Procedures for Rating Natural Areas

North Carolina Natural Heritage Program

Contents

Tables

Figures

Introduction

The North Carolina Natural Heritage Program (NCNHP) is charged under the Nature Preserves Act (N.C.G.S. § 143B-135.250 - § 143B-135.272) with compiling and maintaining information relevant to the protection of North Carolina's most significant natural areas. Since its establishment in 1976, NCNHP has focused on measures related to biodiversity, giving special attention to areas important for the protection of the state's native plants and animals at the population, community, and ecosystem levels of biological organization. In the development of specifications and standards for species and communities, NCNHP participates in the international network comprised of Natural Heritage Programs, Conservation Data Centers, and NatureServe, a non-profit conservation organization established partly to support this endeavor.

The standard Natural Heritage methodology is designed to address both species and natural communities, referred to collectively as "Elements" of biodiversity. This standard methodology is used to define the rarity of Natural Heritage Elements and to delineate individual occurrences of these Elements across the landscape. In assigning priorities for conservation, NCNHP gives special emphasis to natural areas that support populations of rare species or rare or high quality natural communities. A key product resulting from this information is the assessment of conservation priorities for the more than 2,400 natural areas that have been identified. In order to assign conservation priority for each natural area, the two rating systems use Elements, Element Ranks, Element Occurrences, and Element Occurrence Ranks to assign conservation priority.

Each natural heritage area receives two priority ratings:

1. Collective Value rates each natural area based on the number and rarity of the Elements it contains.
2. Representational Value rates each natural area on its importance in protecting the best occurrences of individual Elements.

Each natural area is assigned two values, a Representation Rating (R1-R5) and a Collective Value Rating (C1-C5). The two indices measure different and complementary qualities of each natural area. Though given numerical labels, the values cannot reasonably be combined mathematically and both values are recognized.

These procedures provide several advantages:

- The ratings are derived directly from the Biotics database which requires that all information relevant to the natural area is documented and is easily retrievable.
- The ratings can be calculated quickly, allowing ratings to be assigned to new natural areas as needed and allowing the entire set of natural areas to be updated annually.
- Two distinct characteristics of each natural area are evaluated and reported, providing more clarity about the ecological significance of each natural area.
- Greater natural area rating consistency is achieved across the different types of Elements that are tracked by NCNHP.

The processes are built upon standard components of the natural heritage methodology, used by more than 80 programs in the United States, Canada and Latin America. More information about these components is provided below.

Basic Components of the Natural Heritage Methodology

1. **Identification of conservation targets (Natural Heritage Elements) and assigning Element Ranks**

   Determining which plants and animals are thriving and which are rare or declining is crucial for achieving conservation of the species, habitats and ecosystems in greatest need of conservation. NatureServe and its member Natural Heritage Programs have developed a consistent method for evaluating the relative imperilment of both species and natural communities based on the best available information. These assessments lead to the designation of a conservation rank.

   Conservation ranks reflect the relative risk of extinction faced by each Element. Values range from critically imperiled (1) to demonstrably secure (5). Imperilment is assessed and documented at three distinct geographic scales: global (G), national (N) and subnational (S) (i.e., state/province/municipal). Thus, each Element receives ranks at all three scales (example: red-cockaded woodpecker has a conservation status rank of G3, N3, and S2 in North Carolina). These ranks are based on the best available information for a variety of factors, such as species abundance, geographic distribution, population trends, and threats. Documentation of the methods for developing these assessments is available at https://www.natureserve.org/conservation-status-assessment .

   Global conservation assessments (assigning G-Ranks) generally are carried out by NatureServe scientists (integrating information from the biologists who work in state and provincial member programs), with input from other experts. The NCNHP is responsible for working with partners to conduct conservation assessments to assign state ranks or S-Ranks. These assessments are widely used throughout the conservation community and are regarded as highly credible by scientists, government agencies and private-sector organizations.

