

**EXHIBIT E**



**Ranking Species Occurrences:  
Generic Guidelines and Decision Key**

May 2020

# Ranking Species Occurrences: A Generic Approach and Decision Key

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Version 1.0 published December 2008; Revised May 2020.

## Table of Contents

Introduction .....	2
Generic Guidelines for the Application of Element Occurrence Ranks .....	2
Occurrence Rank Definitions .....	2
A: Excellent viability .....	2
B: Good viability .....	2
C: Fair viability .....	3
D: Poor viability .....	3
E: Verified extant .....	3
H: Historical .....	3
F: Failed to find .....	4
X: Extirpated .....	4
Unrankable .....	4
NR: Not ranked .....	5
Dealing with Uncertainty .....	5
Attaining Consistency in Occurrence Ranking .....	5
Beyond Occurrence Ranks .....	5
Hypothetical Examples of Occurrences with Suggested Ranks .....	5
History and Rationale .....	11
Problems with Previous Occurrence Rank Specifications .....	11
A Simplified Approach .....	12
Advantages of Generic Occurrence Rank Guidelines .....	12
Acknowledgements .....	13
Applying the Generic Approach: Decision Key and Guidance .....	14
Introduction .....	14
Occurrence Ranking Key for Applying the Generic Approach .....	14

## Introduction

Element occurrence (EO, hereafter simply "occurrence") ranks provide a succinct assessment of the estimated viability (probability of persistence) of occurrences of a given species. They provide an estimation of the likelihood that, if current conditions prevail, a species occurrence will persist for a period of time. Because occurrence ranks are used to represent the relative overall "quality" of an occurrence as it currently exists, they are based solely on criteria that reflect the present status of that occurrence. These criteria can be broadly specified as "rank factors," namely size (including population size and/or occupied area), abiotic and biotic conditions, and landscape context. Future threats should not be used to "downgrade" an occurrence rank, but ongoing events (e.g., successional changes, periodic unfavorable management) that result in inexorable degradation of occurrence quality should be considered.

## Generic Guidelines for the Application of Element Occurrence Ranks

The generic approach to ranking species occurrences focuses on occurrences that are potentially rankable as A, B, C, and D. Many occurrences, such as those based solely on old museum records or on a recent observation with scant data, are not rankable as A, B, C, or D, but they could be ranked as E, H, X, U, F, or NR.

### Occurrence Rank Definitions

#### A: Excellent viability

Occurrence exhibits optimal or at least exceptionally favorable characteristics with respect to population size and/or quality and quantity of occupied habitat; and, if current conditions prevail, the occurrence is very likely to persist for the foreseeable future (i.e., at least 20-30 years) in its current condition or better. These occurrences have characteristics (e.g., size, condition, landscape context) that make them relatively invulnerable to extirpation or sustained population declines, even if they have declined somewhat relative to historical levels. For species associated with habitat patches or ephemeral or particularly dynamic habitats, occurrences warranting an A rank generally consist of metapopulations rather than single demes (unless exceptionally large and robust). Occurrences of this rank typically include at least 1,000 mature individuals but may be smaller (100s) or might require larger populations (10,000s), depending on the species and its demographic characteristics. However, occurrences can be ranked A even if population size is not known. For example, for occurrences lacking information on population size, an A rank may be appropriate under the following circumstances: the population is clearly very large but it is not known how large; the area of occupied habitat is exceptionally large; or the occurrence has excellent condition and landscape context and a long history of occurrence persistence. Occurrences with excellent estimated viability are ranked A even if one or more other occurrences have a much larger population size and/or much greater quantity of occupied habitat. In most cases, occurrences ranked A will occupy natural habitats. However, "natural" is an ambiguous concept, and occurrences in "unnatural" conditions (e.g., somewhat modified by human actions) may still be assigned a rank of A if they otherwise meet the criteria.

#### B: Good viability

Occurrence 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. B-ranked occurrences

have good estimated viability and, if protected, contribute importantly to maintaining or improving the conservation status of threatened or declining species. For species associated with habitat patches or ephemeral or particularly dynamic habitats, a high-quality occurrence may warrant a B rank if it consists of a single deme rather than a metapopulation (unless the single deme is exceptionally large and robust, in which case an A rank may be appropriate).

