Conservation Status Assessment Definitions, Process, Rank Factors, and Calculation of State Ranks for Montana Species

Montana Natural Heritage Program
November 2021

Montana Natural Heritage Program

NatureServe

Montana State Library

Suggested Citation:

Montana Natural Heritage Program. 2021. Conservation Status Assessment Definitions, Process, Rank Factors, and Calculation of State Ranks for Montana Species. 18 p.

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Introduction

This document provides an overview of the conservation status assessment definitions, process, ranking factors, and calculations used in the assignment of state conservation status ranks by the Montana Natural Heritage Program (MTNHP). State conservation status ranks inform a variety of conservation management actions by state and federal agencies, tribal nations, and private organizations. These protocols have been used to assign state conservation status ranks in Montana for animal species since 2020 and vascular plants since 2012 and are based on NatureServe methodology for calculating both subnational and global conservation status ranks across the NatureServe's network.

For those interested in an in-depth background on the NatureServe conservation status assessment process, please see the following resources:

- 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. https://www.natureserve.org/sites/default/files/natureserveconservationstatusmethodology_jun12.pdf

- 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. https://www.natureserve.org/sites/default/files/natureserveconservationstatusfactors_apr12.pdf

- Salafsky, N., D. Salzer, A.J. Stattersfield, C. Hilton-Taylor, R. Neugarten, S.H.M. Butchart, B. Collen, N. Cox, L.L. Master, S. O'Connor, and D. Wilkie. 2008. A standard lexicon for biodiversity conservation: unified classifications of threats and actions. Conservation Biology 22:897– 911. https://doi.org/10.1111/j.1523-1739.2008.00937.x

- NatureServe. 2020. NatureServe Conservation Status Assessments: Rank Calculator Version 3.2. NatureServe, Arlington, VA. https://www.natureserve.org/products/conservation-rank-calculator

Conservation Status Rank Definitions

Table 1. Ranks and rank modifiers assigned to Montana species. Modifiers can be applied to any rank (e.g. S1 or SH) which are shown as S#.

Rank	Definition
S1	At high risk because of **extremely limited** and/or **rapidly declining** population numbers, range and/or habitat, making it highly vulnerable to global extinction or extirpation in the state.
S2	At risk because of **very limited** and/or **potentially declining** population numbers, range and/or habitat, making it vulnerable to global extinction or extirpation in the state.
S3	Potentially at risk because of **limited** and/or **declining** numbers, range and/or habitat, even though it may be abundant in some areas.
S4	Apparently secure, though it may be quite rare in parts of its range, and/or suspected to be declining.
S5	Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.
SX	Presumed Extinct or Extirpated - Species is believed to be extinct throughout its range or extirpated in Montana. Not located despite intensive searches of historical sites and other appropriate habitat, and small likelihood that it will ever be rediscovered.
SH	Historical, known only from records usually 40 or more years old; may be rediscovered.
SNR	Not Ranked as of yet.
SU	Unrankable - Species currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
SNA	A conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities as a result of being: 1) not confidently present in the state; 2) non-native or introduced; 3) a long distance migrant with accidental or irregular stopovers; or 4) a hybrid without conservation value.
S#S#	Indicates a range of uncertainty about the status of the species *(e.g., S1S3 = State Rank ranges between S1 and S3).*
S#,S#	Indicates that populations in different geographic portions of the species' range in Montana have a different conservation status *(e.g., S1 west of the Continental Divide and S4 east of the Continental Divide).*
S#T#	Rank of a subspecies or variety. Appended to the state rank of the full species, *e.g. S4T3* where the rank reflects the status of the entire species and the T-rank reflects the status of just the subspecies.
Modifiers	
S#Q	**Questionable** taxonomy that may reduce conservation priority-Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank. *e.g. S3Q*
S#?	**Inexact Numeric Rank** - Denotes uncertainty; inexactness.
S#B	**Breeding** - Rank refers to the breeding population of the species in Montana. Appended to the state rank, *e.g. S2**B**,S5N = At risk during breeding season, but common in the winter*
S#N	**Nonbreeding** - Rank refers to the non-breeding population of the species in Montana. Appended to the state rank, *e.g. S5B,S2**N** = Common during breeding season, but at risk in the winter*
S#M	**Migratory** - Species occurs in Montana only during migration.

Overview of Conservation Status Assessment Process in Montana

1. Data on various conservation status factors are aggregated and rank factors are scored. This may entail gathering all information for an individual species or centralizing information that applies to a suite of species (e.g., documenting trends in habitat types).

2. Factor scores are used to calculate a preliminary state rank for a species (see ranks and rank definitions and Table 1). If sufficient data for determining a robust rank are lacking than the species may be assigned SU (unrankable) or SNR (species not ranked). Additional rank modifiers may be assigned as needed (Table 1).

3. Scores are then vetted according to the following processes:

   a. For terrestrial animal species:

   - For species that remain unchanged from the previous accepted rank, factors are reviewed and updated by MTNHP staff.

