	+?
W2	-	-	-	-	-	+?	-	+	-	-	-	+	-
-K	-	-	-	-	-	-	-	-	-	-	-	-	-

+ denotes a band, - denotes no band, ? denotes some sort of mark or shadow in the lane.

Appendix 1. GPS coordinates for IMT sites surveyed

Site Name	Latitude	Longitude	Score	NetID
Manito				
Armbrust(53)	40.39409	-89.83046	1	12
Armbrust(53A)	40.39957	-89.81754	0	14
Armbrust(53B)	40.39885	-89.82276	1	13
Armbrust(53C)	40.39825	-89.82424	1	3
Armbrust(53D)	40.39897	-89.82615	0	6
Armbrust(53E)	40.39673	-89.82359	1*	4
Blacktop(7)	40.38393	-89.81646	0	NA
Childers(84)	40.39953	-89.81309	0	2
Fornoff(39)	40.40513	-89.80660	1*	11
Fornoff(39A)	40.40188	-89.80485	1	9
Fornoff(39B)	40.40044	-89.80897	0	16
Renick(85)	40.35619	-89.87286	0	NA
Rollo(6)	40.40552	-89.80692	0	10
Sparks(9)	40.39674	-89.81697	0	8
Sparks(9A)	40.39569	-89.81749	0	15
Sparks(9B)	40.39268	-89.82321	0	7
Sparks(9D	40.39110	-89.81800	0	NA
Green Valley				
Burnsmier(55A)	40.39634	-89.68158	1	10
Burnsmier(55B)	40.39611	-89.68474	1	4
Burnsmier(55C)	40.39411	-89.68227	0	19
Hilst N(13)	40.38909	-89.68579	1	11
Hilst S(14)	40.38690	-89.68480	1	24
Jacobs(81)	40.38058	-89.68540	0	14
Jibben(16)	40.38078	-89.66198	1	NA
Nehmelman(80)	40.40039	-89.68065	1	22
North				
Becker(69)	40.46498	-89.77548	1	NA
Cupi(11)	40.43640	-89.84804	0	NA
DeSutter(83)	40.45786	-89.79231	0	NA
Herrman(82)	40.47443	-89.76109	0	NA
VanHies(86)	40.50133	-89.79066	1	NA

0 = not detected; 1 = detected

* no turtles captured but wetland was used by a radio-tracked turtle

Appendix 2. GPS coordinates for ICF sites surveyed

Site Name	Latitude	Longitude	Score
Mason County			
Ainsworth	40.16860	-89.67720	1
Armbrust(53)	40.39409	-89.83046	3
Armbrust(53A)	40.39957	-89.81754	3
Armbrust(53D)	40.39897	-89.82615	3
Armbrust(53E)	40.39673	-89.82359	3
Behrens	40.18790	-89.78580	1
Beltz 1	40.10527	-90.15611	0
Biessman	40.19810	-89.76720	1
Bitner	40.18740	-89.78210	1
Blacktop(7)	40.38393	-89.81646	2
Bluhm	40.23634	-89.69612	2
Brown 3	40.20450	-90.00930	0
Brown 4	40.10768	-90.09348	0
Brown 5	40.13380	-90.06930	0
Brown 6	40.13361	-90.06959	0
Cherry Grove N.	40.23634	-89.69612	2
Duewer 2	40.22650	-89.67736	0
Duewer 3	40.22650	-89.67736	0
Fleener	40.20740	-89.75680	1
Fornoff(39)	40.40513	-89.80660	0
Fornoff(39A)	40.40188	-89.80485	2
Fornoff(39B)	40.40044	-89.80897	2

List Ditch	40.26739	-89.69584	2
Mas 1	40.38979	-89.88053	0
Mas 2	40.38794	-89.87968	0
Mas 5	40.38395	-89.87668	0
Mas 8	40.42342	-89.78448	0
Mas 10	40.42070	-89.79123	1
Mas 11	40.10243	-90.20171	3
Mas 12	40.11910	-90.19994	0
Mas 14	40.10531	-90.19676	3
Mas 16	40.18129	-90.08469	0
Mas 17	40.41015	-89.88836	0
Mas 18	40.41251	-89.79667	0
Montgomery N.	40.24269	-89.69576	0
Montgomery S.	40.23219	-89.69370	2
Mt. Zion	40.13590	-90.06790	0
Powerline Pond	40.38285	-89.81905	2
Robertson	40.22902	-89.69333	1
Rollo(6)	40.40552	-89.80692	2
Ruth Becker	40.21550	-89.67280	1
Smith 1952	40.11472	-90.14051	0
Sparks(9)	40.39674	-89.81697	0
Sparks(9A)	40.39569	-89.81749	0
Sparks(9B)	40.39268	-89.82321	3
Sparks(9D)	40.39110	-89.81800	1
Strolle & Wilker 4	40.19610	-89.76730	0
Tracy 1	40.18630	-89.78020	1
Tracy 2	40.18490	-89.77810	1
Tracy Homestead	40.19090	-89.76940	1
Wetland 267	40.26139	-89.70217	2
Wimpyville Ditch E.	40.11770	-90.20270	1
Wimpyville Ditch W.	40.11590	-90.21300	2
Woodard	40.23079	-90.10746	2
Tazewell County			
Becker(69)	40.46498	-89.77548	2
Burnsmier(55A)	40.39634	-89.68158	0
Burnsmier(55B)	40.39611	-89.68474	3
Burnsmier(55C)	40.39411	-89.68227	2
Cupi(11)	40.43640	-89.84804	0
Hilst N(13)	40.38909	-89.68579	0
Hilst S(14)	40.38690	-89.68480	0
Hofreiter Pond	40.41150	-89.69084	0
Jibben(16)	40.38078	-89.66198	3
Nehmelman(80)	40.40039	-89.68065	3
Short Pond	40.39500	-89.68990	1
Taz 1	40.40578	-89.68954	0
Taz 2	40.40650	-89.68035	3

0 = not surveyed; 1 = calls heard, no samples;
2 = calls heard, samples collected; 3 = unknown calls, samples collected