   Based upon the conservation ranks, the NCNHP has identified the Elements that are considered conservation targets and are tracked by the program. These conservation targets include all community types, because protecting natural communities serves to protect species with insufficient data for ranking and to preserve the characteristic interactions among species that frequently co-occur. The complete list of these tracked Elements is available upon request or can be found on our website. www.ncnhp.org.

2. **Mapping Element Occurrences**

   At the core of the Natural Heritage methodology is the concept of the Element

Occurrence (EO) which is the specific location of a species or ecological community. An Element Occurrence generally represents the geo-referenced biological feature that is of conservation or management interest. An Element Occurrence record is a data management tool that has both spatial and tabular components, including a mappable feature and its supporting database. EO's are typically represented by mapped areas of land and/or water. EO records are most commonly created for current or historically known occurrences of natural communities or native species of conservation interest. They may also be created, in some cases, for extirpated occurrences. NCNHP records and maps the Element Occurrences for the Elements the program has chosen to track.

3. Assigning Element Occurrence Ranks

Each EO is assigned an Element Occurrence Rank. These ranks provide a succinct assessment of estimated viability, probability of persistence, or state of communities relative to the natural reference state (based on condition, size, and landscape context). In other words, EO ranks provide an assessment of the likelihood that, if current conditions prevail, an occurrence will persist for a defined period of time (the time varies by Element but is typically 20-100 years). EO ranks are based on data obtained from recent field surveys (except for historical occurrences) by knowledgeable individuals. EO ranks may be used effectively in conjunction with Element conservation ranks to guide which EO's should be recorded and mapped, and to help prioritize EO's for purposes of conservation planning or action, both locally and throughout the range of the Element**.**

4. Mapping Natural Areas

Once Element Occurrences are mapped, the broader habitat is reviewed and, when appropriate, a natural area is identified and mapped. A natural area is an area of land or water identified as having special importance for the preservation of the natural biodiversity of North Carolina. Biodiversity is generally recognized in the scientific community to refer to the diversity, not only of species but also of natural communities and ecosystems, as well as genetically distinct populations below the species level. NCNHP focuses on natural areas in conservation planning, due both to our legislated mandate to define and inventory natural areas and to our understanding that protecting high quality natural areas is key to conserving the rare as well as the more common species they support. Natural area protection for the preservation of the natural biodiversity of North Carolina is the fundamental objective of defining natural areas.

A natural area contains one or more occurrences of a rare plant or animal, or a rare or high quality natural community. A natural area includes the area needed to sustain the EO's, including ecological processes necessary for maintaining suitable habitat. Natural (not introduced), viable occurrences must be present in order to define a natural area. Natural area boundaries can be delineated to include areas not occupied (or utilized) by the EO's, but which are essential for the continued survival of the EO's within the natural area. The unoccupied area serves important ecological functions that help maintain the viability of the natural area or contribute to the other functions attributed to the natural

area. Where more than one Element occurs within a natural area, the boundary expands to accommodate the needs of each Element.

5. Assigning Conservation Priority Ratings to Natural Areas

Natural areas are evaluated to determine qualification for Dedication and Registry under the Nature Preserves Act, and to focus conservation actions on the highest priority natural areas. Information about natural areas is made available to other users for conservation and planning purposes.

Natural Area Rating Summary

NCNHP established two distinct processes described below for assigning natural area conservation priorities. One procedure is designed to represent a natural area's contribution to supporting a collection of the best natural areas for each tracked Element. The second procedure evaluates the conservation value of each natural area based on the "Element collective value" or number and rarity of the species and community types occurring within the natural area. This paired rating system provides two distinct values for each natural area, one which reflects the biodiversity of the state and one which reflects the overall biodiversity of each natural area.

The rating system requires staff to document their evaluations and treats all natural areas and elements consistently. A key benefit of depending on database-driven answers is that errors in the database will be more quickly identified and corrected.

