

Using the NatureServe Element Rank Calculator for Preparing Pennsylvania Rare Plant Forum Proposals

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Background

In order to provide better documentation and to standardize methodology in the preparation of proposals to refine the conservation status of plant taxa native to Pennsylvania, the Vascular Plant Technical Committee has stipulated that all proposals will be prepared using the NatureServe Rank Calculator. There is a further recommendation that IUCN Red List methodology also be employed and that any discrepancies between the results obtained by the two methodologies are investigated. This modification of Chapter 2 of the Pennsylvania Biological Survey (PABS) Procedural Manual (<http://www.pabiologicalsurvey.org/pabs-op-manual-v1-chapter-2.pdf>) has been agreed to by the PABS Steering Committee and will be included in Chapter 4 of that manual (projected for completion in 2016).

IUCN methodology, recommended but not required, is not addressed in this document. You are encouraged to learn about this system, which is used throughout Europe and other places, including, with some modification, Canada. The NatureServe system is the standard in most of the Americas. Although the mechanisms vary between the two systems, the underlying concepts are the same, as the two organizations have worked closely together as the systems have been refined over the years. IUCN Red List documentation can be downloaded from <http://www.iucnredlist.org/technical-documents/red-list-documents>.

Introduction

This document is intended as a quick reference to accompany the 76-page NatureServe document that provides background and instructions for using the NatureServe Rank Calculator (Master et al 2012). It does not replace that comprehensive document, which is an indispensable reference for the Rank Calculator. This quick reference provides an overview of how to use the tool, and points directly to the relevant place in the NatureServe instructions for more detailed explanations of the factors. For additional information about the Rank Calculator and the underlying methodology, see Faber-Langendoen et al (2012). If you are using the Rank Calculator for the first time, we recommend starting with this document, running a few species through the spreadsheet to get a feeling for the process, and then familiarizing yourself with the two NatureServe documents before finalizing your work. Those documents, and the Rank Calculator itself, can be obtained at <http://www.natureserve.org/conservation-tools/conservation-rank-calculator>. You will need to register (free) at the site before you can download the document.

The Natural Heritage Program staff at WPC is available to assist you with any part of this process. Call 412-288-2777 and ask to speak with a botanist in the Heritage Program. You may also call a staff member directly; names and numbers are not included here only because staff members may change over time.

Note that the Rank Calculator is designed to determine S Ranks, the sub-national (state) conservation ranks used by NatureServe and its member programs, including the Pennsylvania Natural Heritage Program. These ranks closely parallel, but are not equivalent to, the legal statuses in the DCNR regulations (table 1). Appendix 1 includes the status definitions from the Pennsylvania Code, and an explanation of the TU modifiers used by the VPTC and the Rare Plant Forum.

Table 1. Approximate Correspondence Between NatureServe Sub-national Conservation Ranks and Legal Conservation Status in Pennsylvania.

Subnational Rank	Definition	Approximate Corresponding Pennsylvania Status
SX	Presumed Extirpated — Species not located despite intensive searches and virtually no likelihood of rediscovery.	Extirpated (PX)
SH	Possibly Extirpated — Known from only historical occurrences but still some hope of rediscovery. There is evidence that the species may be extinct, but not enough to state this with certainty.	Extirpated (PX)
S1	Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.	Endangered (PE)
S2	Imperiled—At high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors.	Threatened (PT)
S3	Vulnerable—At moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors.	Rare (PR)
S4	Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.	No Status
S5	Secure—Common; widespread and abundant.	No Status

Getting Started

Collection of Data

1. Request the Element Occurrence data for the species of interest from the Pennsylvania Natural Heritage Program. Send an e-mail to naturalheritage@paconserve.org asking for data for the

species of interest and specify that you will be using the Rank Calculator to prepare a RPF proposal.

2. Contact other botanists if you think they might have extensive experience with the species and/or data not yet submitted to the PNHP (PNDI).

Using the Rank Calculator

1. Go directly to the yellow tab “Calculator Form”.
2. The default setting of the calculator is for global ranks. To use the tool for estimating S-ranks, go to line 4, in the yellow cell, use the drop-down list and choose “S”. Enter the species name on line 10.
3. For “Type”, choose species or infraspecies (varieties and subspecies).
4. Classification = Vascular Plant

Filling out the Factors

It is very important to document your reasoning for every category you choose. Do this in the comments field to the right of each factor. Provide citations wherever possible. Published papers are best, but grey literature and personal communications should also be referenced as appropriate.