Figure 1. Distribution of IMT and Soil Association parent material 12

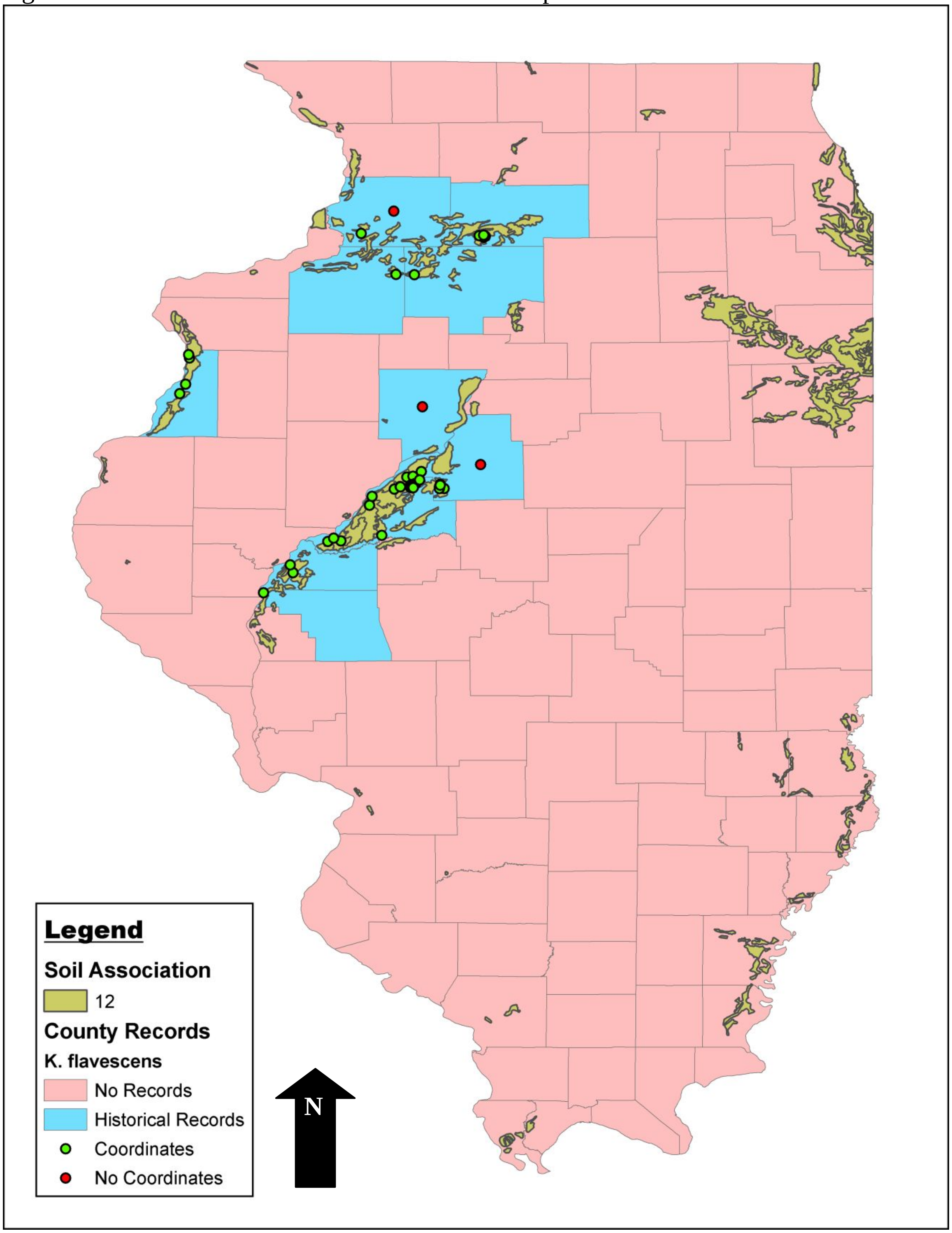


Figure 2. IMT sites surveyed and sandy soil series

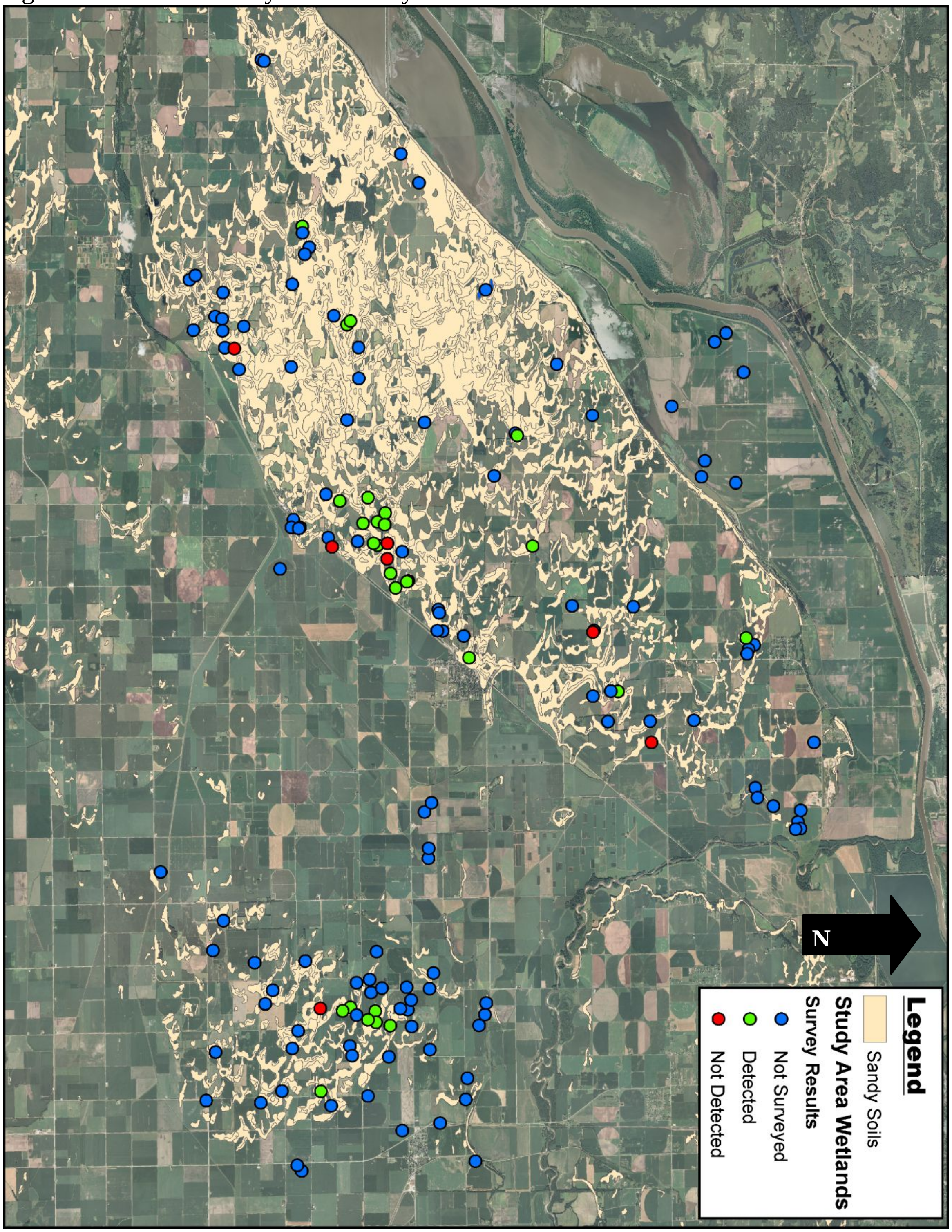


Figure 3. Network analysis for Green Valley Cluster

