ILLINOIS

PRAIRIE RESEARCH INSTITUTE

Illinois Natural History Survey
1816 S. Oak Street
Champaign, IL 61820

Effectiveness of Illinois' Protected Lands Network at Supporting SGCN and their Habitats.

Feng, Mei-Ling; Schartel, Tyler E; South, Eric; Henning, Bridget; Cao, Yong; Hinz Jr, Leon C

INHS Technical Report 2021 (19)

Prepared for IDNR State Wildlife Initiative Grants Program
IDNR Division of Natural Heritage
Illinois Natural History Survey

Issued on 9/28/2021

Release online immediately;

Table of Contents

Project Title: Effectiveness of Illinois' Protected Lands Network at Supporting SGCN and their Habitats.

Executive Summary**:**

This project identified key locations for conservation work to inform and assist conservation manager priorities and decisions. Conservation management decisions and goals can be guided by project results and tools that provide common assessment standards for evaluating the effectiveness of current protection efforts in Illinois.

Key conservation locations were identified based on the site's contribution towards meeting regional conservation goals. This process began with updating sub-national conservation status ranks (sRanks) of Natural Community Types (NCTs) and Species of Greatest Conservation Need (SGCN) within Illinois. These sRanks will assist with prioritizing protection and stewardship activities aimed at maintaining high-quality communities and native populations with the greatest extirpation risks. We also identified the locations of under-protected species and natural communities within the Illinois protected lands network in order to facilitate statewide land acquisition and preservation actions. Protected land and high-quality natural areas known as Illinois Natural Area Inventory sites (INAI) were ranked based on their statewide priority for rarity weighted richness, biodiversity including rarer and endemic species, and viability relative to their exposure to anthropogenic disturbances. Together, the status reviews and protection analyses developed regional species and community targets, while the rarity weighted richness and vulnerability analyses identified high-quality, biodiverse sites. Project tools subsequently include priority-ranked species, natural communities, site lists, and maps that visualize the locations of these priorities based on the above-mentioned analyses. The processes and tools used in this project provide a common assessment standard for evaluating the effectiveness of current protection efforts in Illinois and setting regional goals to assist with conservation management decisions.

Project Objectives and Completion Summaries:

Objective I: Conduct a conservation status review for Natural Community Types.

Job 1: Use NatureServe Rank Calculator tool to conduct conservation status reviews for Natural Community Types (NCTs) occurring in Illinois. (For Methods see Appendix pages 11-13)

Updated sRanks were completed for 99 Illinois NCTs (Table 1). Thirteen Natural Communities that included stream gradients, lakes, and great lakes, were not included in the update as they contained incomplete data due to their classification methods. All NCTs were drawn from the descriptions in The Standards and Guidelines for the Illinois Natural Areas Inventory (Natural Areas Program 2006). Conservation status reviews were completed using NatureServe's Rank Calculator (NatureServe 2015) as a common assessment standard. This Microsoft Excel programmed calculator facilitates NatureServe's Conservation Status Assessment methodology (Faber-Langendoen et al. 2012) to evaluate the risk of regional species extirpation and ecosystems elimination by evaluating rarity, threats, and trends (Figure 1). sRanks were reviewed by the IDNR Heritage staff before being finalized. Updated sRanks were incorporated into the Illinois Natural Heritage Database (Biotics) in June of 2019.

Objective II: Evaluate the inclusiveness of Natural Community Types within the Protected Lands Network and gaps in coverage.

Job 2: Use existing data from the Illinois Natural Heritage Database and the Protected Lands Database to determine the extent of high-quality instances of each NCT on protected land. (For Methods see Appendix pages 13-14)

Data from the Natural Heritage Database and Protected Lands Database (Prairie State Conservation Coalition) were used to identify the extent to which each NCT is represented on Protected Lands. Natural community occurrences from the INAI database were spatially overlaid with both Illinois Nature Preserve sites (INPC) and non-INPC protected land (federal, state, municipal, and NGO) to identify the distribution and number of instances of each community type on protected land. Each community was assigned a protection need based on its number of protected occurrences and known distribution of the community type. This project produced lists of the 99 NCTs, their quality grades, and their protection need (Table 2), as well as a map of the distribution of natural community protection needs across the state (Figure 2).

Objective III: Identify key sites and stream reaches for Stewardship and Protection.

Job 3: Develop a vulnerability index using landscape-scale data summarizing known and projected threats for lands and watersheds in Illinois. (For Methods see Appendix pages 14-20)

A statewide vulnerability index was developed for Illinois lands and watersheds using landscape-scale data summaries of known and projected anthropogenic threats. These data were summarized as density values at 1 km^2 resolution for both Illinois lands and within hydrologic catchments across state watersheds. The known and projected threat data used for these summaries included developed land cover, mining locations, EPA facilities of interest and permit locations, oil fields, wind turbines, dams, roads, railways, census population data, industrial water withdrawal, predicted land development, and traffic rates from government and academic sources (Table 4). Resiliency data concerning core habitat and connectivity from the Midwest Green Infrastructure project (Midwest Green Infrastructure Network 2014) were used to assess the landscape susceptibility to ecological disturbance from these threats and create a more accurate estimate of "vulnerability". This statewide vulnerability index was applied to Illinois Nature Preserves (INPC) and Biologically Significant Stream (BSS) segments to estimate expected high-quality terrestrial and aquatic systems expected vulnerability to disturbance. Maps were made to visualize vulnerability at the landscape level using grids and catchments, as well as relative vulnerability of INPC and BSS sites across the state (Figures 3-12). These maps will assist with prioritizing areas and sites with both high viability and vulnerability for further protection and stewardship. A list of primary threats at each INPC and BSS site was made to support stewardship actions (Table 6). The same methods for INPC sites were used to extrapolate vulnerability scores to the 10km^2 hexagons used in the rarity weighted richness analysis in order to facilitate comparison between analyses.

Job 4: Rank Nature Preserves and Biologically Significant Stream reaches for conservation prioritization based on the vulnerability index developed in Job 3. (For Methods see Appendix page 20)

INPC and BSS reaches were ranked based on their vulnerability determined from the statewide vulnerability index. Relative vulnerability of sites and reaches were ranked statewide and within each Natural Division for INPC and within each Ecological Drainage Unit (EDU) for BSS (Tables 7, 8, 10, and 11). An additional step was to rank INPC sites for each NCT based on the vulnerability index developed in Job 3. INPC sites and natural community occurrences were spatially overlaid to produce a list of protected natural community occurrences and which INPC they occurred on for each of Illinois' 99 different NCTs. The vulnerability ranks for each INPC site were used to rank each protected natural community occurrence within each community type from most to least vulnerable (Table 9).

Job 5: Identify key Illinois Natural Areas Inventory sites using rarity-weighted richness modeling applied to NCTs. (For Methods see Appendix pages 20-21)

Key locations for NCT stewardship were identified using the rarity-weighted richness modeling approach following the method outlined in Setin et al. (2000). Rarity weighted richness of natural communities was calculated for high-quality natural areas statewide and within Natural Divisions using INAI sites. All NCTs were assigned a rarity weight based on the inverse of the number of INAI sites on which they occur. The rarity weighted richness of each INAI site was calculated as the sum of the rarity weights of each NCT that occurs at the site. The INAI sites with the highest rarity weighted richness were considered high-priority sites because they capture a greater diversity of community types, including rarer communities. These site comparisons were made relative across all sites statewide and within Natural Divisions. We evaluated the rarity weighted richness of only critically imperiled and imperiled (S1 and S2) community types. This analysis targets a complete representation of Illinois natural communities by focusing on communities with range restrictions and conservation needs instead of common communities. Priority sites for S1 and S2 community types were ranked (Table 12) and mapped (Figure 13) to assist conservation managers with visualizing their decisions. Maps using the same statewide priorities were generated at different sub-regional scales to assist sub-regional efforts by identifying priorities aligned with regional goals. In addition, a similar landscape analysis using 10 km^2 hexagonal cells as "sites" was used to calculate rarity weighted richness across the entire state to incorporate areas with natural community occurrences outside INAI sites (Figure 14).

Objective IV: Conservation status review for Illinois Species in Greatest Conservation Need (SGCN).

Job 6: Use NatureServe Rank Calculator tool to conduct conservation status reviews for Illinois' non-plant Endangered & Threatened species and other SGCN. (For Methods see Appendix pages 21-25)

Updated sRanks were completed for 210 SGCN, as well as 30 unranked breeding bird and 12 unranked herptile species, occurring in Illinois (Table 13). These 210 SGCN included Illinois' non-plant Endangered and Threatened species and all other SGCN, including fish and mussel species. Unranked SGCN breeding bird and herptile species were identified by consultation with Illinois Natural History Survey (INHS) experts for each taxa group. E/T species and SGCN occurrences were drawn from the Natural Heritage Database Biotics, the IDNR fish database, INHS fish and mussel databases, and USGS Long-Term Research Monitoring Program, along with Lake Michigan and Illinois streams research program data. Occurrence data for breeding bird and herptile species were drawn from INHS collections and the North American Breeding Bird Survey (BBS).

Conservation status reviews were completed using NatureServe's Rank Calculator (NatureServe 2015) versions 3.186 and 3.2 as a common assessment standard; this report includes sRanks generated by these calculators (e.g., S1, S2) and reviewed by Heritage staff. These Microsoft Excel programmed calculators facilitate NatureServe's Conservation Status Assessment methodology (Faber-Langendoen et al. 2012) to evaluate the risk of regional extirpation of species and elimination of ecosystems by evaluating rarity, threats, and trends (Figure 15). Calculator versions differ in that calculator version 3.2 has been modified to correctly account for short-term trends in species population sizes or occurrences. sRanks generated by the NatureServe sRank calculator v3.186 were reviewed by the Heritage staff before being finalized and incorporated into the Illinois Natural Heritage Database (Biotics) in June of 2019. sRanks generated by the NatureServe sRank calculator v3.2 are pending review by the Heritage staff.

Objective V: Identify protected habitats for SGCN.

Job 7: Use existing data from the Illinois Natural Heritage Database and the Protected Lands Database to determine the distribution and number of protected sites occupied by SGCN. (For Methods see Appendix pages 25-26)

Data from the Natural Heritage Database and Protected Lands Database were used to identify the extent to which occupied habitat for state-listed wildlife species is represented on Protected Lands. State Endangered and Threatened wildlife species occurrences from the Illinois Natural Heritage Database were spatially overlaid with both INPC sites and non-INPC protected land (federal, state, municipal, and NGO) to identify the distribution and number of instances of each species on protected land. Each species was assigned a protection need based on its number of protected occurrences and known distribution of the species. This project produced a list of state-listed wildlife species with their protection need (Table 14) as well as a map of the distribution of listed species protection needs across the state (Figure 16).

Objective VI: Identify key locations for biodiversity protection based on E&T.

Job 8: Identify key Illinois Natural Areas Inventory sites using rarity-weighted richness modeling applied to the species reviewed in Job 6. (For Methods see Appendix pages 26-27)

Key locations for stewardship of wildlife species were identified using the rarity-weighted richness modeling approach following the method outlined in Stein et al. (2000). Species included all Illinois fish and mussel SGCN, all other state-listed wildlife, and unranked SGCN breeding birds and herptiles (all species reviewed in Job 6). Rarity weighted richness was calculated for species statewide and within Natural Divisions using INAI sites. Species were assigned a rarity weight based on the inverse of the number of INAI sites on which they occur. The rarity weighted richness of each INAI site was calculated as the sum of the rarity weights of all species that occur at the site. The INAI sites with the highest rarity weighted richness were considered high priority sites. These site comparisons were made relative to all sites statewide and within Natural Divisions. These are sites that capture a diversity of species, including rarer species.

We evaluated the rarity weighted richness of only critically imperiled and imperiled (S1 and S2) species, and an additional richness value including S3 (vulnerable) species. These identified sites target a complete representation of Illinois wildlife biodiversity by focusing on species with range restrictions and conservation needs over concentrations of more common species. We also grouped species into taxonomic categories (aquatic and terrestrial) to generate richness values that accounted for different management needs. Priority sites were ranked (Tables 15-18) and mapped to assist conservation managers with visualizing their priorities (Figures 17, 19, 20, and 23). Maps using the same statewide priorities were generated at different sub-regional scales to assist sub-regional efforts with identifying priorities that aligned with regional goals. In addition, a similar landscape analysis using 10 km^2 hexagonal cells as “sites” was used to calculate rarity weighted richness across the entire state to incorporate areas with species occurrences that fell outside INAI sites (Figures 18, 21, 22, 25, and 26).

Job 9: Identify key Biologically Significant Stream segments using rarity-weighted richness modeling applied to species of fish and mussels reviewed in Job 6. (For Methods see Appendix pages 27-29)

Key locations for stewardship of aquatic species were identified using the rarity-weighted richness modeling approach following the method outlined in Stein et al. (2000). Aquatic species included all Illinois fish and mussel SGCN, in addition to state-listed aquatic crayfish. Rarity weighted richness of aquatic species was calculated for high-quality stream segments statewide and within EDUs using BSS segments. Aquatic species were assigned a rarity weight based on the inverse of the number of BSS segments in which it occurred. The rarity weighted richness of each BSS segment was calculated as the sum of the rarity weights of each species that occurs at the segment. The BSS segments with the highest rarity weighted richness were considered high priority sites. These segment comparisons were made relative to all segments statewide and within EDUs. These are stream segments that capture a diversity of species, including rarer species.

We evaluated the rarity weighted richness of critically imperiled and imperiled (S1 and S2) species and an additional richness value including S3 (vulnerable) species. These identified segments target a complete representation of Illinois fish and mussel SGCN, especially species with range restrictions and conservation needs. Priority sites were ranked (Tables 19 and 20) and mapped to assist conservation managers with visualizing priorities (Figures 27 and 29). Maps using the same statewide priorities were generated at different sub-regional scales to assist sub-regional efforts with identifying priorities that aligned with regional goals. In addition, a similar landscape analysis using National Hydrology Database (NHD plusV2) flowlines as "sites" was used to calculate rarity weighted richness across the entire state stream network to incorporate stream reaches with species occurrences that fell outside BSS sites (Figures 28 and 30).

Objective VII. Complete Reporting requirements.

Job 10: Prepare reports and manuscripts. (For Methods see Appendix pages 29-30)

A cumulative annual report detailing the progress of each job and objective was produced for each project year (2017-2020). A final report summarizing the completion of all project/extension jobs and objectives, and providing the outputs and methodology for all jobs, was written. Staff participated in various opportunities for project outreach and development at Heritage meetings and professional conferences.

Reasons Estimated Goals were not Met:
The actual start date of this project (June 1, 2017) was later than the estimated start date (December 2016). There were staff member changes and departures before the estimated end date (June 2020).

Additional Pertinent Information:
The start of this project was delayed 6 months due to negotiations with the contract (final signature obtained June 1, 2017). No external funds were spent prior to June 2017. A one-year, no-cost project extension was also requested and ultimately granted, to extend this project's grant period from November 1, 2016, until June 31, 2021.

Significant Developments:
Project goals and associated jobs were completed in February 2020. Project extension goals and associated jobs were completed by June 2021.

Acknowledgements:
This project was conceived of and designed by Leon C. Hinz Jr. The project was supervised by, Leon C. Hinz Jr., Brian Anderson, Bridget Henning, and Yong Cao. Mei-Ling Emily Feng was responsible for much of the project's data compilation and analysis. Eric South and Tyler Schartel completed the work commissioned in the project's one-year extension.

Resources, data, and guidance were provided by multiple Illinois Department of Natural Resources, Division of Natural Heritage staff. John Wilker provided access to INAI and INPC data. Tara Kieninger and Jeannie Barnes provided access to the Illinois Natural Heritage Database (Biotics). Andrew Hulin and Charlie Foor provided GIS-related expertise and guidance in developing project GIS layers and output. Ann Holtrop and Todd Strole provided valuable guidance in shaping project objectives and output. Brian Metzke provided valuable guidance concerning project aquatic results. Jenny Skufca provided valuable input in reviewing this report document.

Funding for this project and its extension was provided by the State Wildlife Grants (SWG, Project No. T-115) Program. The Illinois Department of Natural Resources and the Illinois Natural History Survey provided matching funds separate from the SWG Program.

Appendix:

Methods

Objective I: Conduct a conservation status review for Natural Community Types.

Job 1: Use NatureServe Rank Calculator tool to conduct conservation status reviews for Natural Community Types occurring in Illinois.

Compiling information to be used in natural community sRank calculation uncovered unexpected issues in the INAI (Illinois Natural Area Inventory) database (Nat_Comm_7_17). Data in the Nat_Comm_7_17 database was edited to incorporate uncertainty due to the presence of 212 polygons that contained more than one natural community type. sRanks will capture the range of uncertainty by calculating sRanks when excluding such polygons, and when attributing 100% of each polygon with multiple communities to each community type within it.

Additional database issues identified that we would like to point out:

Between the INAI database and Biotics there are different naming conventions that could interfere with queries and analysis [Biotics format (INAI format)]:

- Aquatic cave community (Aquatic cave)
- Dry barren (Dry barrens)
- Low-gradient river (Low gradient river)
- Medium-gradient river (Medium gradient river)
- Mesic barren (Mesic barrens)
- Dry-mesic barren (Dry-mesic barrens)
- Sandstone overhang community (Sandstone overhang)
- Marsh (Freshwater marsh)
- Seep (Seep (neutral))
- Terrestrial cave community (Terrestrial cave)

NCTs not in Biotics:

- Xeric barrens

NCTs not in biotics and with no occurrences:

- Mesic sand forest
- Dry sand woodland
- Dry-mesic sand woodland
- Dolomite hill prairie
- High gradient medium stream
- High gradient large stream
- Medium gradient large stream

The following cultural communities were not ranked:

- Agricultural land

- Artificial impoundment
- Developed land
- Habitat restorations
- Managed grasslands
- Old field

The following aquatic communities could not be accurately ranked because their classifications were not descriptive enough for occurrence records to be mapped and verified by the Heritage staff:

- Medium gradient large stream
- High gradient large stream
- High gradient medium stream
- Medium gradient small stream
- Medium-gradient river
- Medium gradient medium stream
- Low gradient small stream
- Low gradient river
- Low gradient medium stream
- Low gradient large stream
- Lake
- Great Lake
- High gradient small stream
- Pond

Classification criteria for streams, lakes, and ponds were based on area, width, and gradient. The "Type" descriptions mention some details on location and sediment, but neither are reflected in the classification type name (Natural Areas Program 2006). This lack of specificity at the Type level name did not offer enough detail for the Heritage staff to verify occurrence records. Additionally, the documentation of these aquatic sites is incomplete or inconsistent. Large portions of major streams across the state are unclassified in the natural communities database due to the restriction of natural community records within INAI sites. For example, the Great Lakes community type is currently limited to two INAI sites but could be represented by the entire Lake Michigan shoreline. To account for natural communities in Illinois' streams, we will be conducting further prioritization analysis on stream segments throughout the state using NHD flowlines during our analysis of rarity weighted richness in Job 9.

After reviewing and consolidating the Illinois Natural Heritage (Biotics) and INAI Databases, sRanks for 99 NCTs in Illinois were calculated using NatureServe's Conservation Status Assessment Calculator in Microsoft Excel (NatureServe 2015).

The factors used in sRank calculation include:

- <u>Number of occurrences</u>- Data from the INAI database (nat_comm_7_17) and Illinois Natural Heritage database (Biotics) were used to calculate the number of EORs, a single EOR is defined as natural community occurrences within 1 km of each other.

- Extent of Occupancy- This was calculated as a minimum convex polygon (MPC) per IUCN recommendation. MCP were calculated using Minimum bounding geometry in GIS.
- Area of Occupancy- We estimated the area of occupancy per NatureServe and IUCN recommendation. For NCTs, it is recommended to use the exact area estimate, rather than the grid system used for species.
- Area of Occupancy of High Integrity Occurrences- High integrity natural communities were considered any polygon with an A or B quality grade rating within the INAI database system. This factor was calculated as a percent of the total area of occupancy. This factor was frequently high (close to 100% due to the limited data on low-quality natural communities in the database).

In addition, the spatial pattern (matrix, large, patch or small patch) of natural communities in their undisturbed state is required for assigning ranks. NatureServe provided information on the spatial pattern of plant communities in the U.S. National Vegetation Classification (USNVC) framework and a crosswalk table indicating how those plant communities translate to Illinois NCTs. However, not all Illinois natural communities have corresponding USNVC types and many communities have more than one spatial pattern. "Large patch" has been chosen as the default pattern. Spatial pattern assignments were reviewed by IDNR.

NCT sRanks were presented to the Division of Natural Heritage and underwent review before being finalized. This was facilitated through online review process (Figure 1) where reviewers contributed additional information such as threats, EOR integrity, and additional occurrences that altered the spatial pattern designation. All changes were documented and needed justifications were accepted.

This feedback was used to correct misidentified and mislabeled Element Occurrences and add missing species records. Heritage biologists were also able to provide insight into the size and viability of certain populations, which were incorporated as Number of Viable Occurrences and Population Size factors in the calculator. They were also consulted to adjust and add missing threat and short-term trend information for species that had limited documentation in the IWAP (2015). Due to the low resolution of natural community mapping, adjustments were made to the Area of Occupancy and Extent of Occurrence where they were being inflated by partial occurrences within INAI sites.

The updated sRanks for NCTs were incorporated into the Biotics database during an update in June 2019 (Table 1).

Objective II: Evaluate the inclusiveness of Natural Community Types within the Protected Lands Network and gaps in coverage.

Job 2: Use existing data from the Illinois Natural Heritage Database and the Protected Lands Database to determine the extent of high-quality instances of each NCT on protected land.

Using data from the Natural Heritage Database and Protected Lands Database (Prairie State Conservation Coalition), we evaluated the inclusiveness of all NCTs within Illinois' protected lands. Locations of natural community element occurrences (EOs) were classified based on each NCT's protection needs. Natural community occurrences were spatially intersected over INPC land and then non-INPC protected land (federal, state, municipal, NGO). A protected occurrence was counted as one EO occurring on protected land or INPC, regardless of property boundaries. EOs stretching across multiple site boundaries were not counted as multiple protected occurrences. The number of INPC and non-INPC protected occurrences for each community type were summed and classified into the following protection needs, which were assigned to each community type (Table 2):

- Adequate Protection: More than 3 locations within INPC protection.
- Land Acquisition Need: Fewer than 3 INPC protected locations and fewer than 3 locations on non-INPC conservation land.
- Dedication Need: Fewer than 3 INPC protected locations, but 3 or more locations on non-INPC conservation land.
- Information and Protection Need: Fewer than 3 known locations (EORs).

We then created maps visualizing the location, extent, and distribution of NCTs color schemed based on their protection needs across the state (Figure 2).

Objective III: Identify key sites and stream reaches for Stewardship and Protection.

Job 3: Develop a vulnerability index using landscape scale data summarizing known and projected threats for lands and watersheds in Illinois.

We developed a statewide index of vulnerability that summarizes known and potential threats for both land and watersheds encompassing INPC and BSS sites. Anthropogenic and landscape variables from previous habitat vulnerability studies were referenced from the National Fish Habitat Partnership 2015 Assessment and the University of Massachusetts Conservation Assessment and Prioritization System (Crawford et al. 2016; McGarigal et al. 2011). After reviewing literature and spatial datasets available for Illinois, a list of disturbance variables and their associated effect distances and units of measurement were collected (Table 3). We do not anticipate this being a limiting factor to the index, but specific threats of interest to the IDNR such as CAFOs (concentrated animal feeding operations) were not available at fine enough scales to be included at this time.

Separate vulnerability analyses were conducted for terrestrial (lands) and aquatic habitat (watersheds) using two types of "landscape units," grid cells and catchments. For the terrestrial analysis, variables were summarized at 1 km^2 grid cells across the state and then were applied to INPC sites. For the aquatic analysis, we acquired flowlines and their associated catchments used in the Statewide Streams Analysis (SSA), a State Wildlife Grant project providing biotic and non-biotic data for Illinois' streams. We spatially joined SSA catchments with HUC12 boundaries based on the greatest overlap and dissolved catchments within each HUC12. The resulting "watersheds" resembled the HUC12 scale but used SSA catchment boundaries. The vulnerability index variables were summarized at the watershed and local catchment scales. Disturbance variables will be applied to either the catchment or watershed scale depending on the scale of their effect (Sass et al. 2010). The variables were divided as followed:

Watershed scale variables: Impervious Surfaces, Developed Land Predicted Land Use Change, High Intensity Developed Land, Low Intensity Developed Land, Agriculture, Road Length Density, Rail Length Density, Dam Density, Human Population Density, and Water Withdrawal

Local catchments scale variables: Core habitat, Density of Coal Mines, Density of Non-Energy Mines, Density of Road-Stream Crossings, Density of EPA Facilities, TRI Site Pollution, Water Pollution Sites, and Oil Field Density

Local catchment scale disturbances were assumed to represent disturbances whose effects were exerted as a function of proximity to the source. Disturbances such as mining activities, road-stream crossings, and natural riparian cover were considered. These variables, once summarized at different catchment and watershed scales, were combined into a vulnerability rank that was attributed to the stream reach within the flowlines layer. Stream reach vulnerability ranks were rescaled within Ecological Drainage Units to produce relative final estimates.

For the terrestrial vulnerability analysis, data were processed to the same 1km^2 spatial resolution, geographic extent (a minimum bounding rectangle around the Illinois state boundary), and projection (North American Albers Equal Area Conic [meters]). Point occurrence data (water pollution exceedances, Toxic Release Inventory (TRI) sites, EPA facilities, oil fields, wind turbines, and coal mines and non-energy mines) were summarized as density per km^2 using spatial overlays with 1km^2 grid cell units in ArcGIS 10.6.1. Final variables used in the analysis are listed in Table 4.

The densities of TRI sites and water pollutant release sites were adjusted to include the pollutant discharge amounts from each site. Sites had different volumes of pollutant discharges and this impacted the magnitude of disturbance within each grid unit. Certain units with smaller site densities had far greater volumes of pollutant discharge than units with high site densities but smaller site discharges. To account for both magnitude of impact and site density, these two disturbance variables were calculated as the density of sites at the unit multiplied by the relative total discharge volume. The relative discharge volume ranged in value from 0 to 1 and compared the total discharge volume at a unit to all other landscape units in the state (unit volume/maximum unit volume).

Roads, broken into “primary” and “secondary” sub-variables based on the Functional Classification (FC) attribute in IDOTs Highway Information System, and railways were summarized as the total km of length per 1km^2 cell using the intersect tool in ArcMap.

Measures of land use and cover were summarized as percentages at the 1 km^2 cell scale. These disturbance variables consisted of the percent area of high development urban areas (NLCD 2016 classified as High and Medium Intensity), low development urban areas (NLCD 2016 classified as Low Intensity, Open Developed areas, and Barren Land), agriculture (NLCD 2016 classified as Cultivated Crops and Pasture/Hay), impervious surfaces, and coal mining sites.

Coal mine point location data indicated sites classified as mine entrances, undocumented mine openings such as prospect pits, and short-term operations that undermined only a few acres. A buffer of 110 meters was added to each feature. This distance was determined by adding the radius of a 2-acre site footprint plus an effect distance of 60m as suggested in previous studies of effect distances of mining impacts (Decker et al. 2017, Korose et al. 2009, Sgambat et al.1980). This allowed the point data to be merged with the ISGS polygon data which covered mines, exposed refuse materials, abandoned areas, contaminated water impoundments, adjacent affected terrestrial and aquatic areas, and potentially hazardous mine openings. Active-surface coal mine sites were derived from site delineated polygons and point buffer polygons identified as active and surficial. Coal mines were ultimately divided into three land cover sub-variables: percent area of active surface mines, active underground mines, and all inactive underground/surface mines. This was to account for different environmental impacts exerted by surface, underground, and abandoned mines (Korose et al. 2009, Sgambat et al.1980, United States Environmental Protection Agency, 2000). All inactive mines (surficial and underground) were grouped together because, aside from their current potential risks (i.e., acid mine drainage, cave-ins/collapse), they present no additional future risks that accompany active and growing mines.

Human population density and water withdrawal were summarized at a smaller scale than the original resolution of their data sources (census tracts and HUC12 watersheds, respectively). These layers should be considered more as a relative reference of impact rather than true impact.

Resiliency data were included because high-quality, buffered, and connected habitat has the potential to offset disturbance impact at a site (McGarigal et al. 2011). Resiliency was divided into sub-variables by the presence of connectivity and core habitat using The Conservation Fund's Midwest Wind Energy MSHCP Green Infrastructure Network Design. "Core areas", as defined by the Green Infrastructure project, "contain naturally functioning ecosystems, and provide high-quality habitat for native plants and animals. [They] are the nucleus of the ecological network" (The Conservation Fund, 2014, p. 3). These core areas were considered to contain high-quality, buffered, and protected interior habitat. Depending on the natural landcover type and ecoregion, minimum patch sizes were required to delineate core area habitat, and only sites with NatureServe element occurrences (EOs) with fair or better viability were included. "Corridors" are areas that retain core habitat features and can support metapopulations by facilitating movement and genetic exchange between core areas. For our resiliency sub-variables, core areas that were intersected by corridors were categorized as "connected core habitat" and core areas that were not connected by any corridors were categorized as "isolated core habitat." The resiliency measure in the vulnerability index used the proportion of area within each landscape unit classified as connected or isolated core habitat.

Density values of disturbance and resiliency variables for aquatic vulnerability analysis units (catchments and watersheds) were calculated similarly to the terrestrial unit densities described above. Two of the 15 variables used in the terrestrial analysis, Annual Average Daily Traffic (AADT) and wind turbine density, were replaced with road-stream crossing and dam density variables in the aquatic analysis. Road-stream crossing locations were produced from NHD flowline and IDOT road data using the Intersect tool in ArcMap. Both road-stream crossing and dam densities were calculated by using Spatial join and Summary tools before dividing by the total area of the watershed or catchment.

Final vulnerability scores at the landscape unit (grid or catchment) level were calculated by rescaling, weighting, and summing disturbance variables. Resiliency variable scores, also rescaled and weighted, were then subtracted from the summed disturbance variables. The final scores at each landscape unit were used to generate an area weighted average vulnerability score for INPC sites and length weighted average for BSS sites.

The raw, non-zero disturbance, and resiliency density values were rescaled from zero to ten using percentile ranks. Values in the 90th percentile indicated the greatest degree of disturbance for that variable observed in the state. In other words, they presented the highest possible risk of disturbance and were given a score of ten. Values between the 80th percentile and 90th percentile were given a score of nine, continuing in descending order to the lowest values across the state (i.e., less than the 10th percentile) which were given a score of one. Landscape units without disturbance values were given zeroes for those variables. For example, the highest human population densities in Illinois (greater than 90 percent of all other densities) within each catchment were above 102 people/km^2. Comparatively, the 90th percentile of road crossing densities found across catchments were greater than 7 crossings/km^2. Both values were given comparative, rescaled values of 10. For resiliency variables, scores of 10 indicated the greatest proportion of core habitat of all landscape units across the state. Higher proportions of core habitat were interpreted as greater resiliency, which detracted from the overall disturbance impact. Therefore, these scores were subtracted from the summed disturbance score.

Once all the variables were rescaled 0-10, they were weighted if they were considered sub-variables. Variables with sub-variables included Coal Mines (Surface, Underground, and Inactive), Roads (Primary and Secondary), Developed Land (High Intensity and Low Intensity), and Core Habitat (Connected and Isolated). Similar vulnerability indices broke their road, developed land, and mine data into classes based on function, size, surface type, traffic, active status, and intensity (Anderson et al., 2018, Decker et al. 2017, McGarigal et al. 2011). Connectivity has been used as an important integrity metric fin other vulnerability models for calculating the "resistance" of undeveloped landscapes to disturbance (Anderson et al., 2018; McGarigal et al. 2011). Sub-variables were further supported by peer-reviewed literature if their attributes had differing degrees of environmental responses. For example, it is emphasized in the literature that species density with proximity to roads is a function of traffic noise, which itself is a function of traffic rate, the height of road above the ground surface, and the number of traffic lanes (Houlahan and Findlay, 2003; Clevenger et al., 2003; Forman and Alexander, 1998; Carr and Fahrig, 2001; Reijnen et al. 1995). Coal mines are also known to have impacts on the surrounding environment relative to whether the mine is surficial, underground, active, or abandoned based on how each of these states interacts with the local hydrology (Korose et al. 2009, Sgambat et al.1980, United States Environmental Protection Agency, 2000). Sub-variables were weighted by decimal percentages representative of their relative magnitude with reference to the literature to sum to a whole variable value. Within Coal Mines, for instance, surface mines were weighted 0.3, underground mines weighted 0.5, and inactive mines weighted 0.2. This created maximum scores for each as 3 (10*0.3), 5 (10*0.5), and 2 (10*0.2). When summed together, these maximum sub-variable values totaled to a maximum Coal Mine value of 10.

Final landscape unit scores were calculated by summing all rescaled and weighted disturbance variable scores and then subtracting all resiliency scores. This led to a maximum landscape unit score of 150 (15 disturbance variables *10) and a minimum score of -10 (1 resiliency variable *10) (Table 5). Final landscape unit scores were rescaled into relative scores and percentile ranks to facilitate comparison statewide and within each EDU for the aquatic analysis and Natural Division for the terrestrial analysis.

The ecological impact thresholds mentioned in the quarterly reports would be an excellent consideration for the future development of this project. Incorporating the observed magnitude of impact that each disturbance variable has on various natural communities can provide a more informed estimate of a disturbance at a site. Currently, this approach would require more time and prolific species data to achieve reliable model results and, as such, would be outside the timeline of the current project. We have explored multiple approaches that could provide this information, including the full use of species occurrence data from Biotics and R package TITAN2, which detects change points in community compositions along environmental gradients (Baker et al., 2019; Baker and King, 2010).

The next step was to reconcile the landscape vulnerability analyses to INPC and BSS sites. BSS sites were attributed to the scores of each catchment/watershed they were contained within, and INPC sites were attributed to each grid cell they intersected. The intersections of BSS with catchments/watersheds, and INPC with grid cells, were measured in the length or area of each respective intersection. The scores that intersected each site were weighted by the length or area of their intersection with the site and then averaged to produce a final area/length weighted average score for the site. The area weighted average was calculated as follows:
*[(Area Unit 1 * Score Unit 1) + (Area Unit 2 * Score Unit 2) +…] / Total Area of Site*
This avoided analytical issues with sites smaller than the landscape unit resolution when using zonal statistics in ArcMap.

Once every BSS and INPC site had a relative vulnerability score ranging between zero to one, they were ranked from most to least vulnerable. The ranks were produced with the vulnerability scores relative within each ecoregion. Scores within each ecoregion were ranked in ascending order from most vulnerable to least vulnerable (i.e., the most vulnerable/highest vulnerability score of 1 was given a rank of 1).

Upon reviewing the final vulnerability scores, we began considering alternative methods of quantifying site-level vulnerability. The vulnerability scoring method developed and reported in the 2019 reporting period does not clarify between disturbance magnitudes and the number of threats at each site. This is an important point to account for and consider in management decision-making because it would otherwise be difficult to distinguish between sites with multiple low-impact disturbances and sites with few high-impact disturbances. Therefore, we recalculated vulnerability ranks using three methods that considered both the magnitude of impact from each threat and the number of threats at a given site. Ideally, all three methods mentioned below, in addition to the scores developed in the previous reporting period, should be used in reference to each other. Comparing site disturbance by threat magnitude, threat quantity, and interaction of both magnitude and quantity, generates a more complete picture of ecological vulnerability that can be assessed across sites.

The highest magnitude scoring method ranked each site by the value of the highest percentile rescaled disturbance value (0-10) present at the site. This removed resiliency variables from consideration. Weighted sub-variables (i.e., low and high intensity development, primary and secondary roads, and active, inactive, surficial, or underground coal mines) were summed into their associated variables to create an overall magnitude of impact for roads, developed land, and coal mines. The highest percentile rescaled threat variable value at a landscape unit (grid cell or catchment) was used as the unit's vulnerability score and all threat variables that had this maximum score were listed as the primary threats at that unit. Final ranks identified highly vulnerable sites as those with threat values in the highest percentile across the state.

The maximum unit scoring method calculated the observed vulnerability score (sum of the weighted and rescaled threat variables within the site - sum of the weighted and rescaled resiliency variables within the site) and divided it by the potential vulnerability score at each unit (the same method as observed vulnerability score except all threat variables were rescaled as the highest potential magnitude of 10). This approach looked at each unit's threat magnitude proximity to its maximum potential disturbance (if all the threats present at the site were at the highest degree of impact). Final ranks identified highly vulnerable sites whose observed vulnerability came closest to their potential vulnerability.

The threat quantity unit scoring method counted each threat and resiliency variable as binary, presence-absence variables within a unit. Threats present at each unit were summed, and resiliency variables were then subtracted to quantify a disturbance count. This disturbance count was then divided by the total number of disturbance variables (N = 20, including sub-variables separately) considered in the analysis. The resulting proportion was the number of threats at a site out of all the disturbance variables considered in the analysis. This proportion, therefore, compares the relative quantity of disturbance variables at a given unit compared to other units across the state but does not account for varying magnitudes of each threat between units. Final ranks identified highly vulnerable sites as those with the highest number of threats present at the site.

Percentile and relative ranks were calculated for each landscape unit across the state and within ecological regions (Natural Divisions and Ecological Drainage Units). In order to extrapolate these scores to Illinois Nature Preserve sites (INPC) and Biologically Significant Streams (BSS), the raw vulnerability scores for each methodology (i.e, maximum rescaled magnitude, threat ratio, and the observed/potential vulnerability ratio) were again area- and length-weighted averaged at each site. These raw weighted averages for each site were once again rescaled by percentile and relativity to statewide sites to create statewide and ecoregional ranks for sites.

Statewide and ecoregion relative vulnerability maps were created using relative statewide and within-ecoregion scores. Maps were made to display INPC (Figures 3-6) and BSS sites (Figures 8-11) and their relative vulnerability for each vulnerability calculation method mentioned above, as well as for grid cells and catchments (Figures 7 and 12). Additionally, the vulnerability scores were extrapolated from the 1km^2 grid cells to the 10km^2 hexagonal cells used in the rarity weighted richness analysis to allow for comparisons between the two analyses. This was done using the same area weighted averaging technique for the INPC sites. The same combinations of vulnerability scores and maps were generated for the hexagon cells as the INPC sites.

Job 4: Rank Nature Preserves and Biologically Significant Stream reaches for conservation prioritization based on the vulnerability index developed in Job 3.

INPC and BSS sites were ranked based on their area and length weighted average vulnerability scores extrapolated from the landscape scale vulnerability analyses described above (Tables 7, 8, 10, and 11). In addition to these ranks, the description for Job 4 in the project proposal mentions ranking the vulnerability of natural community occurrences based on the rankings from INPC sites.