Assign values for every factor for which you have data, although there are a few that you don’t need unless other specific factors are unknown, as shown in table 2.

Table 2. Summary of NatureServe Conservation Status Factors.

Factor Category	Factor	Condition (Rule)
Rarity	Range Extent	Always use, if available
	Area of Occupancy	Always use, if available
	Population	Always use, if available (species only)
	Number of Occurrences	Always use, if available
	Number of Occurrences or Percent Area with Good Viability/Ecological Integrity	Always use, if available
	Environmental Specificity	Only use if both the Number of Occurrences and Area of Occupancy are Unknown or Null
Trends	Long-term Trend	Always use, if available
	Short-term Trend	Always use, if available
Threats	Threats	Always use, if available
	Intrinsic Vulnerability	Only use if Threats is Unknown or Null

1. **Range Extent:** The simplest estimate is to draw the minimum convex polygon. The minimum convex polygon is the smallest polygon with no indentations that contains all known points including historic (figure 1). Bear in mind that this is not intended to estimate abundance in any way (that is addressed elsewhere), but robustness to stochastic events, i.e. how vulnerable the species is to a single event or a series of events quickly causing drastic reductions.

Compare the area to the Pennsylvania-specific examples in figure 2. In many cases the PA Flora Project map is sufficient for this purpose, unless you know there are additional sites (a quick comparison of counties listed for PNHP records and mapped counties is also useful). There has been some work done to develop a model that will reduce the over-estimation inherent in using a minimum convex polygon, but it turns out that it seldom affects the final result (Bruce Young, pers comm). If the minimum convex polygon appears to be a gross exaggeration of the actual range, draw a shape that more reasonably represents the distribution, measure the area, and see if it affects the category. If it does, choose either a range category or the lower value, depending on how great the disparity is. Consider this factor when deciding at the end of the process whether to accept the computed value or to adjust it.

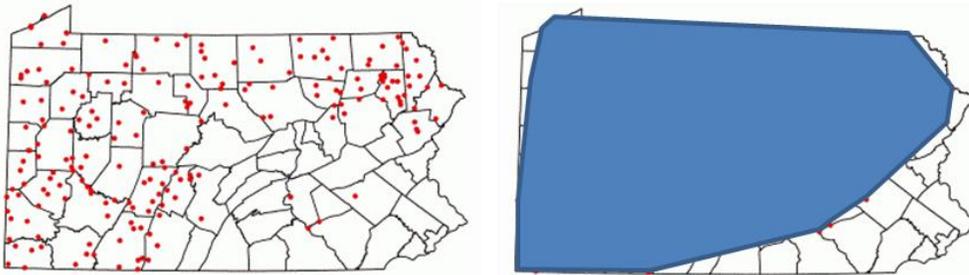


Figure 1. Distribution map of *Ribes cynosbati*. On the left is the dot map (Pennsylvania Flora Project). On the right is a representation of the range using a minimum convex polygon. Other valid range maps can be made by using finer scales and allowing for concavity.