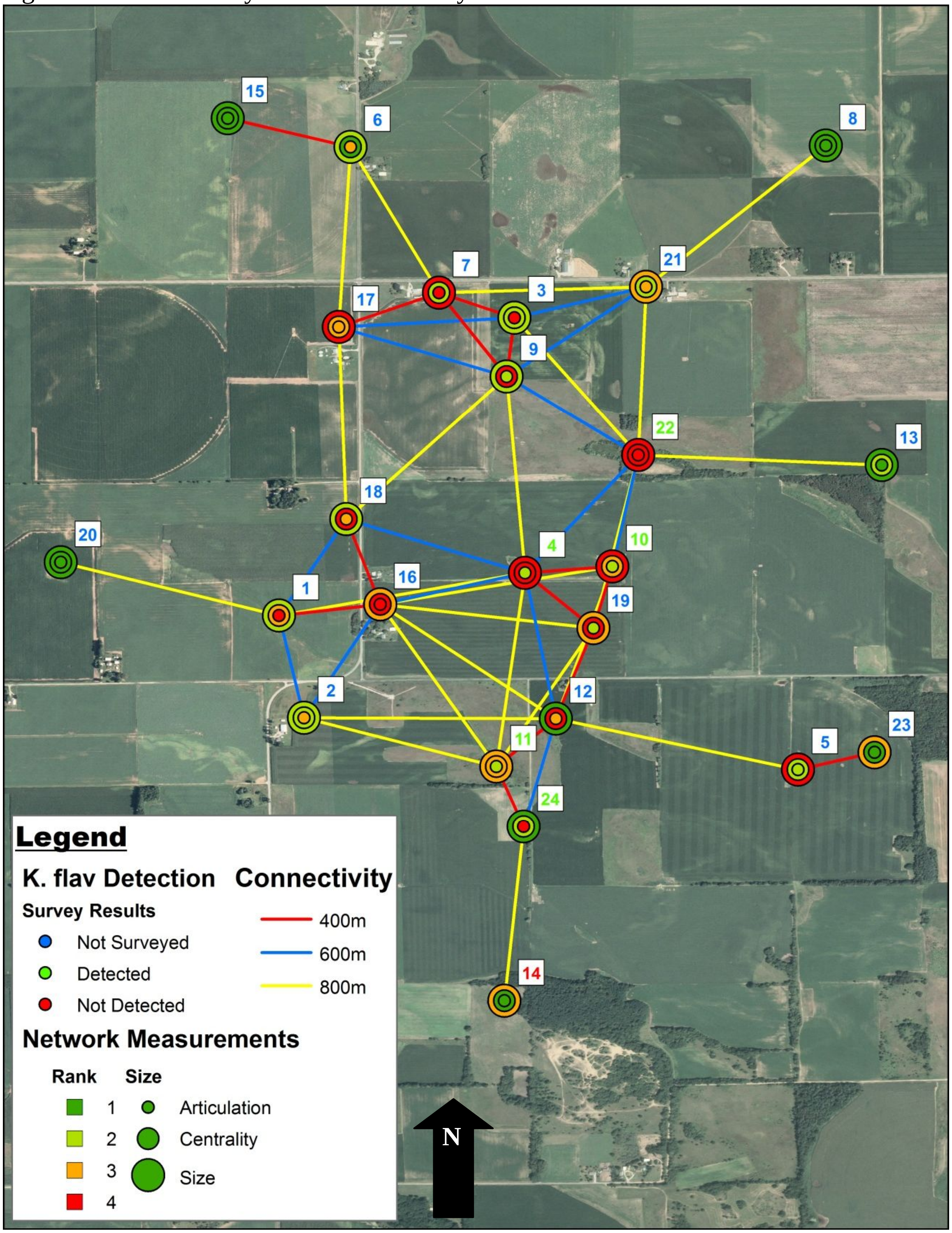


Figure 4. Network analysis for Manito Cluster

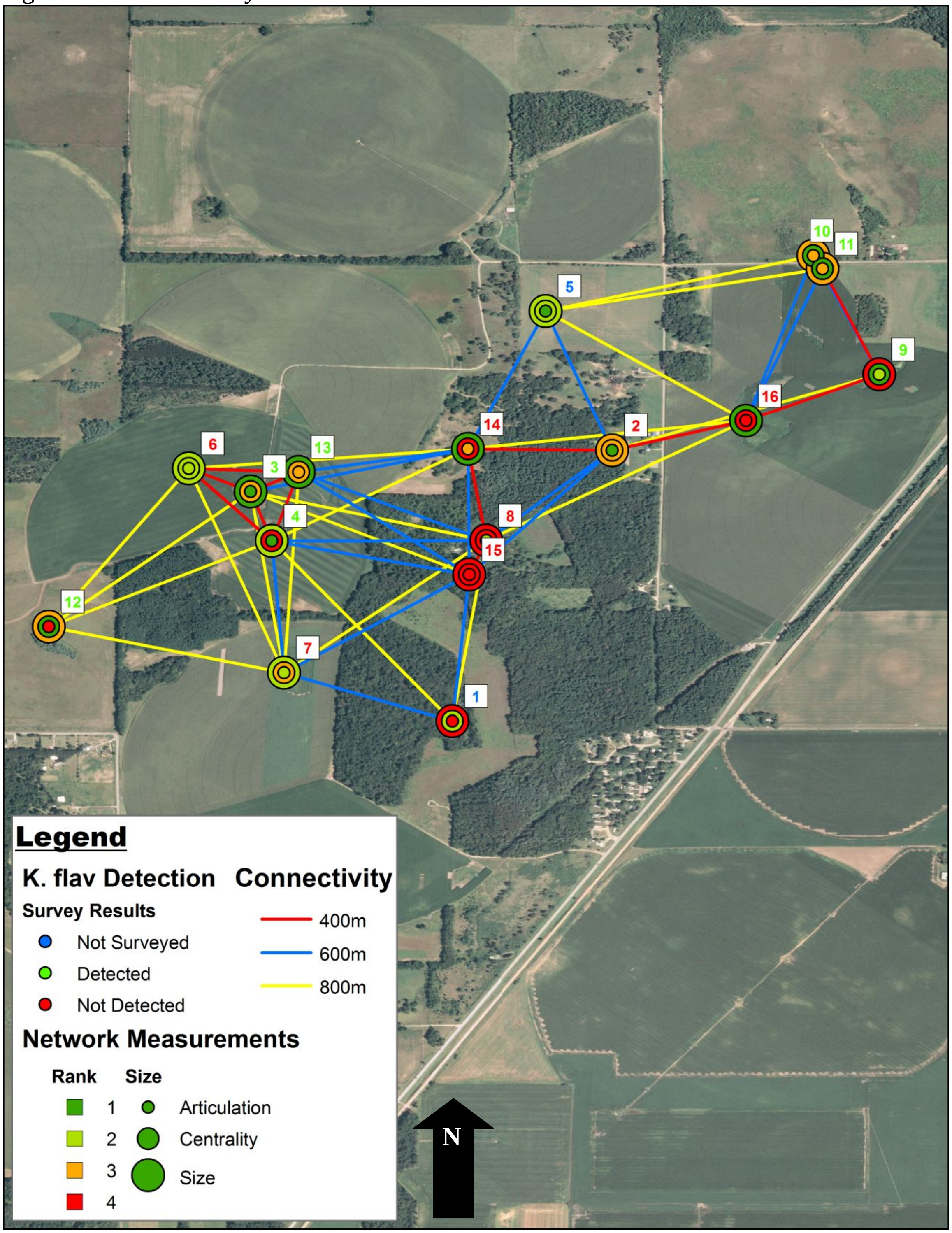


Figure 5. Distribution of ICF and Soil Association parent materials 03, 12 and 15

