Wisconsin Natural Heritage Inventory (NHI)

NHI Program Overview and Methodology

This document is meant to provide a short background on the Wisconsin NHI (WNHI) program and its methods for NHI data users. Much of the information was revised from an earlier document, Chapter 1 of the NHI GIS Handbook. The information presented here is meant to be used along with other NHI training materials which provide more detail for certain topics.

Introduction & History of the NHI Program

The Wisconsin NHI program is part of the Wisconsin DNR's Bureau of Endangered Resources and a member of an international network of Natural Heritage programs representing all 50 states, as well as portions of Canada, Latin America, and the Caribbean. These programs share standardized methods for collecting, processing, and managing data for rare species and natural communities.

The NatureServe network was originally created by The Nature Conservancy (TNC). Since its inception in 1950, TNC has maintained a strong science-driven approach to biodiversity and natural area conservation. As the organization became more active in the protection of biological diversity through direct land purchase, there was a need for better information on which to base its conservation decisions. TNC wished to ensure that scarce funds were invested in areas that were true priorities from the standpoint of biological diversity, and not simply attractive open spaces. Unfortunately, there was no source for well-organized, easily accessible information on the condition, status, and location of species and ecosystems deemed important for conservation. TNC created the Natural Heritage Network, a unique private-public partnership, to meet these needs.

After developing a standardized methodology for collecting and organizing data, TNC set about establishing a series of locally-based programs to operate as a unified network of permanent biological resource databases. The South Carolina Natural Heritage Program, established in 1974, was the first program in the network. The Wisconsin NHI program was formally established in 1985 (Wisconsin Statute 23.27). Natural Heritage programs, sometimes called Conservation Data Centers, now operate in all 50 U.S. states, 11 provinces and territories of Canada, and many countries and territories of Latin America and the Caribbean. NatureServe, an international non-profit organization now coordinates the network (see *www.NatureServe.org* for more information).

Why the Heritage Approach is Unique

Heritage programs focus mostly on *rare* or *declining* species, *high-quality* or *rare* natural communities, and *unique* or *significant* natural features. In Wisconsin, these three types of **elements** comprise the WNHI Working List.

One of the strongest attributes of the Heritage network is its use of standardized methods. The network follows a rigorous set of biological inventory and data management standards and protocols known, collectively, as natural heritage methodology. The Heritage data can be used to determine (at different scales) the rarity of the elements and ascertain which occurrences of each element are the most critical for conservation. The other primary strength of the Heritage approach is that the data can be used for a wide range of analyses and applied to a broad possible array of uses. It can also be re-analyzed at different scales or with different parameters, as needed.

The Wisconsin NHI Working List

The WNHI Working List contains 1) native species known or suspected to be rare and/or declining in the

state, 2) natural communities recognized by WNHI, and 3) certain other natural features that occur in Wisconsin. The Working List includes species legally designated as “Endangered” or “Threatened” by either the State of Wisconsin (State Statute 29.604 and Administrative Rule NR 27) or the federal government (federal Endangered Species Act). It also contains species the department has designated “Special Concern,” as well as the U.S. Fish & Wildlife's formal "Candidate" species.

Special Concern species are rare species designated by the department because there are concerns about their abundance or distribution in Wisconsin. The main purpose of this category is to focus attention on certain species before they become Endangered or Threatened. The WNHI program — in consultation with staff from a variety of state and national agencies, organizations, and universities, as well as naturalists throughout Wisconsin — determines which species to include in the Special Concern category. The Special Concern list is dynamic with species added or removed as additional information is collected and consolidated by the WNHI program. The WNHI tracks most Special Concern species in the NHI database, although there is a group of “watch list” species for which data are collected yet not actively tracked in the database. When data indicate that a species is more common than originally thought, it is removed from the Working List or moved to the watch list. Conversely, a decline in the status and/or distribution of a Special Concern species may warrant proposing it for listing as Endangered or Threatened.

The WNHI natural community list was initially based on the types described by John Curtis in his 1959 seminal work, *The Vegetation of Wisconsin*. The WNHI program has subsequently expanded its natural community list to include several less common, or more distinct, community types and geologic features not covered by Curtis (e.g., Algific Talus Slope, Forested Seep, and Calcareous Fen) as well as many aquatic communities.

The most recent Working List can be found on the department’s Web site. Please see *dnr.wi.gov/org/land/er/wlist/* for more information.