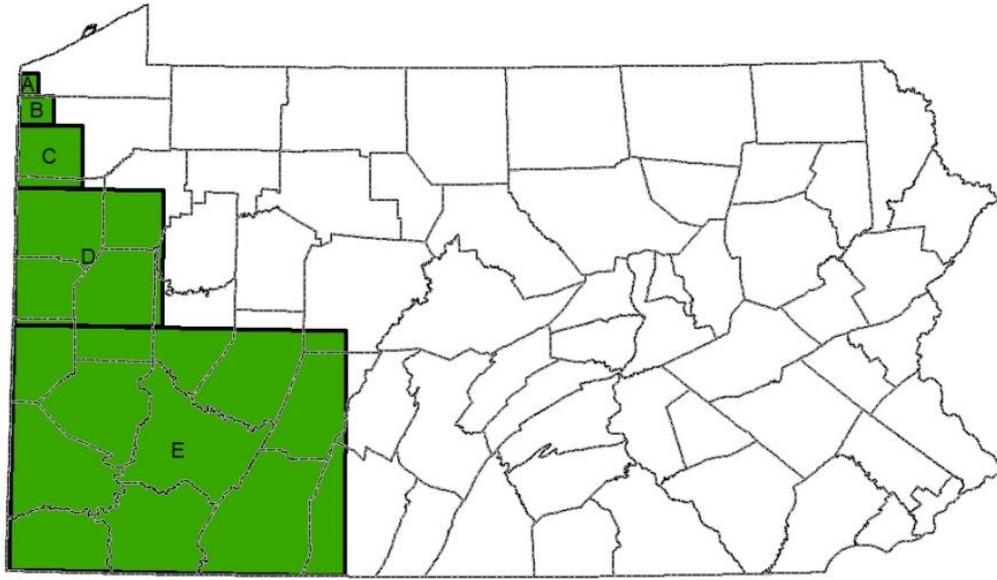


Figure 2. Reference areas for Range Extent. Category F includes anything larger than category E.

2. **Area of Occupancy:** This is the area within the known range that is actually occupied by the species. It is estimated by overlaying a 2 km grid (4 km² cells) over a map of the occurrences of the species, and tallying all occupied grid cells (for plants, this is usually the same as the number of occurrences). This standard is used to address the issues of measuring at different scales in a consistent way (see p. 18 for further explanation; all page number references in this document refer to Master et al 2012). Choose the category (or range of categories) that includes the measured result based on known occurrences, plus an appropriate buffer to account for undiscovered occurrences. If uncertainty regarding how much occupied habitat may be undiscovered is high, choose the appropriate range category. If you do not have a GIS program, or if you have one but would like assistance, call WPC. Note the result of the calculation, plus a description of your estimate, in the adjacent comment field (e.g. “36 grid cells calculated based on known extants, plus 10—15 estimated undiscovered occurrences at one grid cell each for a total of 46—61”)
3. **Number of Occurrences:** Choose the category that includes the number of known extant occurrences plus an estimate of the number of undiscovered occurrences and extant (but unconfirmed) historic that are likely to exist. Make sure to include the actual number of known extants in the comments field, as well as justification for your estimate of undiscovered occurrences or unconfirmed extant historic, especially if it pushes the number into a higher category.
4. **Population Size:** This represents the state-wide total population. This is defined as the number of fertile units capable of surviving independently. For clonal species this will tend to be fertile

ramets (see p. 21 for further details). You will need to sum the data from all the Element Occurrence Records to arrive at a range estimate for the entire Pennsylvania population.

EO size estimates are usually in the EO Data field. These estimates typically include a significant amount of uncertainty, hopefully explicitly expressed. To account for this, make a spreadsheet with two columns, one for low and one for high estimates. Enter the low and high end of the population estimate for each EO. You will usually find this data to be a combination of different precisions and different methods of counting individuals. You will often need to do some interpretation to be consistent and appropriate regarding clumps, ramets, stems, etc. Remember that what we are after is “the number of fertile units capable of surviving independently”. Also, remember that small variations are unlikely to matter if there are bigger numbers elsewhere in the estimate; whether you put “5-10” or “0-10” will not affect the answer if another EO has “500-1000” recorded. Sum the two columns to calculate the population estimate range. Enter this into the comments field. Add comments about quality and precision of the available data, and justification for any adjustment for undiscovered occurrences. Choose the appropriate category (or range of categories) on the factor sheet.

5. **Good Viability/Ecological Integrity:** two options are listed under this factor on the rank calculator worksheet; for plants you will always use Number of Occurrences rather than Percent of Area Occupied. Under Heritage methodology, viability is assessed with Element Occurrence Ranks on a scale A-F. “A” is excellent viability, “D” is poor viability, and “F” is failed to find. A rank of “E” is assigned to an occurrence which is extant but no further assessment of viability has been made. “Number of Occurrences” refers to the number of occurrences with a rounded rank (e.g. BC rounds to B) of B or better. If there are too many E-ranked occurrences to determine the correct category, you might dive into EO data to estimate some ranks, or just apply a range value from the lower section of the pull-down list. Further explanation of EO ranks can be found here: <http://explorer.natureserve.org/eorankguide.htm>
6. **A key to determine EO rank can be found here:**
http://downloads.natureserve.org/explorer/Key_to_Generic_EO_Ranking_Approach_12_15_2008.pdf
7. **Threat Analysis:** This is done on a different worksheet. Move over three tabs to the other yellow tab, Threats Assessment. The orange rows are broad categories called Level 1 Threats. Each Level 1 Threat is followed by a list of more specific Level 2 Threats. For each of the Level 2 Threats that is applicable, you need to choose a scope and severity using the drop down lists. Even if a threat is present but negligible, it is good to document it to demonstrate the completeness of the analysis. It won’t affect the final answer if it is insignificant. Add comments explaining your choices.