   - For species that score an S4 or S5 and were previously scored an SU, SNR, S4, or S5, the rank factors and supporting data are reviewed by MTNHP staff, and only changed if deemed valid.

   - For species that score an S1, S2, S3, or were previously on the SOC list and score an S4 or S5, hence removing them from the list, the rank factors and supporting data are reviewed by the Species of Concern Committee. This committee is composed of 6 professional biologists representing Montana Fish, Wildlife and Parks and the MTNHP. After the committee's review a majority vote determines whether or not to adopt the changes.

   b. For fish species: draft ranks for all species are reviewed in conjunction with the Species of Concern Committee of the Montana Chapter of the American Fisheries Society (MTAFS) and the committee's recommendation is typically adopted by both the MTNHP and MTAFS.

   c. For all other animal species: draft ranks are revied by MTNHP personnel with support from taxonomic experts to assess scoring criteria and finalize the draft rank.

   d. For botanical species: Data analysis and scoring are performed by the MTNHP botanist. Using an informal process, a network of professional, retired, or amateur botanists, biologists, or plant enthusiasts with species-level knowledge are consulted in finalizing the rank.

4. Species with accepted scores of S1, S2, or S3 are considered Species of Concern (SOC). Species that score as an S3/S4 or S4 may be considered Potential Species of Concern (PSOC), especially if they lack adequate surveys. Otherwise, the S4, or S5 ranks indicate either secure, stable, or abundant species. Species determined to be non-native in Montana are ranked as an SNA (Status Not Applicable). Species that have not been ranked by MTNHP are SNR (Status Not Ranked, as of yet). Species for which data is inadequate or conflicting maybe ranked as SU (Status Unrankable with current data).

*Note: In some situations, conservation status ranks are also be applied to varieties, subspecies, other defined infra-taxa, or geographically distinct populations following this process.

Rank Factors

Factors are grouped into three distinct categories which are subsequently scored to generate the numeric rank:

- **Rarity** – Assesses how widespread and/or common the species is within Montana.
- **Trends** – Assess the change in a meaningful metric using population, habitat, or range through time. Both the short-term and long-term trends can be evaluated.
- **Threats** – Assesses the proximate activity or process that has caused, is causing, or may cause the destruction, degradation, and/or impairment to the species. Threats may be related to human activities or may be natural.

Rarity

Population Size

Definition: Population size is the estimated current total population of the species within Montana, based on naturally occurring and wild individuals of reproductive age or stage, including mature but currently non-reproducing individuals (Master et al. 2012).

Factor Assessment: Select the appropriate category describing the estimated current naturally occurring wild total population of the species within Montana. Count or estimate the number of individuals of reproductive age or stage (at an appropriate time of the year), including mature but currently non-reproducing individuals. If uncertainty is estimated and a range of populations is given, consider scoring the low and high estimates to explore impact on rank. Note the source of any estimates used.

When estimating population numbers, the IUCN (2000) recommends considering the following points:

- Mature individuals that will never produce new recruits should not be counted (e.g., densities are too low for fertilization) [But see note below regarding long-persisting nonreproductive clones.)
- In the case of populations with biased adult or breeding sex ratios it is appropriate to use lower estimates for the number of mature individuals, which take this into account (e.g., the estimated effective population size).
- Where the population size fluctuates use a lower estimate. In most cases this will be much less than the mean.
- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g., corals).
- In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.
- Re-introduced individuals must have produced viable offspring before they are counted as mature individuals
- For species that produce more than one generation per year, use the size of the smallest annual reproducing generation in estimations.
- For seed-banking plants or other intermittently obvious organisms, consider population size to be the number of mature individuals in a typical "good" year, but not a "poor" year or an extraordinarily productive year. Although data will rarely be available, population size for such species should be conceptually considered the median of the population over a 10-year or 3-generation (whichever is longer) time span.
- For clone-forming organisms that persist or spread locally but rarely if ever reproduce, consider the population size to be the number of distinct, self-maintaining clonal patches (approximating the number of genets), rather than the number of physiologically separate individuals (ramets).