NHI Data Sources

Various inventories of areas containing exceptional natural resources or features have been conducted by a variety of organizations, universities and agencies in Wisconsin and many other parts of the country. Many of these efforts have been, or continue to be, focused on one resource type such as timber stand composition, game animal population status, and surface water location and description. Other efforts have been conducted with the goal of identifying high-quality natural areas; for example, the Wisconsin DNR conducted surveys in each county from the late-1960s through the early-1980s to identify the highest quality sites relative to pre Euro-American settlement conditions. Many of the best quality sites from these surveys were designated as State Natural Areas (formerly, State Scientific Areas).

Once established in 1985, the WNHI program began gathering data on conditions and known locations of potentially rare elements. Information comes from museums, herbaria, and a variety of texts, guides, and dissertations describing the state's flora and fauna. These data were used to determine the initial rarity ranks of the elements and establish priorities for further data collection.

After incorporating much of the existing information on rare elements into the database, the WNHI program began conducting a variety of species-specific and area-specific inventories. The program also started incorporating the results of inventories conducted by others including other department programs, other agencies, faculty and staff at universities and colleges around the region, and a wide-range of other organizations and individuals involved in resource inventories as either a hobby or profession. These external data sources continue to be important today, and the expertise and cooperation of our partners is critical for maintaining the quality and utility of the WNHI database.

In general, WNHI uses two approaches for conducting inventories. The first approach focuses on locating occurrences of particular elements (e.g., phlox moth locations in Wisconsin), and it can be important for determining the rarity and distribution of certain species. The second approach, sometimes referred to as a "biotic inventory," involves collecting data on numerous biological components within a given area such as a large public property or group of properties. The latter approach is typically used by WNHI to conduct inventories to support department master plans. This "coarse filter-fine filter" approach begins with a broad assessment of the natural communities and aquatic features present, along with their relative quality and condition. The area's landforms, soils, topography, hydrology, current land uses, and the surrounding matrix are also evaluated using Geographic Information Systems (GIS) and other electronic and hardcopy data sources. Data that describe conditions for the area prior to Euro-American settlement are often used during this step and at other times to further understand the ecological capabilities of the area. Often, we consult with local managers, biologists, or others familiar with the ecology of the area when preparing for an inventory project. The goals for this step are to identify the important ecological attributes and biological processes present, as well as to focus our inventory efforts.

Ideally, a combination of the two aforementioned approaches would be used to collect NHI data, depending on the needs of the particular taxa or geographic focus in question. Examples of some of the recent sources of NHI data include the following:

- comprehensive "biotic inventory" projects conducted as part of the master planning process;
- surveys for federally-listed species funded by the U.S. Fish & Wildlife Service;
- status surveys of particular species undertaken for management purposes;
- site-specific inventories conducted in conjunction with DNR's regulatory review and permit process;
- information gleaned from theses, dissertations, and other university studies; and
- species reports from a variety of naturalists and taxa experts throughout the state who set their own inventory priorities.

In recent years, the majority of the inventory work conducted by the WNHI program has been on department managed lands to support master planning efforts. In addition to locating important rare species populations and high-quality natural community occurrences, the major products culminating from this work are "Primary Sites." These areas, delineated by WNHI, contain relatively undisturbed, high-quality, natural communities; provide important habitat for rare species; offer opportunities for restoration; could provide important ecological connections; or some combination of the above factors. The sites are meant to highlight the best opportunities for conserving biological diversity for the study area. They often include important rare species populations, High Conservation Value Forests, or other ecologically important areas.

Despite WNHI's active inventory program, it is important for NHI data users to recognize that most of the state has not been inventoried for rare species. The lack of a particular species or community in a particular location should not be taken as evidence that the species does not exist there. In addition, the presence of one element does not imply that a survey was conducted for other elements, especially other taxa groups.

NHI Data Management

As previously mentioned, the WNHI Program uses standard methods for collecting, processing, and managing data. Data are stored using an application built specifically for the Heritage Network that includes both tabular and spatial (GIS) components. In Wisconsin, the combination of these spatial and tabular tools for storing data is referred to as the NHI Database. Quality control measures are used to keep the database as current and accurate as possible.