#### C: Fair viability

Occurrence characteristics (size, condition, and landscape context) are non-optimal such that occurrence persistence is uncertain under current conditions, or the occurrence does not meet A or B criteria but may persist for the foreseeable future with appropriate protection or management, or the occurrence is likely to persist but not necessarily maintain current or historical levels of population size or genetic variability. This rank may be applied to relatively low-quality occurrences with respect to size, condition, and/or landscape context if they still appear to have reasonable prospects for persistence for the foreseeable future (at least 20-30 years). Examples include very small non-degraded relict occurrences as well as some remnant occurrences of former landscape-level species such as many extant occurrences of tall-grass prairie insects. These occurrences represent the lower bound of occurrences worthy of protection.

#### D: Poor viability

If current conditions prevail, occurrence has a high risk of extirpation (because of small population size or area of occupancy, deteriorated habitat, poor conditions for reproduction, ongoing inappropriate management that is unlikely to change, or other factors). Questionably viable occurrences that could be restored to at least fair viability should not be ranked D if restoration is deemed feasible and plausible; in most such cases CD should be used. Very small occurrences that may be vulnerable to deleterious stochastic events may be ranked as follows: If the stochastic event is highly theoretical or of very low probability in the appropriate time frame (e.g., 20-30 years), then a C or CD rank may be appropriate. If a minority of other similar occurrences have disappeared as a result of, say, disease or inbreeding, then perhaps CD is best. If most of these small occurrences have been extirpated or are disappearing due to such events, then D is probably appropriate. The D rank also applies if the population is so small that there will inevitably be a year (or generation) in the near future in which by chance all adults will be the same gender.

#### E: Verified extant

Occurrence recently has been verified as still existing, but sufficient information on the factors used to estimate viability of the occurrence has not yet been obtained. Use of the E rank should be reserved for those situations in which the occurrence is thought to be extant, but an A, B, C, D, or combination rank cannot be assigned.

#### H: Historical

Recent field information verifying the continued existence of the occurrence is lacking. Examples of this rank include occurrences based only on historical collection data, or occurrences that previously were ranked A, B, C, D, or E but that are now, without field survey work, considered to be possibly extirpated due to general habitat loss or degradation of the environment in the area. H may be applied to recently verified occurrences if two or more competent subsequent efforts that should have found the species did not, or if there has been a known major disturbance since the last observation such that continued

existence of the occurrence is in doubt (for example, an isolated Lepidoptera occurrence that was sprayed with Dimilin®).

In the absence of known disturbance and with the habitat still extant, H is generally recommended for occurrences that have not been reconfirmed for 20 or more years, but for many short-lived insects a shorter interval may be appropriate, and for unusually stable habitats (like undisturbed caves), or for certain plants whose seeds may persist and remain viable in the soil for decades, a longer interval, up to 40 years, may be used. With very few exceptions, occurrences are to be regarded as H after 40 years without confirmation, even with no effort to locate the species. The time frame for H occurrences is necessarily arbitrary, and the values specified here should be regarded as generally appropriate but somewhat flexible rules. The professional judgment of the assessor should determine when resurveys with negative results have been sufficient in quantity and quality to warrant updating an occurrence rank from F to H or from H to X. Deviations from the suggested time frame should be explained in the EO RANK Comment field.

In some cases, H may indicate occurrences with imprecise locational information such that it may be difficult or impossible to determine whether subsequent observations are of the same occurrence; many of these occurrences may remain H indefinitely. Nevertheless, occurrences with imprecise locational information sometimes may be mapped using an appropriate and reasonable indication of the degree of locational uncertainty.

#### F: Failed to find

Occurrence has not been found despite a search by an experienced observer at a time and under conditions appropriate for the Element at a location where it was previously reported, but the occurrence still might be confirmed to exist at that location with additional field survey efforts. For occurrences with vague locational information, the search must include areas of appropriate habitat within the range of locational uncertainty.

#### X: Extirpated

Adequate surveys by one or more experienced observers at times and under conditions appropriate for the species at the occurrence location, or other persuasive evidence, indicate that the species no longer exists there or that the habitat or environment of the occurrence has been destroyed to such an extent that it can no longer support the species.