A list of natural community occurrences on statewide INPC sites was generated using Spatial Join in ArcMap. Each natural community occurrence was reconciled with the relative ecoregion vulnerability score associated with the INPC site it occurred on. This process thereby linked disturbance vulnerability with each protected natural community occurrence. For each natural community type, a reference document containing a list of protected occurrences that have descriptions of the quality grade, acreage, the INPC site it occurs on, the relative ecoregion vulnerability of that INPC site, and a list of the primary threats that contributed to its vulnerability score was produced (Table 9). Primary threats at a site were defined as variables with rescaled values of 6-10 or, in other words, values with a magnitude greater than the 50th percentile (Table 6). This tool can thereby assist with identifying both natural community types in greatest conservation need and high-quality protected occurrences that are either highly resilient or vulnerable to disturbance. This tool also identifies site-level predominant threats that should be prioritized for management and stewardship.

Job 5: Identify key Illinois Natural Areas Inventory (INAI) sites using rarity-weighted richness modeling applied to NCTs.

INAI sites were ranked statewide and within Natural Divisions by the rarity-weighted richness of NCTs (Table 12). Rarity weights of NCTs were calculated as the inverse of the number of INAI sites at which they occur. The rarity-weighted richness of an INAI site was the sum of the rarity weights of all NCTs present at the site. The Nat Comm 7-17 database was used in the analysis using polygons representative of multiple community types. The rarity-weighted richness rankings used richness values from NCTs with S1 or S2 sRanks (Critically Imperiled/Imperiled) from Job 1. Since many sRanks have a range of uncertainty with species imperilment or availability of data, we decided to include the following sRanks in the rarity weighted richness analyses: **S1**, **S1?**, **S1S2**, **S2**, **S2?**, **S2S3**. These rankings reflect species of critically imperiled to vulnerable status.

In addition to the absolute rarity-weighted richness (sums of rarity weights), we have calculated relative rarity richness and rarity richness percentile ranks to facilitate comparison across all sites statewide. Relative rarity-weighted richness values were used to build all associated maps in GIS. The rarity-weighted richness of sites was also ranked relative within Natural Divisions (comparison across all sites within each natural division). The Natural Divisions are geographic regions within the state that represent distinct climates, substrates, and landscapes that support similar compositions of biota. By accounting for highly ranked sites within each Natural Division, we incorporated priorities that equally represented the full diversity of Illinois ecoregions that may have otherwise been overlooked when comparing sites statewide.

Rarity weighted richness was also assessed at the landscape scale using 10 km^2 hexagonal cells across the state of Illinois. By ranking continuous cells, we were able to visualize species occurrences that did not fall within conservation site boundaries. This provided a reference of how well these conservation sites captured the richness of rare species across the landscape. Rarity weights were calculated for S1 and S2 natural communities similarly to the INAI calculations using the inverse of the number of hexagons they occurred in. Due to a large number of cells, this was done by exporting community and cell spatial joins from ArcGIS into a csv file format and creating a binary matrix of presence/no data (1/0) for each unique community occurrence at a cell. These matrices were imported into R and the Tidyverse package was used to calculate the rarity weights for each community. The rarity weights of each community type within each cell were summed to generate absolute rarity richness sums. The relative rarity, rarity rank, and percentile were calculated for each hexagon cell and the relative rarity was used to generate maps (Figures 13 and 14).

The maps identify key INAI sites and areas across the landscape within the state of Illinois for conservation efforts. Rarity ranks using have been calculated and mapped for comparisons statewide and within Natural Divisions, as well as sub-regional management units (Natural Heritage Districts and Regions, and Natural Area Preservation Specialist boundaries). Sub-regional ranks were produced from statewide rarity weighted richness in order to better display regional conservation efforts at sub-regional levels. Jenks natural breaks were used to generate more conservative maps indicating priority sites by relative rarity richness. Natural breaks contained the 90^{th} and 95^{th} percentile of sites in the highest break, ranging in value from 0.4-1.0 in relative rarity richness (0-1 scale). This resulted in up to 8 sites being identified as having the highest rarity richness statewide. For Natural Division relative rarity richness, the highest break once again captured the 90^{th} and 95^{th} percentile of sites, this time with 6 to 21 sites being identified as the highest rarity richness statewide.

An integrated ranking was then developed to represent all sites that were highly prioritized at the statewide and natural division scales. This integrated ranking was based on the higher relative rarity weighted richness value, whether at the state or natural division scale, assigned to each INAI site. This integrated ranking thus incorporated more high-ranking sites (15-22 sites) with relative richness values ranging between 0.8-1.0 in the highest natural break. This integrated ranking is therefore a more liberal prioritization of sites and facilitates more equal representation of natural statewide diversity.

Objective IV: Conservation status review for Illinois Species in Greatest Conservation Need (SGCN).

Job 6: Use NatureServe Rank Calculator tool to conduct conservation status reviews for Illinois' non-plant Endangered & Threatened species and other SGCN.

We conducted Conservation Status Assessments for the state-listed and unranked wildlife species, as well as Illinois' fish and mussel SGCN. Status Assessments evaluate the level of risk of extinction (or regional extirpation) of species. We used the NatureServe Conservation Status Assessment approach that evaluates three categories (rarity, threats, and trends) of conservation status rank factors (i.e., range extent, area of occupancy, population size, number of occurrences, number of occurrences with high viability, environmental specificity, overall threat impact, intrinsic vulnerability, long-term trends, short-term trends) (Faber-Langendoen et al. 2012). To facilitate this activity NatureServe has developed a Rank Calculator tool that has been programmed in Microsoft Excel (NatureServe 2015). Two versions of the NatureServe sRank Calculator were used; versions 3.186 and 3.2 differ in that version 3.2 was modified to correctly account for short-term trends affecting species population sizes or occurrences

sRanks were calculated for 210 SGCN, 30 unranked breeding birds, and 12 unranked herptile species based on 5 factors (Table 13): range extent, area of occupancy, number of occurrences, short-term trend, and threats (Figure 15). We extracted SGCN data from Biotics, the IDNR fish database, INHS fish and mussel databases, and USGS Long-Term Research Monitoring Program, along with Lake Michigan and Illinois streams research programs for the analysis. Data for unranked breeding birds and herptiles were compiled from INHS collections of each respective group and the North American Breeding Bird Survey (BBS). For all ranked species, database limitations were identified and adjusted when possible to improve the accuracy of the sRanks. Limitations include historic spatial data that may inflate EORs, a lack of EOR ranking limiting the integrity of the EORs, and unknown origins of previous species sRanks. We limited data for the analysis to observation collected from 2008-2018 to ensure that the analysis reflected the current status of the species. Status factors calculations are described below.

<u>Rarity</u>

Number of EORs- The number of Element Occurrence Records is intended to represent the number of populations of a species. Species location data is separated into multiple EORs if they are separated by a barrier or beyond a certain "separation distance". The separation distance of a species should be based on the gene flow and spatial ecology of the species. NatureServe provides recommended separation distances, and individual heritage programs can alter these as they deem necessary. We used a number of Element Occurrence Records (EORs) in the biotics database for listed species. For fish and mussel SGCN, which do not have data maintained in Biotics, we create "EORs" by buffering point records with half the recommended separation distance and merging overlapping records in ArcGIS. For mussels, we used a 5km separation distance, and for fish, we used a 3km separation distance, per NatureServe recommendation. Separation distances of 5km were used for unranked breeding bird species unless otherwise noted by NatureServe (i.e., separation distances of 10 and 1km were used for Broad-winged hawk [*Buteo platypterus*] and Ring-necked pheasant [*Phasianus colchicus*], respectively). Separation distances of 3km were used for all unranked herptile species.

The extent of Occupancy- The range extent criterion measures the spatial spread of areas currently occupied by a species. The purpose of this factor is to determine the degree to which risks from threatening factors are spatially distributed across the geographic range of the species or ecosystem. The extent of occupancy was calculated as a minimum convex polygon using Minimum bounding geometry in ArcGIS.

Area of Occupancy- Area of occupancy is defined as the area occupied by a taxon within its ‘extent of occurrence,’ and is intended as a proxy for species abundance. For most species, we used a $4km^2$ grid to standardize the estimation of range per NatureServe and IUCN recommendation. For species that occur in a linear pattern, such as in streams, cliffs, or shorelines, we used a $1km^2$ grid to estimate the area of occupancy. Using ArcGIS we spatially joined the grid layer with the EOR layer, dissolved overlapping grid squares, and summed the area. We repeated this process four times using offset grids to improve estimation. When a different number of grid cells were occupied, we used the minimum number of cells in our rank estimate.

<u>Trend</u>

Short-term Trend- Trend is intended to indicate the degree of change in population size, the extent of occurrence (range extent), area of occupancy, number of occurrences, and/or number of occurrences with good viability. The short-term trend should reflect changes within 10 years or 3 generations (for long-lived taxa), whichever is the longer. We used trend data taken from the Illinois Wildlife Action Plan (2015), which categorized species trends based on changes in abundance or distribution between 2000/2010 and before:

IWAP percent change	IWAP trend	NatureServe Factor rating	NatureServe percent change
-100 to -50%	-2	AD	-100 to -10%
-50 to -25%	-1	E	-30 to -50%
-25 to 25%	0	G	-10 to 10%
25 to 50%	1	I	>25%
50 to 100%	2	I	>25%

<u>Threats</u>

Overall Threat Impact - The overall threat impact indicates the degree to which a species is directly or indirectly threatened in the area of interest. NatureServe provides a method for combining information to characterize threats based on scope, severity, and timing. However, due to data availability, we used threat ratings from the Illinois Wildlife Action Plan (2015) to estimate threat impact based on the number of stressors believed to impact the species. In the Illinois Wildlife Action Plan, expert opinion or available literature was used to affirm if stressors in 4 categories impacted the species: habitat (extent, fragmentation, composition-structure, disturbance/hydrology, invasives/exotics, chemical pollutants, and sedimentation), community (competitors, predators, parasites-disease, and prey-food), population (genetics, dispersal, recruitment, and mortality), and direct human (structures and climate change). We rated species with 1-3 stressors as having low to high threat impact and species with 4 or more stressors as having medium to very high threat impact.

The NatureServe rank calculator facilitates the process of combining status factors to assign conservation status ranks. Factors are weighted differently depending on their influence on risk.

These weightings have been tested and deemed most reasonable (Master et al. 2012). Rarity factors are deemed to have a greater impact on risk, so they are given an overall weight of 0.7. Threats are given a weight of 0.3. Trends are added or subtracted from the combined rarity and threat score.

These status rankings are consistent and comparable because they are based on data. However, special conditions or information that is not incorporated into these rankings requires further staff review. SGCN sRanks generated by the NatureServe sRank Calculator version 3.186 and their status factor calculations were organized and presented in an online review process to the Division of Natural Heritage. Reviewers contributed additional information such as threats, EOR integrity, and additional occurrences that altered the spatial pattern designation. They were also consulted to adjust and add missing threat and short-term trend information for species that had limited documentation in the IWAP (2015). All changes were documented and required justification. Exceptions were made for special cases of EORs. Introduced populations and transient individuals such as the Gray Wolf (*Canis lupus*) were treated as SH because the ephemeral presence of an Element should not result in the designation of an EO following NatureServe protocol (NatureServe 2002). This was also to indicate the presence of the species without marking it as a conservation priority. For stocked species such as Muskellunge (*Esox masquinogy*) and Alligator Gar (*Atractosteus spatula*) we made the criteria depending on whether the stocking effort was for game species or species recovery. Stocked populations were used only if they are intended for the ecological benefit and have potential as a viable population, while game species were ranked as SU. For EORs across state borders within large rivers, a 2km buffer was made around the outer Illinois state boundary to capture records in boundary rivers, however, this prioritizes ecological completeness over state jurisdiction. sRanks for unranked breeding bird and herptile species are pending review by the Division of Natural Heritage.

Sources of bias were recognized during the sRanking process. We noticed data gaps within the past ten years in the databases we pulled species records from (Biotics, Illinois Natural Area Database, INDR ITA Database, INDR Inland Fisheries, INDR Lake Michigan, USGS Long-Term Research Monitoring Program, INHS Collections, INHS Non-Collections, INHS Lake Michigan, and INHS Long-Term Electrofishing). Many records were over ten years old and lacked consistent survey updates. The feedback we received from Heritage Biologists indicated this data gap was apparent in conservative estimates of some species' range extents. This trend was most apparent in mollusks and invertebrates, although it was seen across all taxa. Specifically, feedback from the Heritage staff indicated a need for surveys for five reptiles and amphibians, Hellbender (*Cryptobranchus alleganiensis*), Coachwhip (*Masticophis flagellum*), Mudpuppy (*Necturus maculosus*), River Cooter (*Pseudemys concinna*), and Southern Watersnake (*Nerodia fasciata*); two invertebrates and mollusks, Shawnee Rocksnail (*Lithasia obovata*) and Eryngium Stem Borer (*Papaipema eryngii*); one mammal, Franklin's Ground Squirrel (*Poliocitellus franklinii*); two birds, Yellow-crowned Night-heron (*Nyctanassa violacea*) and Osprey (*Pandion haliaetus*); and two fish, Largescale Stoneroller (*Campostoma oligolepis*) and Silver Lamprey (*Ichthyomyzon unicuspis*). Within the state of Illinois, there are systematic surveys in place for fish and mussels, but there is a difference in survey effort between other taxa. Using only presence data contributes to uncertainty with the sRanks that could be due to a lack of surveying rather than true absences and declines. Other similar projects have adjusted for this by removing taxon that were systematically overrepresented due to data entry priority

(California ACE Data, Areas of Conservation Emphasis). We suggest a unranked SGCN database for listing decisions and species tracking.

We also came across inconsistencies in Element Occurrence separation distances. Within the Biotics database, EORs for species of birds are defined using nests/breeding pairs and using a separation distance. For example, Barn owls currently have 149 EORs defined as a nest/breeding pair and 26 EORs using a 10km separation distance. This method is inconsistent with NatureServe's separation distances which do not incorporate breeding pairs and may present translation issues into the sRank calculations. For fish and mussel non-listed SGCN, we created EORs based on a recommendation of 3km separation distance for fish and 5km for mussels. These recommendations have not been reference verified by NatureServe to assess how well they represent the ecology of these taxa, as mussels rely on fish for dispersal.

The updated sRanks for SGCN, as generated by the NatureServe sRank Calculator version 3.186, were incorporated into the Biotics database during an update in June 2019. Meeting with the Heritage staff brought discussion over the future application of sRanks in listing decisions, adding species to the SGCN list, conservation efforts, and methods of updating and archiving sRank data within the Biotics database.

Objective V: Identify protected habitats for SGCN.

Job 7: Use existing data from the Illinois Natural Heritage Database and the Protected Lands Database to determine the distribution and number of protected sites occupied by SGCN.

Using data from the Natural Heritage Database and Protected Lands Database (Prairie State Conservation Coalition) and species location data, we identified the distribution and number of protected sites containing occupied habitat for Illinois' non-plant E&T species. We indicated locations of species occurrences and classified them based on each species' protection needs. These protection needs were based on whether the species' occurrences were completely outside, insufficiently within, and completely protected within protected land. Species occurrences were intersected over Illinois Nature Preserve Commission (INPC) land and then non-INPC protected land (federal, state, municipal, NGO) using GIS. A protected occurrence was counted as one EO occurring on protected land or INPC, regardless of property boundaries, so we did not count EOs stretching across multiple site boundaries as multiple protected occurrences. To avoid overestimating population occurrences densely located within the same protected area, we dissolved aquatic (non-biotics) data into EOs to have consistent separation distances (3km) that aligned with the separation distances used in the biotics database. The number of INPC and non-INPC protected occurrences for each species were summed and classified into the following protection needs, which were assigned to each species (Table 14):

- <u>Adequate Protection:</u> More than 3 locations within INPC protection
- <u>Land Acquisition Need:</u> Fewer than 3 INPC protected locations and fewer than 3 locations on non-INPC conservation land
- <u>Dedication Need:</u> Fewer than 3 INPC protected locations, but 3 or more locations on non-INPC conservation land

- <u>Information and Protection Need:</u> Fewer than 3 known locations (EORs)

We then created maps visualizing the location, extent, and distribution of species, color schemed based on their protection needs across the state (Figure 16).

A basic intersect function was used to identify the occurrence of records on protected land. This coarse analysis does not include the EOR's proximity to a protected area or EORs that occur on the edge of protected areas. Partial and full protection are counted together, and we did not consider species dispersal for EOR's on site edges for the extent of this project.

Objective VI: Identify key locations for biodiversity protection based on E&T.

Job 8: Identify key Illinois Natural Areas Inventory sites using rarity-weighted richness modeling applied to the species reviewed in Job 6.

We calculated the rarity-weighted richness of INAI sites based on listed wildlife species, all mussel and fish SGCN, and all unranked breeding bird and herptile species. Sites with high rarity-weighted richness were then ranked and identified as conservation priorities (Tables 15-18). A rarity weight of a species was calculated as the inverse of the number of INAI sites at which it occurs. The rarity-weighted richness of an INAI site was the sum of the rarity weights of all species present at the site. We evaluated species richness for three taxonomic groups; aquatic species (i.e., listed aquatic crayfish and fish and mussel SGCN), terrestrial species (i.e., mammals, birds, semi-aquatic herptiles, mollusks and invertebrates, unranked breeding bird and herptiles), and species from all taxonomic groups together. These taxonomic separations accounted for the different management approaches for terrestrial and aquatic species and habitats. For each of these groups, we calculated two rarity richness values, one including S1 and S2 (Critically Imperiled/Imperiled) species, and another including the addition of S3 species (Vulnerable) using the updated sRanks (i.e., those reviewed by the Natural Heritage staff). Since many sRanks have a range of uncertainty with species imperilment or availability of data, we decided to include the following sRanks in the rarity weighted richness analyses: **S1**, **S1?**, **S1S2**, **S2**, **S2?**, **S2S3**, **S3**, and **S3?**. These rankings reflect species of critically imperiled to vulnerable status.

In addition to absolute rarity weighted richness (sums of rarity weights), we have calculated relative rarity weighted richness and percentile ranks to facilitate comparison across all sites statewide (Tables 15-18). Relative rarity weighted richness values were used to build all associated maps in GIS (Figures 17, 19, 20, and 23). Rarity weighted richness of sites was also ranked relative within natural divisions (comparison across all sites within each natural division). The Natural Divisions are geographic regions within the state that represent distinct climates, substrates, and landscapes that support similar compositions of biota. By accounting for highly ranked sites within each Natural Division, we incorporated priorities that equally represented the full diversity of Illinois ecoregions that may have otherwise been overlooked when comparing sites across the whole state.

Rarity weighted richness was also assessed at the landscape scale using 10 km^2 hexagonal cells across the state of Illinois. By ranking these cells, we were able to visualize species occurrences that did not fall within conservation site boundaries. This provided a reference to how well these conservation sites captured the richness of rare species across the landscape. Rarity weights were calculated for the same species categories as the INAI calculations using the inverse of the number of hexagons they occurred in. Due to a large number of cells, this was done by exporting species and cell spatial joins from ArcGIS into csv format and creating a binary matrix of presence/no data (1/0) for each unique species occurrence at a cell. These matrices were imported into R and the Tidyverse package was used to calculate the rarity weights for each species. The rarity weights of each species within each cell were summed to generate absolute rarity richness sums. The relative rarity, rarity rank, and percentile were calculated for each hexagon cell and the relative rarity was used to generate maps.

The maps identify key INAI sites and areas across the landscape within state of Illinois for conservation efforts. Rarity ranks for state-listed species have been calculated and mapped for comparisons statewide and within Natural Divisions, as well as sub-regional management units (Natural Heritage Districts and Regions, and Natural Area Preservation Specialist boundaries). Sub-regional ranks were produced from statewide rarity weighted richness in order to better display regional conservation efforts at sub-regional levels. Rarity ranks for unranked breeding birds and herptiles have been calculated and mapped for comparisons statewide and within Natural Divisions. Jenks natural breaks were used to generate more conservative maps indicating priority sites by relative rarity richness. Natural breaks contained the 90th and 95th percentile of sites in the highest break, ranging in value from 0.4-1.0 in relative rarity richness (0-1 scale). This resulted in up to 8 sites being identified as having the highest rarity richness statewide. For Natural Division relative rarity richness, the highest break once again captured the 90th and 95th percentile of sites, this time with 6 to 21 sites being identified as the highest rarity richness statewide.

An integrated ranking was then developed to represent all sites that were highly prioritized at the statewide and natural division scales. This integrated ranking was based on the higher relative rarity weighted richness value, whether at the state or natural division scale, assigned to each INAI site. This integrated ranking thus incorporated more high-ranking sites (15-22 sites) with relative richness values ranging between 0.8-1.0 in the highest natural break. This integrated ranking is therefore a more liberal prioritization of sites and facilitates more equal representation of natural statewide diversity.

When calculating aquatic rarity, the analysis did not include aquatic taxa other than fish and mussels. This may be important to note when considering the ranks as representative of the entire aquatic community at each site.

Job 9: Identify key Biologically Significant Stream segments using rarity-weighted richness modeling applied to species of fish and mussels reviewed in Job 6.

We calculated the rarity-weighted richness of BSS segments based on mussel and fish SGCN as well as listed aquatic crayfish. BSS segments were similarly ranked as with the INAI sites, with the segments with high rarity-weighted richness ranked as top conservation priorities (Tables 19 and 20). A rarity weight of a species was calculated as the inverse of the number of BSS segments at which it occurs. The rarity-weighted richness of an BSS segment was the sum of the rarity weights of all the aquatic species present at the segment. We grouped aquatic species into two rarity richness values, one including S1 and S2 (Critically Imperiled/Imperiled) species, and another including the addition of S3 species (Vulnerable) using the updated sRanks. Since many sRanks have a range of uncertainty associated with species imperilment or availability of data, we decided to include the following sRanks in the rarity weighted richness analyses: **S1**, **S1?**, **S1S2**, **S2**, **S2?**, **S2S3**, **S3**, and **S3?**. When calculating aquatic rarity, the analysis did not include aquatic taxa other than fish, mussels, and a few crayfish. This may be important to note when considering the ranks as representative of the entire aquatic community at each site.

In addition to absolute rarity weighted richness (sums of rarity weights), we have calculated relative rarity weighted richness and percentile ranks to facilitate comparison across all segments statewide. Relative rarity weighted richness values were used to build all associated maps in GIS. Rarity weighted richness of segments was also ranked relative within ecological drainage units (EDU) (comparison across all segments within each EDU). By accounting for highly ranked segments within each EDU, we incorporated priorities that equally represented the full diversity of Illinois ecoregions that may have otherwise been overlooked when comparing segments across the whole state.

Rarity weighted richness was also assessed at the landscape scale using a stream-wide analysis comparable to the hexagonal cells. Illinois flowlines data from the National Hydrology Database (NHDPlusV2) was filtered to exclude pipelines, coastline, or segments without a stream name (GNIS Name). Rarity weights were assigned to each species by spatially joining occurrences data to sites, cells, and flowlines in GIS. By ranking all flowlines, we were able to visualize species occurrences that did not fall within conservation site boundaries. This provided a reference of how well these conservation sites captured the richness of rare species across the landscape. Rarity weights were calculated for the same species categories as the BSS calculations using the inverse of the number of flowline reaches they occurred in. Due to a large number of cells, this was done by exporting species and flowline spatial joins from ArcGIS into csv format and creating a binary matrix of presence/no data (1/0) for each unique species occurrence at a reach. These matrices were imported into R and the Tidyverse package was used to calculate the rarity weights for each species. The rarity weights of each species within each reach were summed to generate absolute rarity richness estimates. The relative rarity, rarity rank, and percentile were calculated for each flowline reach and the relative rarity was used to generate maps.

While calculating rarity weighted richness for BSS, we encountered issues with aligning species occurrence records with streamline segments. The streamline data did not accurately represent the wetted width that was present during the times of surveys for the aquatic species observation data. Some observational data was captured along islands, sloughs or side channels of main rivers, which were not represented in streamline data. We buffered streams based on their stream order with orders 1-4 buffered by 40m on each side (80m total) and orders 5-12 buffered by 60m (120m total). The stream order attributes were referenced from the NHD plus flowline data which is broken down into smaller stream segments than the BSS data. Therefore, multiple orders were found within single BSS segments. We used the highest order found within the BSS segment to determine how it would be buffered. We wanted to include side channels in the main flows of rivers even if their reach IDs were different. Flowlines are also not necessarily the centerline of each stream, so even buffers on either side of the flowlines still do not accurately represent the actual inundated area.

For occurrences that were still outside buffer boundaries and had the sampling river name in the attributes, the Snap editing tool in ArcMap 10.6.1 was used to snap the occurrence points to the corresponding stream segment. These included the Mississippi, Ohio, Illinois, Kaskaskia, Rock Rivers. The Wabash River was not included in the statewide stream analysis as it was not within the Illinois NHD flowline data.

The resulting maps identify key Illinois BSS segments and streams to be prioritized for conservation efforts. Rarity ranks have been calculated and mapped for comparisons statewide and within Ecological Drainage Units, as well as sub-regional management units (Natural Heritage Districts and Regions, and Natural Area Preservation Specialist boundaries). Sub-regional ranks were produced from statewide rarity weighted richness in order to better display regional conservation efforts at sub-regional levels. Jenks natural breaks were used to generate more conservative maps indicating priority sites by relative rarity richness. Natural breaks contained the 90^{th} and 95^{th} percentile of sites in the highest break, ranging in value from 0.4-1.0 in relative rarity richness (0-1 scale). This resulted in up to 8 sites being identified as having the highest rarity richness statewide. For Natural Division relative rarity richness, the highest break once again captured the 90^{th} and 95^{th} percentile of sites, this time with 6 to 21 sites being identified as the highest rarity richness statewide.

An integrated ranking was then developed to represent all segments that were highly prioritized at the statewide and EDU scales. This integrated ranking was based on the higher relative rarity weighted richness value, whether at the state or EDU scale, assigned to each stream segment. This integrated ranking incorporated more high-ranking sites with relative richness values ranging between 0.8-1.0 in the highest natural break. This integrated ranking is therefore a more liberal prioritization of sites and facilitates more equal representation of natural statewide diversity.

Objective VII. Complete Reporting requirements.

Job 10: Prepare reports and manuscripts.

All quarterly reports (Jan-Mar, April-June, July-Sept, Oct-Dec) were written and submitted from the start of the project (June 2017) until work was completed in June 2021. Annual reports on the progress of the project were submitted for all years the project was active (2017-2020) and a final report that summarized the completed deliverables, methods, and figures for each job was written with the conclusion of the project in June 2021.

Several opportunities for outreach reporting were pursued during the project. A poster on the sRanks of Illinois Fish SGCN was presented at a regional fisheries meeting. A webinar on using sRanks and rarity weighted richness for conservation prioritization was held for the Heritage staff and biologists. We presented and held a workshop on the implications of changing sRanks at the Natural Heritage Division Meeting. There, we specifically discussed conservation implications for species and natural communities that had seen negative changes in sRank. A presentation on the data bias within the development and application of these sRanks and Rarity Ranks was given at NatureServe's 2019 Midwest Region Heritage Forum to initiate discussion on how to approach these common issues with conservation status assessments and prioritization. A poster on the outputs of T-115 and prioritizing conservation work using regional goals and support from quantitative evidence was presented at the 2019 Natural Areas Conference (Figure 27). The updated sRanks for SGCN and natural community types were incorporated into the Biotics database during an update in June 2019. Discussion with Heritage staff initiated discussion on the future application of sRanks in listing decisions, adding species to the SGCN list, conservation efforts and methods of updating and archiving sRank data within the Biotics database.

References

Anderson, M.G., M. M. Clark, M.W. Cornett, K.R. Hall, A. Olivero Sheldon, J. Prince. 2018. Resilient sites for terrestrial conservation in the great lakes and tallgrass prairie. The Nature Conservancy, Eastern Conservation Science and North America Region.

Baker, M. E. and R. S. King. 2010. A new method for detecting and interpreting biodiversity and ecological community thresholds. Methods in Ecology and Evolution. 1, 25-37.

Baker, M. E., R. S. King, and D. Kahle. 2019. TITAN2: Threshold indicator taxa analysis. R package version 2.4. https://CRAN.R-project.org/package=TITAN2

Carr, L.W. and L. Fahrig. 2001. Effect of road traffic on two amphibian species of differing vagility. Conservation Biology. 15:4. Pp 1071-1078.

Clevenger, A.P., B. Chruszcz, and K.E. Gunson. 2003. Spatial patterns and factors influencing small vertebrate fauna road-kill aggregations. Biological Conservation. 109. Pp 15-26.

The Conservation Fund. 2014. Midwest Wind Energy MSHCP Green Infrastructure Network Design Protocol.

Crawford, S., G. Whelan, D. M. Infante, K. Blackhart, W. M. Daniel, P. L. Fuller, T. Birdsong, D. J. Wieferich, R. McClees-Funinan, S. M. Stedman, K. Herreman, and P. Ruhl. 2016. Through a fish's eye: The status of fish habitats in the United States 2015. National Fish Habitat Partnership.

Decker, K.L., A. Pocewicz, S. Harju, M. Holloran, M. M. Fink, T. P. Toombs, and D. B. Johnston. 2017. Landscape disturbance models consistently explain variation in ecological integrity across large landscapes. Ecosphere. 8:4. e01775.

Faber-Langendoen, D. J. Nichols, L. Master, K. Snow, A. Tomaino, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, A. Teucher, and B. Young. 2012. NatureServe conservation status assessments: Methodology for Assigning ranks. NatureServe, Arlington, VA.

Houlahan, J.E. and C. S. Findlay. 2003. The effects of adjacent land use on wetland amphibian species richness and community composition. Canadian Journal of Fisheries and Aquatic Sciences 60. Pp 1078–1094.

Korose, C.P., A. G. Louchios, and S. D. Elrick. 2009. The proximity of underground mines to urban and developed lands in Illinois-circular 575. Illinois State Geological Survey.

Natural Areas Program. 2006. The standards and guidelines for the Illinois Natural Areas

Inventory. Natural Areas Program, Division of Natural Heritage, Illinois Department of Natural Resources, Springfield, Illinois.
NatureServe. 2015. NatureServe Conservation Status Assessments: Rank Calculator Version 3.185. NatureServe, Arlington, VA. Online at http://www.natureserve.org/conservation-tools/conservation-rank-calculator
Master, L. L., D. Faber-Langendoen, R. Bittman, G. A. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. NatureServe conservation status assessments: Factors for evaluating species and ecosystem risk. NatureServe, Arlington, VA.
McGarigal, K., B. W. Compton, S. D. Jackson, E. Plunkett, K. Rolih, T. Portante, and E. Ene. 2011. Conservation assessment and prioritization system (CAPS) statewide Massachusetts assessment: November 2011. Landscape Ecology Program, Department of Environmental Conservation, University of Massachusetts, Amherst.
Midwest Green Infrastructure Network. The Conservation Fund, 2014. Using ArcGIS Version 10.1. Redlands, CA: Esri. 2013.
Reijnen, R. R. Foppen, C.T. Braak, and J. Thissen. 1995. The effects of car traffic on breeding bird populations in woodlands. III. Reduction of density in relation to the proximity of main roads. Journal of Applied Ecology. 32, pp 187-202.
Sass, L., L. C. Hinz, J. Epifanio, A. M. Holtrop. 2010. Developing a multimetric habitat index for wadeable streams in Illinois. Illinois Natural History Survey Technical Report 2010(21).
Sgambat, J.P., E. A. LaBella, and S. Roebuck. 1980. Effects of underground coal mining on ground water in the eastern United States, Volume 1. Industrial Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency. 1-183.
Stein, B. A., L. S. Kutner, and J. S. Adams (editors). 2000. Precious heritage: The status of biodiversity in the United States. New York: Oxford University Press. 416 pages.
United States Environmental Protection Agency. 2000. Abandoned Mine Sites Characterization and Cleanup Handbook.

Figures

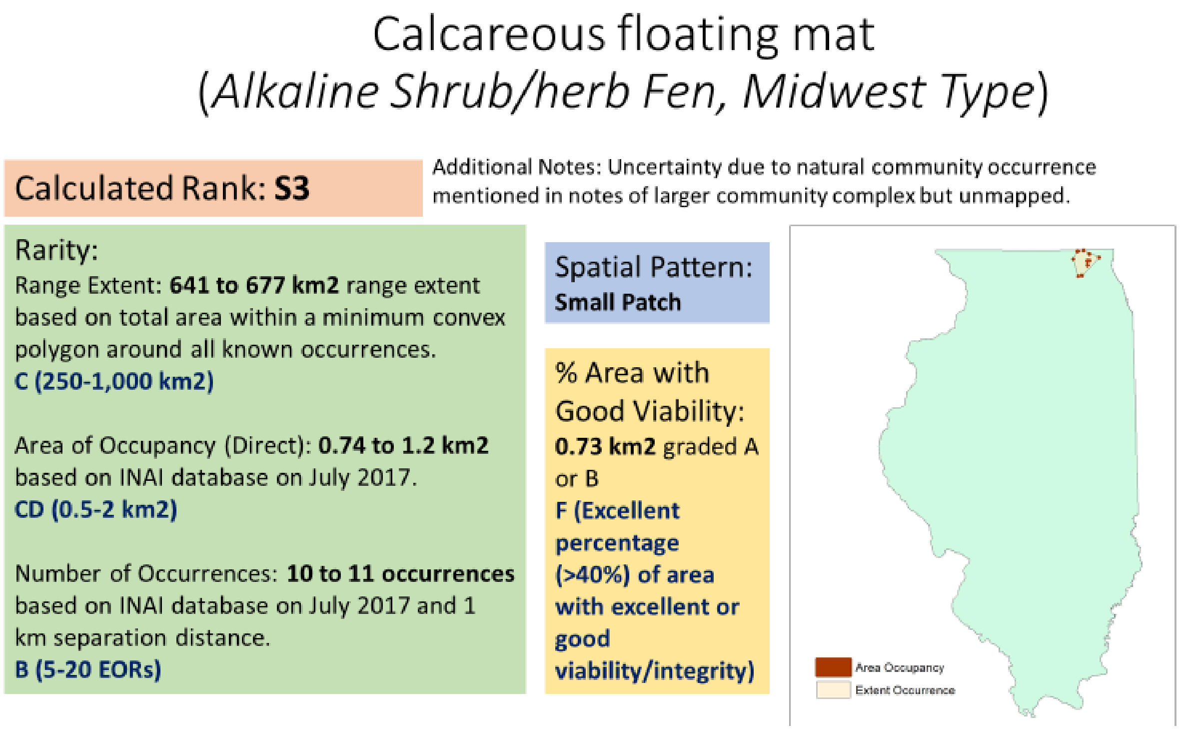

Figure 1. Natural Community sRank factor sheet used to provide insight into the calculation process for Heritage reviewers. Lists the factors used in the NatureServe calculator to determine sub-national conservation statuses.

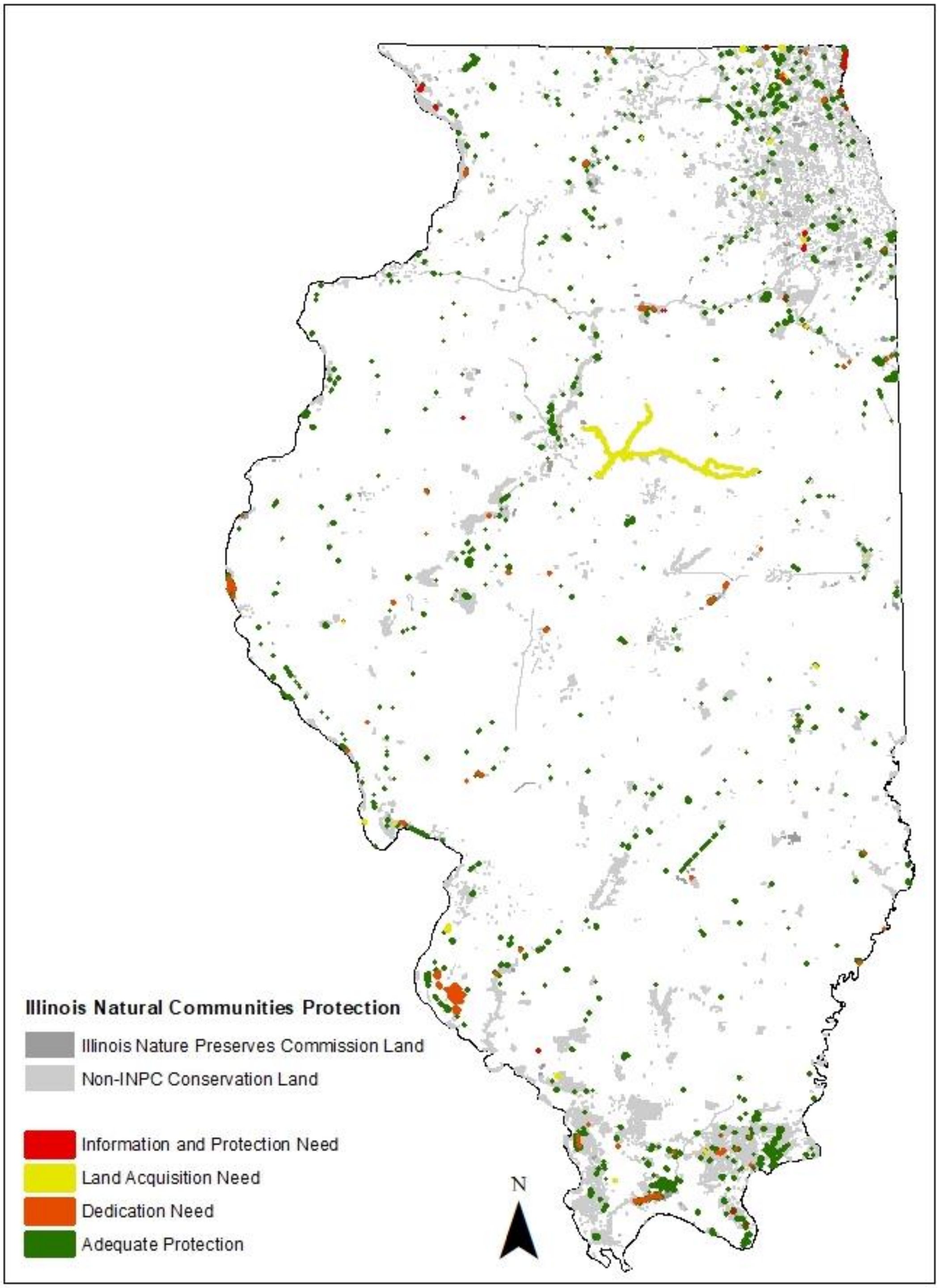

Figure 2. Natural community type occurrences in Illinois color coded by their associated Protection Need category. Areas in red, yellow, and orange are key locations for land dedication or purchasing in order to better protect under-protected communities. Categories are defined as followed: <u>Information and Protection Need</u>- Fewer than 3 known locations, <u>Dedication Need</u>- Fewer than 3 locations on Nature Preserves, but additional locations on non-INPC conservation land, <u>Land Acquisition Need</u>- Fewer than 3 locations on Nature Preserve land and fewer than 3 locations on other conservation land, <u>Adequate Protection</u>- More than 3 locations within Illinois Nature Preserves.