Determining an Element Occurrence

The concept of "element occurrences" is the foundation of the Heritage approach to assessing biodiversity and it is imperative that users of the NHI data understand what an element occurrence is and what it is not. An **element occurrence** (EO) is a locational record representing a single, extant habitat, which sustains or otherwise contributes to the survival of a population or self-sustaining example of a particular element. In somewhat simpler terms, **an EO is a population of a species or an example of a natural community or natural feature naturally occurring at a specific, ecologically appropriate location.** Keep in mind that an EO is not each individual example of the element itself. A population of 17 calypso orchids at a site in the Nicolet National Forest constitutes one EO, not 17 individual EOs. More detailed information explaining the heritage methodology can be found on the NatureServe Web site at *www.natureserve.org/prodServices/heritagemethodology.jsp*.

Because an EO is considered to be a population that occurs on a place on the landscape that sustains or contributes to the survival of this population, the criteria that establish what does and does not qualify as an EO are necessarily dependent upon the biological requirements of the element. For example, what constitutes an EO for a plant is quite different from a bird which, in turn is different from a natural community. A plant EO may contain thousands of individuals spread over hundreds of acres or it may contain just one individual. Bird EOs, however, are mostly limited to one or more breeding pairs. As a general rule, a species is considered an EO if it is located in appropriate habitat, at the appropriate time of the year, and is naturally occurring.

The importance of "appropriate" timing and habitat does not imply that some occurrences are excluded from the NHI database because they are found in habitats where it seems they don't belong. Rather, these evaluations are part of the data screening that is used to ensure that only ecologically valid occurrences are incorporated into the WNHI database. For example, transitory use of an area by an element (Yellow-throated Warbler seen flying over a soybean field) is not considered an EO, nor is a population of pale purple coneflowers which has been planted. However, a report of a singing male Yellow-throated Warbler during the breeding season in a Floodplain Forest dominated by silver maple and elms does constitute an EO. Nearly all naturally occurring rare plant locations are considered EOs.

A single EO can consist of multiple species occurrences that are close, but not contiguous, to one another. For example, it is not uncommon for butterflies associated with pine and oak barrens to exist in several "sub-populations" separated by small wooded areas. Although they are not contiguous, these sub-populations interact genetically, so the entire site is considered one EO (or meta-population). Many species have established criteria (or "EO-specifications") that indicate the separation distances and other characteristics that define whether separate species occurrences should be mapped as a single EO.

Existing EOs are often updated when new information is submitted. These EO updates can clarify or provide additional information about older records. They can be just as valuable new EO information because they allow occurrences to be evaluated over time.

Element Occurrence records are deleted from the NHI Database only under certain circumstances – the two standard reasons being that either the element was mis-identified or that the element is no longer tracked by the WNHI program. Element occurrences with very old "last-observed dates" are not deleted from the database nor are EOs that have been destroyed because they can provide useful information when evaluating trends and other biological issues. EOs that have been destroyed are not included in the NHI Portal.

What follows are general guidelines the WNHI program uses when determining element occurrences within different taxonomic groups.

Mammals: Most small mammals on the Working List are not wide-ranging and collections or observations from any natural habitat can typically be considered an EO because it is assumed that the habitat contributes to their conservation. For bats, sites such as caves and mines where breeding or wintering occurs (hibernacula) are considered EOs. For larger, wider-ranging mammals typically evidence of breeding must be present. In the case of wolves, it is the den, not the territory, that is considered an EO.

Birds: Typically, because of the migratory nature of birds, there must be evidence of breeding and/or nesting for the observation of a bird to be considered an EO. This often includes a reliable observation of a singing male during the breeding season (June) in appropriate nesting habitat. A fly-over observation is not usually considered an EO. In cases of colonial birds (e.g., terns, herons), or birds with more than one nest site (e.g., eagles), the colony or nesting territory is considered the EO. Information on re-introduced species, such as the Whooping Crane, is collected by the Bureau of Endangered Resources but is not included in the NHI database until it has been determined that the species has re-established a self-sustaining population in the state. Sometimes non-breeding habitats are critical to the survival of a species, and are tracked, (eg., "Migratory bird concentration sites").

Herptiles: Any natural habitat where an amphibian or reptile is collected, photographed, or observed constitutes an EO. Since road kills indicate the presence of suitable habitat nearby, they also qualify as EOs. As with bats, herptile hibernacula also constitute EOs. If more than one rare species occupies the same hibernaculum, the species are individually recorded as well as the hibernaculum.