#### Unrankable

An occurrence rank (including E) cannot be assigned due to lack of sufficient information on the occurrence. As currently defined, this category is not clearly distinguishable from H, and use of U is discouraged until this issue is resolved (perhaps by elimination of the U category). Occurrences that currently cannot be surveyed because of access issues (e.g., a cave entrance has been permanently sealed, or an uncooperative landowner denies access) may be ranked A, B, C, D, E, F, H, or X if the rank is based on recent survey data obtained when access was still possible. Currently inaccessible occurrences that are based only on old (historical) information should be ranked H. Note that access issues often are temporary and may be overcome by negotiation, change in ownership, use of novel survey techniques, or other methods. The U code sometimes has been used to indicate occurrences with "unknown" viability, but such occurrences generally should be coded as H, F, or NR, depending on the circumstances.

## NR: Not ranked

An occurrence rank has not been assigned to the occurrence. This category may be used for occurrences that never have been ranked. Additionally, NR may be used for previously ranked occurrences that have been altered to such an extent that the previous rank likely no longer applies but the current appropriate rank is completely unknown. Note that H may be appropriate if there has been a major, presumably detrimental disturbance since the last observation such that continued existence of the occurrence is seriously in doubt (versus unknown).

## Dealing with Uncertainty

Note that certain combination ranks (i.e., AB, AC, BC, and CD) are encouraged and should be used to indicate the range of uncertainty regarding the appropriate rank for an occurrence. In fact, due to pervasive limited information about most occurrences, the appropriate rank for most occurrences will be a combination rank. It may be relatively easy to determine an appropriate rank by eliminating clearly inappropriate ranks (e.g., an occurrence is clearly not an A nor a D, so it's BC; or an occurrence appears to be viable and is clearly better than a D, but little else is known, so it's AC). The ranks AD and BD are uninformative regarding conservation value so their use is strongly discouraged; generally E should be used instead.

## Attaining Consistency in Occurrence Ranking

Occurrence ranking benefits from multiple opinions and may be accomplished most effectively in an "expert's workshop" setting. Occurrence ranks are best determined by persons who have a good understanding of the population characteristics of the species or who at least have good basic knowledge of the biology and ecology of the group of organisms to which the species belongs. Such knowledge allows the ranker to make a good forecast about the viability of a particular occurrence. The rationale for each rank should be recorded in the EO Rank Comments field in Biotics.

## Beyond Occurrence Ranks

For purposes such as monitoring the response of an occurrence to management actions, habitat mitigation, and ecological restoration, occurrence ranks, whether qualitatively or quantitatively defined, will be insufficient. Instead, efforts will need to be made to identify the key ecological attributes (subcomponents of the rank factors) that play an important (driving) function in the viability of the species. For each key ecological attribute, specific indicators or metrics can then be selected that will reflect changes in the viability of a species. For example, "reproductive success" is an indicator of the "reproduction and health" key ecological attribute (a subcomponent of condition), and the specific metric is "number of fledged young."

## Hypothetical Examples of Occurrences with Suggested Ranks

### *Animal Examples*

**Butterfly associated with a wetland food plant:** populations are naturally fragmented throughout the range; species has been known from this site for more than 100 years, and the size and condition of the site appears to have changed little over the past several decades; population occupies a small patch of wetland (stable bog or fen, about 1 hectare); nearest occupied habitat is 50 km away; 5-30 adults seen during recent 2-hour surveys during peak flight season (note that this is the number observed, not the total number of adults present); wetland is on a nature preserve with good prospects for appropriate

habitat management. Suggested rank: C. The small size of this occurrence precludes the A and B ranks, while long-term persistence and stable conditions eliminate the D rank.

**Cave invertebrate:** Surveys 50 years ago found several individuals in a cave pool. Subsequently, the opening used for access to the cave was sealed and likely will remain so indefinitely. No further information on the occurrence is available. Suggested rank: H. Because this occurrence is based only on old information, the appropriate rank is H. In the future, improved remote sensing/survey techniques might allow the rank to be updated. If prior to sealing of the cave entrance the occurrence had been ranked A, B, C, D, or E based on recent surveys, that rank would still apply until the time frame suggested invoking the H rank, unless there is a significant probability that cave sealing might have affected the viability of the occurrence, in which case the appropriate rank would be H.