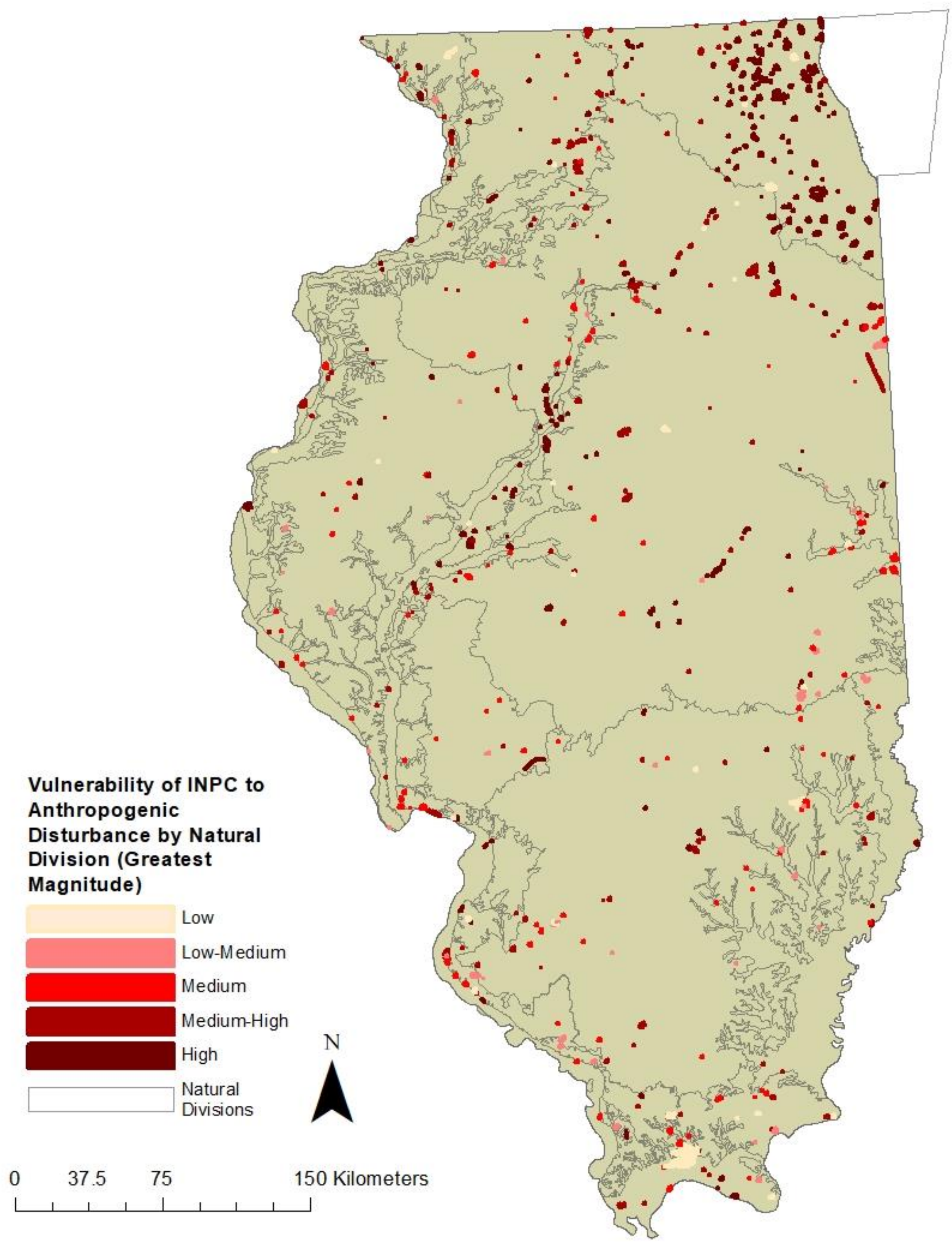

Figure 3. Relative vulnerability of INPC sites within Natural Divisions. Vulnerability is quantified as the highest magnitude present across the threats at a site. All threat variables were rescaled on a 0-10 scale based on the percentile of their values at each site compared to all values for that threat across the state, 10 being all threat values that were greater than 90% of all other occurrences of that threat across the state and 0 being absence of the threat. These percentile rescaled values were used to determine the magnitude of effect of each threat at a site.

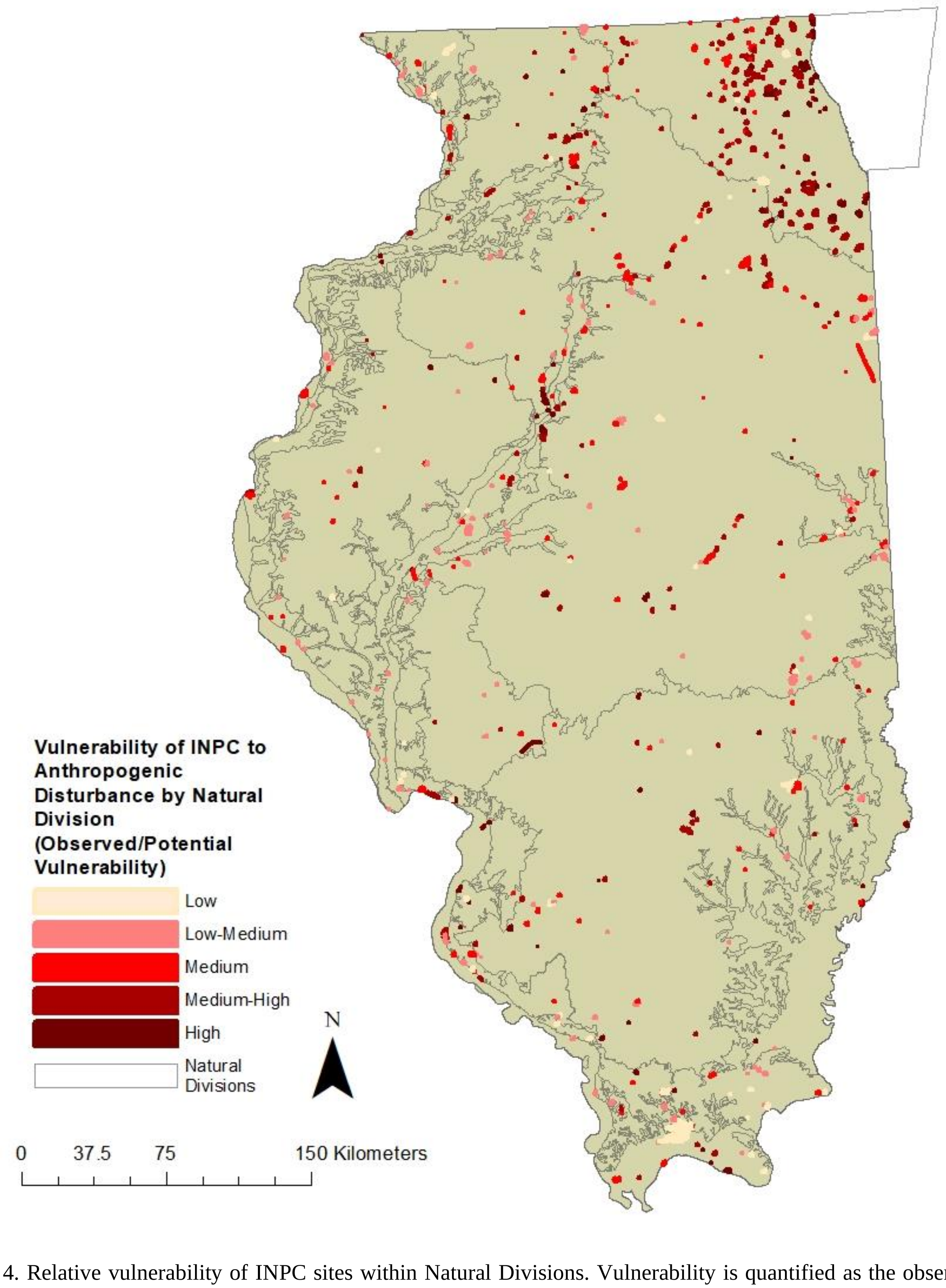

Figure 4. Relative vulnerability of INPC sites within Natural Divisions. Vulnerability is quantified as the observed vulnerability of the site compared to its potential vulnerability (observed/potential). Observed vulnerability sums the magnitude rescaled threat values at the site and subtracts resiliency variables. Potential vulnerability sums the threat values at the site and subtracts resiliency variables, but it rounds all threat variables to their maximum magnitudes (values of 10).

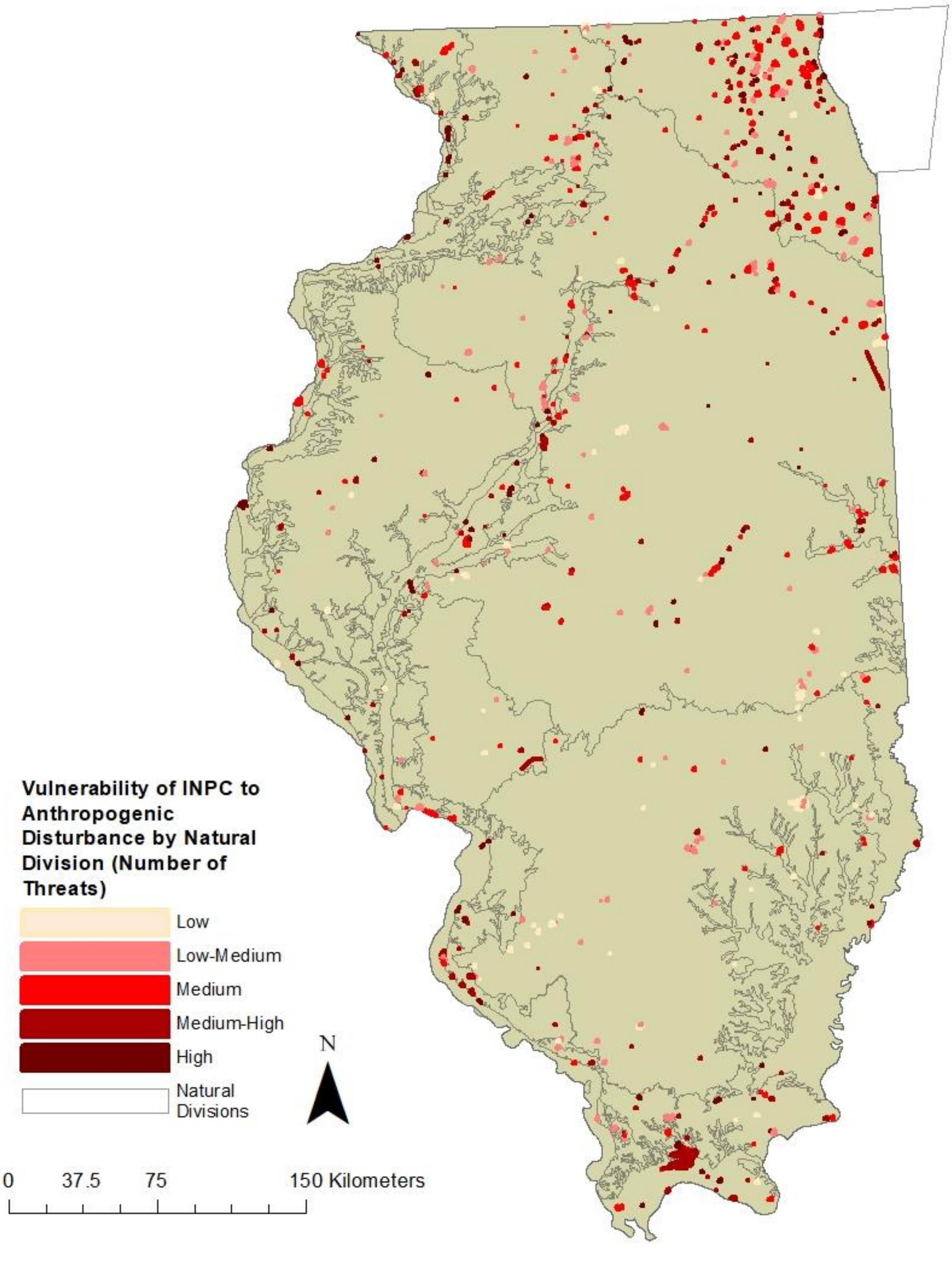

Figure 5. Relative vulnerability of INPC sites within Natural Divisions. Vulnerability is quantified as the number of threats present at a site divided by the total number of threats included in the analysis (20).

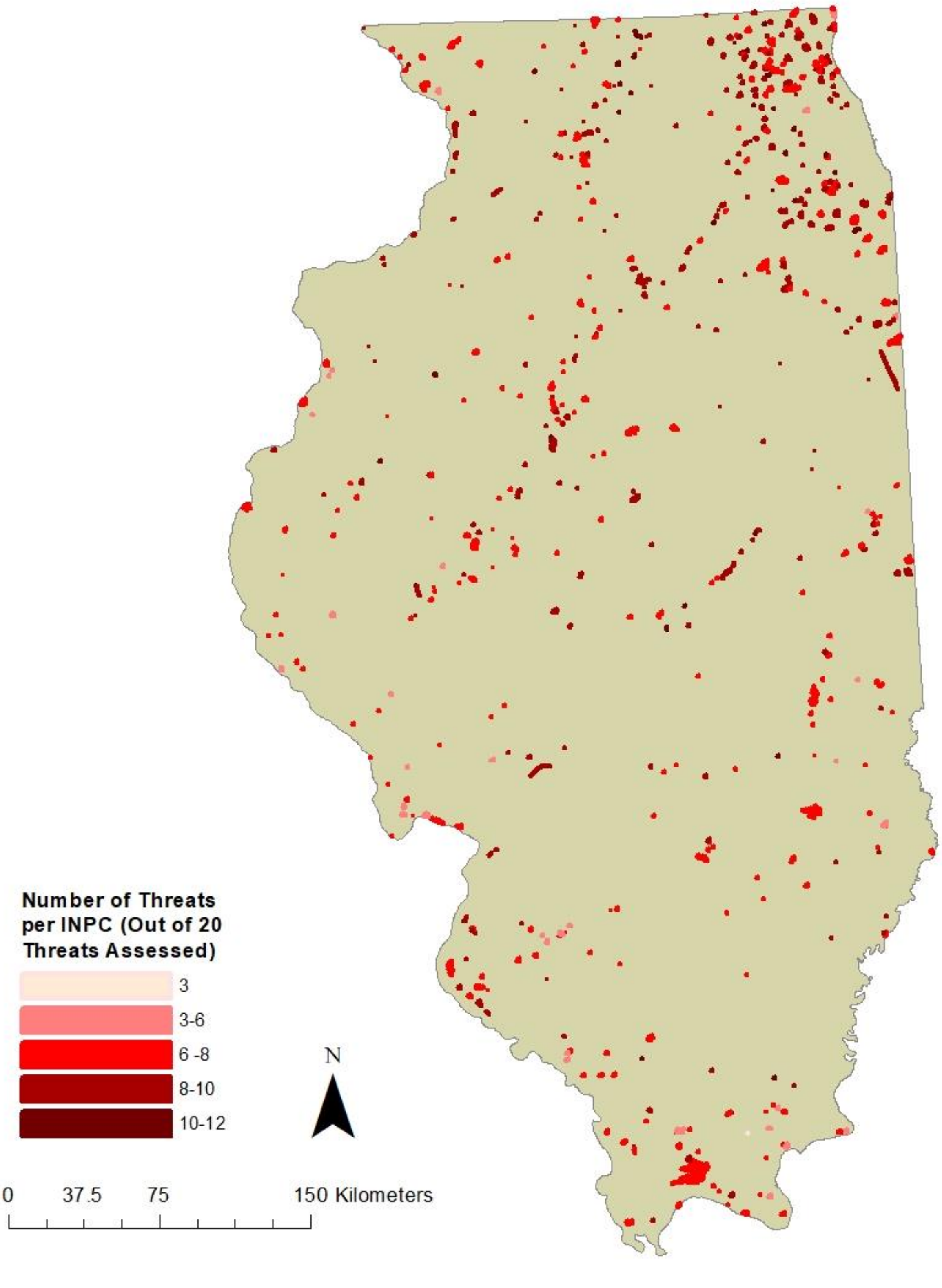

Figure 6. A comparison of vulnerability across INPC sites statewide based on the number of threats at each site.

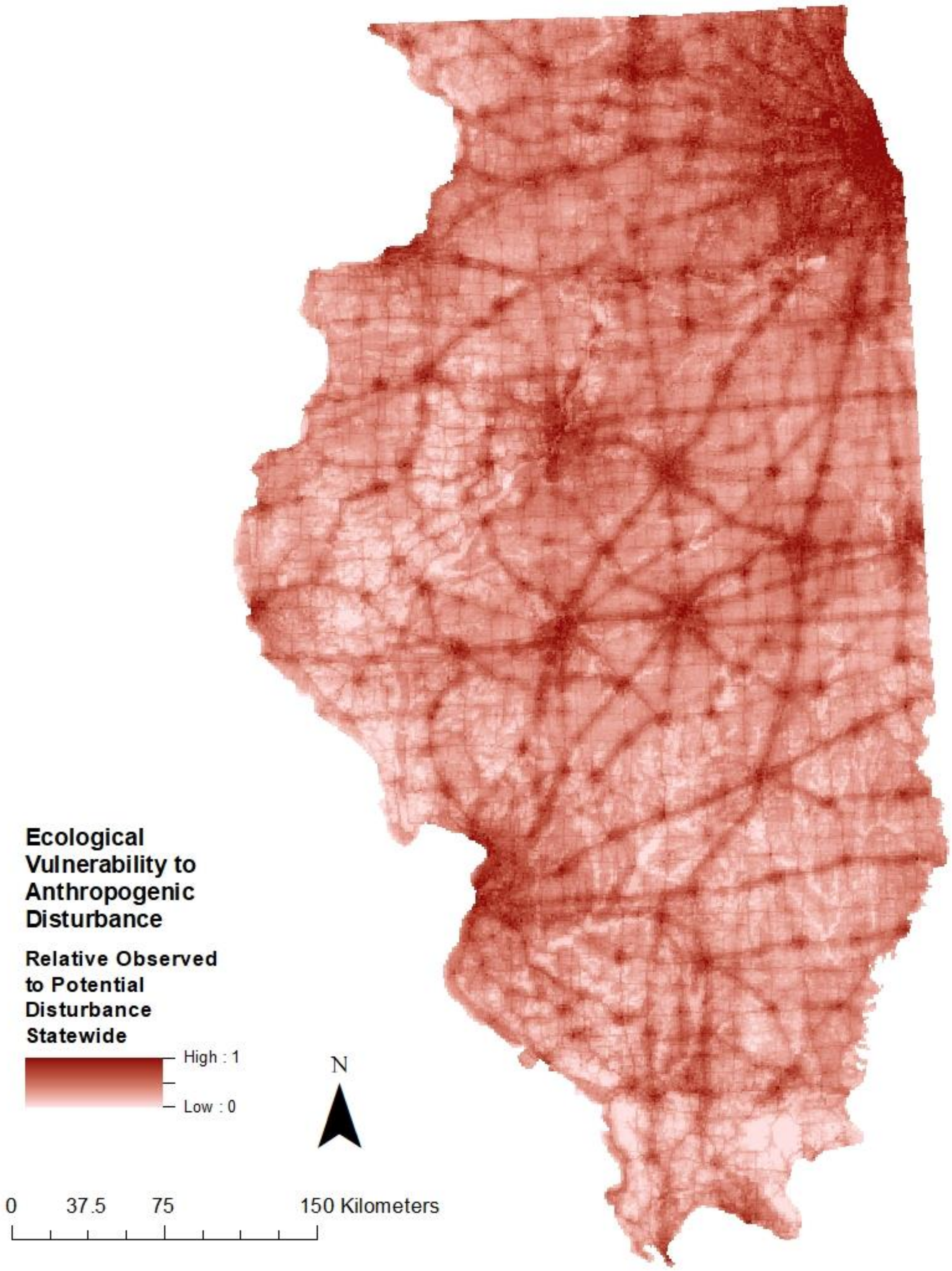

Figure 7. Relative vulnerability of Illinois lands to anthropogenic disturbances statewide. This landscape scale vulnerability analysis map is using the observed/potential vulnerability quantification. This is the observed vulnerability of the unit compared to its potential vulnerability. Observed vulnerability sums the magnitude rescaled threat values at the site and subtracts resiliency variables. Potential vulnerability sums the threat values at the site and subtracts resiliency variables, but it rounds all threat variables to their maximum magnitudes (values of 10).

The landscape scale vulnerability analysis for Illinois lands (terrestrial) used 1 km^2 grid cell units to summarize threat and resiliency variables.

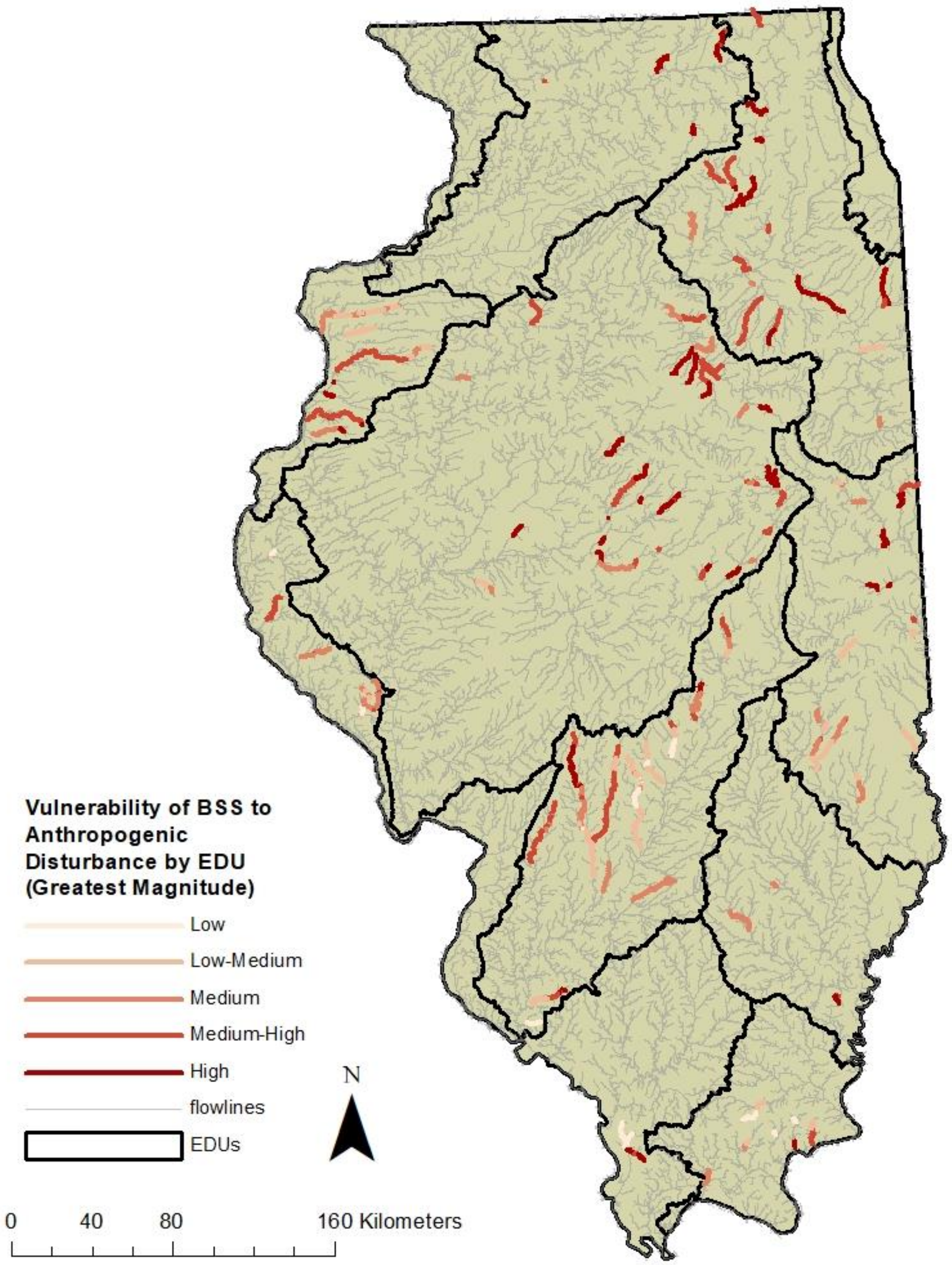

Figure 8. Relative vulnerability of BSS segments within Ecological Drainage Units. Vulnerability is quantified as the highest magnitude present across the threats at a segment. All threat variables were rescaled on a 0-10 scale based on the percentile of their values at each segment compared to all values for that threat across the state, 10 being all threat values that were greater than 90% of all other occurrences of that threat across the state and 0 being absence of the threat. These percentile rescaled values were used to determine the magnitude of effect of each threat at a segment.

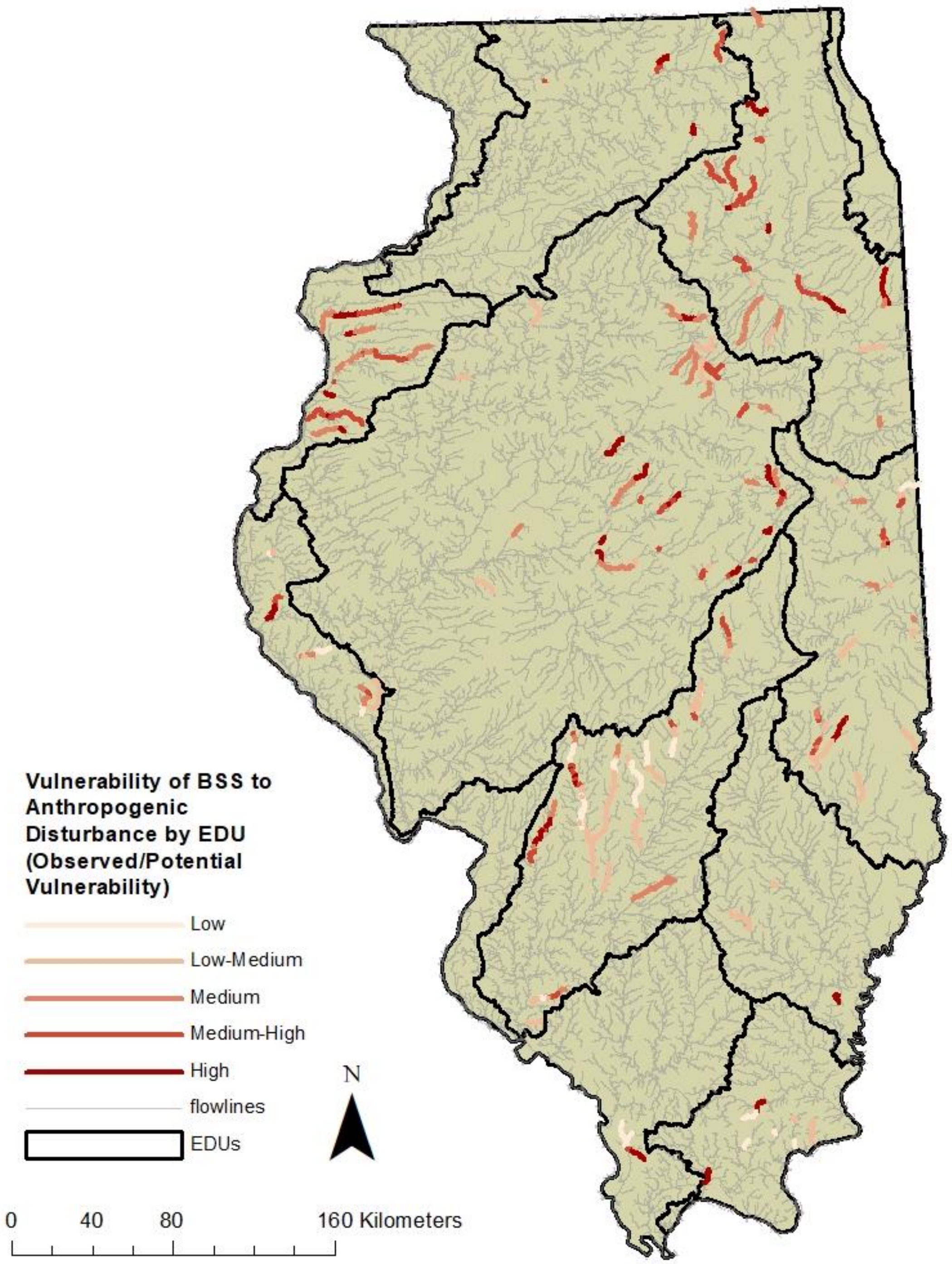

Figure 9. Relative vulnerability of BSS segments within Ecological Drainage Units. Vulnerability is quantified as the observed vulnerability of the segment compared to its potential vulnerability (observed/potential). Observed vulnerability sums the magnitude rescaled threat values at the segment and subtracts resiliency variables. Potential vulnerability sums the threat values at the segment and subtracts resiliency variables, but it rounds all threat variables to their maximum magnitudes (values of 10).

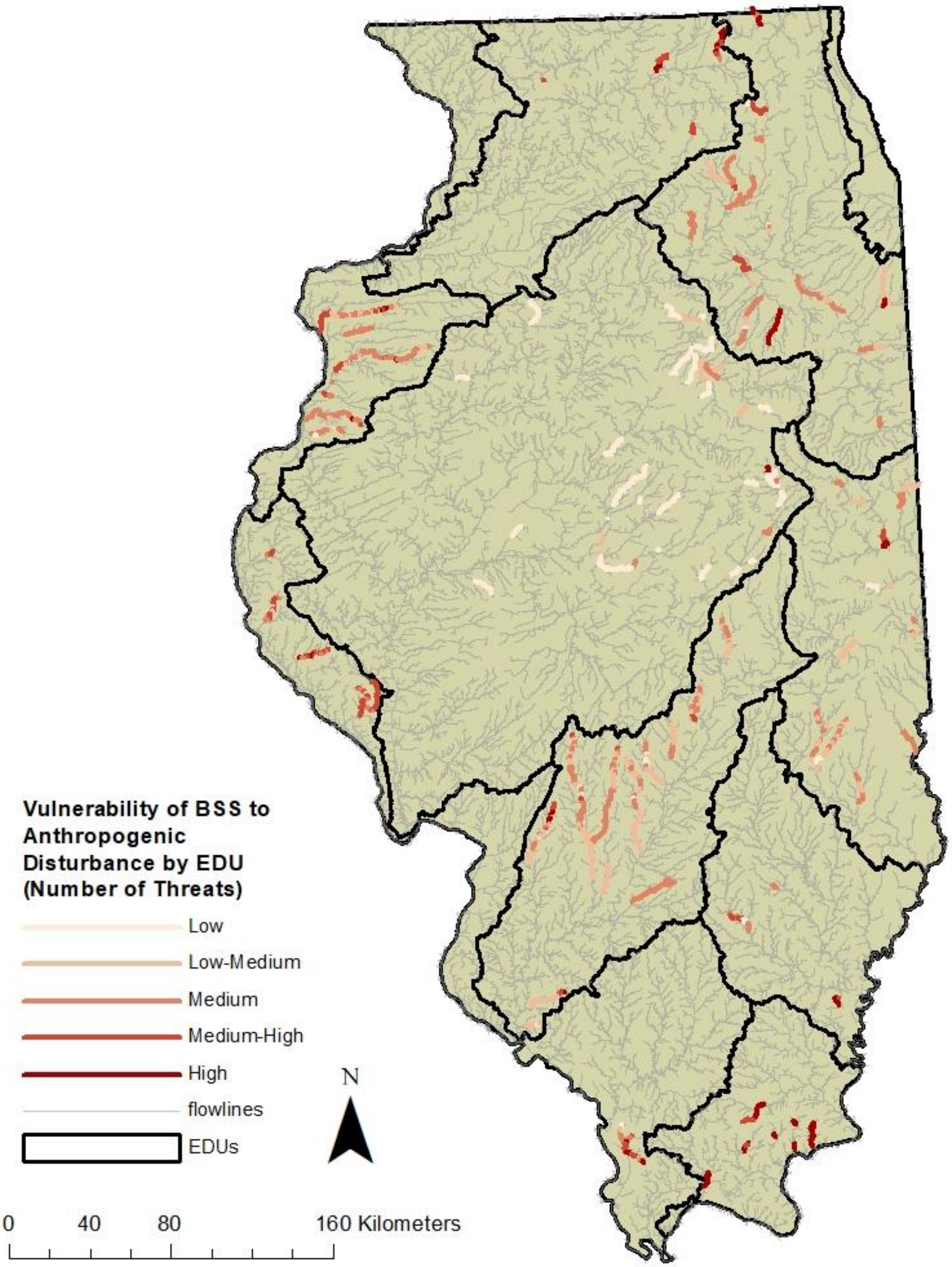

Figure 10. Relative vulnerability of BSS segments within Ecological Drainage Units. Vulnerability is quantified as the number of threats present at a segment divided by the total number of threats included in the analysis (20).

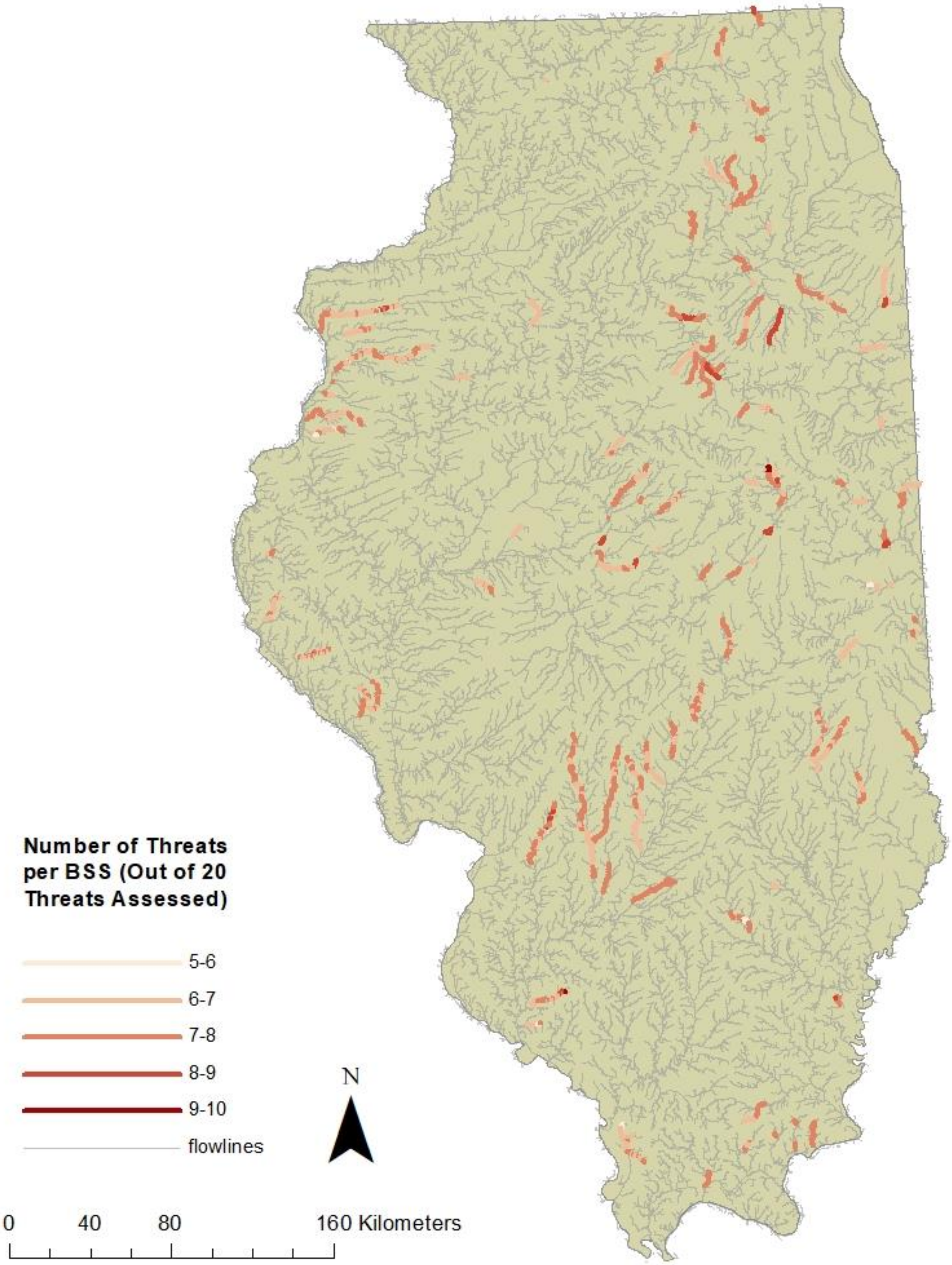

Figure 11. A comparison of vulnerability across BSS segments statewide based on the number of threats at each segment.