From Master et al (2012), “Scope is defined herein as the proportion of the species or ecosystem that can reasonably be expected to be affected (that is, subject to one or more stresses) by the

threat within 10- 20 years with continuation of current circumstances and trends. Current circumstances and trends include both existing as well as potential new threats.” “(S)everity is the level of damage to the species or ecosystem from the threat that can reasonably be expected with continuation of current circumstances and trends (including potential new threats). Note that for species, severity of threats is assessed within a ten-year or three generation time-frame, whichever is longer (up to 100 years)”. There is more relevant detail starting on p. 29.

Once you have completed the Level 2 Threats for a Level 1 category, you must manually rollup the scope and severity of the individual level 2 threats to combined values for the Level 1 threat. This will typically be the same as the scope and severity values of the most significant threat in the category; but if there are 2 or more significant Level 2 Threats in a category, see the guidance on p. 32.

The spreadsheet will compute Threat Impacts from the Level 1 Threats you have entered. It will also aggregate all the Level 1 Threat Impacts to compute an Overall Threat Impact. You must determine for yourself whether the analysis led to a reasonable conclusion. If you feel that the way the calculator compounded the individual threats over- or under-estimated the overall threat, enter the level you feel is appropriate and document why you feel the calculated result is not correct in the Overall Threat Impact Adjustment Reasons cell.

You now need to save the threat documentation, and transfer the outcome back to the main calculator worksheet. To transfer the outcome, click the button “1. Copy Overall Impact...” (to the right of the Assigned Overall Threat Impact cell). The threat analysis is now included in the rank calculation on the main calculator sheet. Now go up a few cells and hit “2. Save to ‘Threats Data Compiled’”. The data is now saved to the “threats data compiled” worksheet, and you can safely clear the form to make it available to use for another species. You can later move the data back from the compilation table to the Threats Assessment form if you want to review/edit your work.

Back in the main calculator worksheet, summarize the threat situation for the species in the adjacent comments field.

7. Trend: Trend is that factor that usually eludes us, but would be so valuable if we had it. It is often a better indication of extinction risk than rarity, and certainly the combination of the two is very powerful in determining the prognosis for a species. Although we usually lack hard data for plant species, the circumstantial evidence is often compelling. For instance when a species formerly occupied an area that has been heavily urbanized, we can confidently declare that the species has declined in that area (with some exceptions for disturbance adapted species) even if surveys have not been conducted for the species in the area. It is important to make use of any credible evidence of trend that is available. Because our evidence is usually inferred, it is usually

appropriate to choose a range of categories to account for uncertainty. Document and explain your reasoning in the comments field.

For Long-Term Trend, go back as far as the arrival of Europeans if you can. For Short-Term Trend consider the past 10 years or 3 generations, whichever is longer, but not over 100 years.

8. Assigned Rank: Once you complete the documentation of the factors, you must review the Calculated Rank and confirm that it makes sense or make an appropriate adjustment. The tool is designed to approximate the thought process that goes into a well-considered expert opinion of the conservation status of a species, but it cannot perfectly reproduce that process. Our experience has shown that it usually confirms the rank we arrived at through intuition. When that happens, it increases our confidence in our initial conclusion. More importantly, the factors that went into the thought process are now thoroughly documented for others to assess.

If you feel that the algorithm used by the Calculator to combine the individual factors over- or under-estimated the conservation rank, enter the rank (or range rank) you feel is appropriate and document why you feel the calculated result is not correct in the Rank Adjustment Reasons cell. For example, one potential glitch we have observed is that in cases where a species calculated as S2 before the addition of threats, the rank switches to S3 if “moderate” threat is assigned; this is an example of a situation where the author may choose to assign a different rank than calculated, and provide explanation (we are working with NatureServe to address this example).

A calculated result that is not an accurate representation of the actual conservation rank does not necessarily imply a problem with the tool. Because of the complexities of biology, ecology, and threats, it is not possible to create a model that will cover every combination of conditions. An example that NatureServe uses is the monarch butterfly. In this case, for various reasons, the size of the population is not a useful factor in determining extinction risk. This can be addressed by not using the population size as a factor, documenting your reasons at the population size level, or by adjusting the final result and providing the comments at that level.