The Nature Preserves Act requires publication of a biennial report with specific recommendations, due on or before February 15 of odd-numbered years. Natural areas are evaluated each year by NCNHP staff, reviewed by the Natural Heritage Advisory Committee, and included in the NCNHP Biennial Report. Individual natural area ratings are also evaluated as needed. Each year, natural area ratings are incorporated into the attribute tables of GIS shape files that are distributed quarterly to our conservation partners and displayed on the Natural Heritage Data Explorer interactive online maps. NCNHP staff and partners use the ratings to inform conservation actions, including appropriateness for Registry or Dedication, and the allocation of resources for funding, management, and biological inventory.

Collective Value Rating System

Introduction

The State Nature Preserves Act (N.C.G.S. § 143B-135.250 - § 143B-135.272) calls for the NC Natural Heritage Program to create a system to classify the natural heritage resources of the state and to create a system of registered and dedicated nature preserves. The associated Administrative Code (07 NCAC 13H .0202) provides the following criteria for eligibility (the criteria in **bold** are addressed by the natural area rating procedures described here):

(a) For an area to qualify as a Natural Heritage Area and be eligible for registration or dedication, the Natural Heritage Program staff shall determine that the area possesses one or more of the following natural values:

(1) **a habitat for individual species of plants or animals that are in danger of or threatened by extirpation;**
(2) **a rare terrestrial natural community**;
(3) **a rare aquatic community;**
(4) features that illustrate geologic processes or the history of the earth;
(5) **unique or unusual ecological types; or**
(6) **biological or ecological phenomena of significance**.

(b) Upon meeting one of the criteria in Paragraph (a) of this Rule, the Natural Heritage Program staff shall evaluate an area with respect to the following factors:

(1) presence of ecological values represented in previously registered Natural Heritage Areas**;**
(2) **the natural diversity of the area**;
(3) **the quality and viability of environmental features including self-sufficiency of the ecosystem when managed and degree of vulnerability to disturbances and intrusions;**
(4) the extent to which past disturbances or land uses have altered natural communities. An area may be considered even if it shows evidence of past disturbance or land use;
(5) the ability to be managed to protect and maintain ecological features in a natural condition, and a buffer area, as set forth in Rule .0304 of this Subchapter, to ensure protection. A buffer zone, where possible, shall follow defensible boundaries and help protect the site against adverse effects from use and development of adjacent land. The buffer zone may be included in the designated area but need not itself possess any eligibility criteria as set forth in this Rule;
(6) compatibility of protective management practices with current use practices on adjacent lands; and
(7) **scientific and educational value**.

To better implement items (a) (1), (2), (5), and (6), and (b) (2), (3) and (7) of the State Nature Preserves Act, NCNHP uses a Collective Value Rating System, with number of Elements weighted by rarity, to prioritize natural areas.

The Collective Value Rating for each natural area is a measure of the number of Elements at a given natural area, and the rarity of those Elements, weighted in terms of both global rarity and state rarity. The weights for rarity were selected to balance the values of number of Elements at a natural area and the rarity of the Elements. This rating system is used along with the Representation Rating system, which represents the natural areas of highest significance for each Element; that rating focuses on the quality and viability of the Element occurrences in the natural area.

Collective Value Rating Principles

The rating provides a score for a natural area based on both the number of Elements at a natural area, and the rarity – both global and state – of each Element in the natural area. Thus, the Global Rank (G-Rank) and State Rank (S-Rank) of Elements are used in the scoring.

The score of a natural area is based on the cumulative scores of each of the extant Elements in the natural area, based on scores given at each level of G-Rank and S-Rank. The scoring is first given to the G-Ranks. The S-Ranks are listed, in descending order, before moving down to the next G-Rank level. However, Global Ranks of G4 and G5 are given equal weight in the scoring, as are State Ranks of S4 and S5 (Table 1).

The values used to weight Elements by rarity are meant to convey a relative measure of importance for conservation and are not intended to indicate interchangeability or exchangeability of Elements.