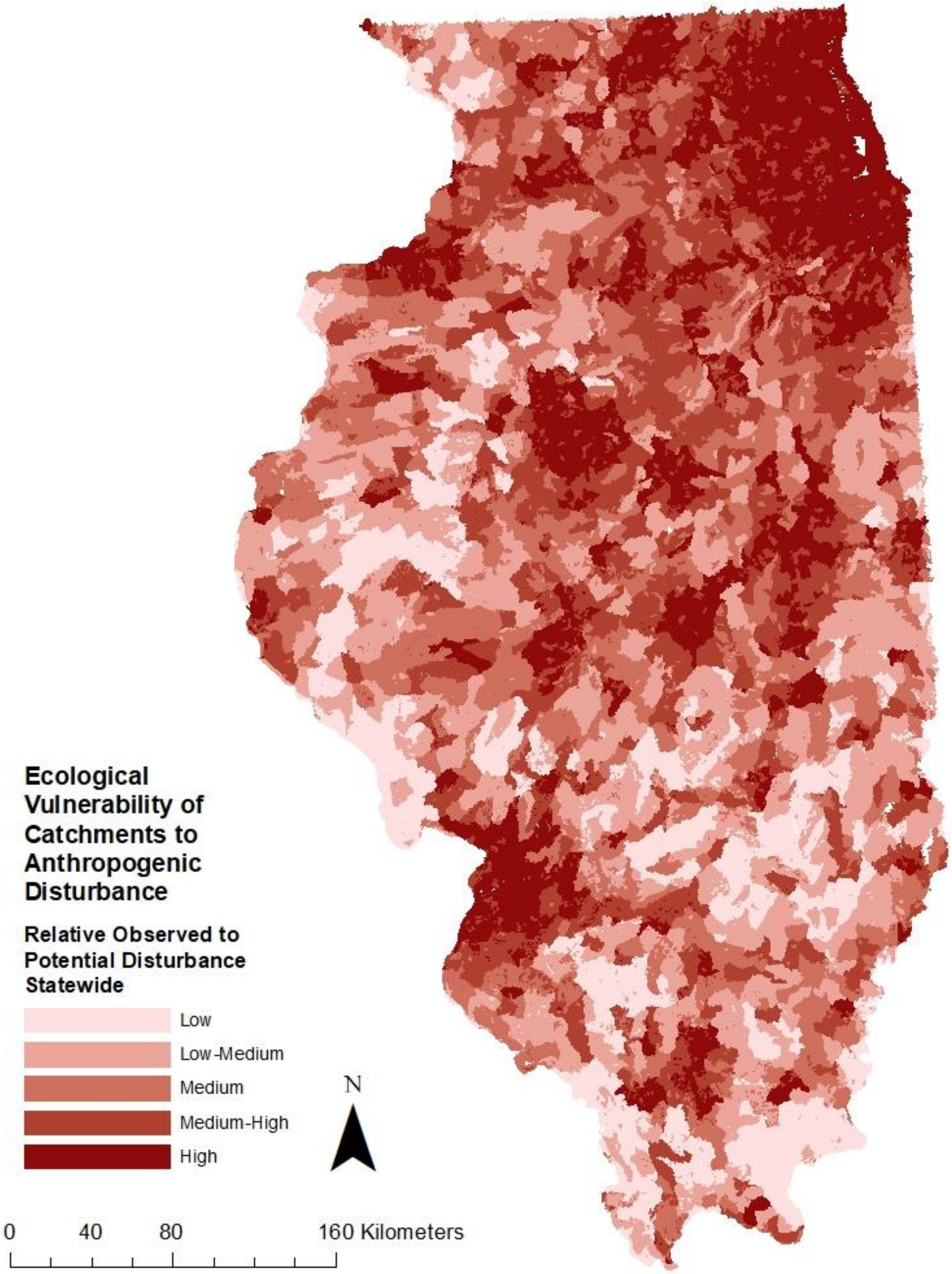

Figure 12. Relative vulnerability of Illinois watersheds to anthropogenic disturbances statewide. This landscape scale vulnerability analysis map is using the observed/potential vulnerability quantification. This is the observed vulnerability of the unit compared to its potential vulnerability. Observed vulnerability sums the magnitude rescaled threat values at the site and subtracts resiliency variables. Potential vulnerability sums the threat values at the site and subtracts resiliency variables, but it rounds all threat variables to their maximum magnitudes (values of 10).

The landscape scale vulnerability analysis for Illinois watersheds (aquatic) used local hydrologic catchments to summarize threat and resiliency variables.

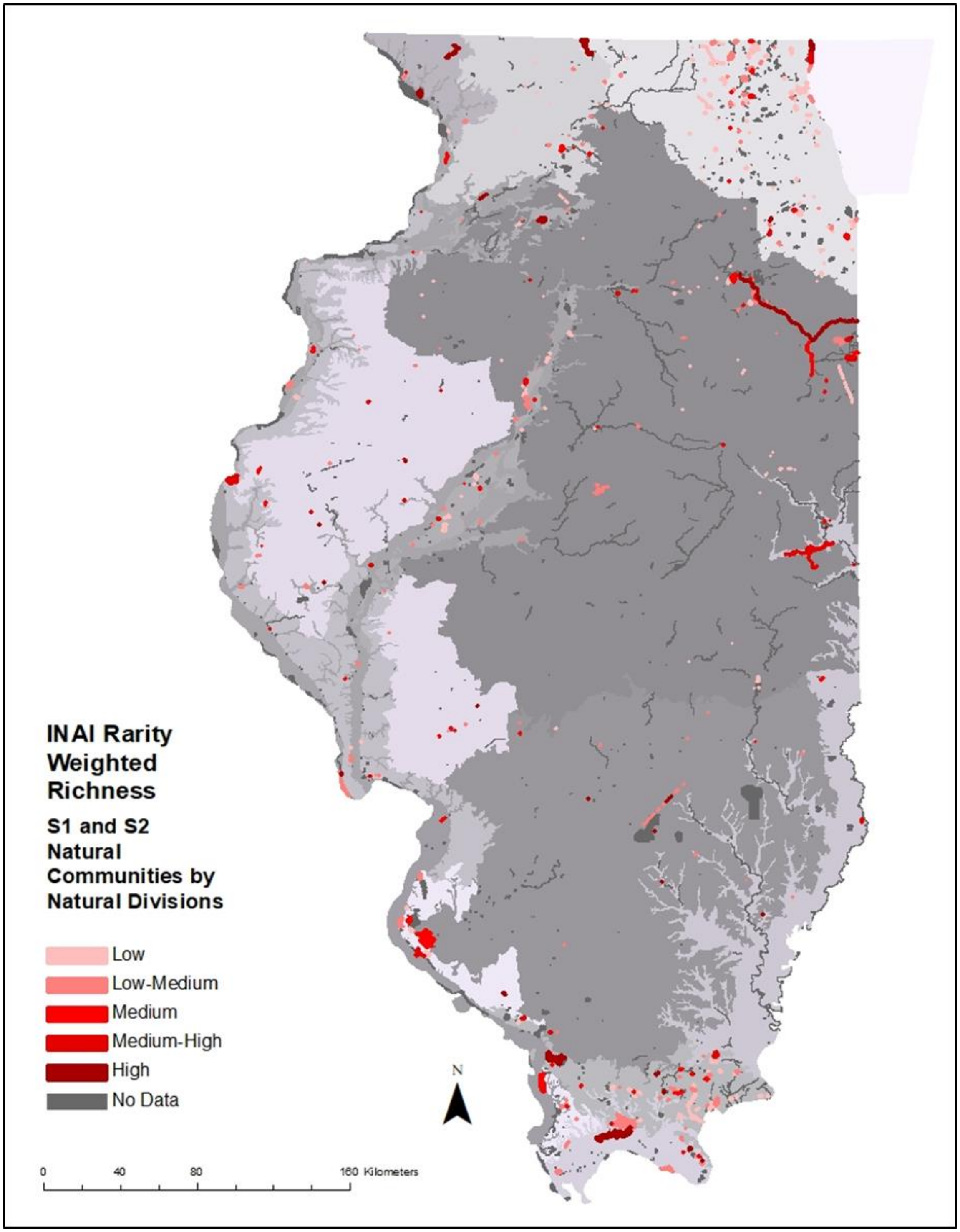

Figure 13. INAI sites grouped from lowest to highest conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) natural community types. High priority sites have the highest rarity weighted richness values relative within each Natural Division across the state.

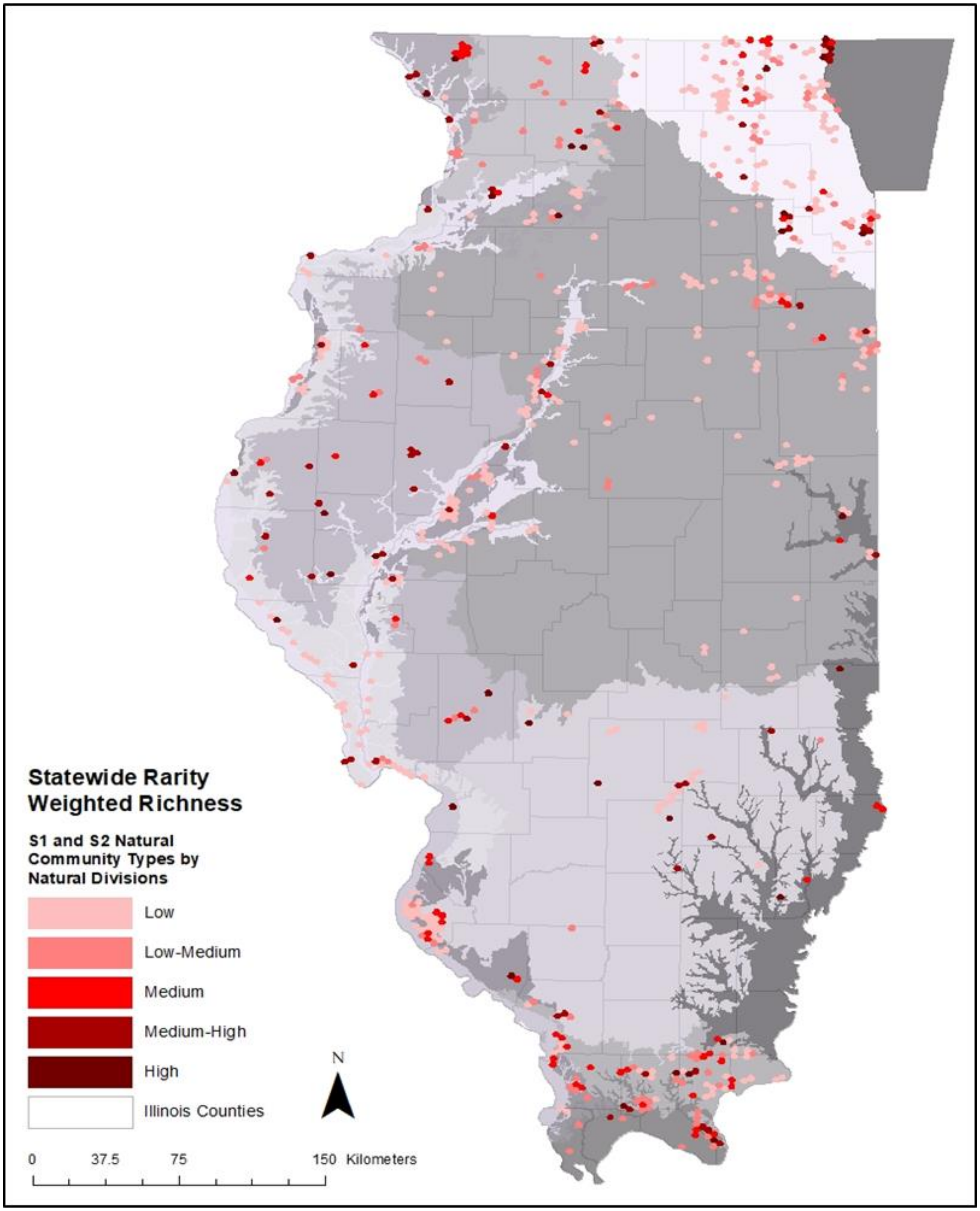

Figure 14. Landscape analysis ranking 10 km2 hexagonal cells from lowest to highest conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) natural community types. High priority areas (hotspots) have the highest rarity weighted richness values relative within each Natural Division across the state.

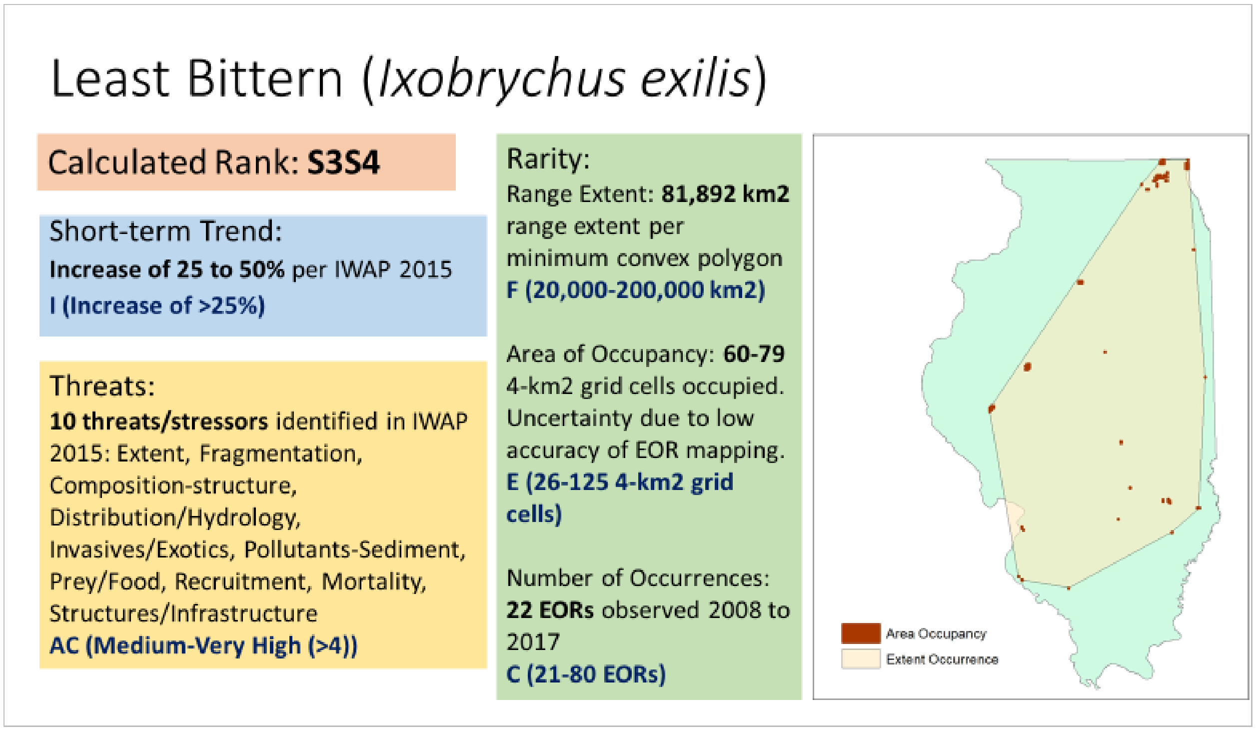

Figure 15. Species sRank factor sheet used to provide insight into the calculation process for Heritage reviewers. Lists the factors used in the NatureServe calculator to determine sub-national conservation statuses.

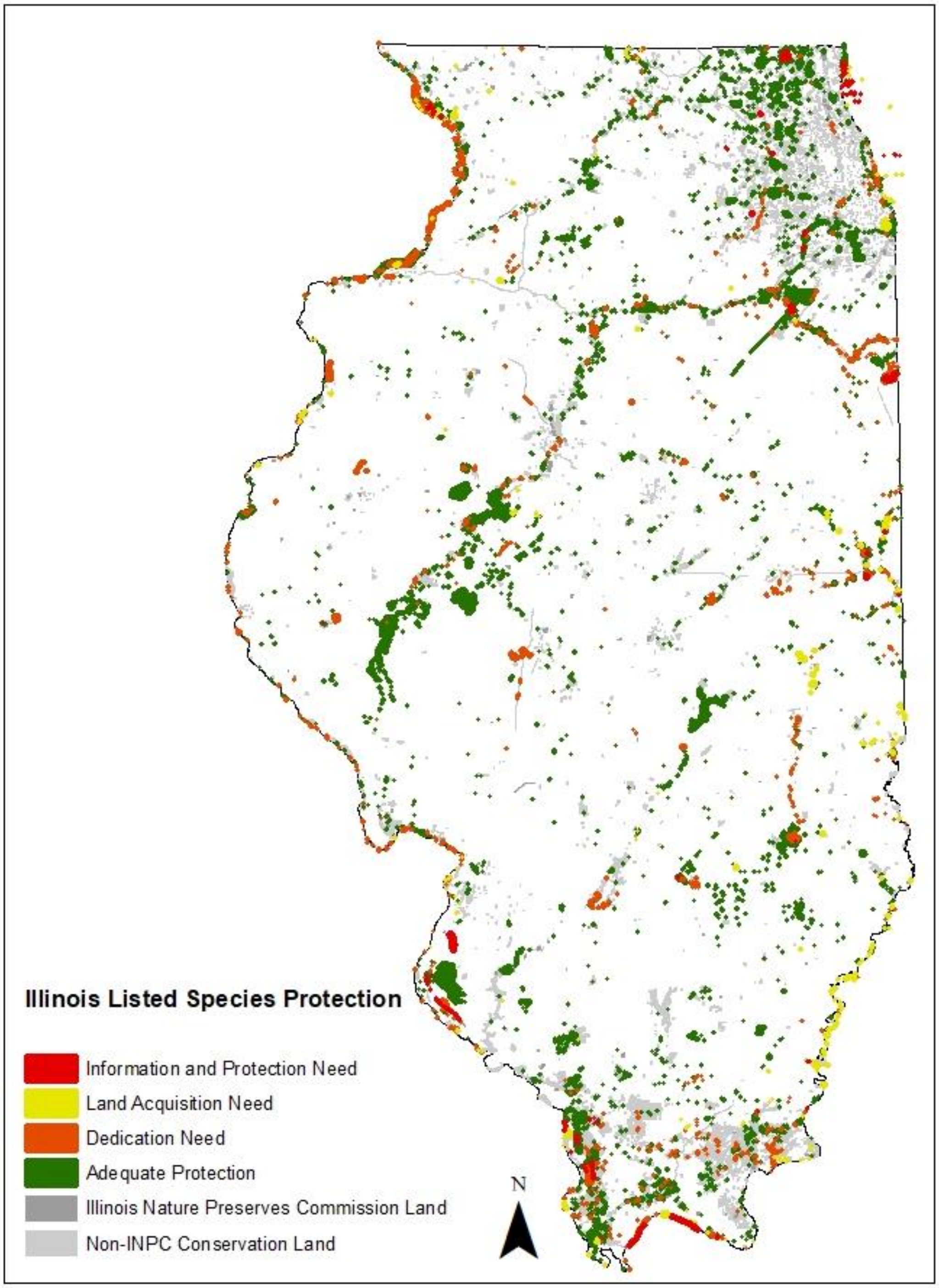

Figure 16. State listed wildlife species occurrences in Illinois color coded by their associated Protection Need category. Areas in red, yellow, and orange are key locations for land dedication or purchasing in order to better protect habitat for under-protected species. Categories are defined as followed: Information and Protection Need- Fewer than 3 known locations, Dedication Need- Fewer than 3 locations on Nature Preserves, but additional locations on non-INPC conservation land, Land Acquisition Need- Fewer than 3 locations on Nature Preserve land and fewer than 3 locations on other conservation land, Adequate Protection- More than 3 locations within Illinois Nature Preserves.

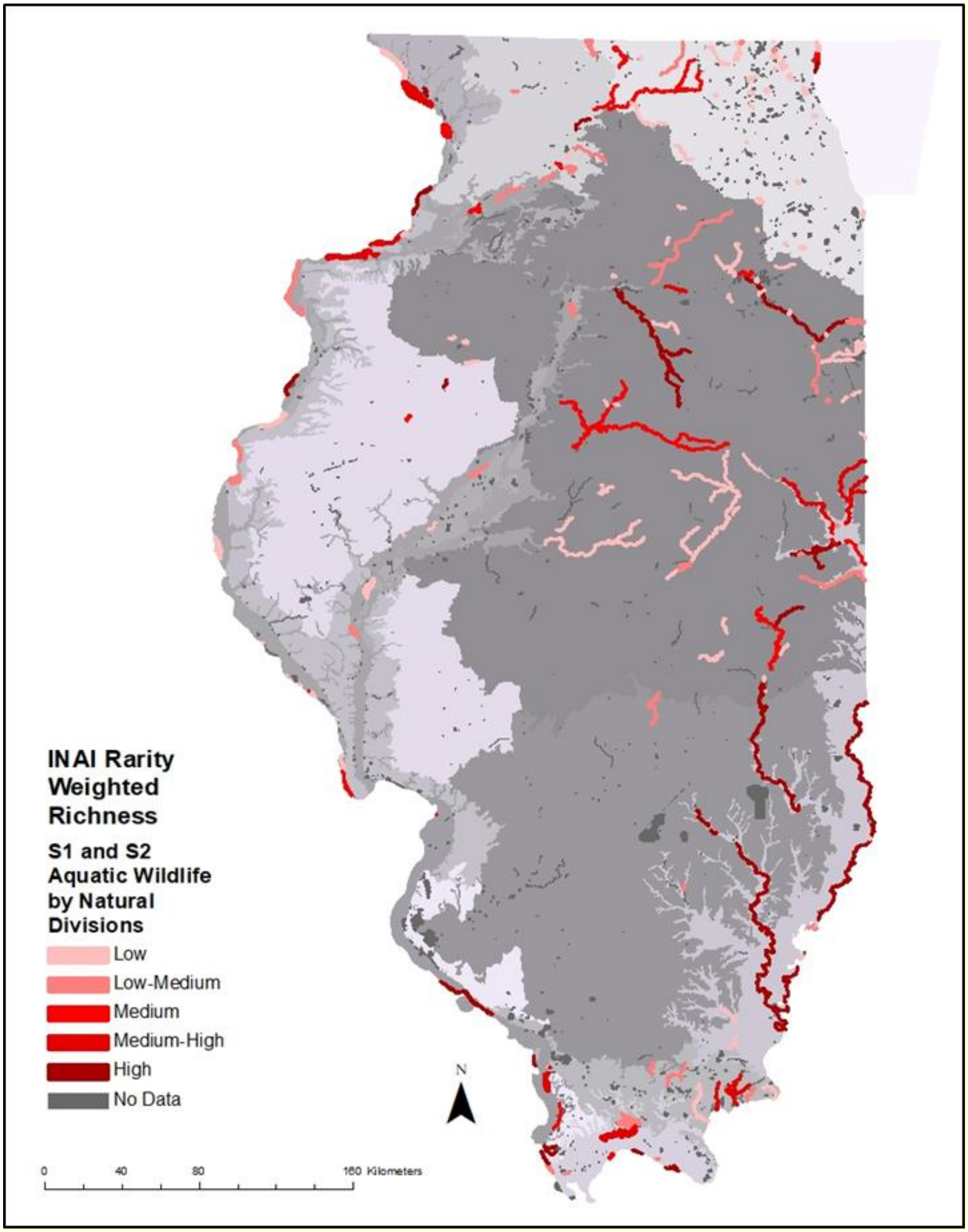

Figure 17. INAI sites grouped from lowest to highest conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) aquatic species (state listed crayfish, fish and mussels SGCN). High priority sites have the highest rarity weighted richness values relative within each Natural Division across the state.

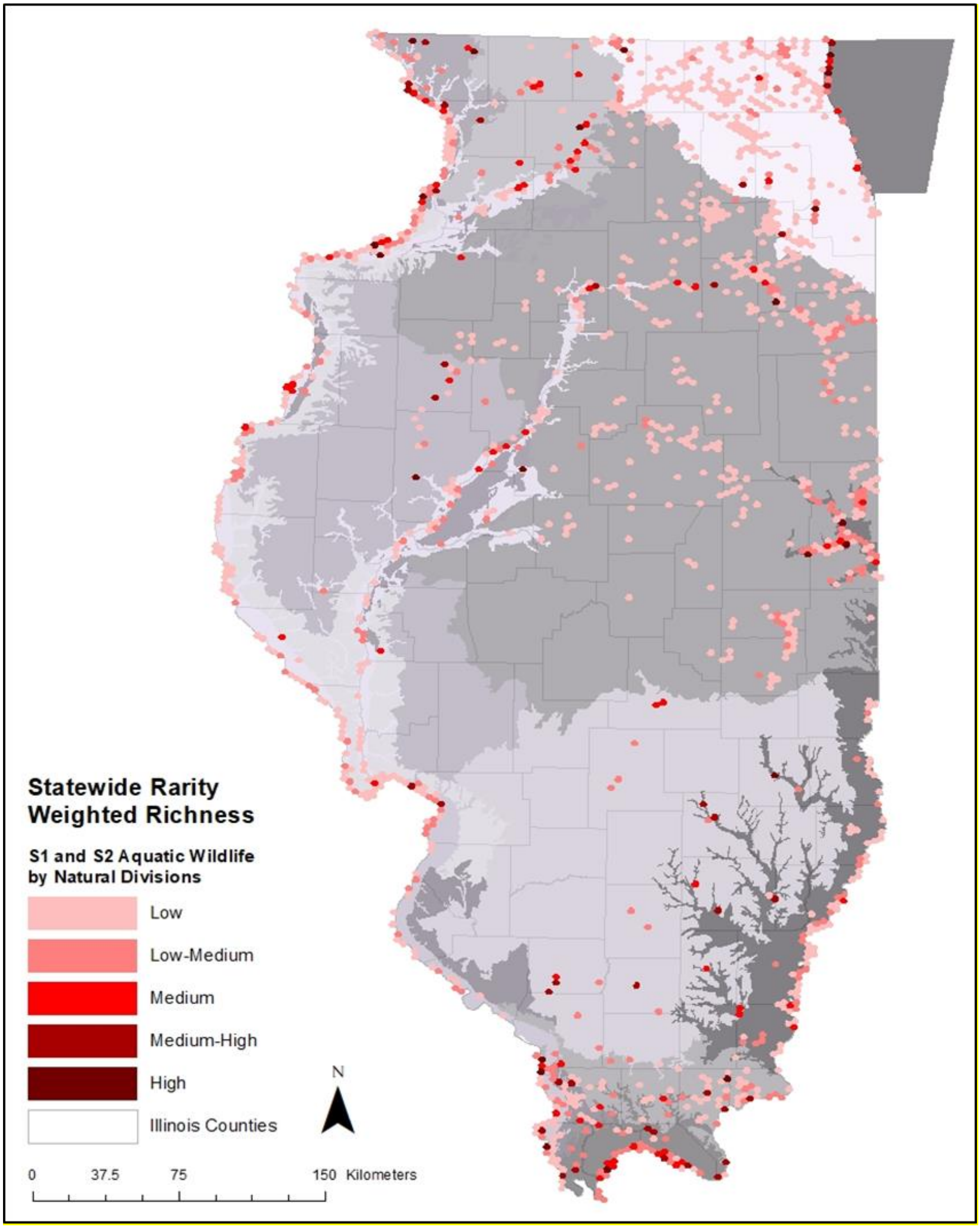

Figure 18. Landscape analysis ranking 10 km2 hexagonal cells from lowest to highest conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) aquatic species (state listed crayfish, fish and mussels SGCN). High priority areas (hotspots) have the highest rarity weighted richness values relative within each Natural Division across the state.

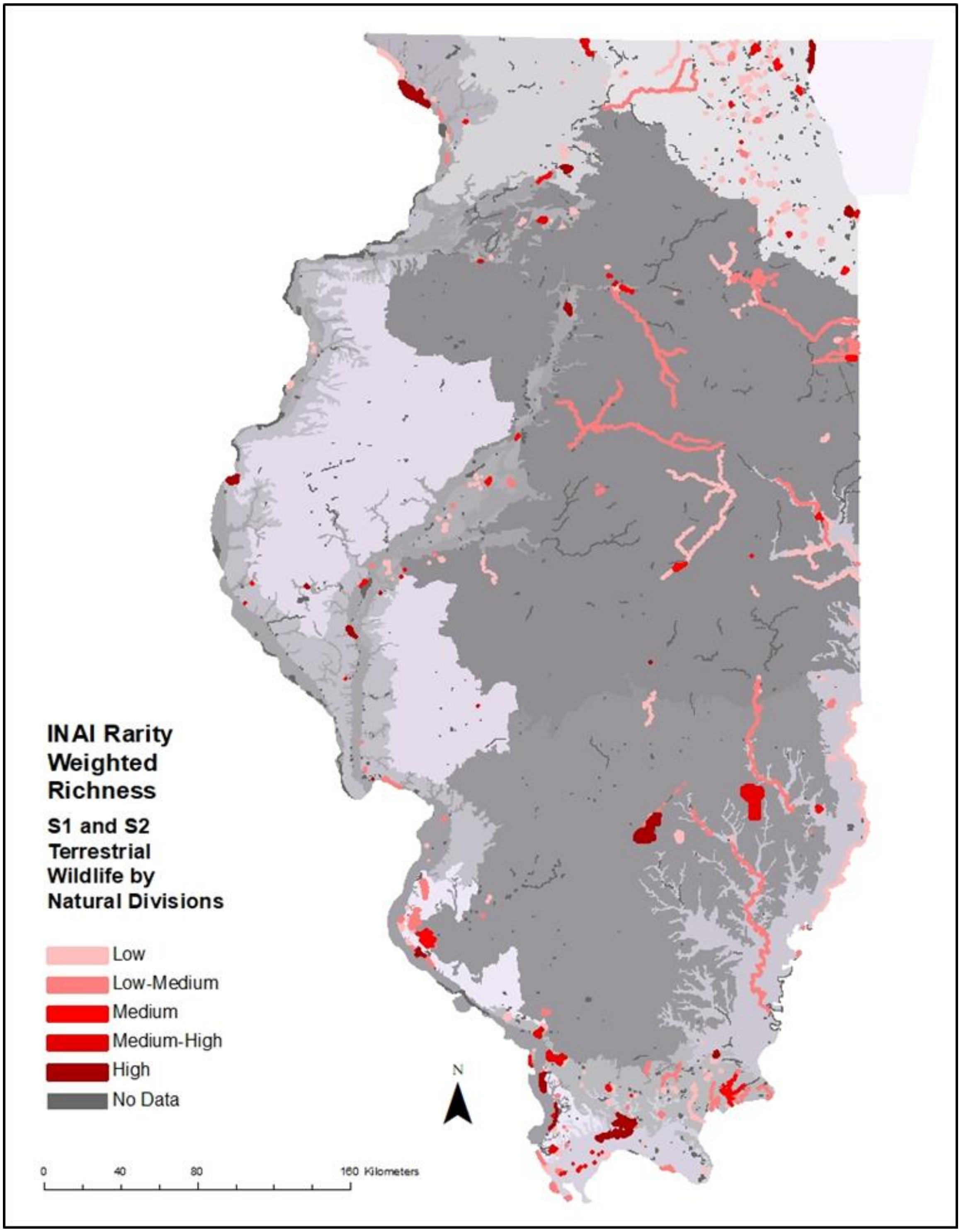

Figure 19. INAI sites grouped from lowest to highest conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) terrestrial species (state listed terrestrial wildlife). High priority sites have the highest rarity weighted richness values relative within each Natural Division across the state.

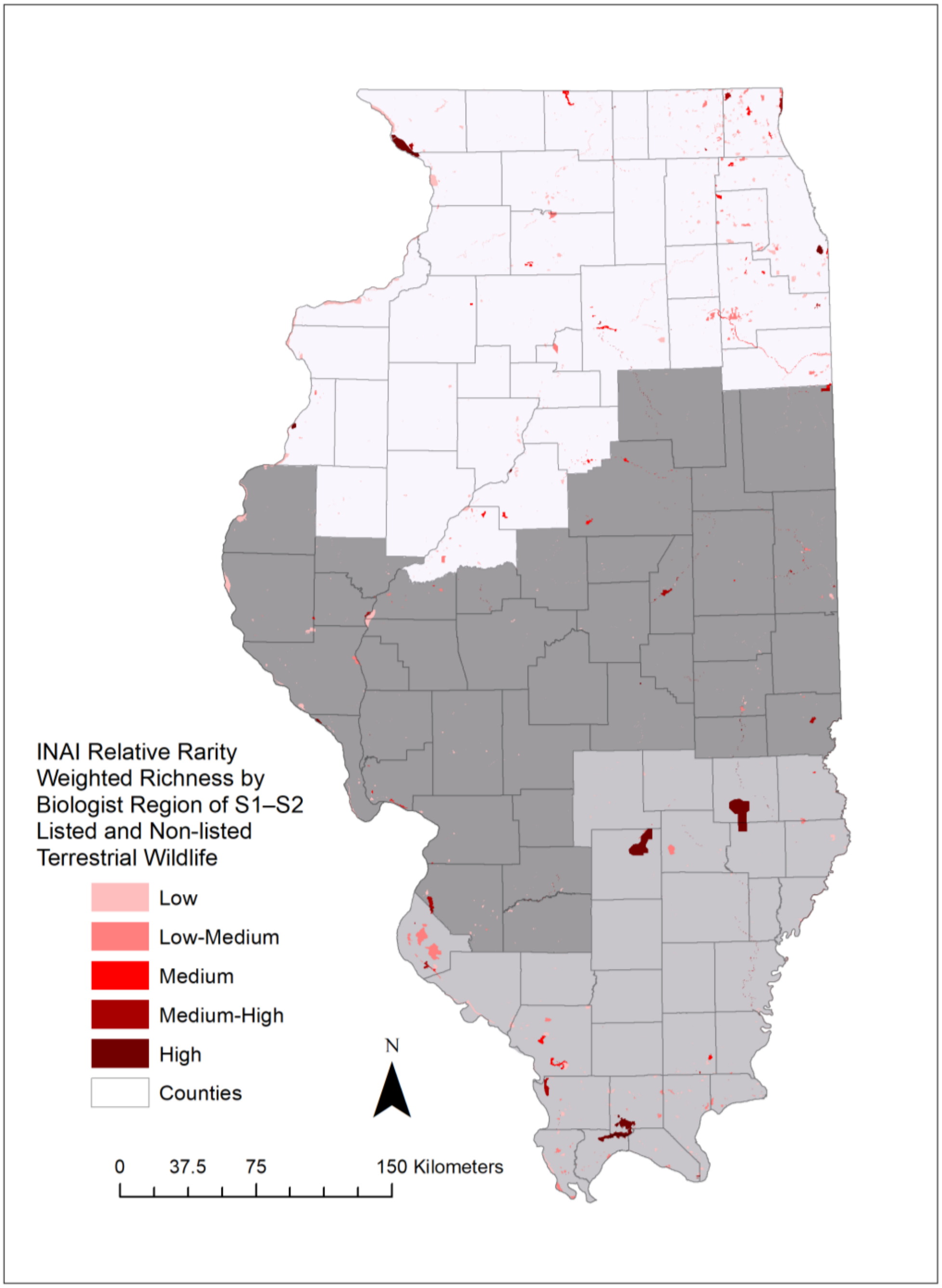

Figure 20. Terrestrial INAI sites grouped from lowest to highest conservation priority by relative rarity weighted richness of critically imperiled/imperiled (S1-S2) state listed and unranked (i.e., breeding birds and herptiles) terrestrial species**.** High priority sites have the highest relative rarity weighted richness values relative within each Biologist Region across the state.

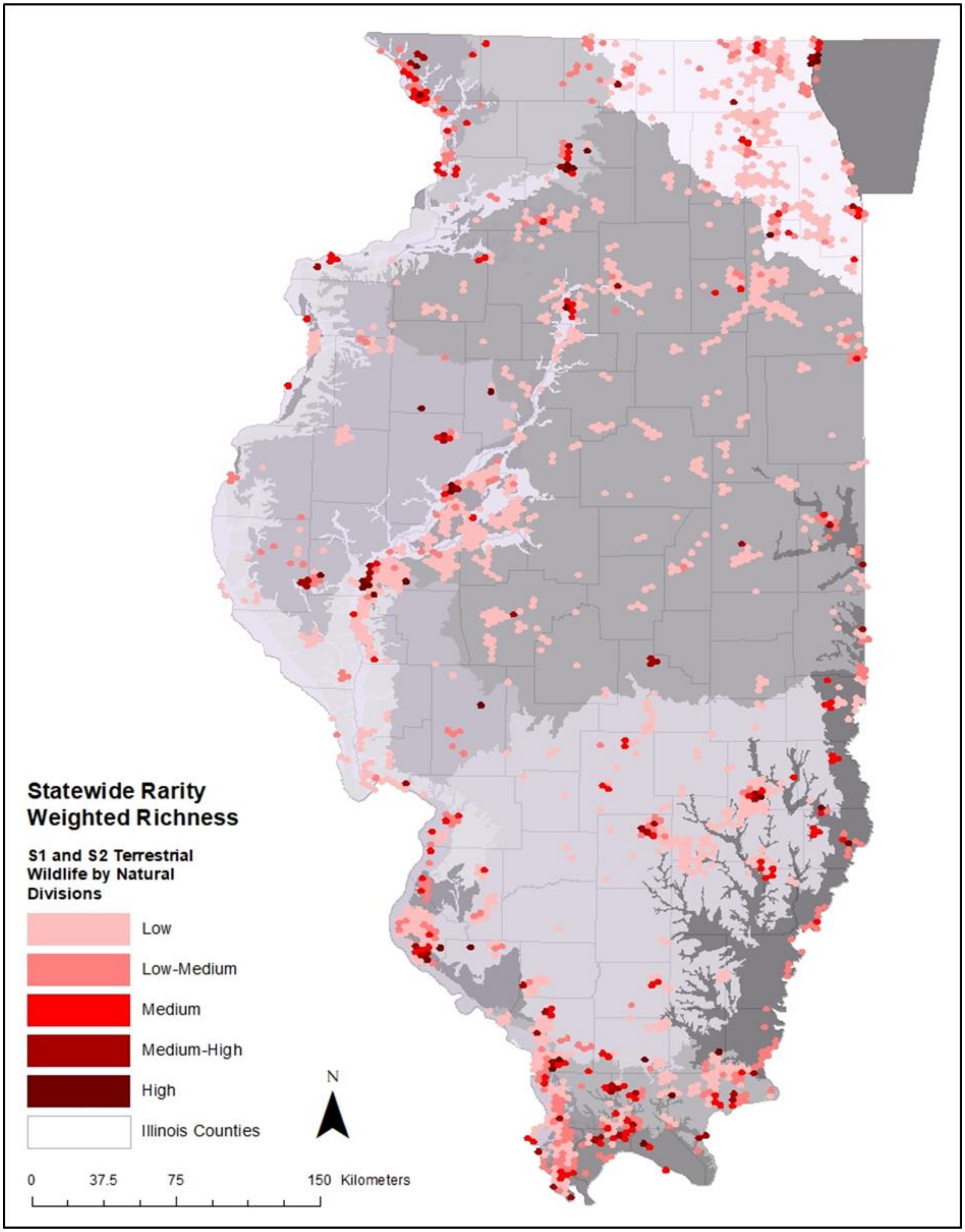

Figure 21. Landscape analysis ranking 10 km2 hexagonal cells from lowest to highest conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) terrestrial species (state listed terrestrial wildlife and unranked breeding birds and herptiles). High priority areas (hotspots) have the highest rarity weighted richness values relative within each Natural Division across the state.