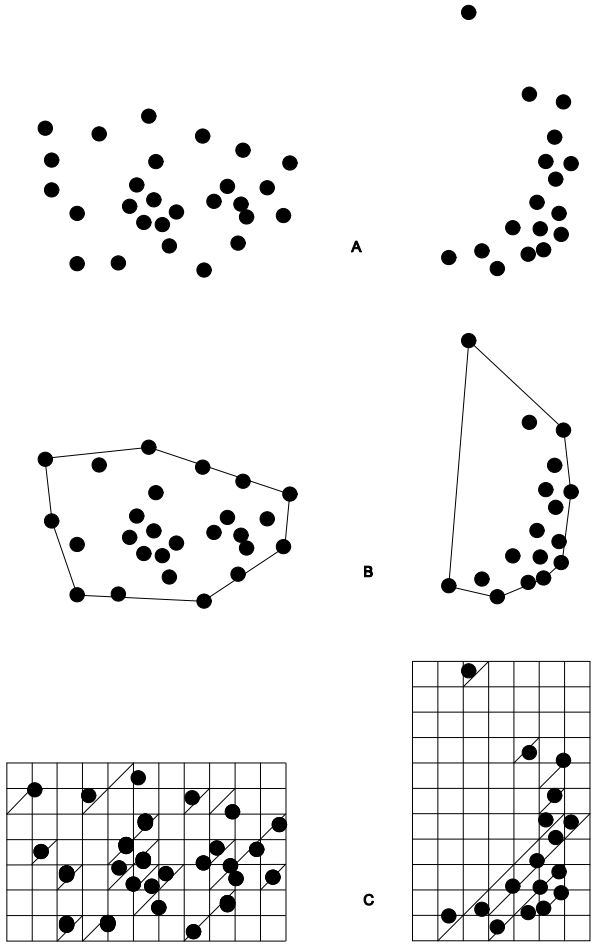
Select from the following values or select a range of values:

Z = Zero, no individuals known extant
A = 1-50 individuals
B = 50-250 individuals
C = 250-1,000 individuals
D = 1,000-2,500 individuals
E = 2,500-10,000 individuals
F = 10,000-100,000 individuals
G = 100,000-1,000,000 individuals
H = >1,000,000 individuals
U = Unknown
Null = Rank factor not assessed

Range Extent vs Area of Occupancy

Range extent as described by IUCN (2001) is the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distribution of a taxon (e.g., large areas of obviously unsuitable habitat); see 'area of occupancy'.

Area of occupancy as described by IUCN (2001) is the area within its 'extent of occurrence' which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases (e.g., colonial nesting sites, feeding sites for migratory taxa) the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon. The size of the area of occupancy will be a function of the scale at which it is measured and should be at a scale appropriate to relevant biological aspects of the taxon, the nature of threats and the available data.



Two examples of the distinction between range extent and area of occupancy. (A) Is the spatial distribution of known, inferred or projected sites of present occurrence. (B) Shows one possible boundary to the range extent, which is the measured area within this boundary using a minimum convex polygon. [Note that Burgman and Fox (2001) strongly recommend the use of α-hulls rather than minimum convex polygons to estimate range extent as otherwise significant overestimates (e.g., right side of example B) may result.] *(C) Shows one measure of area of occupancy, which can be achieved by the sum of the occupied grid squares.*

Figure 1. The difference between range extent and area of occupancy, taken from Master et al. 2012

Range Extent

Definition: Extent of occurrence is the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all the known, inferred, or projected sites of present occurrence of a taxon or ecosystem, excluding cases of vagrancy. While this measure may exclude discontinuities or disjunctions within the overall distribution of a taxon or type (e.g., large areas of obviously unsuitable habitat), such exclusions are discouraged except in extreme cases because these disjunctions and outlying occurrences accurately reflect the extent to which a large range size reduces the chance that the entire population of the taxon will be affected by a single threatening process. Risks are spread by the existence of outlying or disjunct occurrences irrespective of whether the range extent encompasses significant areas of unsuitable habitat (Master et al. 2012).

Factor Assessment: Select the appropriate category that best describes the estimated current range of the species in Montana. For many species in Montana this value is estimated from Natural Heritage Program range maps. If a species' range varies across the year, the range most relevant to the species continued persistence should be used to score this factor. For many migratory species this should be breeding range. As range polygons are delineated with many methods that impact the area of that polygon the reviewer should consider what impacts this may have on the score and whether it is appropriate to use a given range map for the species they are assessing. In particular, species with very specific and uncommon habitats may be over-represented by broadly drawn range maps that include significant amounts of unsuitable habitat.

Select from the following values or range of values:

Z = Zero (no occurrences believed extant)
A = <100 km^2 (less than about 40 square miles)
B = 100-250 km^2 (about 40-100 square miles)
C = 250-1,000 km^2 (about 100-400 square miles)
D = 1,000-5,000 km^2 (about 400-2,000 square miles)
E = 5,000-20,000 km^2 (about 2,000-8,000 square miles)
F = 20,000-200,000 km^2 (about 8,000-80,000 square miles)
G = 200,000-2,500,000 km^2 (about 80,000-1,000,000 square miles)
H = >2,500,000 (> 1,000,000 square miles)
U = Unknown
Null = Rank factor not assessed

Area of Occupancy

Definition: Area of occupancy is the area within its 'extent of occurrence', which is occupied by a taxon or ecosystem type, excluding cases of vagrancy. The measure reflects the fact that a taxon or type will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases, (e.g., irreplaceable colonial nesting sites, crucial feeding sites for migratory taxa) the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon. The size of the area of occupancy will be a function of the scale at which it is measured and should be at a scale appropriate to relevant biological or ecological aspects of the taxon or type, the nature of threats and the available data (Master et al. 2012).