There are a few additional factors that apply at the regional scale, but not the global scale, which are covered in the documentation, but not included directly in the analysis. These should be considered when deciding whether a rank adjustment is appropriate. The primary factor in this category is Rescue Effect. “Rescue effect is the process by which immigrating propagules result in a lower extinction risk for the population being assessed” (p. 38). This factor is more often significant for motile species than for plants, but since the propagules of plants can, to various degrees, travel significant distances from the parent, plants do have the potential for replenishment from nearby regions. If this is a reasonable expectation on a short enough time scale, it may justify the reduction of the conservation status by a category. If mortality in the state exceeds the rate of immigration, however, the state is a sink, which could justify an increase in the conservation status.

9. **Final Details:** Fill in the author, date, etc. and hit the “Save Data to Calculator Table” button to the right of the Calculated Rank. This will clear the form and you can now use it for another species. If you need to review and/or edit your work later, you can move the data from the Calculator Table back to the Calculator Form.

General Comments

You may notice that the “Minimum factors requirement met” turns to “Y” early in the process. That does not mean you can stop! It is very important to include as much evidence as we can gather. It is also not very useful to use this tool without providing plenty of comments. You might get to an answer that you feel confident with, but in terms of making our process transparent, you might as well just write down your gut feeling and skip the spreadsheet.

If you are unsure of how to interpret a factor, or how much to allow for undiscovered occurrences, try both extremes of what might be reasonable and see if it even makes any difference. If not, just choose a range that includes both extremes and write down why you were uncertain. If it makes a significant difference to the final answer, this is the time to discuss the situation with colleagues, and remember that the staff at PNHP is available.

Remember that this is just a condensed guide, not a substitute for the NatureServe documents. Some areas, such as Intrinsic Vulnerability and Threat Timing are not covered at all here, because they usually do not affect the final answer. Most factors are covered here in general terms, and further details and guidance in the NatureServe documents is essential to effective use of the Rank Calculator. Also, I think you will be impressed by the expertise and effort that has gone into development of this tool. Reading the supporting documentation made us feel confident of the value of the tool, and I predict you will also find that to be true.

Literature Cited

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.

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.

Appendix 1

Pennsylvania Conservation Status Definitions for Plants and VPTC Modifiers for TU

Definitions from Pennsylvania Code Title 25, Chapter 45

PX – Pennsylvania Extirpated

A classification of plant species believed by the Department to be extinct within this Commonwealth. The plants may or may not exist outside this Commonwealth. If plant species classified as Pennsylvania Extirpated are found to exist, the species automatically will be considered to be classified as Pennsylvania Endangered.

PE – Pennsylvania Endangered

A classification of plant species which are in danger of extinction throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained or if the species is greatly exploited by man. This classification also includes populations of plant species that have been classified as Pennsylvania Extirpated, but which subsequently are found to exist in this Commonwealth.

PT – Pennsylvania Threatened

A classification of plant species which may become endangered throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained to prevent their further decline in this Commonwealth, or if the species is greatly exploited by man.

PR – Pennsylvania Rare

A classification of plant species which are uncommon within this Commonwealth because they may be found in restricted geographic areas or in low numbers throughout this Commonwealth.

TU – Tentatively Undetermined

A classification of plant species which are believed to be in danger of population decline, but which cannot presently be included within another classification due to taxonomic uncertainties, limited evidence within historical records or insufficient data.

PABS Modifiers for Documenting the Nature of Uncertainty Necessitating a Status of Tentatively Undetermined

The TU category is represented in the PABS scheme by specific tentative categories using a U with a system of modifiers. The U represents a recommendation to DCNR for an official status of TU (Tentatively Undetermined). U is the first letter in the species category, followed by either X, E, T, or R to indicate the status of PX, PE, PT, or PR respectively, that best fits the species based on current data and the professional judgment of the committee. Thus, UX is "undetermined status but probably extirpated in PA". UE is "undetermined status but probably endangered in PA", etc.

The UX, UE, UT, or UR should be followed by one or more of the following modifiers to indicate the issue(s) preventing assignment to a definite category:

I—Identification of specimens is questionable.

T—Taxonomic status is uncertain.

F—Fieldwork is needed to better understand the current distribution and abundance of the species.

D—Dubious: it is unclear whether the supporting specimen(s) were actually collected within the Commonwealth.

N—Native status of the species is unclear.

H—Herbarium studies are needed.