Fishes: Collection points in a lake or pond are typically considered EOs, multiple collections from the same lake or pond are usually grouped into one EO. Multiple collections (including those over a range of years) from a stretch of stream that is devoid of barriers to movement (eg., dams, significant substrate changes) are grouped together into one EO. When collections are made many (5-10) miles apart, the species' life history is used to determine whether these collections could be from two distinct populations and thus two EOs. Dams and the associated impoundments as well as significant changes in flow, substrate, etc. often act as barriers to movement and thus observations made up and downstream of a dam are often considered two distinct EOs.

Aquatic Invertebrates (e.g., mussels, dragonflies): These are treated very similar to fishes. One or more collection points up- or down-stream of a barrier, that tend to be distributed throughout a similar stretch of stream or type of lake are consolidated into one EO that represents the population. Species distribution patterns are taken into account as well. With certain species that tend to be less wide-ranging each collection location may be recorded as a separate EO. It is important to point out that dragonflies and damselflies are generally only mapped when the larvae are found, similar to terrestrial invertebrates below.

Terrestrial Invertebrates: With most terrestrial insects, the observation of an individual in its immature life stage in its natural habitat is considered an EO. In many cases, an observation of an adult may be considered an EO depending on behavior, presence of suitable habitat and how wide-ranging the species is and its flight capabilities. If two or more individuals are found in an area, one EO is mapped as long as the habitat between them is relatively homogeneous. As was stated previously, often several sub-populations may exist within a matrix of vegetative communities. In cases where individuals disperse from one site to another --even though these sub-populations may occur in habitats that are separated from one another-- the entire site (or meta-population) is considered one EO. Generally, if the distance between sightings is greater than the typical dispersal limit, two EOs are mapped.

Plants: In most cases, the observation of a native species in a natural, semi-natural, or even degraded

habitat constitutes an EO. The two cases in which verified observations of native plants do not constitute EOs are when the observation consists of an isolated portion or fragment of a plant (this is most common with aquatic plant species), and when a population is believed, or is known, to have been planted.

Natural Communities: As mentioned earlier, the WNHI program tracks occurrences of all types of natural communities, not just those that are rare (see the Working List for all types currently identified and recognized). For conservation purposes, communities are treated as important in their own right and also as "coarse filters." Effective protection of a natural community will also maintain populations of many native plants and animals, their interactions, and the ecological processes upon which they are dependent. Among rare natural communities, such as oak openings, mesic prairies, and algific talus slopes, all but the most hopelessly degraded occurrences can become EOs. For common, widespread natural communities, such as northern mesic forest and emergent aquatic marshes, the tracked occurrences represent those stands least disturbed by human actions (such as old-growth successional stages of forests) as well as stands which may support exceptionally high biotic diversity, are large, or are associated with other important natural features. The WNHI community database represents a proportionately smaller subset of the known occurrences of common communities relative to those types that are rare.

The significance of a given natural community occurrence is therefore related to not only its quality and condition, but also to its size and context.

As with re-introduced species, occurrences of natural communities that were re-created or planted are not considered EOs. However, communities that have received active management (e.g., burning) to restore or improve their condition are considered EOs.

Mussel Beds, Hibernacula, Migratory Bird Concentration Sites, Bird Rookeries: These are biologically important sites where a catastrophic event at any one location could have a significant impact on an entire taxonomic group. These animal concentration sites are tracked regardless of whether any rare species are known to occur there.

How Element Occurrences (EOs) are Mapped

The entire Heritage Network is quite meticulous about the information that is entered into the database. Processing field data into element occurrence records (EORs) starts with the appropriate WNHI biologist reviewing the data and assessing its validity. The verification process includes considering the observation date, the habitat in which the element was observed, accepted range of the species, documentation of the occurrence and the knowledge and expertise of the observer. If the WNHI botanist, zoologist, or ecologist is unsure about some aspect of the submitted data, they will often try to arrange a visit to the site with the observer to verify the information or have a specimen or photograph identified by an expert.

Once the appropriate biologist has reviewed the data and determined that the information represents a new element occurrence or an update to a previously recorded occurrence, the data can be processed. Data processing includes “mapping” the data using GIS tools, transcribing the relevant species occurrence or observation data onto standardized electronic forms, and quality control.