Factor assessment: Select the appropriate category describing the estimated current area of occupancy of the species in Montana. For species in linear habitats (e.g., riverine shoreline, or cliff-edge species), enter the code for the total number of 1 km^2 grid cells occupied across these linear features. For species that occur in non-linear habitats, area of occupancy can be calculated as the number of 4km^2 grid cells occupied by the species within its state-wide range. Area of Occupancy can be directly calculated from observation or occurrence data, from habitat based (deductive) models, or models that predict habitat suitability (inductive). If using model output to assess this factor, a robust understanding of the type of model used and model performance is necessary as decisions about thresholds and habitat values as well as covariate selection can have drastic impacts on the area of predicted habitat and tuning or interpretation of these outputs in the

context of status ranking may be necessary. If model output is used, note the type of model used and provide a citation or link to a summary of the model implementation and performance in the comments.

Select from the following area values or range of area values for non-linear species:

Z = Zero (no occurrences believed extant)
A = 1 4 km^2 cell
B = 2 4 km^2 cells
C = 3-5 4 km^2 cells
D = 6-25 4 km^2 cells
E = 26-125 4 km^2 cells
F = 126- 500 4 km^2 cells
G = 501-2,500 4 km^2 cells
H = 2,501-12,500 4 km^2 cells
I= >12,500 4 km^2 cells
U = Unknown
Null = Rank factor not assessed

Select from the following area values or range of area values for linear species:

Z = Zero (no occurrences believed extant)
A = 1-4 1 km^2 cell
B = 5-10 1 km^2 cells
C = 11-20 1 km^2 cells
D = 21-100 1 km^2 cells
E = 101-500 1 km^2 cells
F = 501-2,000 1 km^2 cells
G = 2,001-10,000 1 km^2 cells
H = 10,001-50,000 1 km^2 cells
I = >50,000 1 km^2 cells
U = Unknown
Null = Rank factor not assessed

Precent of Area Occupied in Good Condition

Definition: The proportion of the total area occupied with (at least) good (i.e., excellent-to good) viability exhibits favorable characteristics with respect to population size and/or quality and quantity of occupied habitat; and, if current conditions prevail, the occurrence is likely to persist for the foreseeable future (i.e., at least 20- 30 years) in its current condition or better (Master et al. 2012).

Factor Assessment: If Area Occupied is assessed, it may benefit the ranking process to include the proportion of that area that is in “excellent or good condition”. Determine the percent of total area that can be classified as good or excellent condition and score.

Select from the following values

A = No area with good ecological integrity or viability
B = Very small precent (<5%) of area with good integrity or viability
C = Small percent (5-10%) of area with good viability or ecological integrity
D = Moderate percent (11-20%) of area with good viability or ecological integrity
E = Good percent (21-40%) of area with good viability or ecological integrity
F = Excellent percent (>40%) of area with good viability or ecological integrity
U = Unknown
Null = Not assessed

Number of Occurrences

Definition: An occurrence is an area of land and/or water in which a species or ecosystem is, or was, present. An occurrence should have practical conservation value for the species or ecosystem as evidenced by historical or potential continued presence and/or regular recurrence at a given location (Master et al. 2012). For further discussion of the species or ecosystem occurrence concept refer to Master et al. 2012.

Factor Assessment: Count and score the number of occurrences in Montana. If occurrence data is comprehensive such that it represents the species' populations in Montana, then assessing the number of occurrences is valuable data for status ranking. However, if occurrences under-represent the species' population in Montana than it can artificially lower the rank factor. For example, many species are under-surveyed in Montana and have fewer occurrences documented than exist across within the state. For more common species with a significant number of occurrences this is less of an issue because the categories are broad but for rare species this may impact factor assessment.

Select from the following values or range of values:

Z = Zero (no occurrences believed extant)
A = 1-5 occurrences
B = 6-20 occurrences
C = 21-80 occurrences
D = 81-300 occurrences
E = >300 occurrences

Number of Occurrences in Good Condition/ Good Viability/ Good Integrity

Definition: An occurrence with (at least) good (i.e., excellent-to good) viability exhibits favorable characteristics with respect to population size and/or quality and quantity of occupied habitat; and, if current conditions prevail, the occurrence is likely to persist for the foreseeable future (i.e., at least 20- 30 years) in its current condition or better (Master et al. 2012).

Factor Assessment: If the number of occurrences is completed, then this factor can be used to further refine the information to identifying the number of occurrences that are in good condition or have good integrity. For all occurrences determine the total number that can be classified as having "good viability" and select the appropriate category describing this number. This factor should only be assessed if the number of occurrences is also assessed.