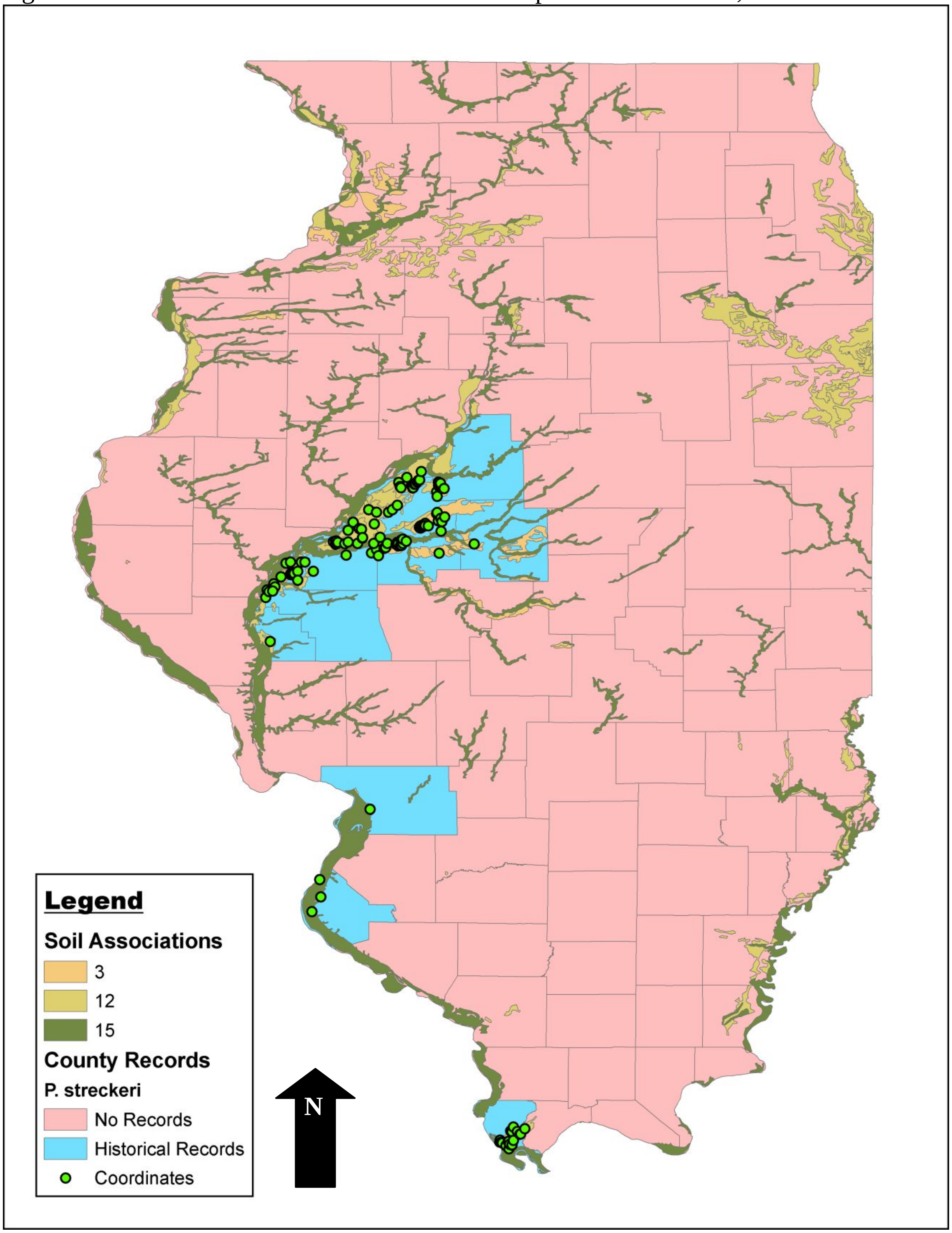


Figure 6. ICF sites surveyed and sandy, loamy sand and sandy loam soil series

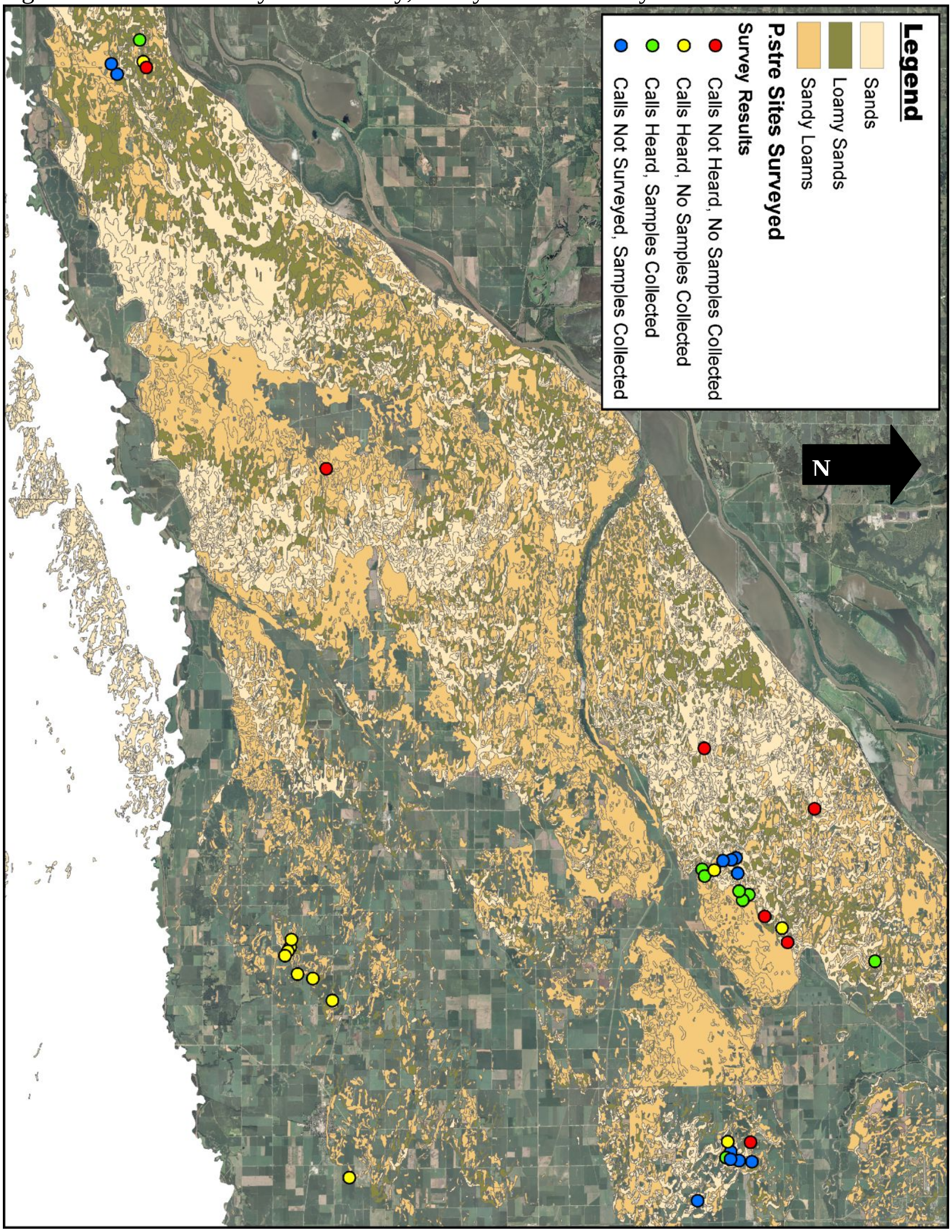


Figure 7. IMT movements at Armbrust property

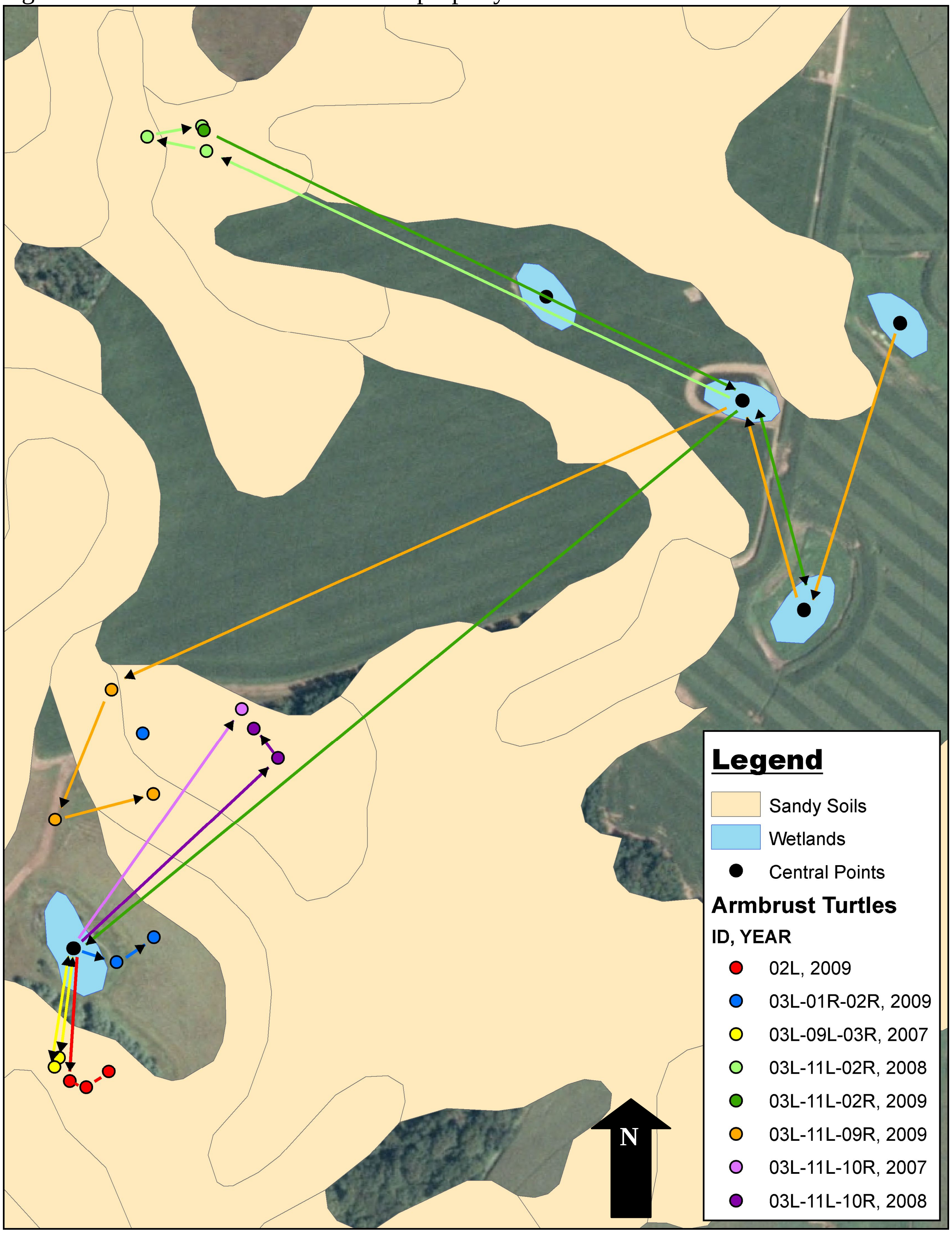