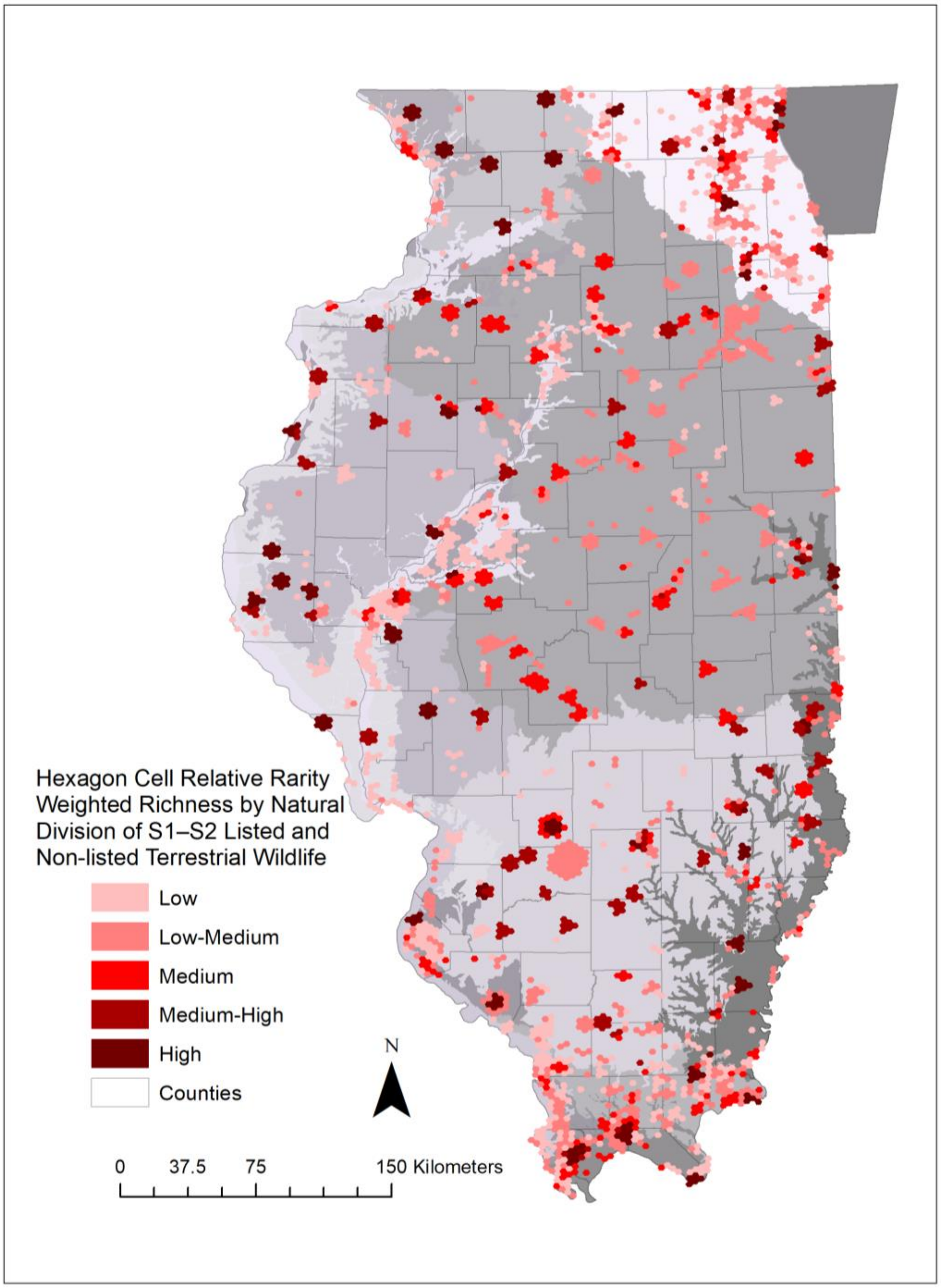

Figure 22. Landscape analysis ranking 10 km2 hexagonal cells from lowest to highest conservation priority by relative rarity weighted richness of critically imperiled/imperiled (S1-S2) state listed and unranked (i.e., breeding birds and herptiles. High priority areas (hotspots) have the highest relative rarity weighted richness values relative within each Natural Division across the state.

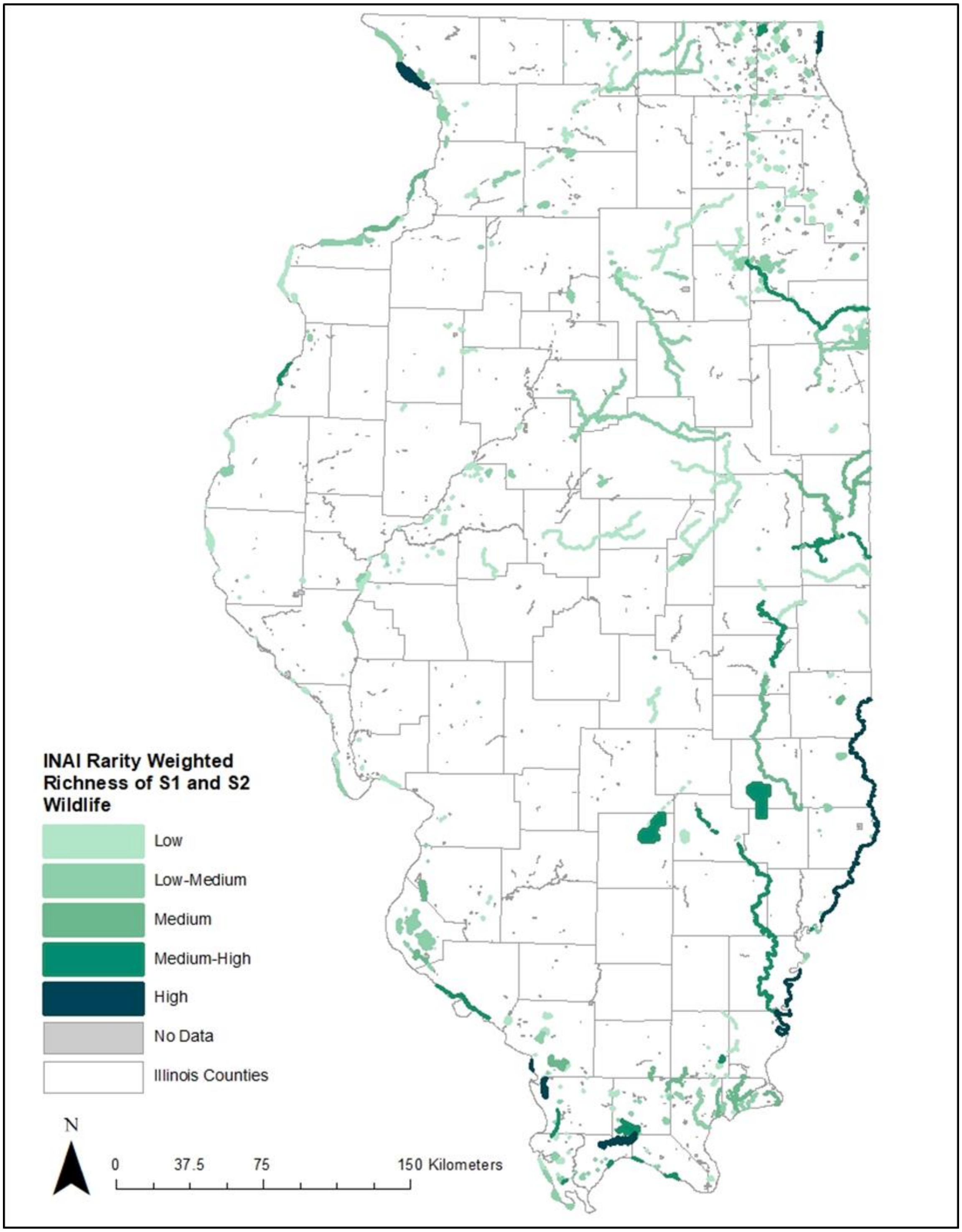

Figure 23. INAI sites grouped from lowest to highest conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) state listed wildlife species and all additional fish and mussel SGCN. High priority sites have the highest rarity weighted richness values relative across all sites statewide.

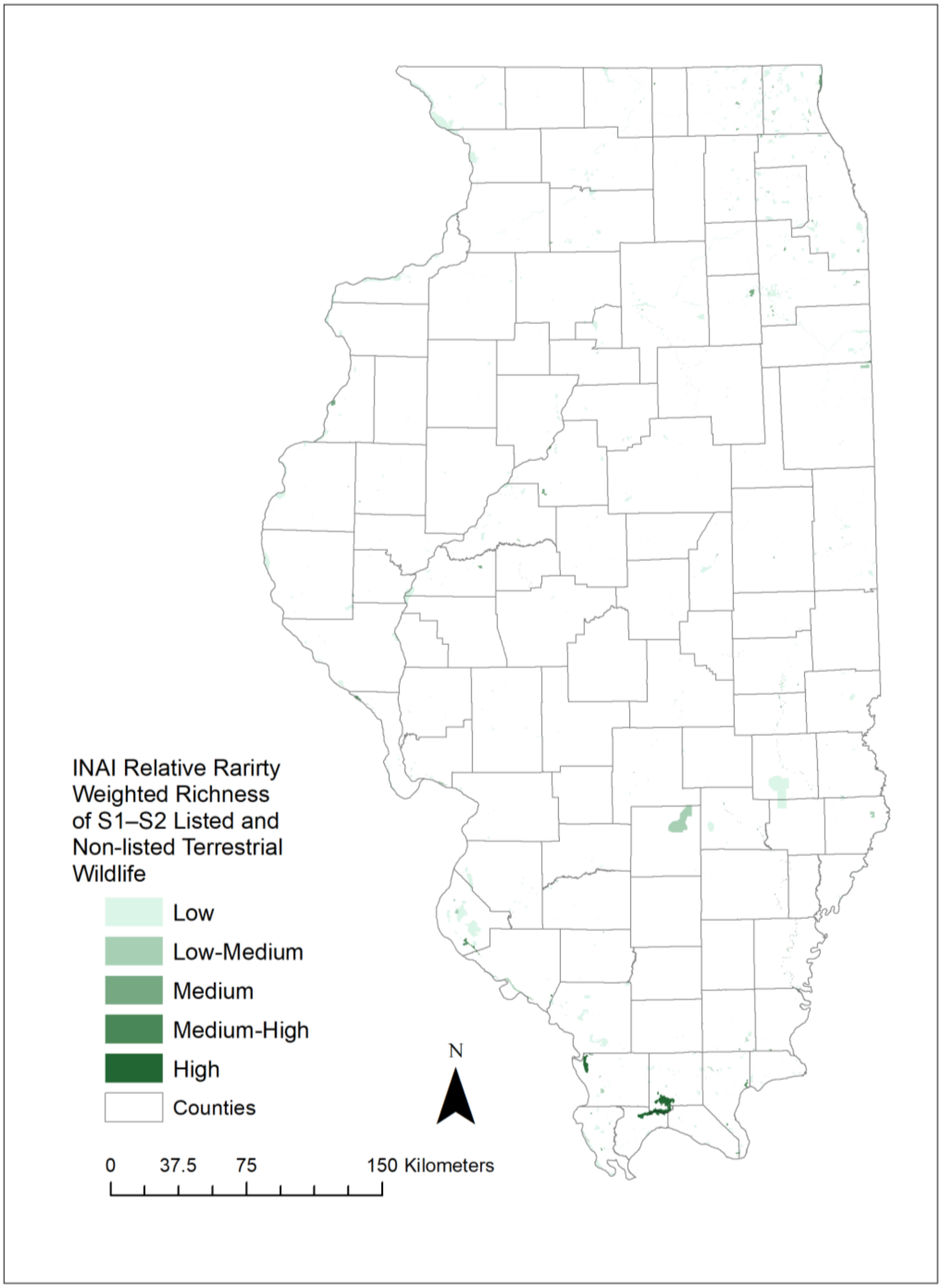

Figure 24. Terrestrial INAI sites grouped from lowest to highest conservation priority by relative rarity weighted richness of critically imperiled/imperiled (S1-S2) state listed and unranked (i.e., breeding birds and herptiles)**.** High priority sites have the highest relative rarity weighted richness values relative across all sites statewide.

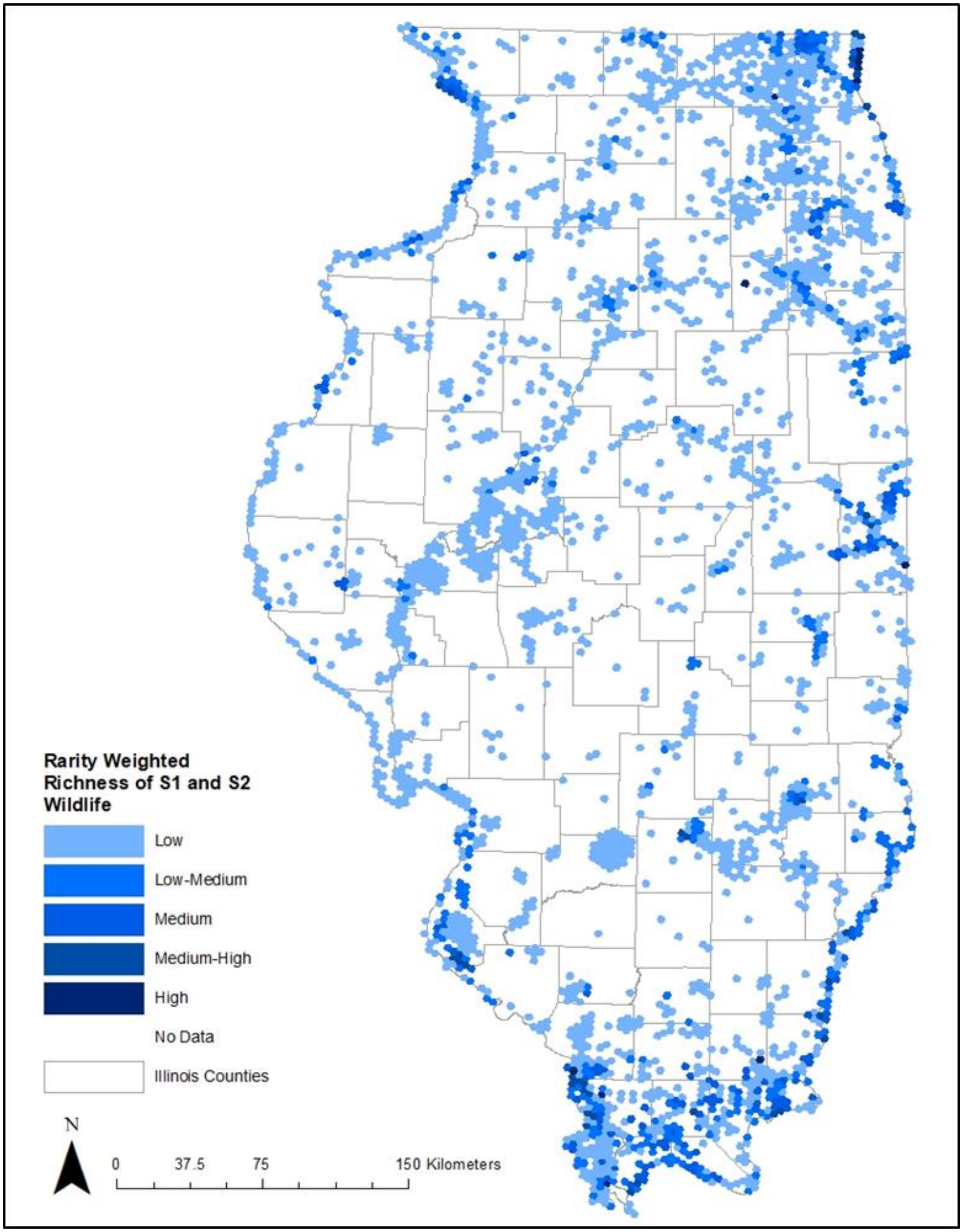

Figure 25. Landscape analysis ranking 10 km2 hexagonal cells from lowest to highest conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) state listed wildlife species and all additional fish and mussel SGCN. High priority areas (hotspots) have the highest rarity weighted richness values relative across the entire state.

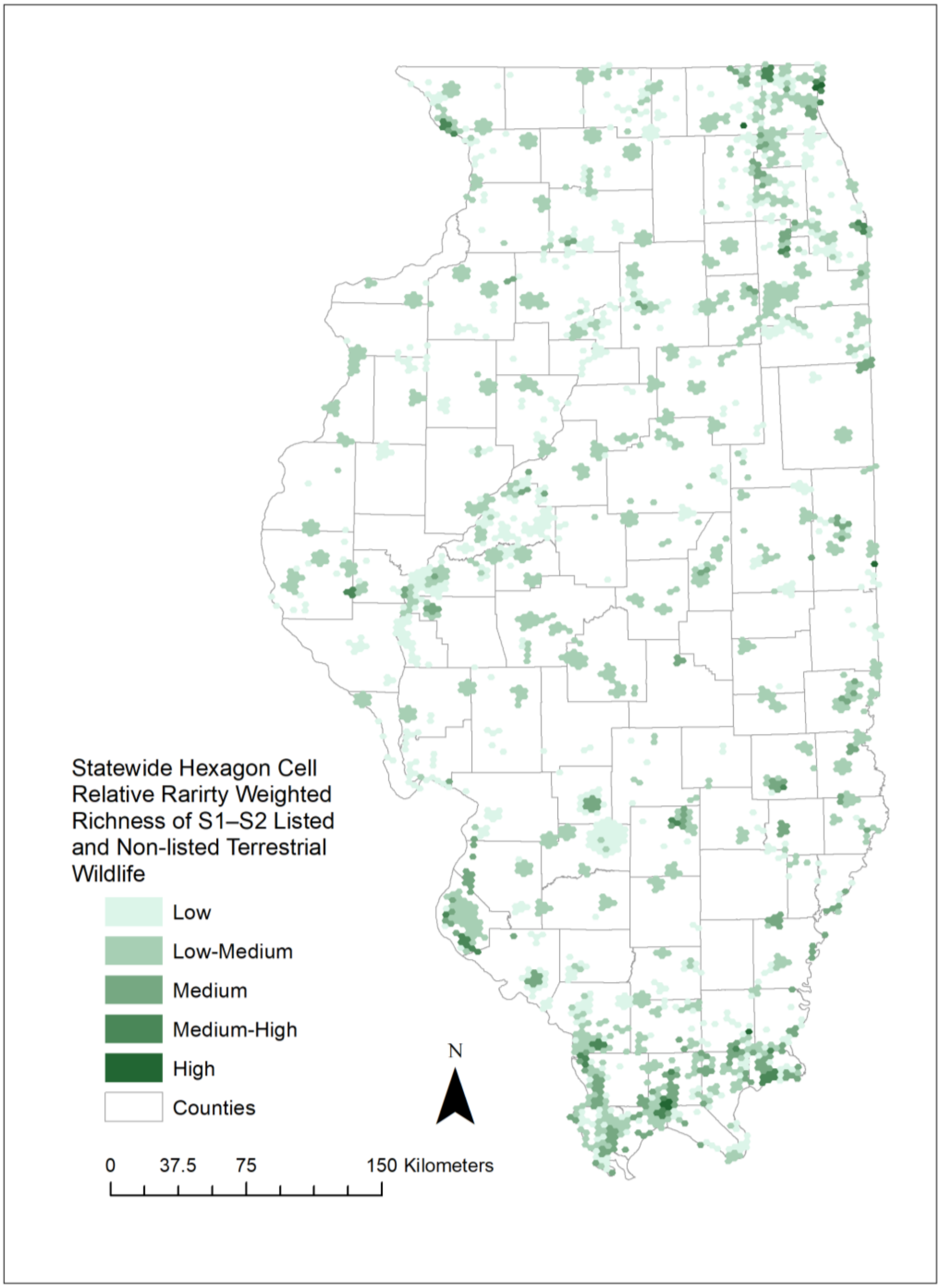

Figure 26. Landscape analysis ranking 10 km2 hexagonal cells from lowest to highest conservation priority by relative rarity weighted richness of critically imperiled/imperiled (S1-S2) state listed and unranked (i.e., breeding birds and herptiles. High priority areas (hotspots) have the highest relative rarity weighted richness values across the state.

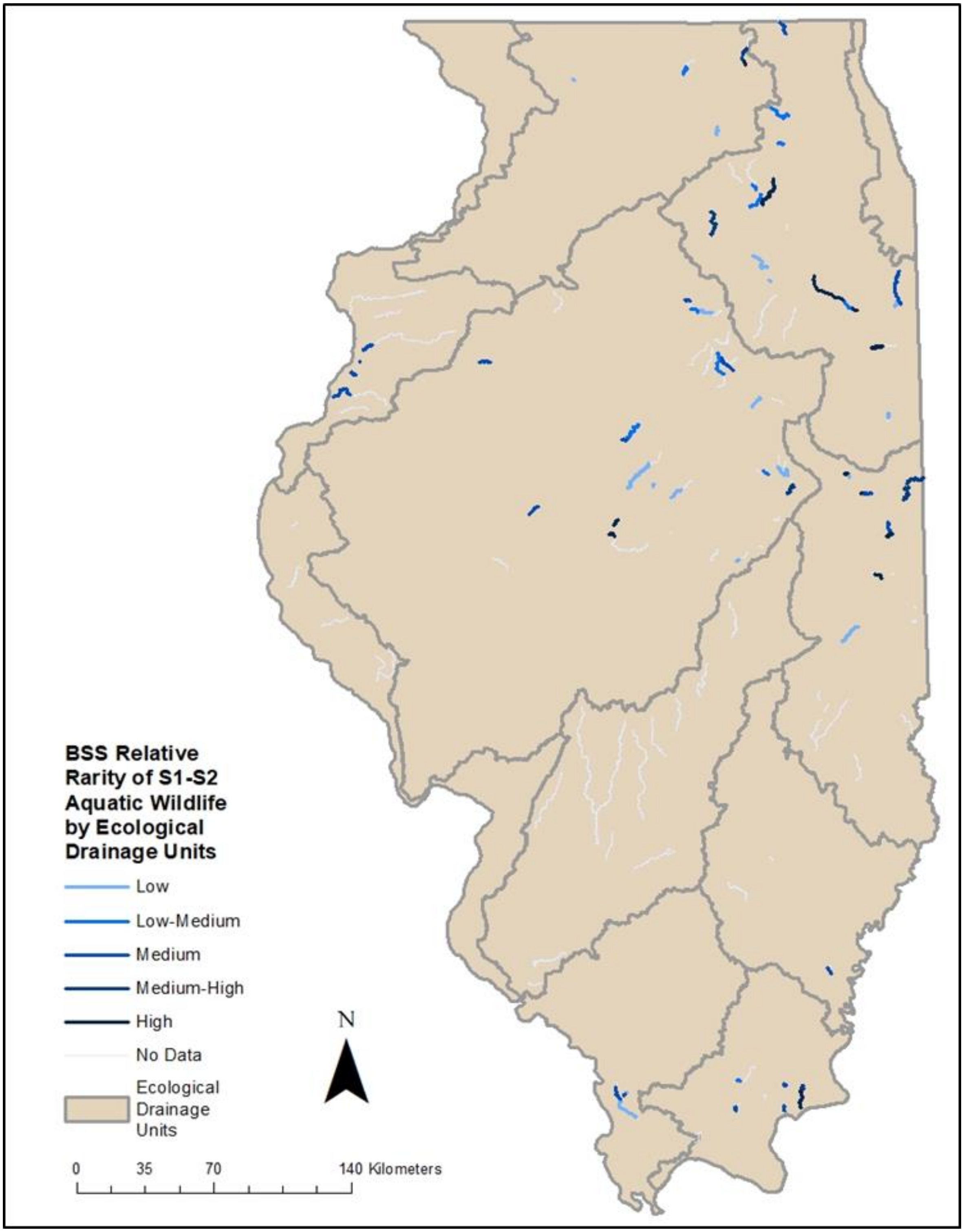

Figure 27. BSS segments classified from low to high conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) aquatic species (state listed crayfish, fish and mussels SGCN). High priority sites have the highest rarity weighted richness values relative within each Ecological Drainage Unit across the state.

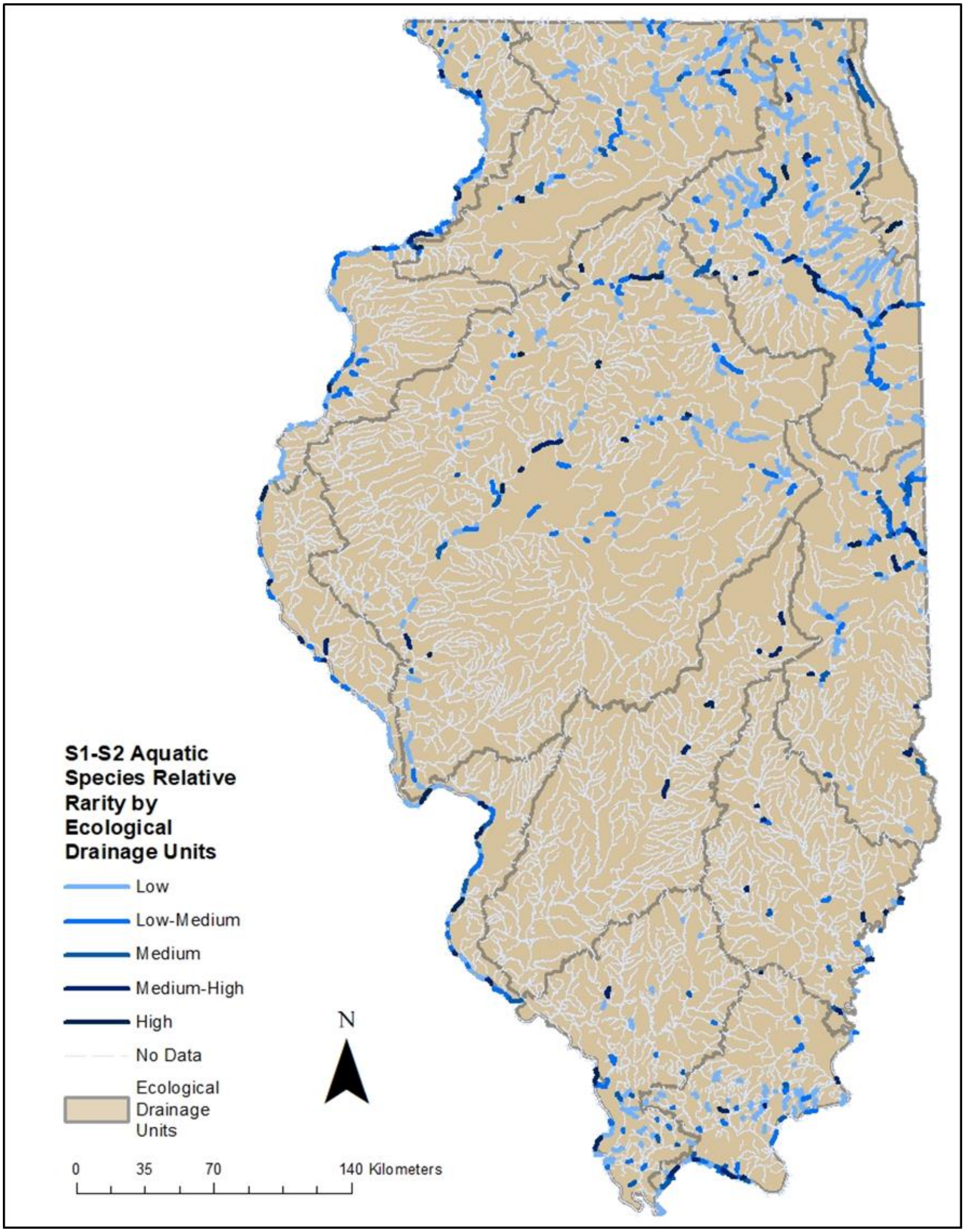

Figure 28. Landscape analysis ranking statewide NHD flowlines classified from low to high conservation priority by rarity weighted richness of critically imperiled/imperiled (S1/S2) aquatic species (state listed crayfish, fish and mussels SGCN). High priority streams have the highest rarity weighted richness values relative within each Ecological Drainage Unit across the state.

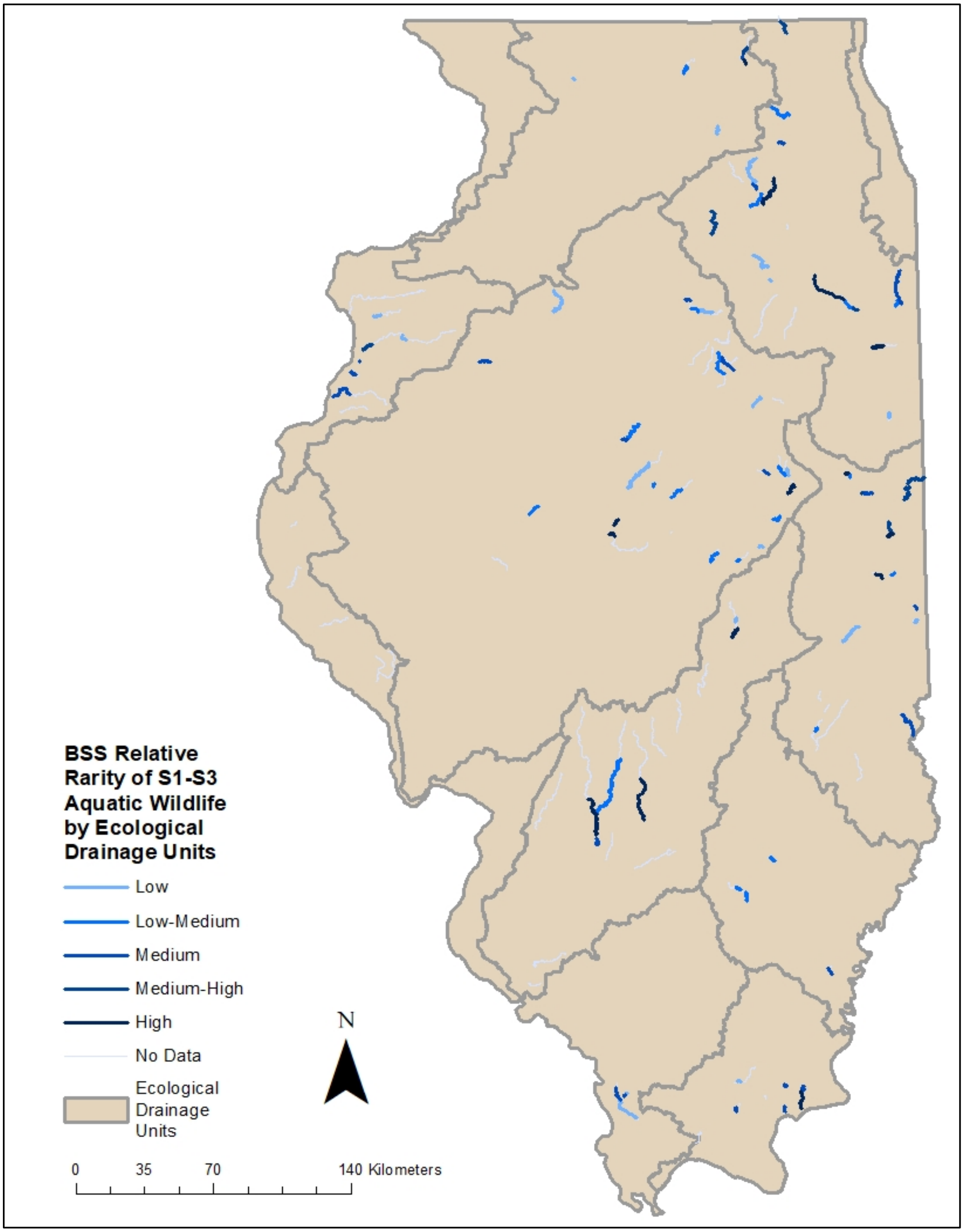

Figure 29. BSS segments classified from low to high conservation priority by rarity weighted richness of critically imperiled/imperiled/vulnerable (S1-S3) aquatic species (state listed crayfish, fish and mussels SGCN). High priority sites have the highest rarity weighted richness values relative within each Ecological Drainage Unit across the state.

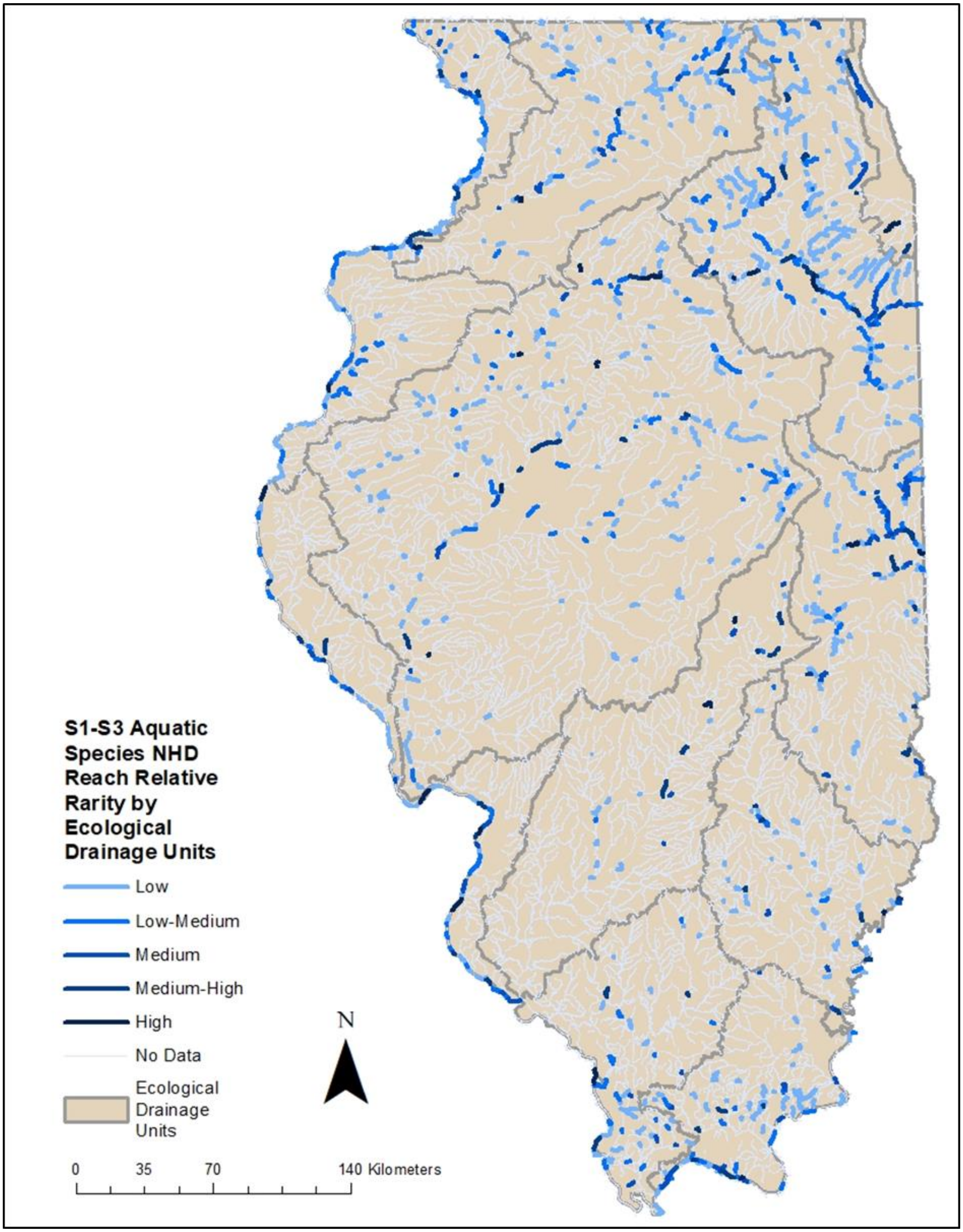

Figure 30. Landscape analysis ranking statewide NHD flowlines classified from low to high conservation priority by rarity weighted richness of critically imperiled/imperiled/vulnerable (S1-S3) aquatic species (state listed crayfish, fish and mussels SGCN). High priority streams have the highest rarity weighted richness values relative within each Ecological Drainage Unit across the state.

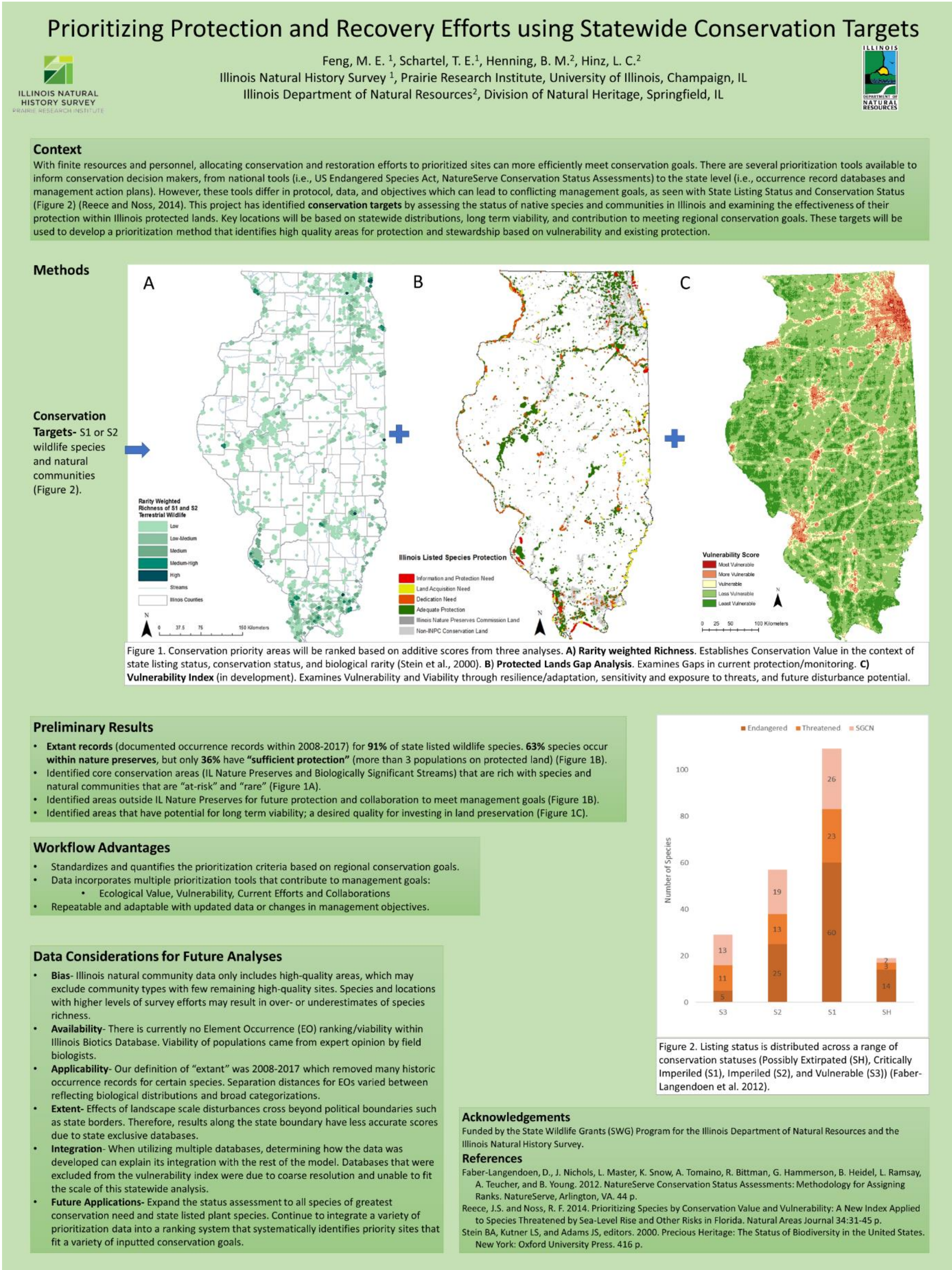

Figure 31. T-115 overview poster presentation presented at the 2019 Natural Areas Conference.