Select from the following values or range of values:

Z = Zero (no occurrences believed extant)
A = 1 occurrences
B = 2-3 occurrences
C = 4-12 occurrences
D = 13-40 occurrences
E = 41-125 occurrences
F = >125 occurrences
U = Unknown
Null = Not assessed

Environmental Specificity

Definition: Environmental specificity is the degree to which a species depends on for a relatively scarce set of habitats, substrates, food types, biotic conditions, and/or abiotic conditions within its Montana range.

Factor Assessment: Select the appropriate letter code for the observed, inferred, or suspected vulnerability or resilience of the species due to habitat preferences or restrictions or other environmental specificity or generality. Describe the reasons for your selection in the Environmental Specificity field. This factor is most

important when the number of populations, number of occurrences or Area of Occupancy are largely unknown or poorly defined. When used in combination with range extent this factor provides a crude measure of how common a species is within range. If Area of Occupancy or Number of occurrences are populated Environmental Specificity is not used in the calculation of Rarity.

Select from the following values:

A = Very Narrow. Specialist. Specific habitat(s), substrate(s), food type(s), hosts, breeding/nonbreeding microhabitats, or other abiotic and/or biotic factor(s) are used or required by the Element in the area of interest, with these habitat(s) and/or other requirements furthermore being scarce within the generalized range of the species within the area of interest, and, the population (or the number of breeding attempts) expected to decline significantly if any of these key requirements become unavailable.

B = Narrow. Specialist. Specific habitat(s) or other abiotic and/or biotic factors (see above) are used or required by the Element, but these key requirements are common and within the generalized range of the species within the area of interest.

C = Moderate. Generalist. Broad-scale or diverse (general) habitat(s) or other abiotic and/or biotic factors are used or required by the species but some key requirements are scarce in the generalized range of the species within the area of interest.

D = Broad. Generalist. Broad-scale or diverse (general) habitat(s) or abiotic and/or biotic factors are used or required by the species, with all key requirements common in the generalized range of the species in the area of interest. If the preferred food(s) or breeding/nonbreeding microhabitat(s) become unavailable, the species switches to an alternative with no resulting decline in numbers of individuals or number of breeding attempts.

U = Unknown

Null = Rank factor not assessed

Trends

Long-term Trend

Definition: The observed, estimated, inferred, or suspected degree of change in population size, extent of occurrence, area of occupancy, and/or number or condition of occurrences over the long-term (ca. 200 years) in Montana.

Factor Assessment: Score the estimated long-term trend according to the values below. Specify in the comment field the time period for the change noted, as well as a longer-term view (e.g., back to European exploration) if information is available. If data on more than one aspect are available, specify which aspect is most influential. Often data to assess this factor are sparse and rely on anecdotal or observational data from early explorers and naturalists. Broad changes in habitat or habitat features can also be used to assess this factor. Given the uncertain and inexact nature of these assessments, ranges of potential change are often better at characterizing these changes through time.

Select from the following values:

A = Very Large Decline (decline of >90%, with <10% of population size, range extent, area occupied, and/or number or condition of occurrences remaining)
B = Large Decline (decline of 75-90%)
C = Substantial Decline (decline of 50-75%)
D = Moderate Decline (decline of 25-50%)
E = Relatively Stable (±25% change)
F = Increase (increase of >25%)
U = Unknown. Long-term trend in population, range, area occupied, or number or condition of occurrences unknown
Null = Rank factor not assessed

Short-term Trend

Definition: The observed, estimated, inferred, suspected, or projected short-term trend in population size, extent of occurrence, area of occupancy, whichever most significantly affects the rank in Montana. Consider short-term historical trend within 10 years or 3 generations (for long-lived species), whichever is the longer (up to a maximum of 100 years).

Factor Assessment: Score the estimated change according to the values below. Trend data may be recent, current, or projected (based on recent past), and the continuation of the trend may be unknown. Trends may be smooth, irregular, or sporadic. Discerning fluctuations within trend data from the trend itself can be difficult, particularly within short time periods. Expert interpretation of available trend data and supporting evidence should be solicited to attempt to quantify trend and any uncertainty scored and noted.

Note in the comment field what is known about various pertinent trends; include trend information for particular factors, more precise information, regional trends, etc. If the cause or causes of decline or increase are understood, provide comments on this as well as whether there are ongoing impacts. If the trend is known not to be continuing, specify that in comments. The source of the trend data should be cited. If the uncertainty in trend was estimated these estimates may be included in the score or noted in the comments.

Select from the following values:

A = Severely Declining. Decline of >70% in population, range, area occupied, and/or number or condition of occurrences

B = Very Rapidly Declining. Decline of 50-70% in population, range, area occupied, and/or number or condition of occurrences

C = Rapidly Declining. Decline of 30-50% in population, range, area occupied, and/or number or condition of occurrences

D = Declining. Decline of 10-30% in population, range, area occupied, and/or number or condition of occurrences

E = Stable. Population, range, area occupied, and/or number or condition of occurrences unchanged or remaining within ±10% fluctuation

F = Increasing. Increase of >10% in population, range, area occupied, and/or number or condition of occurrences

U = Unknown. Short-term trend in population, range, area occupied, and number and condition of occurrences unknown.