Figure 8. IMT movements at Fornoff property

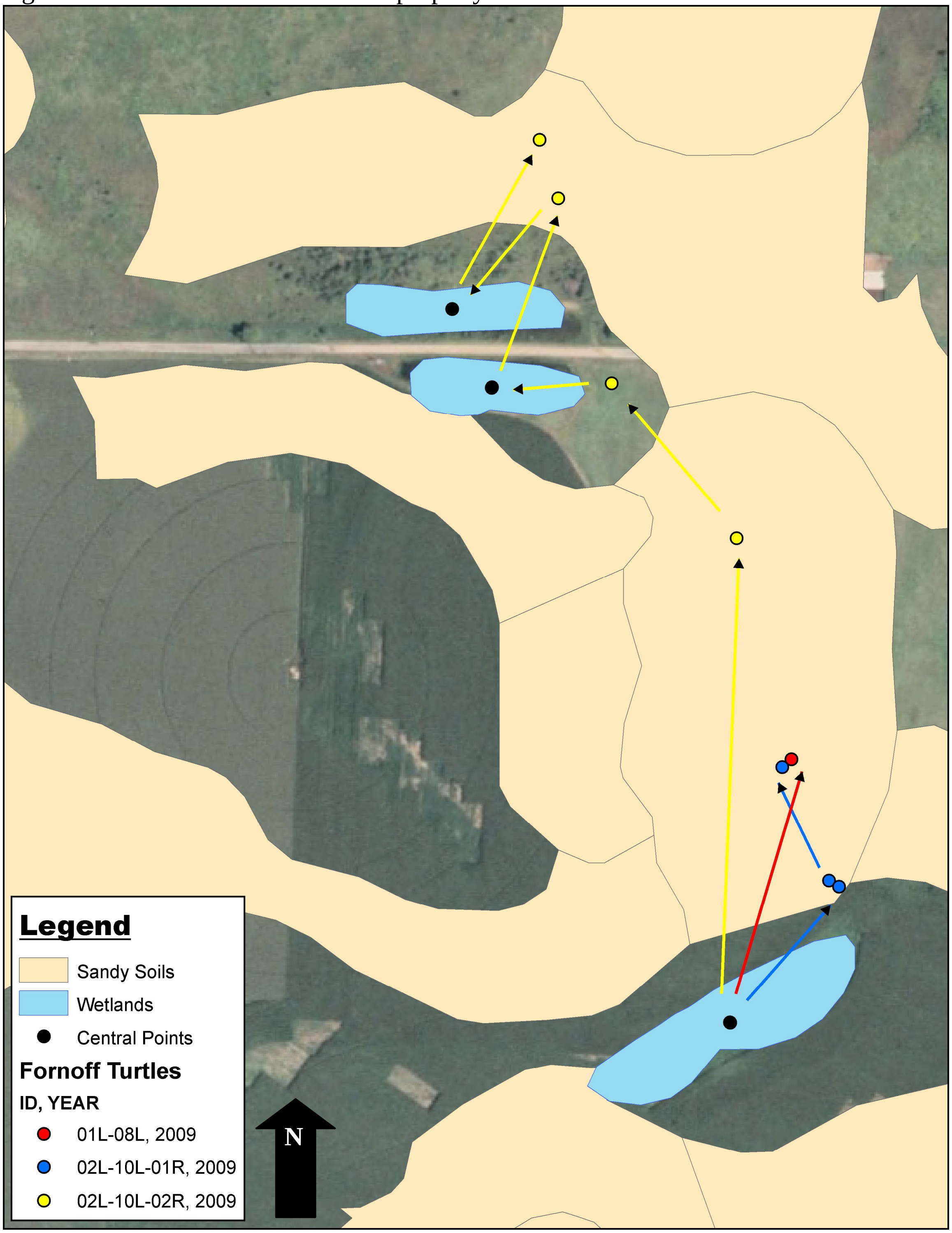


Figure 9. IMT movements at Jibben property

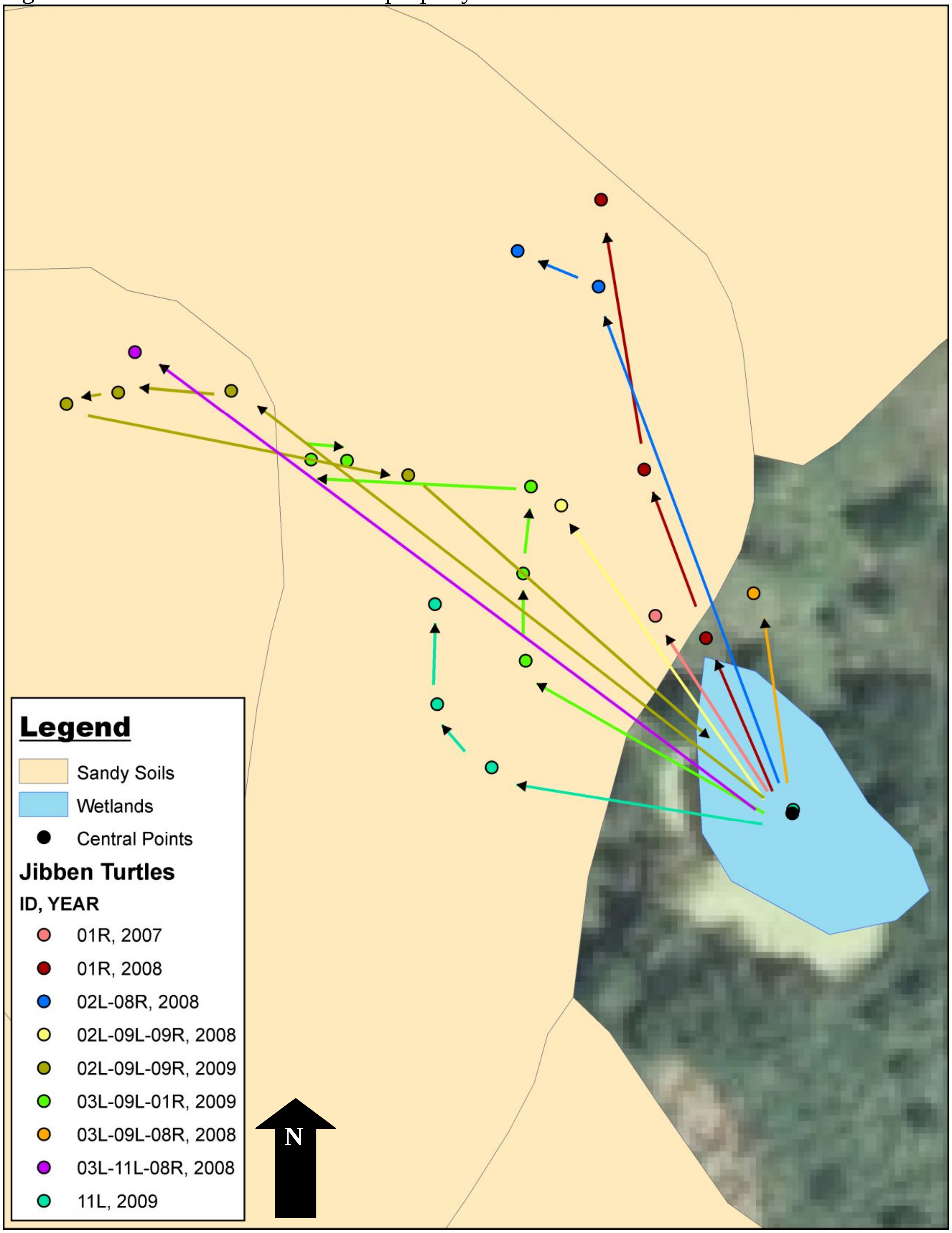


Figure 10. IMT movements at Hilst property