Table 1. List of 2018 updated sRanks for natural community types in Illinois. sRanks were calculated using NatureServe's Conservation Status Assessment methodology and their sRank Calculator. Final updated sRanks are listed under NatureServe Calculator sRanks 2018 unless they were adjusted by Heritage staff in which case the sRank listed under Heritage Review adjustments is the final sRank for that community type. The current state listing status and previous sRank from the 1980s are listed for reference.

Natural Community Type	State Listing Status	Previous sRank	NatureServe Calculator sRank 2018	Heritage Review Adjustments
Algific talus slope		S1	S1	
Aquatic cave community		S3	S1S2	
Beach		S1	S1	
Brackish marsh		S1	S1	
Calcareous floating mat		S1S2	S3	
Calcareous seep		S2	S2S3	
Dry barren		S1	S1	
Dry dolomite cliff		SNR	S1	
Dry dolomite prairie		S2	S1S3	S1S2
Dry gravel prairie		S2	S1	
Dry limestone cliff			S3S4	S3
Dry prairie		S1	S1	
Dry sand forest		S2	S1	
Dry sand prairie		S2	S1	
Dry sand savanna		S1	S3	
Dry sandstone cliff		SNR	S3	
Dry upland forest		S4	S3?	
Dry Woodland		SNR	S1	
Dry-mesic barren		S1	S1S3	S1
Dry-mesic dolomite prairie		S2	S1	
Dry-mesic gravel prairie		S2	S1	
Dry-mesic prairie		S1	S1	
Dry-mesic sand forest		S2	S1	
Dry-mesic sand prairie		S2	S1	
Dry-mesic sand savanna		S1	S2	S3
Dry-mesic savanna		S1	S2	
Dry-mesic upland forest		S4	S3S4	
Dry-mesic woodland		SNR	S1	
Eroding bluff		S5	S1	
Foredune		S1	S1	
Forested bog		S2	S1	

Table 1. Continued

Natural Community Type	State Listing Status	Previous sRank	NatureServe Calculator sRank 2018	Heritage Review Adjustments
Forested fen		S2	S1	
Marsh		S2	S3S4	
Glacial drift hill prairie		S1	S1	
Graminoid bog		S2	S1	
Graminoid fen		S1S2	S3?	
Gravel hill prairie		S1	S1	
Great lake		SU	S1	
High gradient small stream			S1	
Lake		S2	S1	
Limestone glade		S2	S2S3	S1
Loess hill prairie		S2	S1	S4
Low gradient large stream			S1	
Low gradient medium stream			S1	
Low-gradient river			S1	
Low gradient small stream			S1	
Low shrub bog		S2	S1	
Medium gradient medium stream			S3	
Medium-gradient river			S1	
Medium gradient small stream			S1	
Mesic barren		S1	S1	
Mesic dolomite cliff			S1S3	S2S3
Mesic dolomite prairie		S2	S1	
Mesic floodplain forest		S3	S2S3	
Mesic gravel prairie		S2	S1	
Mesic limestone cliff			S1S3	S1
Mesic prairie		S1	S1	
Mesic sand prairie		S2	S1	
Mesic sandstone cliff		SNR	S1S3	S1S2
Mesic savanna		S1	S1	

Table 1. Continued

Natural Community Type	State Listing Status	Previous sRank	NatureServe Calculator sRank 2018	Heritage Review Adjustments
Mesic upland forest		S4	S3S4	
Mesic woodland			S1	
Northern flatwoods		S2	S3	
Panne		S1	S1	
Pond		S2	S3S4	
Sand flatwoods		S1	S2	
Sand hill prairie		S2	S1	
Sand seep		S1	S1	
Sandstone glade		S3	S1	
Sandstone				
overhang community		S5	S1S3	S1
Sedge meadow		S2	S3	
Seep		S2	S2S4	S3
Shale glade		S1	S1	
Shrub fen		S1	S1	
Shrub prairie		S2	S1	
Shrub swamp		S2?	S3	
Southern flatwoods		S2	S2S4	S3
Spring		S1	S1	
Swamp		S2	S3	
Tall shrub bog		S2	S1	
Terrestrial cave community		S3	S2S4	S1S2
Wet dolomite prairie		S2	S1	
Wet floodplain forest		S3	S4	
Wet prairie		S1	S2S3	S1S2
Wet sand prairie		S2	S1	
Wet-mesic dolomite prairie		S2	S1	
Wet-mesic floodplain forest		S3	S3	
Wet-mesic prairie		S1	S2	
Wet-mesic sand prairie		S2	S1	S2S3
Wet-mesic upland forest		S4	S1	
Xeric barrens			S1	
Mesic sand forest			SU	
Dry sand woodland			SU	

Table 1. Continued

Natural Community Type	**State Listing Status**	**Previous sRank**	**NatureServe Calculator sRank 2018**	**Heritage Review Adjustments**
Dry-mesic sand woodland			SU	
Dolomite hill prairie			SU	
High gradient medium stream			SU	
High gradient large stream			SU	
Medium gradient large stream			SU	

Table 2. Natural community types in Illinois with their associated Protection Need category. Categories are defined as followed: Information and Protection Need- Fewer than 3 known locations, Dedication Need- Fewer than 3 locations on Nature Preserves, but additional locations on non-INPC conservation land, Land Acquisition Need- Fewer than 3 locations on Nature Preserve land and fewer than 3 locations on other conservation land, Adequate Protection- More than 3 locations within Illinois Nature Preserves.

Natural Community Name	Protection Need
Acid gravel seep	Info and Protection Need
Algific talus slope	Info and Protection Need
Aquatic cave	Dedication Need
Beach	Adequate Protection
Brackish marsh	Info and Protection Need
Calcareous floating mat	Adequate Protection
Calcareous seep	Adequate Protection
Dry barrens	Adequate Protection
Dry dolomite cliff	Info and Protection Need
Dry dolomite prairie	Adequate Protection
Dry gravel prairie	Adequate Protection
Dry limestone cliff	Dedication Need
Dry prairie	Adequate Protection
Dry sand forest	Adequate Protection
Dry sand prairie	Adequate Protection
Dry sand savanna	Adequate Protection
Dry sandstone cliff	Dedication Need
Dry upland forest	Adequate Protection
Dry woodland	Land Acquisition Need
Dry-mesic barrens	Adequate Protection
Dry-mesic dolomite prairie	Adequate Protection
Dry-mesic gravel prairie	Adequate Protection
Dry-mesic prairie	Adequate Protection
Dry-mesic sand forest	Adequate Protection
Dry-mesic sand prairie	Adequate Protection
Dry-mesic sand savanna	Adequate Protection
Dry-mesic savanna	Adequate Protection
Dry-mesic upland forest	Adequate Protection
Dry-mesic woodland	Land Acquisition Need
Eroding bluff	Adequate Protection
Foredune	Info and Protection Need
Forested bog	Adequate Protection
Forested fen	Land Acquisition Need
Freshwater marsh	Adequate Protection
Glacial drift hill prairie	Adequate Protection
Graminoid bog	Info and Protection Need
Graminoid fen	Adequate Protection

Table 2. Continued

Natural Community Name	Protection Need
Gravel hill prairie	Land Acquisition Need
Great Lake	Info and Protection Need
High gradient small stream	Adequate Protection
Lake	Adequate Protection
Limestone glade	Adequate Protection
Loess hill prairie	Adequate Protection
Low gradient large stream	Dedication Need
Low gradient medium stream	Adequate Protection
Low gradient river	Dedication Need
Low gradient small stream	Adequate Protection
Low shrub bog	Land Acquisition Need
Medium gradient medium stream	Land Acquisition Need
Medium gradient river	Adequate Protection
Medium gradient small stream	Adequate Protection
Mesic barrens	Info and Protection Need
Mesic dolomite cliff	Adequate Protection
Mesic dolomite prairie	Info and Protection Need
Mesic floodplain forest	Adequate Protection
Mesic gravel prairie	Adequate Protection
Mesic limestone cliff	Land Acquisition Need
Mesic prairie	Adequate Protection
Mesic sand prairie	Adequate Protection
Mesic sandstone cliff	Adequate Protection
Mesic savanna	Adequate Protection
Mesic upland forest	Adequate Protection
Mesic woodland	Info and Protection Need
Northern flatwoods	Adequate Protection
Panne	Info and Protection Need
Pond	Adequate Protection
Sand flatwoods	Adequate Protection
Sand hill prairie	Info and Protection Need
Sand seep	Dedication Need
Sandstone glade	Adequate Protection
Sandstone overhang	Dedication Need
Sedge meadow	Adequate Protection
Seep (neutral)	Adequate Protection
Shale Glade	Adequate Protection
Shrub fen	Adequate Protection
Shrub prairie	Adequate Protection
Shrub Swamp	Adequate Protection
Southern flatwoods	Adequate Protection

Table 2. Continued

Natural Community Name	Protection Need
Spring	Dedication Need
Swamp	Adequate Protection
Tall shrub bog	Dedication Need
Terrestrial cave	Adequate Protection
Wet dolomite prairie	Land Acquisition Need
Wet floodplain forest	Adequate Protection
Wet prairie	Adequate Protection
Wet sand prairie	Adequate Protection
Wet-mesic dolomite prairie	Adequate Protection
Wet-mesic floodplain forest	Info and Protection Need
Wet-mesic prairie	Adequate Protection
Wet-mesic sand prairie	Adequate Protection
Wet-mesic upland forest	Adequate Protection
Xeric barrens	Dedication Need

Table 3. Data compiled for the vulnerability index. Variables that were ultimately included are highlighted in grey.

Metric	Description	Source
Water pollution point sources	Facility discharges in toxic-weighted Pounds (TWPE) 2018, only includes facilities with exceedances.	EPA NPDES Clean Water Act DMR Pollutant Loading Tool
Infrastructure	Dams, bridges, canals, channels, crossings, trails, and oilfields	USGS US geographic names information system (GNIS)
303d impaired streams	CWA Section 303(d) list of impaired waters that are too polluted or degraded to meet state water quality standards.	EPA
303d impaired waters	CWA Section 303(d) list of impaired waters that are too polluted or degraded to meet state water quality standards.	EPA
CAFO density by County	Concentrated Animal Feeding Operations (CAFO's) per County 2007-2013. Boundaries of US counties and US EPA value-added dataset derived from the 2007 USDA Census of Ag.	Data.gov EPA and USDA Census of Agriculture
Toxic Release Point Sources	EPA TRI tracks management of toxic chemical that may threaten human and environmental health. Industrial facilities report annually how much each chemical is treated or disposed and released. Production-related waste managed.	EPA's Toxics Release Inventory (Envirofacts)
Mineral Extraction Sites	Metallic and non-metallic mineral resources including deposit name, location, description, production, etc.	USGS Mineral Resources Data System (MRDS)
Active Mines and Mineral Plants	Active mines and mineral plants. Includes active mines from 2003	USGS and National Minerals Information Center.
All Mining extraction activities	Prospect and mine related features including prospect pits, mine shafts and adits, quarries, open-pit mines, tailings piles and pond, gravel and borrow pits, etc.	USGS, Prospect and mine related features
Mining Impact areas	Prospect and mine related features including prospect pits, mine shafts and adits, quarries, open-pit mines, tailings piles and pond, gravel and borrow pits, etc.	USGS, Prospect and mine related features
Nitrogen loading	Catchment or HUC level estimated amount of contaminant transported from inland watersheds to larger water bodies by linking monitoring data with watershed characteristics and contaminant sources.	USGS Spatially Referenced Regressions on Watershed attributes (SPARROW) 2002
Phosphorous loading	Catchment or HUC level estimated amount of contaminant transported from inland watersheds to larger water bodies by linking monitoring data with watershed characteristics and contaminant sources.	USGS Spatially Referenced Regressions on Watershed attributes (SPARROW) 2003
Coal Mines	National Coal Resources Data System	USTRAT
Coal Mines	Shapefiles of coal mine points and polygons including active mines as of 2016	Illinois State Geological Survey (ISGS) Illinois Coal Resource Shapefiles
Active Coal Mines	Shapefiles of coal mine points and polygons including active mines as of 2017	Illinois State Geological Survey (ISGS) Illinois Coal Resource Shapefiles
Land Cover	landcover data marking areas that changed land cover type from 2001-2011	NLCD
Land Cover	landcover data marking areas that changed land cover type from 2001-2011 and listing the changing cover types	NLCD
Land Cover	Current land cover types as of 2011 (Urban,Ag, Forest, ect.)	NLCD
Impervious surfaces	Percent impervious surfaces as of 2011	NLCD
Pesticide Leaching Potential	A statewide dataset for evaluating the potential for contamination of shallow aquifers by pesticides and nitrate. Potential for aquifer contamination by pesticides derived by taking soil data and modeling it against pesticide data. Chemical properties and soil properties interactions were taken into consideration. 0-uncoded, 1 excessive sensitivity, 2 high sensitivity, 3 moderate sensitivity, 4 somewhat limited sensitivity, 5 limited sensitivity, 6 very limited sensitvity, 8 disturbed lands (mines, quarries, etc), 9 surface water bodies.	Illinois State Geological Survey (ISGS) off of Illinois geospatial clearinghouse

Table 3. Continued

Metric	Description	Source
NO3 Leaching Potential	Potential for aquifer contamination by NO3 derived by taking soil data and modeling it against pesticide data. Chemical properties and soil properties interactions were taken into consideration. 0-uncoded, 1 excessive sensitivity, 2 high sensitivity, 3 moderate sensitivity, 4 somewhat limited sensitivity, 5 limited sensitivity, 6 very limited sensitvity, 8 disturbed lands (mines, quarries, etc), 9 surface water bodies.	Illinois State Geological Survey (ISGS) off of Illinois geospatial clearinghouse
Human Population	5 year estimates American Community Survey 2012-2016, cities, towns, villages. ACS is continuous census data averaged over 5 years. It has a residency protocol that requires residents to be living in their homes for minimum of 2 months.	US Census, TIGER
Human Population	Decennial Census data total populations per cities, towns, villages.	US Census, TIGER
Human Population Change	changes in population over time by county	US Census, TIGER
Human Population	Decennial Census data total populations per census block	US Census, TIGER
Streets	Highways and streets in IL. Lists street classification and material.	IDOT
Wind turbine Locations	Point locations of wind turbines	USWTDB
Forest Pest/Disease Risk	Values 'At Risk' in NIDRM 2012 represent the expectation that, without remediation, 25 percent or more of the standing live basal area of trees greater than 1 inch in diameter will die over a 15-year (2013 to 2027) time frame due to insects and diseases. Loss estimates assume no remediation. This 2018 update shows area where recent significant basal area losses have already occurred, removing these areas from an 'At Risk' condition.	Forest Health Protection. 2019. National Insect and Disease Composite Risk Map, 2018 Update. Digital Data. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Forest Health Assessment and Applied Sciences Team.
Wildland Urban Interface	Types of WUI: intermix and interface. Intermix WUI are areas where housing and vegetation intermingle; interface WUI are areas with housing in the vicinity of contiguous wildland vegetation. WUI GIS data were designed to provide a spatially detailed national assessment of the Wildland Urban Interface (WUI) across the conterminous U.S. to support inquiries into the effects of housing growth on the environment, and to inform both national policy and local land management concerning the WUI and associated issues.	Silvis Lab/USDA Forest Service
Water Withdrawals	HUC12 level water withdrawal from agriculture and industries	EPA enviroatlas. Derived from 30m water usage from 2010 and summarized at the HUC12 scale.
Dam Storage	Volume of impounded water from dams. NID_Storage-(Acre-Feet, Number) Calculated field: Maximum value of normal storage and maximum storage. Accepted as the general storage of the dam.	NID
FRS	The Facility Registry Service (FRS) identifies and geospatially locates facilities, sites or places subject to environmental regulations or of environmental interest.	EPA FRS

Table 4. Final variables used in the Vulnerability Index analysis. Grey highlighted factors were only used in the aquatic analysis.

Variable	**Sub-variables**	**Units**	**Data Sources**	**Source Date**	**Data Resolution**
Resource Extraction	Density non-energy mineral mines (includes active, historical, prospect, surface and underground features)	# mines/km2	Active Mines and Mineral Plants (USGS and National Minerals Information Center); Prospect and mine related features (USGS);Mineral Extraction Sites (USGS Mineral Resources Data System (MRDS))	2003, 2001, 2005	1:24,000
	Proportion Active Surface coal mines	Km2/km2	Illinois State Geological Survey (ISGS) Illinois Coal Resource Shapefiles	2019	1:500,000
	Proportion Active Underground coal mines	Km2/km2	Illinois State Geological Survey (ISGS) Illinois Coal Resource Shapefiles	2019	1:500,000
	Proportion Inactive Underground/Surface Coal Mines	Km2/km^2	Illinois State Geological Survey (ISGS) Illinois Coal Resource Shapefiles	2019	1:500,000
	Oil Field Density	# oil fields/km^2	USGS Geographic Names Information System (GNIS)	2006	
Land Use	Proportion Developed Low Intensity	Km^2/km^2	NLCD 2016 (Open, Low Developed, Barren)	2016	30mx30m
	Proportion Developed High Intensity	Km^2/km^2	NLCD 2016 (High, Medium intensity)	2016	30mx30m
	Proportion Impervious surfaces	Km^2/km^2	NLCD 2016	2016	30mx30m
	Proportion Agriculture	Km^2/km^2	NLCD 2016 (Combination of Crop and Pasture)	2016	30mx30m
	Proportion Predicted Urban Land Conversion	Km^2/km^2	LTM 2006	2006	
Human Population	Human population Density	Km^2/km^2	2010 Census	2010	Census tract
Point Source Pollution	Toxic Release Inventory Density (Active Release)	Km^2/km^2	EPA Toxic Release Inventory (Envirofacts)	2016	
	Facility Water Pollution Exceedances (Active Release)	# sites/km^2	EPA NPDES Clean Water Act DMR Pollutant Loading Tool	2018	
	EPA Facilities of Interest (Air Programs, Animal Operations/CAFOs, Chemical Release Programs, Chemical Storage Programs, Hazardous Waste Programs, Legal/Enforcement Activities, Radiation Protection Programs, Remediation and Redevelopment Programs/Brownsfield, Underground storage tank Programs, Waste Water Programs, Water Resources) (Potential Release)	# sites/km^2	EPA FRS	2019	

Table 4. Continued

Variable	**Sub-variables**	**Units**	**Data Sources**	**Source Date**	**Data Resolution**
Infrastructure/Barriers	Road-Stream Crossing Density	# crossings/local catchment area (km^2)	NHD Flowlines; TIGER Railroads; IDOT Roads		
	Minor Road Length Density	Km/km^2	IDOT	2018	
	Major Road Length Density	Km/km^2	IDOT	2018	
	Railroad Length Density	Km/km^2	TIGER Railroads		
	Average Annual Daily Traffic Rate (AADT)	Average # Cars/Day	IDOT	2018	
	Dams	# Dams/watershed area (km^2)	NID		
	Wind Turbine Density	# Turbines/km^2	USWTDB	2019	10m
Hydrologic Diversion	Average Water Withdrawal within watershed	millions gallons/ day	EPA EnviroAtlas	2010	HUC12
Resistance	Proportion Isolated Core Habitat	Km^2/km^2	Midwest Green Infrastructure Network. The Conservation Fund, 2014. Using ArcGIS Version 10.1. Redlands, CA: Esri. 2013	2014	30mx30m
	Proportion Core Habitat with Connectivity	Km^2/km^2	Midwest Green Infrastructure Network. The Conservation Fund, 2014. Using ArcGIS Version 10.1. Redlands, CA: Esri. 2013	2014	30mx30m

Table 5. The raw variable rescaling, weighting, and final scoring process. For each disturbance and resiliency variable there is the range of rescaled values, sub variable weights, and the maximum and minimum possible vulnerability scores across landscape units (grid cells, catchments, watersheds).

Variables	**Variable Score Range**	**Sub-variables**	**Weighted Contribution to Variable Score**
Coal Mines	0 (Not Present) - 10 (Highest Magnitude)	Inactive Active Surface Active Underground	0.2 0.3 0.5
Developed Land	0 (Not Present) - 10 (Highest Magnitude)	Low Intensity High Intensity	0.4 0.6
Agriculture	0 (Not Present) - 10 (Highest Magnitude)		
Impervious Surfaces	0 (Not Present) - 10 (Highest Magnitude)		
Developed Land Use Conversion	0 (Not Present) - 10 (Highest Magnitude)		
Water Withdrawal	0 (Not Present) - 10 (Highest Magnitude)		
Roads	0 (Not Present) - 10 (Highest Magnitude)	Primary Secondary	0.6 0.4
Rail Roads	0 (Not Present) - 10 (Highest Magnitude)		
Road Crossings+	0 (Not Present) - 10 (Highest Magnitude)		
Dams+	0 (Not Present) - 10 (Highest Magnitude)		
EPA Facilities of Interest	0 (Not Present) - 10 (Highest Magnitude)		
Non-Energy Mines	0 (Not Present) - 10 (Highest Magnitude)		
Oil Fields	0 (Not Present) - 10 (Highest Magnitude)		
TRI Pollution	0 (Not Present) - 10 (Highest Magnitude)		
Water Pollution	0 (Not Present) - 10 (Highest Magnitude)		
Core Habitat	0 (Not Present) - 10 (Greatest Resilience)	Connected Isolated	0.6 0.4
Annual Average Daily* Traffic	0 (Not Present) - 10 (Highest Magnitude)		
Wind Turbines*	0 (Not Present) - 10 (Highest Magnitude)		
Highest/Lowest Possible Vulnerability Score	150 or -10		

*terrestrial analysis (grid cells) only +aquatic analysis (catchments and watersheds) only

Table 6. The 50th percentile values used to determine the list of primary threats for the protected natural community rankings along with primary threat definitions.

Threat/ Disturbance	**50th Percentile Disturbance Value**	**Description**	**Disturbance Value Units**	**Data Source**
Predicted Development (2020-2100)	0.1053	Projections of land use from 2020 to 2100 using 2010 census data. Uses projections based on an increasing climate emissions scenario until 2100. Used proportion of study site area projected as future developed land.	km^2/ km^2	EPA Integrated Climate and land Use Scenarios (ICLUS) 2016
EPA Toxic Release Inventory Site	0.000517	Management of toxic chemicals that may threaten human and environmental health. Industrial facilities report annually how much each chemical is treated or disposed and released. The relative total pollutant releases within each study site was multiplied by the density of sites within each study site.	(# sites/ km2) * relative total releases	EPA Toxic Release Inventory (Envirofacts) 2016
Annual Average Daily Traffic	400	Average Annual Daily Traffic Rate (AADT)	Average # Cars/Day	IDOT 2018
Low Intensity Development	0.06	Within the National Land Cover Database (NLCD), landcovers classified as "barren land," "developed open space," and "developed low intensity" were used to create the proportion of Low Intensity Development within the study site.	km^2/ km^2	NLCD 2016
High Intensity Development	0.002721	Within the National Land Cover Database (NLCD), landcovers classified as "Developed Medium Intensity" and "Developed High Intensity" were used to create the proportion of High Intensity Development within the study site.	km^2/ km^2	NLCD 2016
EPA Facility of Interest	1	The Facility Registry Service (FRS) identifies and geospatially locates facilities, sites or places subject to environmental regulations or of environmental interest due to potential or current contamination. Measured in density of sites within the study site.	# sites/ km^2	EPA FRS 2019
Impervious Surfaces	0.27	Proportion of impervious surfaces within the study site.	m^2/ m^2	NLCD 2016

Table 6. Continued

Threat/ Disturbance	**50th Percentile Disturbance Value**	**Description**	**Disturbance Value Units**	**Data Source**
Non-Energy Mines	1	Density non-energy mineral mines (includes active, historical, prospect, surface and underground features) within each study site.	# sites/ km^2	Active Mines and Mineral Plants (USGS and National Minerals Information Center) 2003; Prospect and mine related features (USGS) 2001; Mineral Extraction Sites (USGS Mineral Resources Data System (MRDS)) 2005
Oil Fields	1	Density of oil field sites within each study site.	# sites/ km^2	USGS Geographic Names Information System (GNIS) 2016
Human Population Density	10.41698	Decennial Census data total human population per census block. Converted to density per km2 and then averaged census block densities within each study site.	# people/ km^2	2010 Census
Agriculture	0.8334	Within the National Land Cover Database (NLCD), the proportion of Agricultural landcover within the study site includes landcovers classified as "pasture/hay" and "cultivated crops."	km^2/ km^2	NLCD 2016
Primary Roads	0.273367	Illinois Department of Transportation Highway and street layers. Highways and streets were divided by Functional Classifications into different intensities. Primary Roads include features classified as Interstate, Freeway/Expressway, other principal Arterial, Minor Arterial. Measured as the length of road (km) per km2. Literature indicates road effect distance of up to 4 km. Therefore, primary road density was calculated within a 4km buffer around each site.	km/ km^2	IDOT 2018
Railways	0.200313	Railway line features were taken from TIGER Railroad Census data. Length density was calculated similarly to Primary and Secondary Roads and railways were buffered with the same effect radius as Secondary Roads (3km).	km/ km^2	TIGER Railroads

Table 6. Continued

Threat/ Disturbance	50th Percentile Disturbance Value	Description	Disturbance Value Units	Data Source
Secondary Roads	1.016196	Illinois Department of Transportation Highway and street layers. Highways and streets were separated by Functional Classifications into different intensities. Secondary Roads include features classified as Major Collector, Minor Collector, and Local Road or Street. Measured as the length of road (km) per km2. Literature indicates road effect distance of up to 4 km.. Therefore, secondary road density was calculated within a 3km buffer (since they were a lower intensity) at each site.	km/ km^2	IDOT 2018
Water Withdrawal	0.14396	Water withdrawal within HUC12 watersheds from agriculture and industries. Gallons per year were averaged within each study site.	Millions of Gallons/Year	EPA EnviroAtlas 2010
Wind Turbines	2	Density of the number of turbines per study site.	# Turbines/ km^2	USWTDB 2019
Coal Mines (Underground)	0.4916	Proportion of active underground coal mine impact area within each study site.	km^2/ km^2	Illinois State Geological Survey (ISGS) Illinois Coal Resource Shapefiles 2019
Coal Mines (Surface)	0.11495	Proportion of active surface coal mine impact area within each study site.	km^2/ km^2	Illinois State Geological Survey (ISGS) Illinois Coal Resource Shapefiles 2019
Coal Mines (Inactive or Abandoned)	0.36805	Proportion of inactive coal mine impact area (both surficial and underground) within each study site.	km^2/ km^2	Illinois State Geological Survey (ISGS) Illinois Coal Resource Shapefiles 2019
Water Pollution Release Sites	0.000243	Facility discharges in toxic-weighted pounds in 2018. Only includes facilities with exceedances. Total pollutant discharge per study site multiplied by site density within each study site.	(# sites/km2) * relative total discharge (lbs/yr)	EPA NPDES Clean Water Act DMR Pollutant Loading Tool 2018

Table 7. The 50 most vulnerable INPC sites in the state listed in descending order of vulnerability by number of threats. Relative vulnerabilities are comparing segments within Natural Divisions on a scale of 0-1 with a value of 1 indicating the highest disturbance impact (vulnerability). In addition to number of threats, vulnerability is quantified by the observed/potential vulnerability of the site (i.e., how the observed number and magnitudes of threats compare to all threats at the site being at the highest magnitude). Vulnerability is also quantified by the highest disturbance magnitude present at the site. Threat values were rescaled 0-10 based on their percentiles comparing all values statewide. Threats with rescaled values of 10 had the highest magnitudes present in the state (90th percentile). The primary threats listed are the threats at the site with this highest disturbance magnitude.

INPC Name	**Highest Disturbance Magnitude**	**Highest Disturbance Magnitude Relative Vulnerability**	**Number of Threats Relative Vulnerability**	**Observed/Potential Relative Vulnerability**	**Primary Threats**
Short Fork Seep Nature Preserve	0.03	0.003	1	0.003	Water Withdrawal
Fern Rocks Nature Preserve	9.0	1	1	0.85	Human Population Density
Ayers Sand Prairie Nature Preserve	10.00232197	0.99	1	0.52	Railways
Hartman Spring Nature Preserve	9.0	0.90	1	0.78	Streets and Highways
Anderson Prairie Land and Water Reserve	9.5	0.97	1	0.93	Developed Land, Streets and Highways, Population Density
Sterling Rock Falls Family YMCA Camp Merrill M. Benson Land and Water Reserve	9.0	1	1	1	Streets and Highways, Water Withdrawal
Pruett Woods Nature Preserve	9.0	0.90	1	1	Annual Average Daily Traffic
Bois du Sangamon Nature Preserve	10.0	0.99	1	0.71	Water Withdrawal, Developed Land, Human Population Density, Railways, Streets and Highways
Sugar Loaf Mound Natural Heritage Landmark	10.0	0.99	1	0.95	Annual Average Daily Traffic, Developed Land
Elton E. Fawks Bald Eagle Refuge Nature Preserve	10.0	1	1	0.72	Human Population Density
Freeport Prairie Nature Preserve	10.0	0.99	1	0.95	Human Population Density, Developed Land, Streets and Highways
Prairie of the Rock Nature Preserve	10.0	0.99	1	0.87	Railways
Old Plank Road Prairie Nature Preserve	9.9	0.99	1	0.74	Annual Average Daily Traffic, Human Population Density, Developed Land, Streets and Highways, EPA Facility of Interest

Table 7. Continued

INPC Name	**Highest Disturbance Magnitude**	**Highest Disturbance Magnitude Relative Vulnerability**	**Number of Threats Relative Vulnerability**	**Observed/Potential Relative Vulnerability**	**Primary Threats**
The Slough Natural Heritage Landmark	10.0	0.99	1	0.89	Impervious Surfaces, Human Population Density, Railways, Developed Land
Openlands Lakeshore, Bluff and Ravine Nature Preserve	9.1	0.91	1	0.93	Annual Average Daily Traffic, Impervious Surfaces, Human Population Density, Railways, Water Withdrawal, Developed Land, Streets and Highways
Hahnaman Sand Prairie Nature Preserve	9.7	0.97	0.99	0.45	Water Withdrawal
St. Mary's Cemetery Hill Prairie Natural Heritage Landmark	10.0	0.99	0.99	0.92	Human Population Density, Railways, Water Withdrawal, Developed Land, Streets and Highways
Long Branch Sand Prairie Nature Preserve	10.0	0.99	0.99	0.44	Water Withdrawal
Wheelock Railroad Prairie Natural Heritage Landmark	9.0	0.89	0.99	0.67	Water Withdrawal
Chandlerville Cemetery Hill Prairie Land and Water Reserve	8.4	0.83	0.99	0.48	Developed Land
Charles ""Chinee"" Colvin Sand Prairie Land and Water Reserve	8.0	0.80	0.99	0.52	Water Withdrawal, Developed Land
Excel Sand Prairie Natural Heritage Landmark	8.6	0.85	0.99	0.56	Developed Land
Columbia Quarry - Sugar Loaf Prairie Land and Water Reserve	10.0	0.99	0.99	0.95	Developed Land, Annual Average Daily Traffic
Poag Railroad Prairie Natural Heritage Landmark	10.0	0.99	0.99	0.98	Annual Average Daily Traffic, Human Population Density, Railways, Water Withdrawal, Developed Land, Impervious Surfaces

Table 7. Continued

INPC Name	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Number of Threats Relative Vulnerability	Observed/Potential Relative Vulnerability	Primary Threats
Knox Prairie Natural Heritage Landmark	9.0	0.98	0.98	0.84	Railways, Streets and Highways
Illinois River Sand Areas Land and Water Reserve	8.1	0.81	0.98	0.52	Water Withdrawal
Hinkle Prairie Natural Heritage Landmark	10.0	0.99	0.97	0.62	Water Withdrawal
Beardstown Railroad Prairie Natural Heritage Landmark	9.36	0.93	0.97	0.64	Developed Land, Railways
Stoneside Natural Heritage Landmark	7.0	0.77	0.97	0.52	Annual Average Daily Traffic
Savanna South Railroad Prairie Natural Heritage Landmark	8.9	0.89	0.97	0.48	Developed Land, Annual Average Daily Traffic, Non-Energy Mines, Railways
Josua Lindahl Hill Prairies Nature Preserve	10.0	0.99	0.97	0.88	Annual Average Daily Traffic, Impervious Surfaces, Human Population Density, Developed Land, Streets and Highways
Collie - Flower Acres Natural Heritage Landmark	8.9	0.89	0.96	0.92	Human Population Density, Annual Average Daily Traffic
Black Hawk Forest Nature Preserve	10.0	0.99	0.96	1	Annual Average Daily Traffic, Human Population Density, Water Withdrawal, Developed Land, Streets and Highways
Tucker-Millington Fen Nature Preserve	1.3	0.13	0.95	0.07	Human Population Density
Vermont Cemetery Prairie Nature Preserve	10.0	0.99	0.95	0.79	Human Population Density, Water Withdrawal, Developed Land, Streets and Highways
Prairie Trails Natural Heritage Landmark	9.5	0.95	0.95	0.74	Water Withdrawal, Developed Land
Millington Railroad Fen Natural Heritage Landmark	1.5	0.15	0.95	0.09	Human Population Density
Sparks Pond Land and Water Reserve	10.0	0.99	0.95	0.68	Water Withdrawal
Johns Mound Group Land and Water Reserve	10.0	0.99	0.95	0.66	Developed Land

Table 7. Continued

INPC Name	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Number of Threats Relative Vulnerability	Observed/Potential Relative Vulnerability	Primary Threats
Winquist Prairie Natural Heritage Landmark	9.0	0.89	0.95	0.60	Human Population Density, Developed Land, Streets and Highways
Shoe Factory Road Prairie Nature Preserve	10.0	0.99	0.95	0.64	Annual Average Daily Traffic, Human Population Density, Water Withdrawal, Developed Land, Streets and Highways
Jamar Haven Land and Water Reserve	0.01	0.001	0.94	0.001	Annual Average Daily Traffic, Developed Land, Railways, Water Withdrawal
Julius J. Knobeloch Woods Nature Preserve	9.0	0.90	0.94	0.65	Human Population Density
Stony Hills Nature Preserve	0.01	0.001	0.94	0.0009	Annual Average Daily Traffic, Developed Land, Railways, Water Withdrawal
Newman Cemetery Savanna Natural Heritage Landmark	8.0	0.79	0.94	0.40	Water Withdrawal
Jennings Family Hill Prairie Nature Preserve	5.9	0.59	0.94	0.22	Annual Average Daily Traffic
Mississippi River Sand-Hills Nature Preserve	9.0	0.90	0.94	0.49	Developed Land
Sielbeck Forest Land and Water Reserve	10.0	0.99	0.94	0.66	Water Withdrawal
Forest Park South Nature Preserve	10.0	0.99	0.93	0.83	Annual Average Daily Traffic, Human Population Density, Water Withdrawal, Developed Land, Streets and Highways
Superior Street Prairie Land and Water Reserve	9.9	0.99	0.93	0.75	Annual Average Daily Traffic, Human Population Density, Water Withdrawal, Developed Land, Streets and Highways

Table 8. The 50 most resilient INPC sites in the state listed in ascending order of vulnerability as quantified by number of threats. Relative vulnerabilities are comparing segments within Natural Divisions on a scale of 0-1 with a value of 1 being the highest disturbance impact (vulnerability). In addition to number of threats, vulnerability is quantified by the observed/potential vulnerability of the site (i.e., how the observed number and magnitudes of threats compare to all threats at the site being at the highest magnitude). Vulnerability is also quantified by the highest disturbance magnitude present at the site. Threat values were rescaled 0-10 based on their percentiles comparing all values statewide. Threats with rescaled values of 10 had the highest magnitudes present in the state (90th percentile). The primary threats listed are the threats at the site with this highest disturbance magnitude.