Null = Rank factor not assessed

Threats and Intrinsic Vulnerability

The Threats category can be defined using a direct assessment of threats to the species or if these data are not available the species' intrinsic vulnerability should be assessed.

Threats

Definition: Threats are the proximate activity or process that has caused, is causing, or may cause the destruction, degradation, and/or impairment to the species. Threats may be related to human activities or may be natural (Master 2012).

Factor Assessment: NatureServe provides relevant threat categories for the nation (Table 2). The scope, severity, and timing of any individual threat that is observed, inferred, or suspect to be directly or indirectly affecting a species is considered. Threats may be classified at a category or at a subcategory level, which provides a more precise description and assessment of the threat. The subcategory data are then combined by the reviewer and "rolled up" to the category level for scoring.

Table 2. Threat categories (whole numbers) and subcategories (decimals) for ranking species. Subcategories are aggregated and contribute to the category score. Impact (or lack thereof) is assessed for each category to generate an overall threat impact for a species.

	Threat Categories
1	**Residential & commercial development**
1.1	Housing & urban areas
1.2	Commercial & industrial areas
1.3	Tourism & recreation areas
2	**Agriculture & aquaculture**
2.1	Annual & perennial non-timber crops
2.2	Wood & pulp plantations
2.3	Livestock farming & ranching
2.4	Marine & freshwater aquaculture
3	**Energy production & mining**
3.1	Oil & gas drilling
3.2	Mining & quarrying
3.3	Renewable energy
4	**Transportation & service corridors**
4.1	Roads & railroads
4.2	Utility & service lines
4.3	Shipping lanes
4.4	Flight paths
5	**Biological resource use**
5.1	Hunting & collecting terrestrial animals
5.2	Gathering terrestrial plants
5.3	Logging & wood harvesting
5.4	Fishing & harvesting aquatic resources
6	**Human intrusions & disturbance**
6.1	Recreational activities
6.2	War, civil unrest & military exercises
6.3	Work & other activities

	Threat Categories
7	**Natural system modifications**
7.1	Fire & fire suppression
7.2	Dams & water management/use
7.3	Other ecosystem modifications
8	**Invasive & other problematic species, genes & diseases**
8.1	Invasive non-native/alien species/diseases
8.2	Problematic native species/diseases
8.3	Introduced genetic material
8.4	Problematic species/diseases of unknown origin
8.5	Viral/prion-induced diseases
8.6	Diseases of unknown cause
9	**Pollution**
9.1	Domestic & urban waste water
9.2	Industrial & military effluents
9.3	Agricultural & forestry effluents
9.4	Garbage & solid waste
9.5	Air-borne pollutants
9.6	Excess energy
10	**Geological events**
10.1	Volcanoes
10.2	Earthquakes/tsunamis
10.3	Avalanches/landslides
11	**Climate change & severe weather**
11.1	Habitat shifting & alteration
11.2	Droughts
11.3	Temperature extremes
11.4	Storms & flooding
11.5	Other impacts
12	**Other options**
12.1	Other threat

Threat considerations apply to the present and the future condition. Effects of past threats (whether or not continuing) should be addressed under the short-term trend and/or long-term trend factors. For species without recent observations but historically documented in the area of interest, and significant likelihood of rediscovery in identifiable areas, current or foreseeable threats in those areas may be addressed here where appropriate if they would affect any extant (but unrecorded) occurrences of the species.

Threats may be observed, inferred, or projected to occur in the near term. They should be characterized in terms of severity (how badly and irreversibly the species population is affected), scope (what proportion of it is affected), and degree of imminence (how likely the threat is and how soon is it expected). "Magnitude" is sometimes used to refer to scope and severity collectively.

Table 3. Threat impact scoring for threat categories (from Master et al. 2012). For each category the Severity (grey rows) and Scope (grey columns) are compared to calculate an impact score. Only threats with Immediacy scores of High (continuing) or Medium (short-term) are used to calculate an overall threat impact.

		Scope				
		Pervasive	Large	Restricted	Small	Unknown
Severity	Extreme	Very High	High	Medium	Low	Medium
	Serious	High	High	Medium	Low	Medium
	Moderate	Medium	Medium	Low	Low	Low
	Slight	Low	Low	Low	Low	Low
	Unknown	Medium	Medium	Low	Low	Unknown

For each ongoing or potential threat score according to the following criteria:

Severity
Extreme= 71-100% decline in population
Serious = 31-70% decline in population
Moderate = 11-30% decline in population
Slight= 1-10% decline in population
Negligible = <1% decline in population
Neutral or Potential Benefit
Unknown

Scope
Pervasive = 71-100% of total population or area affected
Large = 31-70% of total population or area affected
Restricted = 11-30% of total population or area affected
Small = 1-10% of total population or area affected
Negligible = <1% of total population or area affected
Unknown

Immediacy
High: Threat is operational (happening now)
Moderate: Threat is likely to be operational within the short-term
Low: Threat is likely to be operational in the long-term
Insignificant: Threat may exist but is not likely to be operational within the scope of this status ranking analysis.