Table 1: Collective Value Point Scoring for each G-Rank and S-Rank combination

G-Rank	S-Rank	Element Score
G1	S1	10
G2	S1	9
G2	S2	8
G3	S1	7
G3	S2	6
G3	S3	5
G4/G5	S1	4
G4/G5	S2	3
G4/G5	S3	2
G4/G5	S4/S5	1

Element Collective Value Rating Procedure

Step 1. Select Element Occurrences

To qualify for inclusion in the rating system, EO's must be naturally occurring (not introduced), have EO viability ranks of A (excellent), B (good), C (fair), D (poor), E (extant, but viability not assessed) or F (failed to find, but believed extant), and occur in a natural area. EO Ranks of H (historical) or X (extirpated) for an Element in a natural area are not included or scored. Stand-alone and sub-EO's are used for this calculation; thus, for occurrences that occur in multiple patches, only the portion of the occurrence that is known to occur at the natural area is used to generate a natural area rating.

Step 2. Element Scoring

The scores are assigned to each qualifying Element occurrence on a 10-point scale, with the rarest combination (G1S1) given the highest score. This 10-point scale is used to assign the relative contribution of an Element to the significance of a natural area, with the rarest Element having 10 times the value as a low-ranked (S4, S5, G4, and/or G5) Element. An Element with a mid-range of rarity – a G3S3 (5 points), is thus considered to have one-half the significance of a G1S1, but 5 times the significance for protection as a G5S5. Elements that have multiple occurrences or sub-occurrences within a natural area are counted only one time for each natural area. This avoids artificially inflating scores for natural areas where multiple sub-EO's have been delineated.

Step 3. Assigning Natural Area Scores

For each natural area, the scores for occurrences of each Element are added to give the final "Collective Value Score" for the natural area. (For example, if a natural area has four Elements: a G2S2, a G3S1, a G5S1, and a G5S3, it scores: 8 + 7 + 4 + 2 = 21 points

There are 5 Categories of "natural area significance" for the Collective Value Rating. These Categories are Exceptional (C1 rating), Very High (C2 rating), High (C3 rating), Moderate (C4 rating), and General (C5 rating), based on point scoring of the Elements within a natural area. From Table 2 (below), a site that scores 21 points, as in the above example, is given a Moderate (C4) Collective Value rating.

Table 2: Collective Value Ratings

Collective Value Rating	Cumulative Element Score	Minimum Number of Elements
C1 (Exceptional)	91 and above	10
C2 (Very High)	61-90	7
C3 (High)	31-60	4
C4 (Moderate)	11-30	2
C5 (General)	2 -10	1

The lower limit (91 points) for an Exceptional (C1) natural area requires a minimum of 10 Elements at a natural area. That is, 10 (the score for the rarest Element – a G1S1) x 9 = 90, which is the maximum score for a natural area rating of Very High. Therefore, a natural area must score at least 91 points to be Exceptional. Likewise, a Very High (C2) natural area requires a minimum

of 7 Elements (as 6 Elements can score a maximum of only 60 points), and a High (C3) natural area requires a minimum of 4 Elements. A Moderate (C4) natural area requires a minimum of 2 Elements. A General (C5) natural area can have between 1 and 10 Elements (though if 10 Elements, all would have to score only a single point).

Additional Information Regarding Ranking

Rules for scoring, for intermediate or other unconventional ranks, are derived from NatureServe Element rank rounding rules as described below.

A. Elements with range ranks spanning two levels are treated as if they had the higher of the two ranks (e.g., treat G2G3 as G2).

B. Elements with range ranks spanning three levels are treated at the middle rank (e.g., treat (e.g., G3G5 as G4).

C. Elements with T ranks attached to their global ranks are treated as if the T ranks were G ranks (e.g., treat a G4T1 as G1).