INPC Name	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Number of Threats Relative Vulnerability	Observed/Potential Relative Vulnerability	Primary Threats
Bennet Hills - Robbs Tract Natural Heritage Landmark	1.0	0.11	0.35	0	Human Population Density, Developed Land
Cretaceous Hills Nature Preserve	2.5	0.25	0.40	0	Human Population Density, Agriculture
Wieland Woods Land and Water Reserve	5.0	0.51	0.41	0.28	Human Population Density
Marilandica Acres Land and Water Reserve	0.2	0.02	0.41	0.02	Human Population Density
Marilandica Acres Natural Heritage Landmark	0.1	0.01	0.41	0.01	Human Population Density
Jackson Slough Woods Land and Water Reserve	7.0	0.72	0.42	0.39	Human Population Density
Buck Hill Bottom Land and Water Reserve	0.0	0.002	0.42	0.002	Human Population Density
Nature's Way Natural Heritage Landmark	0.2	0.03	0.43	0.01	Human Population Density
Lusk Creek Canyon Nature Preserve	1.0	0.11	0.43	0	Developed Land, Streets and Highways, Human Population Density
Roderick Prairie Nature Preserve	3.0	0.32	0.44	0.32	Agriculture
Sipple Slough Woods Land and Water Reserve	5.4	0.56	0.45	0.52	Human Population Density, Developed Land
Wagon Lake Land and Water Reserve	7.0	0.72	0.46	0.50	Human Population Density, Agriculture
Bullard Lake Club Natural Heritage Landmark	3.3	0.36	0.46	0.35	Developed Land
Tallmadge Sand Forest Land and Water Reserve	6.9	0.69	0.49	0.44	Human Population Density
Chip-O-Will Land and Water Reserve	6.1	0.63	0.49	0.60	Human Population Density, Developed Land

Table 8. Continued

INPC Name	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Number of Threats Relative Vulnerability	Observed/Potential Relative Vulnerability	Primary Threats
Huddlestun Woods Natural Heritage Landmark	5.9	0.61	0.49	0.29	Streets and Highways
Ira Huddlestun Woods-Leon Tract Natural Heritage Landmark	5.9	0.61	0.49	0.29	Streets and Highways
Ira Huddlestun Woods-Denzel Tract Natural Heritage Landmark	5.9	0.61	0.49	0.29	Streets and Highways
Dry Fork Woods Natural Heritage Landmark	6.5	0.68	0.49	0.49	Streets and Highways
Karcher's Post Oak Woods Nature Preserve	4.0	0.41	0.49	0.35	Streets and Highways
Horse Creek Glade Natural Heritage Landmark	4.0	0.41	0.49	0.25	Water Withdrawal
Campbell Lake Natural Heritage Landmark	8.0	0.82	0.50	0.36	Human Population Density
Recker Woods Natural Heritage Landmark	5.0	0.51	0.50	0.17	Human Population Density
DesPain Wetlands Land and Water Reserve	7.3	0.76	0.50	0.55	Human Population Density
Pilot Knob Limestone Glade Natural Heritage Landmark	9.0	0.89	0.50	0.28	Water Withdrawal
Big Britches Natural Heritage Landmark	8.9	0.89	0.50	0.50	Water Withdrawal
Sholem Farm Natural Heritage Landmark	6.0	0.62	0.50	0.55	Human Population Density, Streets and Highways
Prairie Ridge State Natural Area Land and Water Reserve	5.9	0.61	0.50	0.52	Annual Average Daily Traffic, Agriculture, Streets and Highways
Armin Krueger Speleological Nature Preserve	9.0	0.92	0.51	0.77	Human Population Density

Table 8. Continued

INPC Name	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Number of Threats Relative Vulnerability	Observed/Potential Relative Vulnerability	Primary Threats
Busse Forest Nature Preserve	9.9	0.99	0.51	0.96	Annual Average Daily Traffic, Human Population Density, Water Withdrawal, Developed Land, Streets and Highways, EPA Facility of Interest
Sugar River Preserve Natural Heritage Landmark	8.0	0.80	0.51	0.33	Human Population Density
Amberin Ash Ridge Nature Preserve	9.0	0.90	0.51	0.63	Human Population Density, Streets and Highways
Baber Woods Nature Preserve	6.2	0.62	0.52	0.51	Water Withdrawal, Developed Land
Upper Embarras Woods Nature Preserve	4.5	0.45	0.52	0.17	Annual Average Daily Traffic, Streets and Highways
Cox Creek Hill Prairies Land and Water Reserve	6.3	0.59	0.52	0.29	Water Withdrawal, Human Population Density
Revis Spring Hill Prairie Nature Preserve	10.0	0.99	0.52	0.27	Water Withdrawal
Wiegand Prairie Natural Heritage Landmark	8.0	0.79	0.52	0.35	Human Population Density
Parklands Nature Preserve	10.0	0.99	0.52	0.57	Water Withdrawal
Mehl's Bluff Nature Preserve	10.0	0.99	0.52	0.61	Water Withdrawal
Myer Woods Nature Preserve	7.17	0.71	0.52	0.67	Human Population Density, Water Withdrawal, Developed Land, Streets and Highways
Ambraw Woods Land and Water Reserve	8.9	0.89	0.52	0.52	Developed Land, Streets and Highways
New Athens Woods Land and Water Reserve	8.1	0.83	0.52	0.84	Developed Land, Human Population Density, Annual Average Daily Traffic
Embarras Ridges Land and Water Reserve	5.4	0.54	0.52	0.29	Developed Land, Streets and Highways, Annual Average Daily Traffic

Table 8. Continued

INPC Name	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Number of Threats Relative Vulnerability	Observed/Potential Relative Vulnerability	Primary Threats
Iroquois County State Wildlife Area Land and Water Reserve	4.5	0.45	0.52	0.16	Streets and Highways, Agriculture, Water Withdrawal
Rall Woods Land and Water Reserve	3.9	0.39	0.52	0.19	Human Population Density, Developed Land, Streets and Highways
Cap Sauers Holdings Nature Preserve	9.9	0.99	0.52	0.76	Human Population Density, Developed Land, Human Population Density, Annual Average Daily Traffic, Streets and Highways
Upper Embarras Woods Land and Water Reserve	4.5	0.45	0.53	0.16	Annual Average Daily Traffic, Streets and Highways
Horn Prairie Grove Land and Water Reserve	4.1	0.42	0.53	0.47	Human Population Density, Agriculture, Streets and Highways
Prairie Ridge Land and Water Reserve	0	0	0.53	0	Agriculture, Streets and Highways
Padgett Pin Oak Woods Land and Water Reserve	4.1	0.42	0.53	0.27	Streets and Highways, Agriculture, Water Withdrawal

Table 9. An example natural community type vulnerability ranking. It includes the protected occurrences of dry dolomite prairie, the quality grade of each occurrence, acreage, which INPC site it occurs on, and the vulnerability score (original scoring method) relative within Natural Divisions of the INPC site along with any primary threats at the site (threats with magnitudes greater than the 50th percentile of all other instances in the state, refer to table).

Natural Community Type: Dry dolomite prairie
sRank: S1S2
State Occurrences:

Quality Grade	Area (Acres)	INPC Name	Relative Vulnerability (0-1)	Threats/Disturbances
A	1.8770617	Freeport Prairie Nature Preserve	0.98	Annual Average Daily Traffic, Low Intensity Development, High Intensity Development, Impervious Surfaces, Human Population Density, Primary Roads, Railways, Secondary Roads, Water Withdrawal
B	0.90761385			
D	1.0756367			
C	1.12814824	Lockport Prairie Nature Preserve	0.66	Annual Average Daily Traffic, Low Intensity Development, High Intensity Development, EPA Facility of Interest, Human Population Density, Primary Roads, Railways, Secondary Roads, Water Withdrawal, Water Pollution Release Sites
A	0	Wirth Prairie Nature Preserve	0.26	Human Population Density, Agriculture, Primary Roads
A	1.19503914	Heeren Prairie Nature Preserve	0.13	Agriculture, Primary Roads
B	1.52526124			
C	0.66024635			
C	0.18372682	Colored Sands Bluff Nature Preserve	0.002	Annual Average Daily Traffic, Human Population Density
C	11.3795033	Sugar River Alder Nature Preserve	0.001	Human Population Density, Water Withdrawal

Table 10. The 50 most vulnerable BSS segments in the state listed in descending order of vulnerability by number of threats. Relative vulnerabilities are comparing segments within Ecological Drainage Units (EDU) on a scale of 0-1 with a value of 1 being the highest disturbance impact (vulnerability). In addition to number of threats, vulnerability is quantified by the observed/potential vulnerability of the segment (i.e., how the observed number and magnitudes of threats compare to all threats at the site being at the highest magnitude). Vulnerability is also quantified by the highest disturbance magnitude present at the segment. Threat values were rescaled 0-10 based on their percentiles comparing all values statewide. Threats with rescaled values of 10 had the highest magnitudes present in the state (90th percentile). The primary threats listed are the threats at the segment with this highest disturbance magnitude.

Stream Name	BSS Segment ID	Observed/ Potential Relative Vulnerability	Number of Threats Relative Vulnerability	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Primary Threats
Drummer Creek	191	0.929	1.000	10.0	0.992	Railways
	568	0.698	1.000	10.0	0.944	Dams
Hadley Creek	404	0.497	1.000	9.2	0.894	Impervious Surfaces, Predicted Development (2020-2100), Dams, Road-Stream Crossings
	627	0.816	1.000	7.2	0.713	Water Withdrawal, Road-Stream Crossings
	497	0.844	1.000	8.0	0.935	Water Withdrawal, Human Population Density, Road-Stream Crossings
Salt Fork Vermilion River	93	0.737	1.000	10.0	0.978	Predicted Development (2020-2100)
Cache River	8	0.916	1.000	6.2	0.708	Water Withdrawal, Railways, Predicted Development (2020-2100), Road-Stream Crossings
Beaver Creek	86	0.862	1.000	10.0	0.947	Impervious Surfaces, Predicted Development (2020-2100), Human Population Density, Developed Land, Streets and Highways

Table 10. Continued

Stream Name	BSS Segment ID	Observed/ Potential Relative Vulnerability	Number of Threats Relative Vulnerability	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Primary Threats
	480	0.669	1.000	9.4	0.907	Predicted Development (2020-2100)
Little Wabash River	376	0.992	1.000	9.3	1.000	EPA Facility of Interest, Impervious Surfaces, Human Population Density, Water Withdrawal, Developed Land
North Branch Kishwaukee River	450	0.741	0.993	10.0	0.971	Predicted Development (2020-2100)
Big Grand Pierre Creek	77	0.246	0.977	8.7	1.000	Dams, Non-Energy Mines
North Branch Kishwaukee River	447	0.728	0.975	9.8	0.918	Predicted Development (2020-2100)
North Branch Kishwaukee River	449	0.763	0.971	10.0	0.973	Predicted Development (2020-2100)
Bay Creek	445	0.163	0.958	5.2	0.598	Road-Stream Crossings, Dams
Hadley Creek	407	0.610	0.953	7.9	0.761	Impervious Surfaces, Predicted Development (2020-2100), Dams
Big Creek	444	0.489	0.953	5.2	0.595	Human Population Density
Little Wabash River	74	1.000	0.946	9.2	0.988	Impervious Surfaces, Human Population Density, Water Withdrawal, Developed Land, EPA Facility of Interest
Big Creek	75	0.535	0.945	7.2	0.827	Dams, Human Population Density, Road-Stream Crossings, Non-Energy Mines

Table 10. Continued

Stream Name	BSS Segment ID	Observed/ Potential Relative Vulnerability	Number of Threats Relative Vulnerability	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Primary Threats
Big Creek	630	0.855	0.943	7.1	0.704	Water Withdrawal
North Branch Nippersink Creek	169	0.693	0.942	9.3	0.899	Impervious Surfaces, Human Population Density, Developed Land
Lusk Creek	82	0.061	0.938	2.2	0.257	Impervious Surfaces, Agriculture, Human Population Density, Water Withdrawal, Dams, Developed Land, Streets and Highways, Road-Stream Crossings
Hadley Creek	76	0.613	0.937	7.8	0.758	Impervious Surfaces, Predicted Development (2020-2100), Dams
East Fork Mazon River	182	0.531	0.936	10.0	0.991	Agriculture
	597	0.296	0.932	3.1	0.360	Human Population Density
Little Saline River	84	1.000	0.932	6.0	0.683	Human Population Density, Dams, Road-Stream Crossings
Bay Creek	80	0.090	0.930	6.2	0.712	Streets and Highways, Dams, Road-Stream Crossings
North Branch Kishwaukee River	456	0.813	0.930	10.0	1.000	Predicted Development (2020-2100)
Big Grand Pierre Creek	81	0.506	0.928	4.1	0.464	Human Population Density
Butler Branch	95	1.000	0.927	10.0	0.992	Predicted Development (2020-2100)

Table 10. Continued

Stream Name	BSS Segment ID	Observed/ Potential Relative Vulnerability	Number of Threats Relative Vulnerability	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Primary Threats
Butler Branch	606	0.991	0.926	8.2	0.954	Human Population Density
Henderson Creek	131	0.812	0.926	8.9	0.890	Water Withdrawal
Henderson Creek	123	0.811	0.925	8.9	0.887	Water Withdrawal
East Fork Mazon River	14	0.625	0.924	9.2	0.889	Agriculture
Silver Creek	342	0.914	0.923	8.7	0.823	Developed Land, Streets and Highways
North Branch Kishwaukee River	448	0.824	0.923	10.0	0.993	Predicted Development (2020-2100)
North Branch Kishwaukee River	458	0.823	0.922	10.0	0.992	Predicted Development (2020-2100)
Little Saline River	380	0.163	0.922	3.0	0.345	Dams
North Branch Kishwaukee River	451	0.793	0.921	10.0	0.991	Predicted Development (2020-2100)
Big Creek	442	0.493	0.921	5.2	0.597	Road-Stream Crossings, Human Population Density
North Branch Kishwaukee River	461	0.833	0.921	10.0	0.991	Predicted Development (2020-2100)
Little Saline River	382	0.132	0.921	3.0	0.345	Dams
Little Saline River	377	0.172	0.921	3.0	0.348	Road-Stream Crossings, Dams
Silver Creek	338	0.663	0.920	9.4	0.882	Road-Stream Crossings, Railways
Ellison Creek	149	0.783	0.920	9.1	0.904	Water Withdrawal
Big Creek	443	0.412	0.920	5.0	0.574	Human Population Density, Road-Stream Crossings

Table 10. Continued

Stream Name	**BSS Segment ID**	**Observed/ Potential Relative Vulnerability**	**Number of Threats Relative Vulnerability**	**Highest Disturbance Magnitude**	**Highest Disturbance Magnitude Relative Vulnerability**	**Primary Threats**
North Branch Kishwaukee River	457	0.801	0.916	10.0	0.985	Predicted Development (2020-2100)
	605	0.921	0.914	8.1	0.942	Human Population Density
North Branch Nippersink Creek	50	0.605	0.913	9.1	0.880	Impervious Surfaces, Human Population Density, Developed Land
Silver Creek	341	0.674	0.911	9.2	0.871	Developed Land, Streets and Highways, Railways

Table 11. The 50 most resilient BSS segments in the state listed in ascending order of vulnerability by number of threats. Relative vulnerabilities are comparing segments within Ecological Drainage Units (EDU) on a scale of 0-1 with a value of 1 being the highest disturbance impact (vulnerability). In addition to number of threats, vulnerability is quantified by the observed/potential vulnerability of the segment (i.e., how the observed number and magnitudes of threats compare to all threats at the site being at the highest magnitude). Vulnerability is also quantified by the highest disturbance magnitude present at the segment. Threat values were rescaled 0-10 based on their percentiles comparing all values statewide. Threats with rescaled values of 10 had the highest magnitudes present in the state (90th percentile). The primary threats listed are the threats at the segment with this highest disturbance magnitude.

Stream Name	**BSS Segment ID**	**Observed/Potential Relative Vulnerability**	**Number of Threats Relative Vulnerability**	**Highest Disturbance Magnitude**	**Highest Disturbance Magnitude Relative Vulnerability**	**Primary Threats**
Mole Creek	41	0.722	0.577	10.0	0.953	Agriculture
Sangamon River	200	0.877	0.577	9.0	0.857	Water Withdrawal, Agriculture
Mackinaw River	33	0.986	0.589	10.0	0.951	Water Withdrawal
Kickapoo Creek	203	0.855	0.631	9.9	0.935	Impervious Surfaces, Predicted Development (2020-2100), Human Population Density, Developed Land, Streets and Highways
Dickerson Slough	193	0.610	0.635	10.0	0.966	Agriculture
Little Vermilion River	364	0.705	0.636	9.4	0.928	Agriculture
Sangamon River	196	0.700	0.640	8.6	0.816	Agriculture
	544	0.674	0.640	8.6	0.816	Agriculture
	489	0.499	0.641	8.0	0.757	Agriculture
Salt Creek	217	0.621	0.641	9.6	0.907	Agriculture, Road-Stream Crossings
Salt Creek	215	0.610	0.641	7.7	0.727	Agriculture
Kickapoo Creek	199	0.957	0.642	10.0	0.953	Predicted Development (2020-2100)
	557	0.524	0.642	9.6	0.910	Road-Stream Crossings, Agriculture
Court Creek	16	0.566	0.643	7.9	0.749	Road-Stream Crossings, Railways
Kickapoo Creek	202	0.805	0.643	9.6	0.912	Predicted Development (2020-2100)
Cox Creek	52	0.438	0.645	7.7	0.729	Road-Stream Crossings, Water Withdrawal, Dams
Little Vermilion River	365	0.700	0.645	9.6	0.941	Agriculture
Sangamon River	195	0.723	0.646	8.7	0.824	Agriculture
Cox Creek	225	0.411	0.649	6.8	0.644	Water Withdrawal, Dams

Table 11. Continued

Stream Name	BSS Segment ID	Observed/Potential Relative Vulnerability	Number of Threats Relative Vulnerability	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Primary Threats
Cox Creek	227	0.432	0.650	6.8	0.644	Water Withdrawal, Dams
Salt Creek	218	0.704	0.650	7.8	0.737	Agriculture, Road-Stream Crossings
Silver Creek	350	0.944	0.650	8.2	0.771	Developed Land, Streets and Highways
Crane Creek	205	0.600	0.652	9.8	0.924	Agriculture, Water Withdrawal
Cox Creek	224	0.430	0.656	6.9	0.651	Water Withdrawal, Dams
Sangamon River	49	0.719	0.657	8.8	0.838	Agriculture
Salt Creek	214	0.683	0.657	7.9	0.745	Agriculture
Sangamon River	194	0.676	0.658	8.9	0.840	Agriculture
	558	0.924	0.659	9.8	0.933	Predicted Development (2020-2100), Agriculture
Mackinaw River	26	0.961	0.660	10.0	0.960	Water Withdrawal, Road-Stream Crossings
Tenmile Creek	51	0.765	0.661	8.9	0.844	Agriculture, Road-Stream Crossings
Salt Creek	213	0.676	0.661	7.9	0.749	Agriculture
Crane Creek	43	0.640	0.661	10.0	0.963	Water Withdrawal
Salt Creek	212	0.692	0.662	7.9	0.750	Agriculture
Salt Creek	221	0.664	0.662	7.9	0.751	Road-Stream Crossings, Agriculture
Ninemile Creek	363	0.468	0.663	5.0	0.469	Agriculture
Camp Creek	39	0.820	0.663	8.0	0.762	Agriculture, Human Population Density, Water Withdrawal, Road-Stream Crossings
	551	0.644	0.664	9.9	0.940	Agriculture
Salt Creek	210	0.707	0.664	7.9	0.753	Agriculture
Salt Creek	220	0.696	0.666	8.0	0.754	Agriculture
Dickerson Slough	190	0.596	0.666	10.0	0.997	Agriculture
Salt Creek	208	0.682	0.666	8.0	0.755	Agriculture
Salt Creek	216	0.675	0.667	8.0	0.756	Agriculture
East Fork Spoon River	23	0.536	0.667	8.9	0.841	Agriculture, Road-Stream Crossings
Vermilion River	34	0.591	0.668	7.7	0.732	Water Withdrawal
Salt Creek	219	0.696	0.668	8.0	0.757	Agriculture, Road-Stream Crossings

Table 11. Continued

Stream Name	BSS Segment ID	Observed/Potential Relative Vulnerability	Number of Threats Relative Vulnerability	Highest Disturbance Magnitude	Highest Disturbance Magnitude Relative Vulnerability	Primary Threats
	490	0.649	0.668	10.0	0.947	Agriculture
Friends Creek	27	0.784	0.670	9.4	0.886	Predicted Development (2020-2100), Agriculture
Drummer Creek	24	1.000	0.670	10.0	0.963	Railways
Friends Creek	223	0.528	0.670	10.0	0.949	Agriculture
	548	0.475	0.671	8.0	0.761	Road-Stream Crossings, Agriculture

Table 12. INAI sites in descending order of the 50 highest priority sites across the state by greatest rarity weighted richness of critically imperiled/imperiled (S1/S2) natural community types. Relative Rarity Weighted Richness values are ranked from high to low (1-0 scale) relative within Natural Divisions. Rarity ranks list the numerical order of site priorities from high to low richness and relative rank (percentile) gives the percentile rank of the site's rarity richness value relative within each Natural Division.

Name	**Conservation ID**	**S1-S2 Relative Rarity Richness**	**Rarity Rank**	**Relative Rank (Percentile)**
Kankakee River Prairie	29	1	1	0.997797357
Illinois Dunes North	214	1	1	0.997797357
Apple River Canyon	325	1	1	0.997797357
Cap Au Gris	377	1	1	0.997797357
Green River Prairie and Wetlands	463	1	1	0.997797357
Kickasola Cemetery Barrens and Seeps	565	1	1	0.997797357
Little Grand Canyon - Cedar Creek	794	1	1	0.997797357
Lower Cache River Swamp	801	1	1	0.997797357
Lyndon - Agnew Railroad Prairie	1009	1	1	0.997797357
Sugar River	1194	1	1	0.997797357
Rockcastle Creek Area	1203	1	1	0.997797357
Dismal Creek Savanna	1237	1	1	0.997797357
Paint Rock Bluffs	1502	1	1	0.997797357
Schuyler025	1537	1	1	0.997797357
Kickapoo Hill Prairie	1554	1	1	0.997797357
Todd Fink Natural Area	621	0.95	16	0.964757709
Carlinville Railroad Prairie	917	0.94	17	0.962555066
Romeoville Prairie	715	0.91	18	0.960352423
Seville Savanna	1428	0.9	19	0.95814978
Brown019	1536	0.9	19	0.95814978
Kankakee River Segment	455	0.89	21	0.953744493
Hanover Bluff	518	0.88	22	0.95154185
Bauman Pond	99	0.86	23	0.949339207
Wise Ridge	406	0.86	23	0.949339207
Beadles Barrens	573	0.86	23	0.949339207
Forbes Woodland	1620	0.86	23	0.949339207
Burke Branch	504	0.85	27	0.940528634
Hopkins Park Savanna	1574	0.85	27	0.940528634
Ava Cave	44	0.8	29	0.936123348
Culley Barrens	1412	0.8	29	0.936123348
Hennepin Canal - Wyanet Prairie	380	0.78	31	0.931718062
Harper - Rector Woods	103	0.75	32	0.929515419
Weinburg - King Natural Area	131	0.75	32	0.929515419
Lockport Prairie	551	0.75	32	0.929515419
Grubb Hollow Prairie	904	0.75	32	0.929515419
Cedar Glen Kibbe	910	0.75	32	0.929515419
Diers Seep Spring	1032	0.75	32	0.929515419

Table 12. Continued

Name	Conservation ID	S1-S2 Relative Rarity Richness	Rarity Rank	Relative Rank (Percentile)
Pearsall Sand Prairie	1058	0.75	32	0.929515419
Haw Creek Sedge Meadow	1378	0.75	32	0.929515419
Cypress Hill	608	0.73	40	0.911894273
Beach Cemetery Prairie	236	0.69	41	0.90969163
Sibley Grove	1411	0.69	41	0.90969163
Illinois Beach	260	0.68	43	0.905286344
Matthiessen Dells	21	0.67	44	0.9030837
Cave Hill	32	0.67	44	0.9030837
Sweet Fern Savanna	39	0.67	44	0.9030837
Fults Hill Prairie - Kidd Lake Marsh	355	0.67	44	0.9030837
Kankakee River Nature Preserve Addition	411	0.67	44	0.9030837
Salt Fork Vermilion River Segment	661	0.67	44	0.9030837
Miller Pond	720	0.67	44	0.9030837

Table 13. List of 2018 updated sRanks for listed wildlife species and all fish and mussel SGCN, as well as unranked breeding bird and herptiles, in Illinois. sRanks were calculated using NatureServe's Conservation Status Assessment methodology and their sRank Calculators versions 3.186 and 3.2. Previously finalized, updated sRanks are listed under NatureServe sRank Calculator version 3.186 unless they were adjusted by Heritage staff; in these cases the sRank listed under Heritage Review adjustments is the species' final sRank. Heritage staff review of sRanks generated by the NatureServe sRank Calculator version 3.2 are pending. The current state listing status and previous sRank from the 1980s are listed for reference.

FISH						
Scientific Name	**Common Name**	**State Listing Status**	**Previous sRank**	**sRank Calculator v3.186**	**Heritage Review**	**sRank Calculator v3.2**
Acipenser fulvescens	Lake Sturgeon	E	S2	S1?	S1?	S1S2
Alosa alabamae	Alabama shad	SGCN		SH	SH	SH
Ameiurus nebulosus	Brown Bullhead	SGCN	S3	S3S4	S3S4	S3S4
Ammocrypta clarum	Western Sand Darter	E	S2	S2S3	S2S3	S2S3
Ammocrypta pellucidum	Eastern Sand Darter	T	S1	S3S4	S3S4	S3?
Anguilla rostrata	American Eel	T	S2	S1S3	S1S3	S2S3
Atractosteus spatula	Alligator Gar	H	SH	SU	S1	SU
Campostoma oligolepis	Largescale Stoneroller	SGCN	S2S3	S3S4	S3S4	S3S4
Catostomus catostomus	Longnose Sucker	T	S3	S1S2	S1S2	S1S2
Centrarchus macropterus	Flier	SGCN	S3	S2S3	S2S3	S2S3
Clinostomus elongatus	Redside Dace	SGCN		SH	SU	SH
Coregonus artedi	Cisco	T	S1?	SH	SH	SH
Coregonus clupeaformis	Lake Whitefish	SGCN	S1S2	S2S3	S2S3	S2S3
Coregonus hoyi	Bloater	SGCN	S1	S2	S2S3	S2S3
Cottus cognatus	Slimy Sculpin	SGCN	S1	S1	S1	S1
Couesius plumbeus	Lake Chub	SGCN	SU	S2	S2S3	S2S3
Crystallaria asprella	Crystal Darter	SGCN	S2	S1	S1	S1
Cyprinella venusta	Blacktail Shiner	SGCN	S1	S1	S1	S1
Elassoma zonatum	Banded Pygmy Sunfish	SGCN	S1S2	S1	S1	S1
Erimystax x-punctatus	Gravel Chub	T	S1S2	S3?	S3?	S2S3
Esox lucius	Northern Pike	SGCN	S4	S2?	S2?	S2?
Esox masquinongy	Muskellunge	SGCN	SNR	SU	SU	SU
Etheostoma camurum	Bluebreast Darter	E	S1	S2S3	S2S3	S2S3
Etheostoma crossopterum	Fringed Darter	SGCN		S1	S1	S1
Etheostoma exile	Iowa Darter	T	S2	S2?	S2?	S2S3
Etheostoma histrio	Harlequin Darter	E	S1	S1S2	S1S2	S1S2
Etheostoma kennicotti	Stripetail Darter	SGCN	S2S3	S1S2	S1S2	S1S2
Etheostoma microperca	Least Darter	SGCN	S2S3	S3?	S3?	S2S3
Etheostoma proeliare	Cypress Darter	SGCN	S2	S1	S1	S1
Etheostoma squamiceps	Spottail Darter	SGCN	S2	S2S3	S2S3	S2S3

Table 13. Continued

Scientific Name	Common Name	State Listing Status	Previous sRank	sRank Calculator v3.186	Heritage Review	sRank Calculator v3.2
Forbesichthys agassizii	Spring Cavefish	SGCN	S2S3	S1	S1	S1
Fundulus diaphanus	Banded Killifish	T	S1	S3S4	S3S4	S3?
Fundulus dispar	Starhead Topminnow	T	S2	S3S4	S3S4	S2S3
Hiodon tergisus	Mooneye	SGCN	S2S3	S2?	S2S3	S2S3
Hybognathus hankinsoni	Brassy Minnow	T	S1S2	S1	S1	S1
Hybognathus hayi	Cypress Minnow	E	S1	S1	S1	S1
Hybognathus placitus	Plains Minnow	SGCN	S2	SH	S1	S1
Hybopsis amblops	Bigeye Chub	E	S1	S3?	S3?	S2S3
Hybopsis amnis	Pallid Shiner	E	S1	S3S4	S3?	S2S3
Ichthyomyzon castaneus	Chestnut Lamprey	SGCN	S3	S1S2	S1S2	S2
Ichthyomyzon fossor	Northern Brook Lamprey	E	S1	S1	SH	SH
Ichthyomyzon unicuspis	Silver Lamprey	SGCN	S3	S1S2	S1S2	S1S3
Lampetra aepyptera	Least Brook Lamprey	T	S1	S2?	S2?	S2?
Lepomis miniatus	Redspotted Sunfish	E	S2	S2S3	S2S3	S2S3
Lepomis symmetricus	Bantam Sunfish	T	S1	S1	S1	S1
Lethenteron appendix	American Brook Lamprey	T	S2	S1?	S1?	S1S2
Lota lota	Burbot	SGCN	S1S2	S2	S1	S1S2
Luxilus zonatus	Bleeding Shiner	SGCN		S1	S1	S1
Lythrurus fumeus	Ribbon Shiner	SGCN	S3	S1	S1	S1
Macrhybopsis gelida	Sturgeon Chub	E	S1	S1	S1	S1
Macrhybopsis hyostoma	Shoal Chub	SGCN	S3	S1	S1S3	S2S3
Macrhybopsis meeki	Sicklefin Chub	SGCN	S1	S1	S1	S1
Moxostoma carinatum	River Redhorse	T	S2	S3S4	S3S4	S3S4
Moxostoma valenciennesi	Greater Redhorse	E	S1S2	S3S4	S3S4	S3?
Myoxocephalus thompsonii	Deepwater Sculpin	SGCN		S1S2	S1S2	S1S2
Nocomis micropogon	River Chub	E	S1	SH	SH	SH
Notropis anogenus	Pugnose Shiner	E	S1	S1S2	S1S2	S1S2
Notropis boops	Bigeye Shiner	E	S2	S2S3	S2S3	S2S3
Notropis buchanani	Ghost Shiner	SGCN	S3	S2?	S2?	S2S3
Notropis chalybaeus	Ironcolor Shiner	T	S2	S3S4	S3S4	S3?
Notropis heterodon	Blackchin Shiner	T	S2	S2S3	S2S3	S2?
Notropis heterolepis	Blacknose Shiner	E	S2	S1S2	S1S2	S1S3
Notropis maculatus	Taillight shiner	E	S1	SH	SH	SH
Notropis shumardi	Silverband Shiner	SGCN	S2	S3S4	S3S4	S3?
Notropis texanus	Weed Shiner	E	S1S2	S3S4	S3S4	S3S4
Noturus eleutherus	Mountain Madtom	SGCN	S2	S1	S1	S1
Noturus stigmosus	Northern Madtom	E	S1	S1	S1	S1S2

Table 13. Continued

Scientific Name	Common Name	State Listing Status	Previous sRank	sRank Calculator v3.186	Heritage Review	sRank Calculator v3.2
Opsopoeodus emiliae	Pugnose Minnow	SGCN	S2S3	S3S4	S3S4	S3S4
Perca flavescens	Yellow Perch	SGCN	S3	S2S3	S2S3	S2S3
Percina shumardi	River Darter	SGCN	S2S3	S3	S3?	S2S3
Percopsis omiscomaycus	Trout-Perch	SGCN	S2	S1	S1	S1
Platygobio gracilis	Flathead Chub	X	SX	SH	SH	SH
Polyodon spathula	Paddlefish	SGCN	S2S3	S1	S1?	S1
Prosopium cylindraceum	Round Whitefish	X	SX	S1	S2	S2
Pungitius pungitius	Ninespine Stickleback	SGCN	S1S2	S1	S1S2	S1S2
Rhinichthys cataractae	Longnose Dace	SGCN	S2	S2S3	S2S3	S2?
Salvelinus fontinalis	Brook Trout	SGCN	SNA	SH	SH	SH
Salvelinus namaycush	Lake Trout	SGCN	S2S3	S2?	S2?	S2?
Scaphirhynchus albus	Pallid Sturgeon	E	S1	S2?	S2?	S2?
Umbra limi	Central Mudminnow	SGCN	S4	S3S4	S3S4	S3S4
REPTILES AND AMPHIBIANS						
Ambystoma jeffersonianum	Jefferson Salamander	T	S2	S2S3	S2S3	S2?
Ambystoma platineum	Silvery Salamander	E	S1	S2S3	S2S3	S2?
Apalone mutica	Smooth Softshell	E	S3	S1S2	S1S2	S1S3
Clemmys guttata	Spotted Turtle	E	S1	S1S2	S1S2	S1S2
Clonophis kirtlandi	Kirtland's Snake	T	S2	S1S2	S1S2	S1S2
Crotalus horridus	Timber Rattlesnake	T	S3	S2S3	S2S3	S2S3
Cryptobranchus alleganiensis	Hellbender	E	S1	SH	SH	SH
Desmognathus conanti	Spotted Dusky Salamander	E	S2	S1S2	S1S2	S1S2
Emydoidea blandingii	Blanding's Turtle	E	S3	S2S3	S2S3	S3?
Gastrophryne carolinensis	Eastern Narrowmouth Toad	T	S2	S1S2	S1S2	S1S2
Hemidactylium scutatum	Four-toed Salamander	T	S2	S1S2	S1S2	S1S2
Heterodon nasicus	Plains Hog-nosed Snake	T	S2	S1S2	S1S2	S2
Hyla avivoca	Bird-voiced Treefrog	T	S3	S2?	S2?	S2?
Kinosternon flavescens	Yellow Mud Turtle	E	S1	S1	S1	S1?
Macrochelys temminckii	Alligator Snapping Turtle	E	S1	S1	S1	S1
Masticophis flagellum	Coachwhip	E	S1	SH	SH	SH
Necturus maculosus	Mudpuppy	T	S5	S1S2	S1S2	S1S2
Nerodia cyclopion	Mississippi Green Watersnake	T	S1	S1	S1	S1
Nerodia erythrogaster neglecta	Copperbelly Water Snake	SGCN	S2	S2S3	S2S3	S2S3
Nerodia fasciata	Southern Watersnake	E	S1	SH	SH	SH
Pantherophis emoryi	Great Plains Ratsnake	E	S2	S1	S1	S1
Pseudacris illinoensis	Illinois Chorus Frog	T	SNR	S2S3	S2S3	S2S3
Pseudemys concinna	River Cooter	E	S1	S1	S1	S1?
Sistrurus catenatus catenatus	Eastern Massasauga	E	S2	S1?	S1	S1S2

Table 13. Continued

Scientific Name	Common Name	State Listing Status	Previous sRank	sRank Calculator v3.186	Heritage Review	sRank Calculator v3.2
Tantilla gracilis	Flathead Snake	T	S2	S1	S1	S1
Terrapene ornata	Ornate Box Turtle	T	S4	S1S2	S1S2	S1S3
Thamnophis sauritus	Eastern Ribbon Snake	T	S1	S1?	S1?	S1S2
Tropidoclonion lineatum	Lined Snake	T	S1?	S1	S1	S1
INVERTEBRATES						
Aflexia rubranura	Redveined Prairie Leafhopper	T	S2	SH	SH	SH
Athysanella incongrua	Leafhopper	E	S1	SH	SH	SH
Bombus affinis	Rusty Patched Bumblebee	E	SNR	S2S3	S2S3	S2S3
Calephelis muticum	Swamp Metalmark	E	S1	S1S2	S1S2	S1S2
Centruroides vittatus	Common Striped Scorpion	E	S1	S1S2	S1S2	S1S2
Crangonyx packardi	Packard's Cave Amphipod	E	S1	S1	S1	S1
Diploperla robusta	Robust Springfly	E	SNR	S1	S1	S1
Gammarus acherondytes	Illinois Cave Amphipod	E	S1S3	S1S2	S1S2	S1S2
Hesperia metea	Cobweb Skipper	E	S3	SH	SH	SH
Hesperia ottoe	Ottoe Skipper	E	S2	SH	SH	SH
Incisalia polios	Hoary Elfin	E	S1	S1?	S1	S1
Lycaeides melissa samuelis	Karner Blue Butterfly	E	S1	SH	SH	SH
Nannothemis bella	Elfin Skimmer	T	S3	S1	S1?	S1?
Orconectes indianensis	Indiana Crayfish	E	S2	S2?	S2?	S2?
Orconectes kentuckiensis	Kentucky Crayfish	E	S2	S1	S1	S1
Orconectes placidus	Bigclaw Crayfish	E	S2	S1S2	S1S2	S1S2
Papaipema eryngii	Eryngium Stem Borer	T	S1	S2S3	S1S2	S2S3
Prostoia completa	Central Forestfly		S1	SH	SH	SH
Pygmarrhopalites madonnensis	Madonna Cave Springtail	E	SNR	SH	SH	SH
Somatochlora hineana	Hine's Emerald Dragonfly	E	S1	S1S2	S1S2	S1S2
Speyeria idalia	Regal Fritillary	T	S2	S2S3	S2S3	S2S3
MOLLUSKS						
Discus macclintocki	Iowa Pleistocene Snail	E	S1	SH		
Fontigens antroecetes	Hydrobiid cave snail	E	SNR	S1	S1	S1
Lithasia obovata	Shawnee Rocksnail	SGCN	S1	S1	S1	S1
MUSSELS						
Alasmidonta marginata	Elktoe	SGCN	S4	S2S3	S2S3	S2S3
Alasmidonta viridis	Slippershell	T	S2	S2S3	S2S3	S2S3
Cumberlandia monodonta	Spectaclecase	E	S1	S1	S1	S1?
Cyclonaias tuberculata	Purple Wartyback	T	S2	S2?	S2?	S2S3
Cyprogenia stegaria	Fanshell	E	S1	S1	S1	S1
Ellipsaria lineolata	Butterfly	T	S2	S2?	S2?	S2S3
Elliptio crassidens	Elephantear	E	S2	S2?	S2?	S2?
Elliptio dilatata	Spike	T	S2	S3?	S3?	S3?