To distill all threats to a single score for the species, subcategories of threats are aggregated within their respective categories using expert opinion to score scope and severity in a manner best representative of all these subcategories and the impact of each calculated (Table 3). Once the impact of each category has been assessed, these are tallied, and the Overall Impact Score is calculated according to Table 4.

Table 4. Guidelines for assigning overall threat impact value (from Master et al. 2012). Impact scores of threat categories are tallied, and an overall threat impact score is assigned according to the rubric below.

Overall Threat Score	Threat Category Tallies			
	Very High	High	Medium	Low
Very High	≥1	≥0	≥0	≥0
	0	≥2	≥0	≥0
	0	1	≥2	≥0
High	0	1	<2	≥0
	0	0	≥3	≥0
	0	0	2	2
	0	0	1	≥3
Medium	0	0	1	<3
	0	0	0	≥4
Low	0	0	0	1-3
No Threat	0	0	0	0

Intrinsic Vulnerability

Definition: Intrinsic vulnerability is the observed, inferred, or suspected degree to which characteristics of the species (such as life history or behavior characteristics of species) make it vulnerable or resilient to natural or anthropogenic stresses or catastrophes (Master et al. 2012). Examples of such factors include reproductive rates and requirements, time to maturity, dormancy requirements, and dispersal patterns.

Factor Assessment: Enter the appropriate letter describing the species intrinsic vulnerability based on the criteria below. Intrinsic vulnerability is only used in rank score calculation if threats are unknown or not scored. However, these data are often helpful for understanding aspects of the species' life history and providing context for status assessment so including these data with the assessment can be beneficial.

Since geographically or ecologically disjunct or peripheral populations may show additional vulnerabilities not generally characteristic of the species, these factors are to be assessed for the species throughout the area of interest, or at least for its better populations. Do not consider here such topics as population size, number of occurrences, area of occupancy, extent of occurrence, or environmental specificity; these are addressed as other ranking factors.

Note that the intrinsic vulnerability factors exist independent of human influence but may make the species more susceptible to disturbance by human activities. The extent and effects of current or projected extrinsic influences themselves should be addressed in the Threat comments field.

Select from the following values:

A = Highly Vulnerable. Species is slow to mature, reproduces infrequently, and/or has low fecundity such that populations are very slow (> 20 years or 5 generations) to recover from decreases in abundance; or species has low dispersal capability such that extirpated populations are unlikely to become reestablished through natural recolonization (unaided by humans).

B = Moderately Vulnerable. Species exhibits moderate age of maturity, frequency of reproduction, and/or fecundity such that populations generally tend to recover from decreases in abundance over a period of several years (on the order of 5-20 years or 2-5 generations); or species has moderate dispersal

capability such that extirpated populations generally become reestablished through natural recolonization (unaided by humans).

C = Not Intrinsically Vulnerable. Species matures quickly, reproduces frequently, and/or has high fecundity such that populations recover quickly (< 5 years or 2 generations) from decreases in abundance; or species has high dispersal capability such that extirpated populations soon become reestablished through natural recolonization (unaided by humans).

U = Unknown

Null = Rank factor not assessed

Other Considerations

Considerable uncertainty often exists within the information used to assess rank factors. Factors such as Range Extent, Area Occupied, Population, Trend, and others are often estimated and although these statistics may be expressed as a point value, they are more correctly represented as a range of possible values that are likely to encapsulate the true value. Rather than ignoring this uncertainty, it is best to perpetuate it into the ranking process. If reasonable values for a factor overlap two or more scores for that factor, the reviewer should consider using both the lowest and highest score in rank calculation. Often times this will return two numeric scores with the same rank classification. If two ranks are returned (e.g. S3S4) the reviewer can propose and justify selecting one of the scores or retain the split rank to express uncertainty in status.

This rank process allows for additional information to be considered in assigning a conservation status rank. This is especially important when the status rank resulting from the overall assessment is different from the factors scores when take alone This (text only) field may also be used for other general notes pertinent to multiple factors.

The following are some examples information that may be used to justify assignment of a rank that differs from the calculated numeric score:

- Preliminary rank assessment does not necessarily reflect current status, since the rank was done by inspection from review of published distribution and habitat information, or museum collection information.

- A population viability analysis may indicate that the species has x percent probability of surviving for y years (or an equivalent number of generations) in the same area of interest (globe, nation, or subnation).

Aggregation of Rank Factors and Calculation of Conservation Status Ranks

Rarity

Letter scores for each rarity factor are assigned a numeric score following the table below. Each factor is further assigned a numeric score (Table 5). These scores are then summed then divided by the sum of their respective weights to generate a single Rarity score.