D. Elements with “Q”s attached to their global ranks are treated as if there were no “Q”s (e.g., treat G4Q as G4).

E. Elements with “?” attached to their ranks are treated as if there were no question mark (e.g., treat G3? as G3).

F. Elements with non-numeric ranks are treated as if they are G5 (e.g., treat GU or GNR as G5).

Representational Rating System

Introduction

The State Nature Preserves Act (N.C.G.S. § 143B-135.250 - § 143B-135.272) calls for the NCNHP to classify the natural heritage resources of the state and to create a system of registered and dedicated nature preserves. The associated Administrative Code (07 NCAC 13H .0202) provides the following criteria for eligibility (the criteria in **bold** are addressed by the natural area rating procedures described here):

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(2) **a rare terrestrial natural community**;
(3) **a rare aquatic community;**
(4) features that illustrate geologic processes or the history of the earth;
(5) **unique or unusual ecological types; or**
(6) **biological or ecological phenomena of significance**.

To better prioritize natural areas and improve implementation of items (a) (1), (2), (3) (5), and (6) of the State Nature Preserves Act, NCNHP uses a rating system that identifies the highest quality occurrences of each Element. This system is based on the idea of a portfolio, a complementary set of natural areas selected to optimally protect the wide spectrum of Elements of diversity that we track. The emphasis is on protecting the best occurrences (as indicated by Element Occurrence Rank) of each Element, attempting to ensure that no Elements are ignored and that emphasis among them is balanced.

NCNHP uses EO ranks (see Element Occurrence Ranks above) to determine the natural areas containing the best occurrences of each Element. The conservation priority of these occurrences is assigned using the categories listed in Table 3. Collectively, these natural areas make up a portfolio representing the best natural areas for each Element tracked by NCNHP. Each natural area is rated according to the importance of the Element Occurrences contained within the natural area.

Table 3: Representational Rating for Natural Areas based on Element Occurrences

Representational Rating	Definition	Defining EO Importance	
		G1-G2, G3 Endemic	G3 Non-Endemic, G4, G5
R1 (Exceptional)	Natural area contains one of the best three examples of G1 or G2 or G3 Endemic\Near-endemic[2] Elements.	1st to 3rd	--
R2 (Very High)	Natural area contains the 4th – 6th best examples in the state of G1-G2 or G3 Endemic\Near-endemic Elements, and/or one of the best three examples of any non-Endemic G3 or any G4 or G5 Element within it.	4th to 6th	1st to 3rd
R3 (High)	Natural area contains the 7th to 10th best examples in the state of G1-G2 or G3 Endemic\Near-endemic Elements and/or the 4th to 7th best occurrences of any non-Endemic G3 or any G4 or G5 Element within it.	7th to 10th	4th to 7th
R4 (Moderate)	Natural area contains the 11th to 14th best examples in the state of G1-G2 or G3 Endemic\Near-endemic Elements and/or the 8th to 11th best occurrences of any non-Endemic G3 or any G4 or G5 Element within it.	11th to 14th	8th to 11th
R5 (General)	Natural area contains one of the 30 best examples in the state of Elements within it, which do not qualify for categories R1-R4.	15th to 30th	12th to 30th

Representation Rating Procedure

Step 1: Select Element Occurrences.

To qualify for inclusion in the rating system, EO's must be naturally occurring (not introduced), have EO viability ranks of A (excellent), B (good), C (fair), D (poor), E (extant, surviving but viability not assessed) or F (failed to find, but believed extant), and occur in a natural area. Stand-alone and sub-EO's are used for this calculation; thus, for occurrences that occur in multiple patches, only the portion of the occurrence that is known to occur at the natural area is used to generate a natural area rating.

Step 2: Determine the highest quality occurrences of each Element.

For each Element, the query sorts the EO's from best to worst using data in the Biotics database and then assigns them to categories. The initial sorting is by EO rank.[1] The EO's are then further sorted to clarify which ones are the best within the same EO rank, breaking ties to determine

[1] According to NatureServe data standards, EO rank summarizes information on viability and value for conservation, incorporating condition, size, and landscape context.

[2] Near-endemic was added to designate North Carolina elements that have >80% of their distribution in North Carolina

which will be selected for the portfolio of highest quality occurrences (see Figure 2). Because the data fields are not universally filled out in the database, there is a hierarchy of fields that are used. Fields that are most accurate for the purpose of identifying the best EO's are used first, and if they are unavailable or result in ties, the next most desirable fields are used. Use of all the fields in the hierarchy effectively eliminates ties and provides an unambiguous calculation of which EO's are best to meet the conservation goals.