As part of data processing, each occurrence is assigned a **mapping precision**, which reflects the locational accuracy to which the occurrence is known. There is a wide range in the quantity and specificity of information that is submitted regarding where elements were observed. In the best cases, adequate information is included with an observation report that allows the occurrence to be represented very precisely on maps and GIS products. In other cases, it is only possible to ascribe a very general

location to the occurrence. It is important to note that *the precision to which the occurrence is known is independent of the amount of area the EO occupies*. That is, it is possible to know the precise boundary of a 600-acre Southern Sedge Meadow occurs, yet only a general location could be available for a particular plant population. In general, recent EOs are available at a higher level of precision than much older records.

The Heritage system defines mapping precision using common distance and area measurements. These categories are arbitrary and are simply used to standardize the data. The WNHI uses the following seven precision levels:

S: "Seconds" - mappable to a precision of a 3-second (~200-foot) radius.

F: "Forty" - mappable to a 40-acre (Quarter-Quarter section) area, or within ⅛-mile radius.

Q: "Quarter" - mappable to a 160-acre (Quarter Section) area, or within ¼-mile radius.

M: "Minute" - mappable to a one-minute radius, or within a 1 to 1½-mile radius.

G: "General" - mappable to a 5-mile radius.

NM: "Not Mapped" - generally EOs are not mapped for one of two reasons:
(1) There are so many known occurrences (200-300+) that mapping each one would not be a worthwhile use of staff time (this is true of wood and Blanding's turtles, eagles and osprey) or,
(2) The EOs cover too large an area to effectively depict their locations on a 7½-minute quadrangle map (as in the case with wolves and riverine aquatic taxa such as mussels or fish).
(3) Natural community EOs for which an accurate boundary is available on a 7½-minute quadrangle, yet that shape has not been mapped in the NHI Database.

U: "Unmappable" - the information available does not allow for the location to be identified within a ten-mile area.

Understanding and considering mapping precision is critical when using Heritage data. It is important to know the difference between the actual location of the EO and how it is represented in the NHI Database (and NHI Portal). For example, an EO mapped at an F precision will not necessarily cover the entire 40 acres. Small occurrences could be represented by large spatial representations in the database and vice-versa. This is why it is important to evaluate habitats when trying to interpret NHI data. This concept can be easier to understand by looking at a map, and it is covered in more detail during NHI Training sessions.

Data Confidentiality

The WNHI database is considered sensitive for several reasons, and NHI are not appropriate for general public distribution. When the WNHI program was established, the legislature specifically exempted the WNHI database from the state's open-records law (Wisconsin Statute 23.27). The department has the authority to decide how and what information in the WNHI database is distributed outside the agency and has delegated this responsibility to the WNHI program. The NHI program follows specific guidelines when distributing information on endangered resources to individuals and organizations outside of the department.

The potential threat to rare species is the most obvious reason NHI data are not publicly distributed. Illegal collection, in addition to actions of well-intended people who simply are interested in viewing rare species, have impacted several populations of showy and highly sought after species. Although first-hand

experience is a good way to engage the public in endangered resource protection, there is little question that for some species (such as turtles and orchids) it can have disastrous consequences. Also, the potential exists for outright destruction of rare species by those who view them as barriers to resource utilization.

Commercialization and subsequent distribution of the database is a less obvious threat. The department, and particularly the Bureau of Endangered Resources, has invested considerable resources in the WNHI database, and it is now the most comprehensive collection of information on natural communities and rare species in the state. As the demand for this type of information has grown, the value of the data within the WNHI database, as well as the entire Heritage Network, has dramatically increased. Many programs within the Heritage Network have received requests for their databases from organizations that wish to market and sell their data. Commercial, unrestricted distribution of sensitive data, particularly information in the EOR database, is not compatible with goals of the WNHI program or the Heritage Network. Furthermore, several important partners would no longer provide data if we are unable to protect the data from public distribution.

Misinterpretation and, worse, misapplication of the data are also a concern with public distribution of the NHI Database. It is critical to understand NHI methodology and key characteristics of the data to be able to interpret it properly, so the WNHI program spends considerable time training users within the department, as well as outside partners, on proper data interpretation and application.

In spite of the potential problems with distributing NHI data outside of the department, the WNHI program believes sharing data with responsible users is one of the most powerful means of protecting endangered resources. The WNHI program invests considerable effort into collecting data and managing the NHI database, with a major goal of assisting efforts to protect our state's biodiversity. The program would like the information put to good use whenever possible.