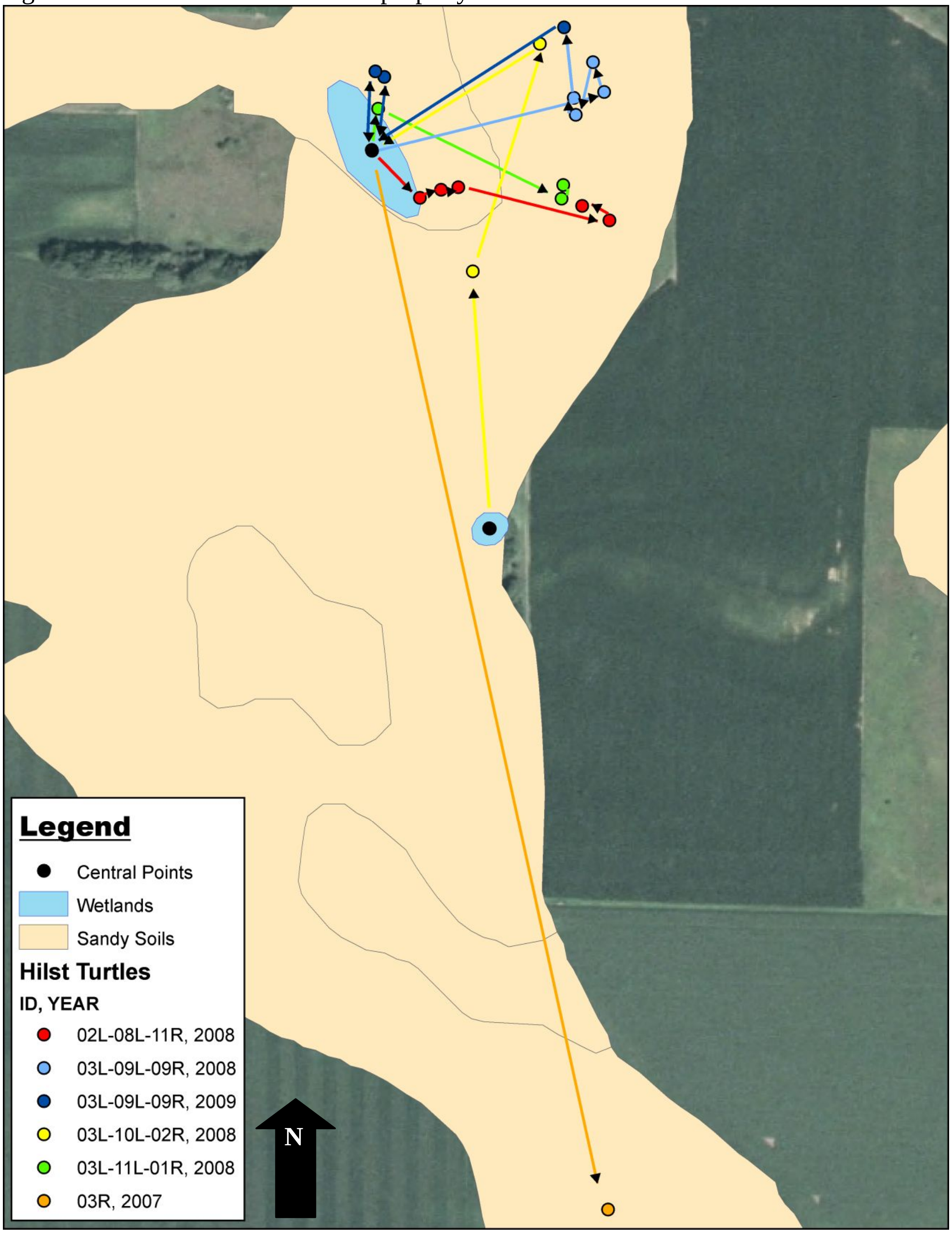


Figure 11. IMT movements at Burnsmier and Nehmelman properties

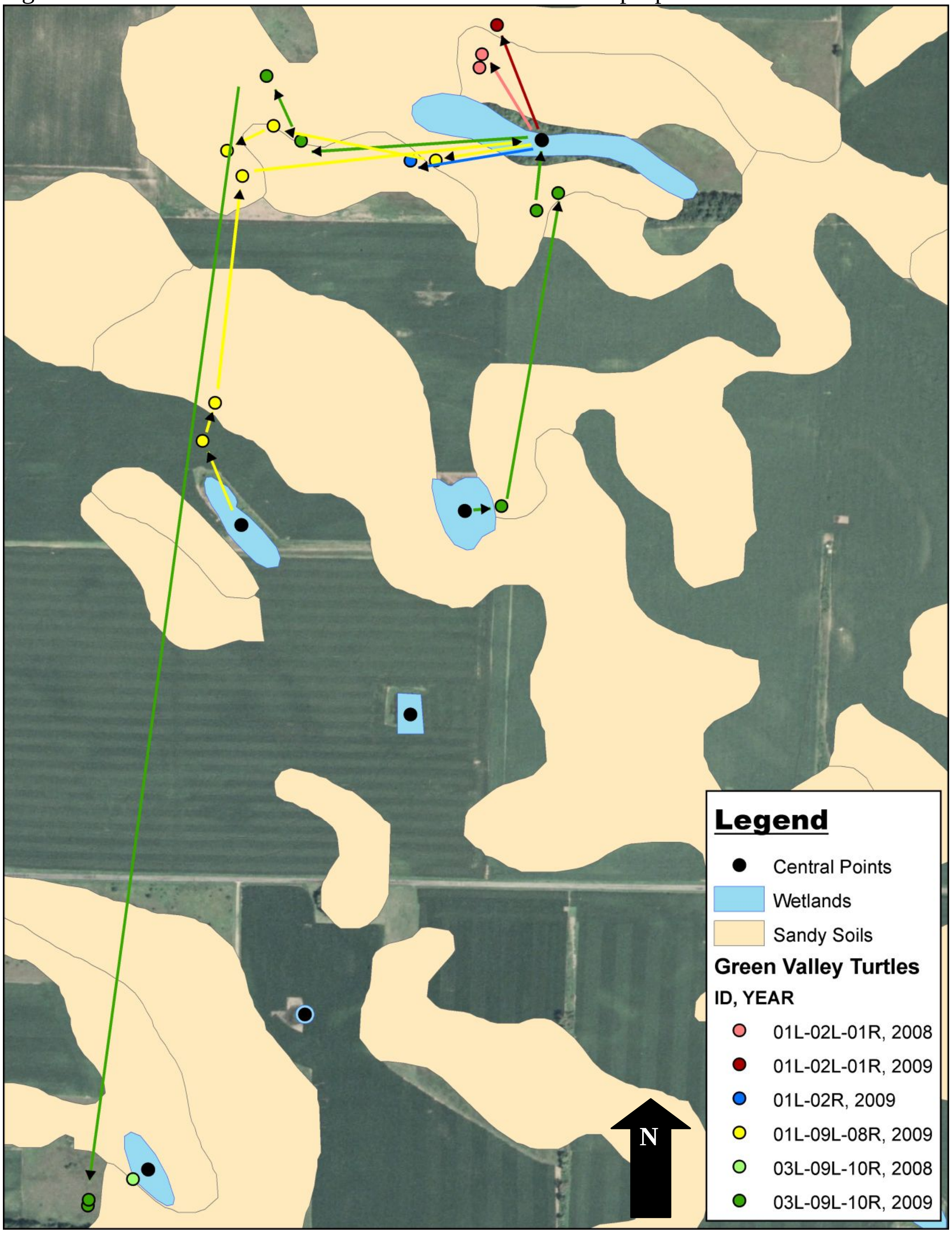


Figure 12. IMT movements at VanHies property

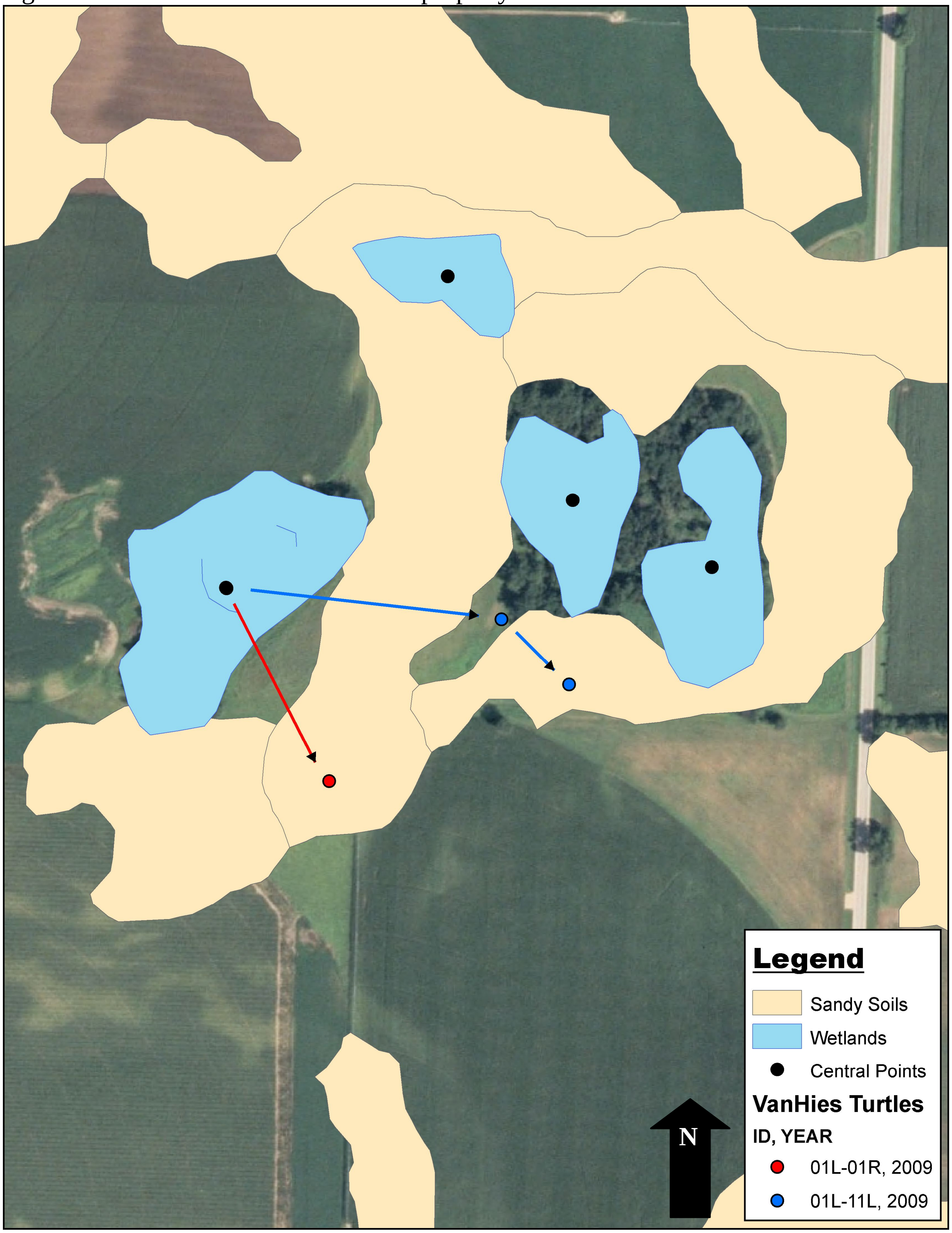