The order of data for tie-breaking among EO's with the same EO ranks is shown below. See also the Decision Tree for a visual representation of tie-breaking criteria.

1. EO condition rating (for community EO's, this rating assigns values A-D based on EO Rank Specifications (Specs), and is a measure of the quality of biotic and abiotic factors and processes within the EO, and the degree to which they affect the continued existence of the occurrence. Components of this factor are: development/maturity; ecological processes; species composition and biological structure; abiotic physical/chemical factors. If EO condition ratings are present for some EO's and absent for others, EO rank is used again in the comparison to other condition ratings. This is justified because EO ranks are determined most strongly by condition. In community EO's described longer ago, the EO rank often effectively represents condition alone.
2. EO acreage (observed area). As of 2021, twenty-eight percent of EO's have recorded EO acreage, including most community EO's.
3. Landscape context rating[2] (for community EO's, this rating assigns values A–D based on EO Rank Specs, and is intended to be a measure of the quality of factors **and** processes surrounding the EO, and the degree to which they affect the continued existence of the occurrence. Components of this factor are: landscape structure and extent surrounding the EO; development/maturity of the surrounding landscape context; ecological processes in the surrounding landscape; species composition of the surrounding landscape; abiotic physical/chemical factors in the surrounding landscape.
4. Aggregate acreage of community EO's in the natural area (larger is better). This is used as a surrogate measure of the total size of the natural habitat in the natural area. Other things being equal (or unknown), EO's in large natural areas are more likely to be larger and in good condition compared to those in small natural areas.
5. Total number of EO's in the natural area (larger number of EO's is better). This is a final measure for breaking ties in the absence of any other information. While different kinds of habitat tend to support different numbers of EO's, within a given species, natural areas with more other EO's are more likely to be large and in good condition than those that support fewer EO's.

If the ratings returned by this query seem unreasonable or inaccurate, a more detailed analysis of the data will be performed. If no condition or landscape context ratings have been entered for community EO's, assigning them for the EO in question and competing EO's will often clarify

[2] Because ties are unlikely among the acreage values of observed area, landscape context and the subsequent criteria seldom come into play for Elements where observed areas are entered.

which is better. After further analysis, taxa-specific rules for breaking ties among EORs may be proposed.

Step 3: Assign Element Importance Rank for each Element (Top ranked 1st-30th).
The Element Importance Ranks for all EO's can be calculated quickly by a query in NCNHP database. Because we want to focus conservation priority especially on rare Elements, only natural areas with the best 1-3 examples of G1 or G2 Elements can be placed in the highest category. The results can readily be sorted by Element rather than by natural area, to review the placement of a given EO relative to others.

Step 4: Assign Representation Rating to each natural area based on Element Occurrences present.
Natural areas are rated on the quality of the EO's they contain. The highest Element Importance Rank in the natural area determines the natural area significance rating. This value is entered into the natural area record in Tracker. If the result is not reasonable, the user can review the underlying data, potentially enter more precise data, and re-run the query. In cases where the algorithm does not measure the most import important ecological features of a natural area, NCNHP staff can override the calculated results and record justification comments in the Biotics database.

In rare cases where the most important features of a natural area are not adequately assessed by the query, NCNHP staff can override the calculated rating and assign another appropriate natural area rating, as long as supporting information for the assigned natural area rating is recorded in the database. Such cases will be discussed among staff and determined by consensus of staff with expertise about the natural areas or Elements present. Examples include:

1. Natural Communities with outstanding condition (e.g., old growth forests) but smaller acreage than younger (but otherwise excellent) examples of the same natural community.
2. Natural areas that are known to be the nationally most outstanding examples of G3-G5 Elements (e.g., Black River Cypress Swamp) can be elevated.
3. Natural areas with multiple sub-EO's for the same Element, where no sub-EO properly indicates the significance of the collection of the Element at the natural area.
4. Cases where natural area delineation (historical splitting of natural areas that are contiguous) obscures the significance of a natural area, and where there are reasons not to lump the natural areas together.
5. Elements that have multiple A-ranked EO's and the size and condition of the surrounding natural communities does not necessarily affect the viability of the target Element (e.g., *Gymnoderma lineare*, *Helianthus schweinitzii*).
6. Natural areas with Element occurrences that have insufficient data to determine significance may be down-ranked.