Table 13. Continued

Scientific Name	Common Name	State Listing Status	Previous sRank	sRank Calculator v3.186	Heritage Review	sRank Calculator v3.2
Epioblasma rangiana	Northern Riffleshell			S1	S1	S1?
Epioblasma torulosa rangiana	Northern Riffleshell	E	SNR	S1	S1	S1S2
Epioblasma triquetra	Snuffbox	E	S1	S1	S1	S1
Fusconaia ebena	Ebonyshell	E	S2	S2?	S2?	S2S3
Lampsilis abrupta	Pink Mucket	E	S1	SH	SH	SH
Lampsilis fasciola	Wavy-rayed Lampmussel	E	S2	S1S2	S1S2	S1S2
Lampsilis higginsii	Higgins Eye	E	S1	S1S2	S1S2	S2?
Lampsilis hydiana	Louisiana Fatmucket	SGCN		S3?	S3?	S3?
Lampsilis ovata	Pocketbook	SGCN	S2	S1	S1	S1S2
Lasmigona compressa	Creek Heelsplitter	SGCN	S3	S3?	S3?	S3?
Lasmigona costata	Flutedshell	SGCN	S4	S2S3	S2S3	S2S3
Leptodea leptodon	Scaleshell Mussel	E	S1	S1	S1	S1
Ligumia recta	Black Sandshell	T	S2	S3S4	S3S4	S3S4
Plethobasus cooperianus	Orange-foot Pimpleback	E	S1	S1	S1	S1
Plethobasus cyphyus	Sheepnose	E	S1	S1?	S1?	S1S2
Pleurobema clava	Clubshell	E	S1	S1?	S1?	S1S2
Pleurobema cordatum	Ohio Pigtoe	E	S1	S1?	S1?	S1S2
Potamilus capax	Fat Pocketbook	E	S1	S1S2	S1S2	S2S3
Potamilus purpuratus	Bleufer	SGCN	SNR	S1	S1	S1
Ptychobranchus fasciolaris	Kidneyshell	E	S1	S1S2	S1S2	S1S2
Quadrula cylindrica	Rabbitsfoot	E	S1	S1	S1?	S1S2
Quadrula metanevra	Monkeyface	SGCN	S3	S2?	S2?	S2S3
Quadrula nobilis	Gulf Mapleleaf	SGCN		S1	S1	S1
Simpsonaias ambigua	Salamander Mussel	E	S1	S1	S1	S1
Toxolasma lividus	Purple Lilliput	E	S1	S2?	S2?	S2?
Tritogonia verrucosa	Pistolgrip	SGCN	S4	S3?	S3?	S3?
Venustaconcha ellipsiformis	Ellipse	SGCN	S3	S2S3	S2S3	S2?
Villosa fabalis	Rayed Bean	X	SX	SH	SH	SH
Villosa iris	Rainbow	E	S1	S1?	S1?	S1S2
Villosa lienosa	Little Spectaclecase	T	S2	S3S4	S3S4	S3?
BIRDS						
Ammodramus henslowii	Henslow's Sparrow	SGCN	S2	S3?	S3?	S2S3
Asio flammeus breeding	Short-eared Owl breeding	E	S1	S1S2	S1S2	S1S2
Asio flammeus wintering	Short-eared Owl wintering	E	SH	S2S3	S2S3	S2S3
Bartramia longicauda	Upland Sandpiper	E	S2S3	S3?	S2S3	S2S3
Botaurus lentiginosus	American Bittern	E	S1S2	S1S2	S1S2	S2?
Buteo swainsoni	Swainson's Hawk	E	S1	S1	SH	S1
Calidris canutus rufa	Rufa Red Knot	T	SNRN	SH	SX	SH
Caprimulgus carolinensis	Chuck-will's-widow	T	S4	S1S2	S1S2	S1S2

Table 13. Continued

Scientific Name	Common Name	State Listing Status	Previous sRank	sRank Calculator v3.186	Heritage Review	sRank Calculator v3.2
Charadrius melodus	Piping Plover	E	S1	S1	S1	S1
Chlidonias niger	Black Tern	E	S1	S1	S1	S1
Circus cyaneus breeding	Northern Harrier breeding	E		S2S3	S1S3	S1S3
Circus cyaneus wintering	Northern Harrier wintering	E		S2S4	S2S3	S2S3
Coccyzus erythropthalmus	Black-billed Cuckoo	T	S4	S1S2	S1S2	S1S2
Dendroica cerulea	Cerulean Warbler	T	S3	S1S2	S1S2	S1S2
Egretta caerulea	Little Blue Heron	E	S1	S1S2	S1S2	S1S2
Egretta thula	Snowy Egret	E	S1	SH	SH	SH
Falco peregrinus	Peregrine Falcon	SGCN	S1	S3S4	S3S4	S2S3
Gallinula galeata	Common Gallinule	E	S3	S2S3	S2	S2
Grus canadensis	Sandhill Crane	SGCN	S3	S3S4	S3S4	S3?
Haliaeetus leucocephalus	Bald Eagle	SGCN	S2S3	S4S5	S4S5	S4?
Ictinia mississippiensis	Mississippi Kite	T	S2S3	S3?	S2S3	S2S3
Ixobrychus exilis	Least Bittern	T	S2	S3S4	S3S4	S3?
Lanius ludovicianus	Loggerhead Shrike	E	S3	S1S2	S1S2	S1S3
Laterallus jamaicensis	Black Rail	E	S1	S1	S1	S1
Limnothlypis swainsonii	Swainson's Warbler	E	S1	S1	S1	S1
Nyctanassa violacea	Yellow-crowned Night-Heron	E	S1	S1S2	S1S2	S2?
Nycticorax nycticorax	Black-crowned Night-Heron	E	S2	S2?	S2?	S2?
Pandion haliaetus	Osprey	E	S1	S3S4	S3S4	S3S4
Phalaropus tricolor	Wilson's Phalarope	E	S1	S2S3	S2S3	S2?
Rallus elegans	King Rail	E	S2	S2S3	S2	S2
Sterna forsteri	Forster's Tern	E	S1	S1?	S1	S1?
Sterna hirundo	Common Tern	E	S1	S1	S1	S1
Sternula antillarum	Least Tern	E	S1	S2?	S1S2	S2?
Thryomanes bewickii	Bewick's Wren	E	S1	S1	S1	S1
Tympanuchus cupido	Greater Prairie-Chicken	E	S1	S1	S1	S1S2
Tyto alba	Barn Owl	T	S1S2	S3S4	S3S4	S3S4
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	E	S2	S1S2	S1S2	S2?
MAMMALS						
Canis lupus	Gray/timber Wolf	T	S1	S1S2	SH	S1S2
Corynorhinus rafinesquii hibernaculum	Rafinesque's Big-eared Bat hibernaculum	E		S1	S1	S1
Corynorhinus rafinesquii maternity	Rafinesque's Big-eared Bat maternity	E		S1S2	S1S2	S1S2
Myotis austroriparius hibernaculum	Southeastern Myotis hibernaculum	E		S2	S2	S2
Myotis austroriparius maternity	Southeastern Myotis maternity	E		S2	S2	S2

Table 13. Continued

Scientific Name	Common Name	State Listing Status	Previous sRank	sRank Calculator v3.186	Heritage Review	sRank Calculator v3.2
Myotis grisescens hibernaculum	Gray Bat hibernaculum	E		S1S2	S1S2	S1S2
Myotis grisescens maternity	Gray Bat maternity	E		S1	S2	S1
Myotis leibii hibernaculum	Eastern Small-footed Myotis hibernaculum	T		S1S2	S1S2	S1S2
Myotis leibii maternity	Eastern Small-footed Myotis maternity	T		S2?	S2?	S2?
Myotis septentrionalis hibernaculum	Northern Long-eared Myotis hibernaculum	T		S1	S1	S1?
Myotis septentrionalis maternity	Northern Long-eared Myotis maternity	T		S1S3	S1S2	S3?
Myotis sodalis hibernaculum	Indiana Bat hibernaculum	E		S1S2	S2	S1S2
Myotis sodalis maternity	Indiana Bat maternity	E		S2S3	S2	S2S3
Neotoma floridana	Eastern Wood Rat	E	S1	S2?	S2?	S2?
Ochrotomys nuttalli	Golden Mouse	SGCN	S2	S2S3	S2S3	S2S3
Oryzomys palustris	Marsh Rice Rat	SGCN	S2	S2S3	S2S3	S2S3
Poliocitellus franklinii	Franklin's Ground Squirrel	T	S4	S1S2	S1S2	S1S2
UNRANKED BREEDING BIRDS						
Ammodramus savannarum	Grasshopper Sparrow					S2S3
Antrostomus vociferus	Eastern Whip-poor-will					S1S2
Buteo platypterus	Broad-winged Hawk					S2S3
Chaetura pelagica	Chimney Swift					S2S3
Chordeiles minor	Common Nighthawk					S2S3
Cistothorus palustris	Marsh Wren					S2?
Cistothorus platensis	Sedge Wren					S3
Coccyzus americanus	Yellow-billed Cuckoo					S2S3
Colinus virginianus	Northern Bobwhite					S2S3
Dolichonyx oryzivorus	Bobolink					S1S3
Empidonax traillii	Willow Flycatcher					S2S3
Empidonax virescens	Acadian Flycatcher					S1S3
Geothlypis formosa	Kentucky Warbler					S1S3
Helmitheros vermivorum	Worm-eating Warbler					S3
Hylocichla mustelina	Wood Thrush					S2S3
Icteria virens	Yellow-breasted Chat					S2S3
Melanerpes erythrocephalus	Red-headed Woodpecker					S2S3
Phasianus colchicus	Ring-necked Pheasant					S1S3
Pipilo erythrophthalmus	Eastern Towhee					S2S3
Podilymbus podiceps	Pied-billed Grebe					S1S2
Protonotaria citrea	Prothonotary Warbler					S3S4
Scolopax minor	American Woodcock					S2?
Seiurus aurocapillus	Ovenbird					S2?

Table 13. Continued

Scientific Name	**Common Name**	**State Listing Status**	**Previous sRank**	**sRank Calculator v3.186**	**Heritage Review**	**sRank Calculator v3.2**
Setophaga discolor	Prairie Warbler					S2?
Spiza americana	Dickcissel					S2S3
Spizella pusilla	Field Sparrow					S2S3
Sturnella magna	Eastern Meadowlark					S2S3
Toxostoma rufum	Brown Thrasher					S2S3
Vermivora cyanoptera	Blue-winged Warbler					S2S3
Vireo bellii	Bell's Vireo					S2S3
UNRANKED HERPTILES						
Ambystoma laterale	Blue-spotted salamander					S2S3
Farancia abacura	Red-bellied mudsnake					S1S2
Kinosternon subrubrum	Eastern mud turtle					S1
Lithobates areolatus	Crawfish frog					S1S2
Lithobates palustris	Pickerel frog					S2?
Notophthalmus viridescens	Eastern newt					S3?
Opheodrys vernalis	Smooth greensnake					S2?
Ophisaurus attenuatus	Slender glass lizard					S2?
Regina grahamii	Graham's crayfish snake					S1S2
Regina septemvittata	Queensnake					S1S2
Siren intermedia	Lesser siren					S2?
Terrapene carolina	Eastern box turtle					S3?

Table 14. State listed wildlife species in Illinois with their associated Protection Need category. Categories are defined as followed: Information and Protection Need- Fewer than 3 known locations, Dedication Need- Fewer than 3 locations on Nature Preserves, but additional locations on non-INPC conservation land, Land Acquisition Need- Fewer than 3 locations on Nature Preserve land and fewer than 3 locations on other conservation land, Adequate Protection- More than 3 locations within Illinois Nature Preserves.

Scientific Name	Common Name	Protection Need
Acipenser fulvescens	Lake Sturgeon	Dedication Need
Alasmidonta viridis	Slippershell	Adequate Protection
Ambystoma jeffersonianum	Jefferson Salamander	Land Acquisition Need
Ambystoma platineum	Silvery Salamander	Dedication Need
Ammocrypta clarum	Western Sand Darter	Land Acquisition Need
Ammocrypta pellucidum	Eastern Sand Darter	Dedication Need
Ammodramus henslowii	Henslow's Sparrow	Adequate Protection
Anguilla rostrata	American Eel	Dedication Need
Apalone mutica	Smooth Softshell	Adequate Protection
Asio flammeus	Short-eared owl	Adequate Protection
Bartramia longicauda	Upland Sandpiper	Dedication Need
Bombus affinis	Rusty Patched Bumblebee	Adequate Protection
Botaurus lentiginosus	American Bittern	Adequate Protection
Buteo swainsoni	Swainson's Hawk	Info and Protection Need
Calephelis muticum	Swamp Metalmark	Info and Protection Need
Canis lupus	Gray/timber Wolf	Land Acquisition Need
Caprimulgus carolinensis	Chuck-will's-widow	Dedication Need
Catostomus catostomus	Longnose Sucker	Land Acquisition Need
Centruroides vittatus	Common Striped Scorpion	Info and Protection Need
Charadrius melodus	Piping Plover	Info and Protection Need
Chlidonias niger	Black Tern	Adequate Protection
Circus cyaneus	Northern Harrier	Adequate Protection
Clemmys guttata	Spotted Turtle	Info and Protection Need
Clonophis kirtlandi	Kirtland's Snake	Adequate Protection
Coccyzus erythropthalmus	Black-billed Cuckoo	Adequate Protection
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	Dedication Need
Crangonyx packardi	Packard's Cave Amphipod	Info and Protection Need
Crotalus horridus	Timber Rattlesnake	Adequate Protection
Crystallaria asprella	Crystal Darter	Land Acquisition Need
Cumberlandia monodonta	Spectaclecase	Land Acquisition Need
Cyclonaias tuberculata	Purple Wartyback	Adequate Protection
Cyprogenia stegaria	Fanshell	Land Acquisition Need
Dendroica cerulea	Cerulean Warbler	Adequate Protection
Desmognathus conanti	Spotted Dusky Salamander	Dedication Need
Diploperla robusta	Robust Springfly	Info and Protection Need
Egretta caerulea	Little Blue Heron	Land Acquisition Need
Ellipsaria lineolata	Butterfly	Dedication Need
Elliptio crassidens	Elephantear	Dedication Need

Table 14. Continued

Scientific Name	Common Name	Protection Need
Elliptio dilatata	Spike	Adequate Protection
Emydoidea blandingii	Blanding's Turtle	Adequate Protection
Epioblasma torulosa rangiana	Northern Riffleshell	Dedication Need
Epioblasma triquetra	Snuffbox	Land Acquisition Need
Erimystax x-punctatus	Gravel Chub	Dedication Need
Etheostoma camurum	Bluebreast Darter	Dedication Need
Etheostoma exile	Iowa Darter	Adequate Protection
Etheostoma histrio	Harlequin Darter	Land Acquisition Need
Falco peregrinus	Peregrine Falcon	Dedication Need
Fontigens antroecetes	Hydrobiid cave snail	Info and Protection Need
Fundulus diaphanus	Banded Killifish	Adequate Protection
Fundulus dispar	Starhead Topminnow	Adequate Protection
Fusconaia ebena	Ebonyshell	Dedication Need
Gallinula galeata	Common Gallinule	Adequate Protection
Gammarus acherondytes	Illinois Cave Amphipod	Adequate Protection
Gastrophryne carolinensis	Eastern Narrowmouth Toad	Dedication Need
Grus canadensis	Sandhill Crane	Adequate Protection
Haliaeetus leucocephalus	Bald Eagle	Adequate Protection
Hemidactylium scutatum	Four-toed Salamander	Adequate Protection
Heterodon nasicus	Plains Hog-nosed Snake	Adequate Protection
Hybognathus hankinsoni	Brassy Minnow	Land Acquisition Need
Hybognathus hayi	Cypress Minnow	Info and Protection Need
Hybopsis amblops	Bigeye Chub	Dedication Need
Hybopsis amnis	Pallid Shiner	Adequate Protection
Hyla avivoca	Bird-voiced Treefrog	Adequate Protection
Ictinia mississippiensis	Mississippi Kite	Adequate Protection
Incisalia polios	Hoary Elfin	Info and Protection Need
Ixobrychus exilis	Least Bittern	Adequate Protection
Kinosternon flavescens	Yellow Mud Turtle	Land Acquisition Need
Lampetra aepyptera	Least Brook Lamprey	Dedication Need
Lampsilis fasciola	Wavy-rayed Lampmussel	Adequate Protection
Lampsilis higginsii	Higgins Eye	Dedication Need
Lanius ludovicianus	Loggerhead Shrike	Adequate Protection
Laterallus jamaicensis	Black Rail	Info and Protection Need
Lepomis miniatus	Redspotted Sunfish	Dedication Need
Lepomis symmetricus	Bantam Sunfish	Info and Protection Need
Leptodea leptodon	Scaleshell Mussel	Info and Protection Need
Lethenteron appendix	American Brook Lamprey	Adequate Protection
Ligumia recta	Black Sandshell	Adequate Protection
Limnothlypis swainsonii	Swainson's Warbler	Info and Protection Need
Lithasia obovata	Shawnee Rocksnail	Info and Protection Need

Table 14. Continued

Scientific Name	Common Name	Protection Need
Macrhybopsis gelida	Sturgeon Chub	Info and Protection Need
Macrochelys temminckii	Alligator Snapping Turtle	Info and Protection Need
Moxostoma carinatum	River Redhorse	Dedication Need
Moxostoma valenciennesi	Greater Redhorse	Dedication Need
Myotis austroriparius	Southeastern Myotis hibernaculum	Dedication Need
Myotis grisescens	Gray Bat hibernaculum	Dedication Need
Myotis leibii	Eastern Small-footed Myotis hibernaculum	Dedication Need
Myotis septentrionalis	Northern Long-eared Myotis hibernaculum	Adequate Protection
Myotis sodalis	Indiana Bat hibernaculum	Adequate Protection
Nannothemis bella	Elfin Skimmer	Info and Protection Need
Necturus maculosus	Mudpuppy	Adequate Protection
Neotoma floridana	Eastern Wood Rat	Adequate Protection
Nerodia cyclopion	Mississippi Green Watersnake	Info and Protection Need
Nerodia erythrogaster neglecta	Copperbelly Water Snake	Adequate Protection
Notropis anogenus	Pugnose Shiner	Dedication Need
Notropis boops	Bigeye Shiner	Dedication Need
Notropis chalybaeus	Ironcolor Shiner	Dedication Need
Notropis heterodon	Blackchin Shiner	Adequate Protection
Notropis heterolepis	Blacknose Shiner	Adequate Protection
Notropis texanus	Weed Shiner	Dedication Need
Noturus stigmosus	Northern Madtom	Info and Protection Need
Nyctanassa violacea	Yellow-crowned Night-Heron	Adequate Protection
Nycticorax nycticorax	Black-crowned Night-Heron	Adequate Protection
Ochrotomys nuttalli	Golden Mouse	Dedication Need
Orconectes indianensis	Indiana Crayfish	Land Acquisition Need
Orconectes kentuckiensis	Kentucky Crayfish	Land Acquisition Need
Orconectes placidus	Bigclaw Crayfish	Dedication Need
Oryzomys palustris	Marsh Rice Rat	Adequate Protection
Pandion haliaetus	Osprey	Adequate Protection
Pantherophis emoryi	Great Plains Ratsnake	Info and Protection Need
Papaipema eryngii	Eryngium Stem Borer	Adequate Protection
Phalaropus tricolor	Wilson's Phalarope	Adequate Protection
Plethobasus cooperianus	Orange-foot Pimpleback	Info and Protection Need
Plethobasus cyphyus	Sheepnose	Dedication Need
Pleurobema clava	Clubshell	Adequate Protection
Pleurobema cordatum	Ohio Pigtoe	Land Acquisition Need
Poliocitellus franklinii	Franklin's Ground Squirrel	Dedication Need
Potamilus capax	Fat Pocketbook	Land Acquisition Need
Prosopium cylindraceum	Round Whitefish	Info and Protection Need
Pseudacris illinoensis	Illinois Chorus Frog	Adequate Protection

Table 14. Continued

Scientific Name	**Common Name**	**Protection Need**
Pseudemys concinna	River Cooter	Land Acquisition Need
Ptychobranchus fasciolaris	Kidneyshell	Land Acquisition Need
Quadrula cylindrica	Rabbitsfoot	Land Acquisition Need
Rallus elegans	King Rail	Adequate Protection
Scaphirhynchus albus	Pallid Sturgeon	Land Acquisition Need
Simpsonaias ambigua	Salamander Mussel	Info and Protection Need
Sistrurus catenatus	Eastern Massasauga	Dedication Need
Somatochlora hineana	Hine's Emerald Dragonfly	Adequate Protection
Speyeria idalia	Regal Fritillary	Adequate Protection
Sterna forsteri	Forster's Tern	Info and Protection Need
Sterna hirundo	Common Tern	Info and Protection Need
Sternula antillarum	Least Tern	Land Acquisition Need
Tantilla gracilis	Flathead Snake	Adequate Protection
Terrapene ornata	Ornate Box Turtle	Adequate Protection
Thamnophis sauritus	Eastern Ribbon Snake	Adequate Protection
Thryomanes bewickii	Bewick's Wren	Info and Protection Need
Toxolasma lividus	Purple Lilliput	Dedication Need
Tropidoclonion lineatum	Lined Snake	Info and Protection Need
Tympanuchus cupido	Greater Prairie-Chicken	Adequate Protection
Tyto alba	Barn Owl	Adequate Protection
Villosa iris	Rainbow	Dedication Need
Villosa lienosa	Little Spectaclecase	Adequate Protection
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Adequate Protection

Table 15. INAI sites in order of the 50 highest priority sites across the state by greatest rarity weighted richness of critically imperiled/imperiled (S1/S2) aquatic species (state listed crayfish, fish and mussels SGCN). Relative Rarity Weighted Richness values are ranked from high to low (1-0 scale) relative within Natural Divisions. Rarity ranks list the numerical order of site priorities from high to low richness and relative rank (percentile) gives the percentile rank of the site's rarity richness value relative within each Natural Division.

Name	**Conservation ID**	**Relative Rarity Weighted Richness**	**Rarity Rank**	**Relative Rank (Percentile)**
Mississippi River - Cordova	104	1	1	0.99
Mississippi River - Drew Chute	243	1	1	0.99
Wabash River	570	1	1	0.99
Mississippi River - Grand Tower	624	1	1	0.99
Salt Fork Vermilion River Segment	661	1	1	0.99
Little Wabash River	780	1	1	0.99
Waukegan Beach	856	1	1	0.99
Embarras River	879	1	1	0.99
Fort Massac Area	921	1	1	0.99
Miller Creek	949	1	1	0.99
Thebes Area	1207	1	1	0.99
Apple River	1348	1	1	0.99
Rock River Byron Segment	1636	1	1	0.99
Spoon River Maquon Reach	1689	1	1	0.99
Wabash River - Mount Carmel	437	0.91	15	0.92
Brushy Fork Newman Segment	1635	0.84	16	0.91
Mississippi River - Mudds Landing	669	0.83	17	0.91
Kankakee River Segment	455	0.82	18	0.90
Vermilion River - Illinois Drainage	1167	0.77	19	0.90
Ohio River Hillerman	269	0.76	20	0.89
Middle Fork of the Vermilion River	1028	0.71	21	0.89
Mississippi River - Andalusia Slough	306	0.7	22	0.88
Big Creek	531	0.58	23	0.88
Savanna Army Depot	1037	0.58	23	0.88
Rock River - Carr Island	1239	0.57	25	0.87
Illinois River - Marseilles	75	0.52	26	0.86
LaRue - Pine Hills Research Natural Area	423	0.5	27	0.86
Clear Springs Geological Area	757	0.5	27	0.86
Lower Cache River Swamp	801	0.5	27	0.86
Mississippi River - Moline	413	0.48	30	0.84
Big Grand Pierre Creek	1230	0.48	30	0.84
North Fork Vermilion River	40	0.46	32	0.83

Table 15. Continued

Name	**Conservation ID**	**Relative Rarity Weighted Richness**	**Rarity Rank**	**Relative Rank (Percentile)**
Illinois Beach	260	0.44	33	0.83
Rock River Rockton Segment	1673	0.41	34	0.82
Illinois River - Dresden	412	0.4	35	0.82
Chestnut Hills	841	0.4	35	0.82
Rock River Prophetstown Segment	1639	0.4	35	0.82
Vermilion River - Wabash Drainage Danville Segment	585	0.39	38	0.80
Embarras River - Camargo	713	0.38	39	0.80
Rock River Grand Detour Reach	1638	0.36	40	0.79
Mississippi River - Cap Au Gris	954	0.35	41	0.79
Clear Creek	1204	0.33	42	0.78
Mississippi River - Hartford	1600	0.33	42	0.78
Cedar Creek Avon Reach	1681	0.33	42	0.78
Clarksville Dam Bed	71	0.32	45	0.77
Mackinaw River	1106	0.32	45	0.77
Kishwaukee River	1163	0.3	47	0.76
Spring Lake - Carroll	637	0.28	48	0.75
Rock River Rockford Segment	1641	0.28	48	0.75
Kyte River - Flagg Center/Daysville Segment	1433	0.25	50	0.74

Table 16. INAI sites in order of the 50 highest priority sites across the state by greatest rarity weighted richness of critically imperiled/imperiled (S1-S2) terrestrial species (state listed terrestrial wildlife). Relative Rarity Weighted Richness values are ranked from high to low (1-0) relative within Natural Divisions. Rarity ranks list the numerical order of site priorities from high to low richness and relative rank (percentile) gives the percentile rank of the site's rarity richness value relative within each Natural Division.

Name	**Conservation ID**	**Relative Rarity Weighted Richness**	**Rarity Rank**	**Relative Rank (Percentile)**
Prairie Ridge - Marion County	773	1	1	0.99
LaRue - Pine Hills Research Natural Area	423	1	1	0.99
Savanna Army Depot	1037	1	1	0.99
Waukegan Beach	856	1	1	0.99
Illinois Beach	260	1	1	0.99
Lower Cache River Swamp	801	1	1	0.99
Cave Hill	32	1	1	0.99
Lake Calumet	1166	1	1	0.99
Margaret Guzy Pothole Wetlands	1455	1	1	0.99
Hanover Bluff	518	1	1	0.99
Hennepin Hopper Lakes	1034	1	1	0.99
Nachusa Grasslands	1114	1	1	0.99
Cedar Glen Kibbe	910	1	1	0.99
McKee Creek Barrens and Sedge Seep	677	1	1	0.99
Burns Springs	1261	1	1	0.99
Meredosia Hill Prairie	465	1	1	0.99
Little Black Slough - Heron Pond Area	449	0.89	17	0.95
Clear Creek	1204	0.84	18	0.95
Brainerd Cave	438	0.83	19	0.94
Prairie Ridge - Jasper County	420	0.82	20	0.94
Illinois Dunes North	214	0.82	20	0.94
Fults Hill Prairie - Kidd Lake Marsh	355	0.75	22	0.93
Grass Lake Wetlands	836	0.73	23	0.93
Little Grand Canyon - Cedar Creek	794	0.71	24	0.93
Little Wabash River	780	0.63	25	0.93
Stemler Karst Area	111	0.59	26	0.92
Lake-in-the-Hills Fen	392	0.59	26	0.92
Russell M. Duffin Natural Area	873	0.59	26	0.92
American Beech Woods	1181	0.59	26	0.92
Green River Prairie and Wetlands	463	0.58	30	0.91
Sugar River	1194	0.58	30	0.91

Table 16. Continued

Name	Conservation ID	Relative Rarity Weighted Richness	Rarity Rank	Relative Rank (Percentile)
Union County State Conservation Area	1133	0.56	32	0.91
Carlinville Railroad Prairie	917	0.5	33	0.90
Shick Shack Sand Pond	419	0.5	33	0.90
Fall Creek Gorge	831	0.5	33	0.90
Messenger Woods	769	0.49	36	0.90
Mineral Marsh	716	0.48	37	0.89
Miller Hills	1510	0.47	38	0.89
SW Kinkaid Route 3	1441	0.46	39	0.89
Pecumsaugan Creek - Blackball Mine	442	0.45	40	0.88
Wolf Lake	1002	0.44	41	0.88
Big Creek	531	0.43	42	0.88
Kinney's Ford	433	0.42	43	0.88
Mitchell's Grove	754	0.4	44	0.87
Starved Rock - East	1038	0.4	44	0.87
Lake Creek	273	0.39	46	0.87
Bluff Spring Fen	705	0.39	46	0.87
Renault Herpetological Area	471	0.38	48	0.86
Pounds Hollow	746	0.38	48	0.86
Lockport Prairie	551	0.37	50	0.86

Table 17. INAI sites in order of the 50 highest priority sites across the state by greatest rarity weighted richness of critically imperiled/imperiled (S1-S2) state listed and unranked terrestrial species. Relative Rarity Weighted Richness values are ranked from high to low (1-0) relative within Natural Divisions. Rarity ranks list the numerical order of site priorities from high to low richness.

Name	**Conservation ID**	**Relative Rarity Weighted Richness**	**Rarity Rank**
Lower Cache River Swamp	801	1	1
Little Black Slough - Heron Pond Area	449	0.926144	2
Little Wabash River	780	0.628857	3
Prairie Ridge - Marion County	773	0.574437	4
LaRue - Pine Hills Research Natural Area	423	0.515711	5
Savanna Army Depot	1037	0.502581	6
Illinois Beach	260	0.501451	7
Waukegan Beach	856	0.489899	8
Prairie Ridge - Jasper County	420	0.472743	9
Clear Creek	1204	0.45275	10
Cave Hill	32	0.410324	11
Grass Lake Wetlands	836	0.405821	12
Sally Hollow	1489	0.382205	13
P & E Refuge	1460	0.372403	14
Little Grand Canyon - Cedar Creek	794	0.366971	15
Post Creek Cutoff Site	77	0.346901	16
Lake Calumet	1166	0.346859	17
Stemler Karst Area	111	0.323474	18
Lake-in-the-Hills Fen	392	0.323474	18
Russell M. Duffin Natural Area	873	0.323474	18
American Beech Woods	1181	0.323474	18
Lockport Prairie	551	0.273492	22
Fults Hill Prairie - Kidd Lake Marsh	355	0.267061	23
Embarras River	879	0.250354	24
Cache Valley Geological Area	456	0.2353	25
Dupont Hill Prairies	567	0.2338	25
Lewis Estate	975	0.233297	27
Lewis Estate South	1026	0.233297	27
Haney Creek	860	0.226432	29
Margaret Guzy Pothole Wetlands	1455	0.222649	29
Clarksville Island	204	0.211039	31
Carroll Island Bed	1403	0.211039	31
Sny Island Bed	1407	0.211039	31
Renault Herpetological Area	471	0.211028	34
Miles Prairie	513	0.203182	35
Romeoville Prairie	715	0.202366	36
Worley Lake Area	224	0.1851	37
Robert Allerton Park	173	0.184841	38

Table 17. Continued

Name	Conservation ID	Relative Rarity Weighted Richness	Rarity Rank
Wabash River - Mount Carmel	437	0.176226	39
Colp Bottoms	1135	0.170605	40
Fourth Lake - Rollins Road Savanna	364	0.168521	41
Iroquois County Conservation Area	561	0.168224	42
Sparks Ponds	74	0.163661	43
Witter's Bobtown Hill Prairie	115	0.162748	44
Spivey Valley Glade	2	0.162636	45
Marseilles North Hill Prairie Complex	28	0.161737	46
South Ledges of Kinnikinnick Creek	70	0.161737	46
Sugar Creek - Saline Drainage	304	0.161737	46
Peters Creek	926	0.161737	46
Hosick Creek	1134	0.161737	46

Table 18. INAI sites in order of the 50 highest priority sites across the state by greatest rarity weighted richness of all critically imperiled/imperiled (S1-S2) state listed wildlife species (and additional fish and mussel SGCN). Vulnerable species were added to species richness (S1-S3) to provide a broader range of conservation targets, so ranks for S1-S3 species rarity weighted richness are provided for comparison. Relative Rarity Weighted Richness values are ranked from high to low (1-0 scale) relative within Natural Divisions. Rarity ranks list the numerical order of site priorities from high to low richness and relative rank (percentile) gives the percentile rank of the site's rarity richness value relative within each Natural Division.

Name	Conservation ID	S1-S2 Relative Rarity Weighted Richness	S1-S2 Rarity Rank	S1-S3 Relative Rarity Weighted Richness	S1-S3 Rarity Rank
Waukegan Beach	856	1	1	1	1
Wabash River	570	0.84	2	0.63	2
Wabash River - Mount Carmel	437	0.76	3	0.57	4
Mississippi River - Grand Tower	624	0.74	4	0.52	5
Illinois Beach	260	0.73	5	0.58	3
Lower Cache River Swamp	801	0.60	6	0.45	6
LaRue - Pine Hills Research Natural Area	423	0.50	7	0.33	10
Savanna Army Depot	1037	0.49	8	0.42	7
Clear Creek	1204	0.46	9	0.31	12
Prairie Ridge - Marion County	773	0.40	10	0.29	13
Salt Fork Vermilion River Segment	661	0.38	11	0.35	9
Lake Creek	273	0.35	12	0.23	20
Little Wabash River	780	0.34	13	0.24	17
Mississippi River -Drew Chute	243	0.34	14	0.28	15
Kankakee River Segment	455	0.33	15	0.40	8
Prairie Ridge – Jasper County	420	0.33	16	0.24	18
Vermilion River - Wabash Drainage Danville Segment	585	0.32	17	0.31	11
Chestnut Hills	841	0.32	18	0.22	23
Embarras River - Camargo	713	0.31	19	0.22	22
Little Black Slough - Heron Pond Area	449	0.31	20	0.26	16
Cave Hill	32	0.31	21	0.20	24
Mississippi River - Mudds Landing	669	0.31	22	0.23	21
Grass Lake Wetlands	836	0.30	23	0.20	26
Schuh Bend Island Mussel Bed	865	0.29	24	0.20	25
Ohio River - Hillerman	269	0.29	25	0.19	28
Fort Massac Area	921	0.28	26	0.19	29

Table 18. Continued

Name	Conservation ID	S1-S2 Relative Rarity Weighted Richness	S1-S2 Rarity Rank	S1-S3 Relative Rarity Weighted Richness	S1-S3 Rarity Rank
Little Grand Canyon - Cedar Creek	794	0.27	27	0.18	32
Middle Fork of the Vermilion River	1028	0.26	28	0.28	14
Lake Calumet	1166	0.25	29	0.17	34
Russell M. Duffin Natural Area	873	0.25	30	0.17	35
Stemler Karst Area	111	0.23	31	0.16	37
Lake-in-the-Hills Fen	392	0.23	31	0.16	37
American Beech Woods	1181	0.23	31	0.16	37
Kinney's Ford	433	0.23	34	0.18	31
Big Creek	531	0.23	35	0.23	19
Mississippi River - Cordova	104	0.22	36	0.18	30
Mississippi River - Moline	413	0.21	37	0.16	36
Big Grand Pierre Creek	1230	0.21	38	0.17	33
Loon Lake	1380	0.18	39	0.14	42
Fults Hill Prairie - Kidd Lake Marsh	355	0.18	40	0.12	45
Haney Creek	860	0.17	41	0.12	46
North Fork Vermilion River	40	0.17	42	0.14	43
Elizabeth Lake	1271	0.17	43	0.11	47
Sugar Creek - Saline Drainage	304	0.16	44	0.11	49
Kennekuk Cove County Park	120	0.16	45	0.10	53
Renault Herpetological Area	471	0.15	46	0.10	57
Little Saline River	811	0.15	47	0.10	58
Pounds Hollow	746	0.15	48	0.10	59
Rock River Rockton Segment	1673	0.15	49	0.13	44
Fourth Lake - Rollins Road Savanna	364	0.15	50	0.10	60

Table 19. BSS segments in order of the 50 highest priority segments across the state by greatest rarity weighted richness of critically imperiled/imperiled (S1-S2) aquatic species (state listed crayfish, fish and mussel SGCN). Relative Rarity Weighted Richness is given as the relative richness compared within each EDU (1-0 scale).

Stream Name	BSS Segment ID	Relative Rarity Weighted Richness	Rarity Richness Rank	Relative Rank (Percentile)
Beaver Creek	24	1	1	0.98
Kankakee River	31	1	1	0.98
Blackberry Creek	56	1	1	0.98
Salt Creek	72	1	1	0.98
Kickapoo Creek	74	1	1	0.98
Little Vermilion River	91	1	1	0.98
Big Creek	96	1	1	0.98
Salt Fork Vermilion River	119	1	1	0.98
Big Creek	589	1	1	0.98
Big Creek	590	1	1	0.98
Middle Fork Vermilion River	614	1	1	0.98
Middle Fork Vermilion River	615	1	1	0.98
Kankakee River	244	0.99	13	0.84
North Branch Kishwaukee River	113	0.89	14	0.83
Kankakee River	250	0.89	15	0.82
Butler Branch	121	0.86	16	0.81
Sangamon River	61	0.76	17	0.80
North Fork Vermilion River	116	0.72	18	0.79
Middle Branch	122	0.68	19	0.77
Big Creek	588	0.67	20	0.76
North Branch Kishwaukee River	597	0.66	21	0.75
North Branch Kishwaukee River	598	0.66	21	0.75
North Branch Kishwaukee River	604	0.66	21	0.75
Little Indian Creek	39	0.64	24	0.72
Jordan Creek	115	0.57	25	0.70
Clear Creek	499	0.5	26	0.69
North Branch Kishwaukee River	607	0.5	26	0.69
Middle Fork Vermilion River	118	0.48	28	0.67
Vermilion River	49	0.45	29	0.66
Big Grand Pierre Creek	100	0.44	30	0.65
Bay Creek	103	0.44	30	0.65
North Branch Nippersink Creek	65	0.42	32	0.62
North Branch Nippersink Creek	69	0.42	32	0.62
Trim Creek	30	0.42	34	0.60

Table 19. Continued

Stream Name	**BSS Segment ID**	**Relative Rarity Weighted Richness**	**Rarity Richness Rank**	**Relative Rank (Percentile)**
Big Grand Pierre Creek	104	0.41	35	0.59
Court Creek	27	0.40	36	0.58
Mackinaw River	48	0.40	36	0.58
Hutchins Creek	97	0.37	38	0.55
Middle Fork Vermilion River	117	0.36	39	0.54
Crane Creek	60	0.33	40	0.53
Crane Creek	292	0.33	40	0.53
Henderson Creek	2	0.33	42	0.51
Jinks Hollow Creek	4	0.33	43	0.5
Ellison Creek	10	0.33	43	0.5
South Henderson Creek	11	0.33	43	0.5
Little Wabash River	95	0.33	43	0.5
Vermilion River	66	0.32	47	0.45
Kankakee River	243	0.32	48	0.44
Ferson Creek	44	0.23	49	0.43
Sangamon River	68	0.23	50	0.41

Table 20. BSS segments in order of the 50 highest priority segments across the state by greatest rarity weighted richness of critically imperiled/imperiled/vulnerable (S1-S3) aquatic species (state listed crayfish, fish and mussel SGCN). Relative Rarity Weighted Richness is given as the relative richness compared within each EDU (1-0 scale).

Stream Name	BSS Segment ID	Relative Rarity Weighted Richness	Rarity Richness Rank	Relative Rank (Percentile)
Beaver Creek	24	1	1	0.99
Kankakee River	31	1	1	0.99
Salt Creek	72	1	1	0.99
Kickapoo Creek	74	1	1	0.99
Hurricane Creek	77	1	1	0.99
West Okaw River	84	1	1	0.99
Shoal Creek	85	1	1	0.99
Little Vermilion River	91	1	1	0.99
Salt Fork Vermilion River	119	1	1	0.99
Kankakee River	244	1	1	0.99
Big Creek	589	1	1	0.99
Big Creek	590	1	1	0.99
Middle Fork Vermilion River	614	1	1	0.99
Butler Branch	121	0.92	14	0.87
North Branch Kishwaukee River	113	0.87	15	0.86
Big Creek	96	0.85	16	0.85
Blackberry Creek	56	0.85	17	0.84
Sangamon River	61	0.84	18	0.83
Middle Fork Vermilion River	615	0.8	19	0.82
Kankakee River	250	0.77	20	0.81
North Fork Vermilion River	116	0.68	21	0.80
Little Indian Creek	39	0.67	22	0.79
North Branch Kishwaukee River	597	0.66	23	0.78
North Branch Kishwaukee River	598	0.66	23	0.78
North Branch Kishwaukee River	604	0.66	23	0.78
Henderson Creek	2	0.65	26	0.75
Middle Branch	122	0.65	27	0.75
Jordan Creek	115	0.62	28	0.74
Middle Fork Vermilion River	118	0.54	29	0.73
North Branch Nippersink Creek	65	0.52	30	0.72
North Branch Nippersink Creek	69	0.52	30	0.72
Big Creek	588	0.50	32	0.70

Table 20. Continued

Stream Name	BSS Segment ID	Relative Rarity Weighted Richness	Rarity Richness Rank	Relative Rank (Percentile)
Kankakee River	243	0.49	33	0.69
Vermilion River	49	0.46	34	0.68
Middle Fork Vermilion River	117	0.42	35	0.67
Crabapple Creek	7	0.42	36	0.66
Clear Creek	499	0.4	37	0.65
North Branch Kishwaukee River	607	0.4	37	0.65
Big Grand Pierre Creek	100	0.39	39	0.63
Bay Creek	103	0.39	39	0.63
Trim Creek	30	0.39	41	0.62
Little Wabash River	95	0.38	42	0.61
Big Grand Pierre Creek	104	0.37	43	0.60
Court Creek	27	0.36	44	0.59
Mackinaw River	48	0.36	44	0.59
Vermilion River	66	0.34	46	0.57
Shoal Creek	87	0.33	47	0.56
Hutchins Creek	97	0.33	48	0.55
Ferson Creek	44	0.30	49	0.54
Rock Creek	53	0.28	50	0.53