Some factors are ignored if the following conditions are met:

1. Number of Good Occurrences is ignored if the Number of Occurrences is populated.
2. Proportion of Area in Good Condition is ignored if the Area of Occupancy is populated.
3. If both Number of Good Occurrences and Proportion of Area in Good Condition are assessed only the more restrictive score is used in rank calculation.
4. Environmental specificity is only used if both Number of Occurrences and Area of Occupancy are Unknown or Null

Example: A species for which Rarity was assessed on Range Extent = C, Number of Occurrences = B and Proportion of Occurrences in Good Condition = B would score (1.57 + 1.38 + 2.20) / (1 + 1 + 2) = 1.29

Table 5. Point scores for Rarity factors. Letter scores are calculated using the previously described process and scored according the rubric below. Score values left blank are either not applicable to trend or denote values that do not contribute to the calculation of a Rarity score.

	Weight	Z	A	B	C	D	E	F	G	H	I	U/Null
Population Size	**2**	**0.00**	**0.00**	**1.57**	**3.14**	**4.71**	**6.29**	**7.86**	**9.43**	**11.0**		
Range Extent	**1**	**0.00**	**0.00**	**0.79**	**1.57**	**2.36**	**3.14**	**3.93**	**4.71**	**5.50**		
Area of Occupancy	**2**	**0.00**	**0.00**	**1.38**	**2.75**	**4.13**	**5.50**	**6.88**	**8.25**	**9.63**	**11.0**	
Number of Occurrences	**1**	**0.00**	**0.00**	**1.38**	**2.75**	**4.13**	**5.50**					
Number of Good Occurrences/ Populations	**2**		**0.00**	**2.20**	**4.40**	**6.60**	**8.80**	**11.0**				
Proportion Area in Good Condition	**2**		**0.00**	**2.20**	**4.40**	**6.60**	**8.80**	**11.0**				
Environmental Specificity	**1**		**0.00**	**1.83**	**3.67**	**5.50**						

Trends

Letter scores for both Short and Long-term trend factors are assigned a numeric score (Table 6). Scores for Short-term trend are twice the value of Long-term trend to emphasize the importance of this factor. The scores from both factors are then summed to calculate a single trend score.

Example: A species scoring a B on Long-term trend and an H on Short-term trend would have a trend score of (-0.40 + 0.14) = -0.26

Table 6. Point scores for Trend factors. Score values left blank are either not applicable to trend or denote values that do not contribute to the calculation of a Trends score.

	Z	A	B	C	D	E	F	G	H	I	U/Null
Long-term Trend		**-0.50**	**-0.40**	**-0.31**	**-0.22**	**-0.14**	**-0.07**	**0.00**	**0.07**	**0.14**	
Short-term Trend		**-1.00**	**-0.80**	**-0.62**	**-0.45**	**-0.29**	**-0.14**	**0.00**	**0.14**	**0.29**	

Threats

Scores for both Overall Threat and Intrinsic Vulnerability are assigned a numeric value (Table 7). Intrinsic Vulnerability is only used if the Overall Threat Score is Unknown or Null, otherwise it is ignored.

Example: A species with a Medium threat level and an Intrinsic Vulnerability score of Moderately Vulnerable would have a Threats score of 3.67 as Intrinsic Vulnerability is ignored when threat data are assessed.

Table 7. Point scores for Threat factors.

Overall Threat	**Very High**	**High**	**Medium**	**Low**	**U/Null**
Score	**0.00**	**1.83**	**3.67**	**5.50**	
Intrinsic Vulnerability	**Highly Vulnerable**	**Moderately Vulnerable**	**Not Intrinsically Vulnerable**		**U/Null**
Score	**0.00**	**2.75**	**5.50**		

Calculation of a Raw Rank Score

To generate a raw rank score, scores for both Rarity and Threats are weighted against each other (70% and 30% respectively) then trend is added following Equation 1. This raw score is then assigned a state rank based on Table 8.

For the above examples this would be calculated as Rarity (1.29 * 0.70) = 0.9, Threats (3.67* 0.30) = 1.101, Trends= (-0.26) which sum to 0.903+1.101+-0.26 = 1.744 which then scores at S2 which would place the species on the SOC list.

Equation 1. Raw score calculation

$$(\mathbf{Rarity} \times \mathbf{0.7}) + \mathbf{Trends} + (\mathbf{Threats} \times \mathbf{0.3}) = \mathbf{Raw\ Score}$$

Table 8. Translation of raw conservation status scores to State Rank. Note that Species with scores of S1, S2, and S3 are considered Species of Concern and species ranking S3S4 or S4 may be considered Potential Species of Concern. If uncertainty in rank score perpetuates through the ranking process a split rank reflecting this uncertainty may be assigned.

Raw Score	**SRANK**
$P < 1.5$	S1
$1.5 \leq P < 2.5$	S2
$2.5 \leq P < 3.5$	S3
$3.5 \leq P < 4.5$	S4
$P \geq 4.5$	S5