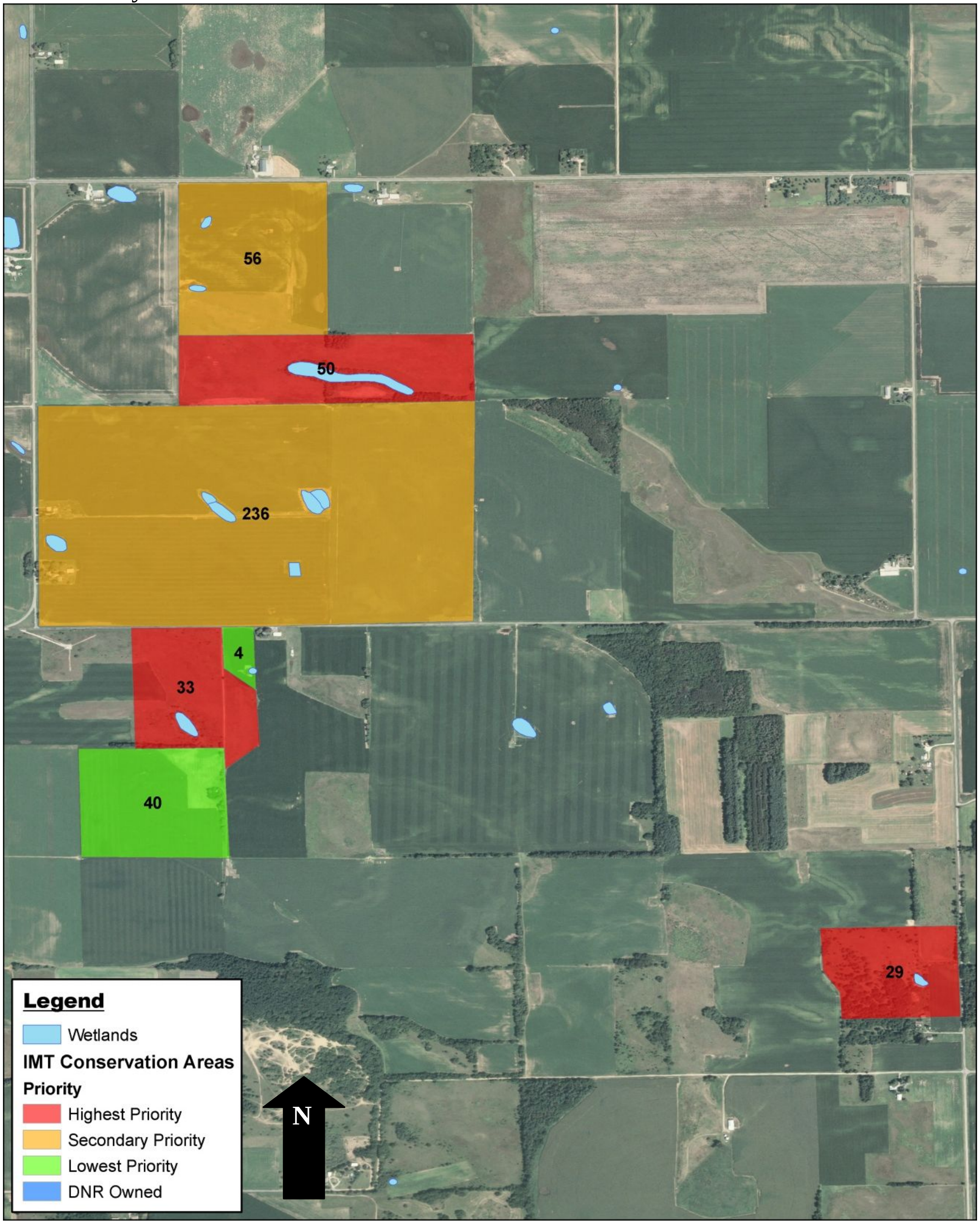
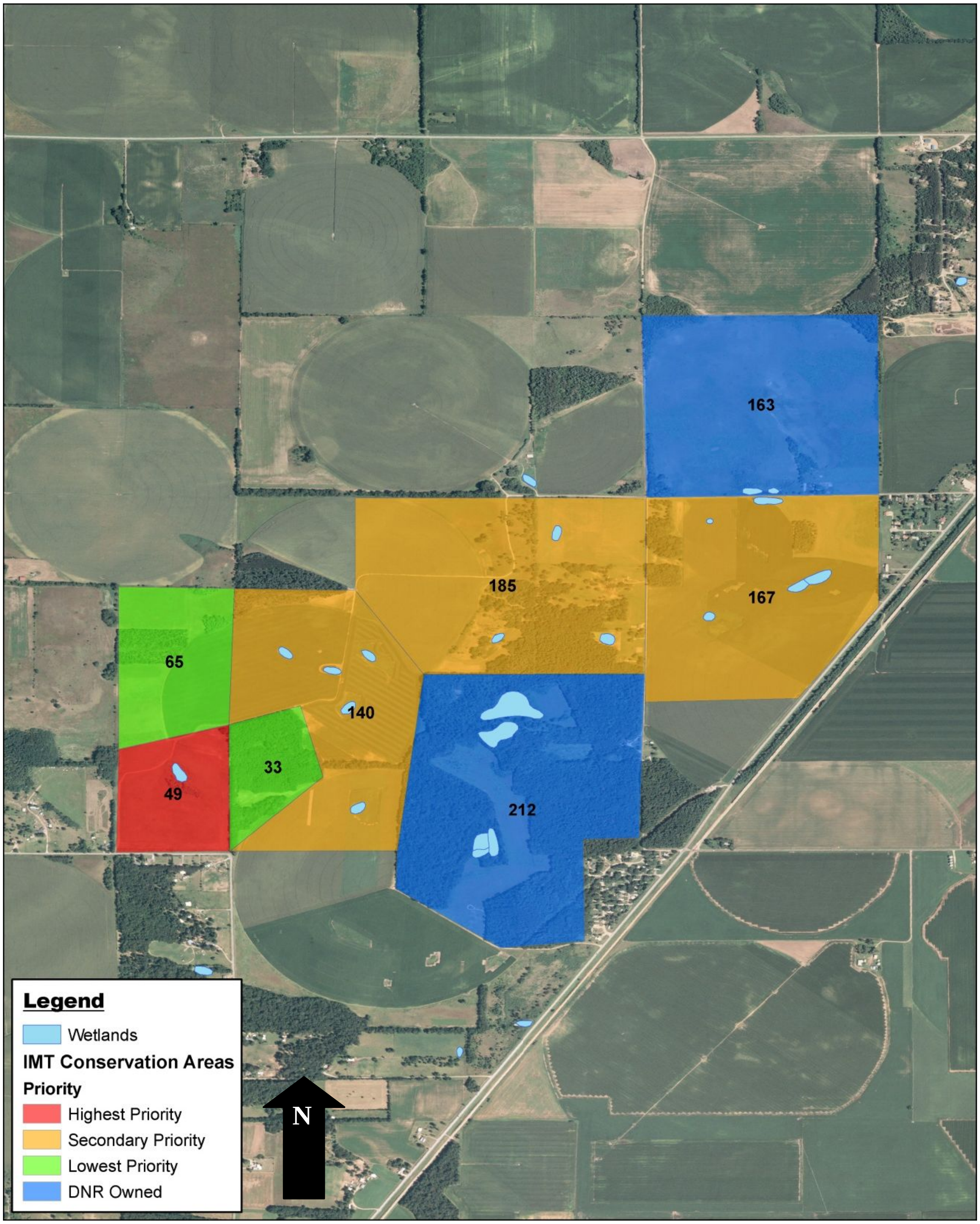


Figure 13. Recommendations for land acquisition/ conservation easement in Green Valley cluster



Polygons labeled with area in acres

Figure 14. Recommendations for land acquisition/ conservation easement in Manito cluster



Polygons labeled with area in acres

Figure 15. Recommendations for land acquisition/ conservation easement around pond 86

Polygons labeled with area in acres