Figure 1: Steps for assigning representation ratings to natural areas

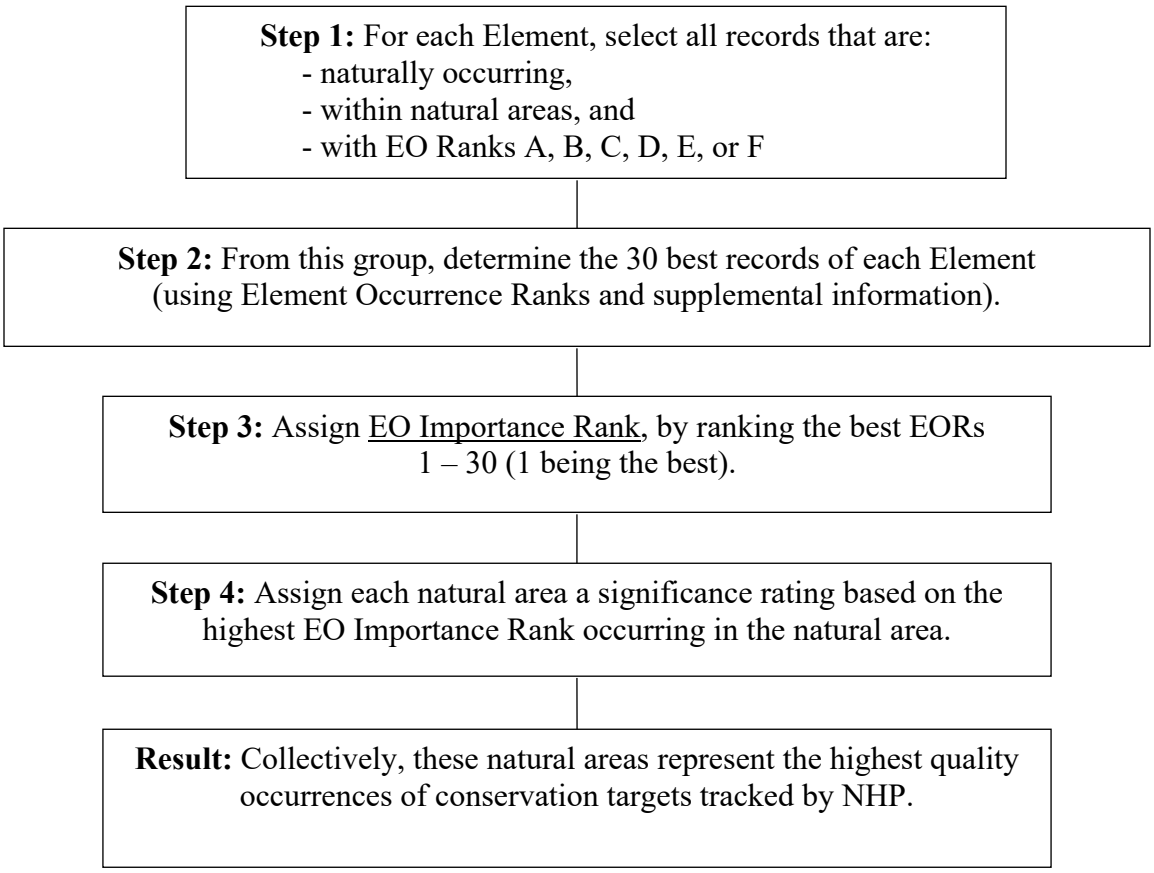

Figure 2: Decision tree for selecting best occurrences of each Element for representation rating