**Colonial seabird:** occurrence consists of 5 adjacent islands, all of which are protected; nesting population recently was estimated at 400,000 pairs, with no evidence of decline compared to estimates made 25 years ago. Suggested rank: A. An occurrence with these highly favorable characteristics is very likely to persist for the foreseeable future (i.e., at least 20-30 years) in its current condition or better.

**Freshwater mussel of riverine habitat:** extensive searching by experienced mussel biologists yields only a few mature individuals and no younger age classes; despite several surveys, no other occupied habitat patches have been found in this river in recent decades. Suggested rank: CD or D. This occurrence might not be completely devoid of viability; some mussels have a long life span, and it is plausible that conditions could change for the better. For example, riverine fish faunas are notoriously dynamic, and arrival of a new host fish could allow a renewal of successful reproduction.

**Grassland songbird:** Surveys in the late 1970s found a few nesting pairs around the margins of a large pasture. Since then, the species has not been detected in that area or in other locations in the vicinity, despite surveys at the appropriate time by expert birders in each of the past three years. Suggested rank: X. This evidence is sufficient to regard the occurrence as extirpated. If the evidence of extirpation were not so conclusive (i.e., there is a reasonable probability that the species is still there but was not detected), then the appropriate rank would be H.

**Passerine bird associated with grassland habitat:** in recent years 2-3 singing males have been present in May in a 5-hectare hayfield surrounded by residential development and young forest; a few fledglings were observed in July in one of the years. Suggested rank: D. This information substantiates the existence of a legitimate occurrence, but very small size and poor landscape context indicate a high probability of extirpation in the foreseeable future. Feasible management could not do much to improve the prospects for persistence.

**Passerine bird associated with old field conditions:** recent surveys (3-5 years old) found 25-30 singing males during the nesting season; occupied habitat patch is 100 hectares, surrounded by forest and residential development; reforestation is slowly occurring; land is divided among several private owners. Suggested rank: CD. Certainly the size, condition, and landscape context are not optimal or highly favorable, so it is not an A occurrence. If existing conditions (including ongoing reforestation) prevail, the occurrence is likely to undergo habitat degradation and thus not to maintain its current condition, so a rank of B can be eliminated. Appropriate management is at least plausible and probably could maintain this population for the foreseeable future in its current condition or better, so the C rank cannot be eliminated. Because persistence of this occurrence for the foreseeable future depends on appropriate

management that may not occur (in which case the occurrence may be extirpated), a rank of CD is warranted.

**Pond-breeding odonate:** occurrence encompasses a complex of several neighboring wetland patches of various sizes of up to a few hectares; species was first discovered in this location 75 years ago; recent quick surveys yielded multiple adults and exuviae in nearly every patch; wetland and adjacent upland habitat are protected and not subject to pesticide applications. Suggested rank: AB. This occurrence, which likely represents a metapopulation and for which long-term persistence has been documented, can be expected to exhibit at least good viability. Further information on population size, habitat condition, and landscape context might allow one to distinguish between A or B.

**Pool-breeding ambystomatid salamander of forested landscapes:** occurrence is represented by several breeding sites; pools contain dozens to hundreds of egg masses; breeding sites are surrounded by an extensive tract of mature forest. Suggested rank: AB. This occurrence, which likely represents a metapopulation, can be expected to exhibit at least good viability. Further information on occurrence size, condition, and landscape context might allow one to distinguish between A or B.

**Pool-breeding amphibian of forested landscapes:** occurrence consists of a single, isolated breeding pool and surrounding, mostly intact uplands; 20 percent of the upland area contains rural residential development; single recent survey found several hundred egg masses in the breeding pool. Suggested rank: B. Evidence indicates a substantial population that is, however, confined to a single pool, and the upland habitat has been somewhat degraded, so the occurrence does not meet the criteria for an A rank. On the other hand, an occurrence such as this is likely to persist if current conditions prevail, hence it is not a D occurrence. Given the large number of egg masses, the occurrence has good prospects for persistence and appears to be better than a marginal or C occurrence.

**Pond-breeding toad: occurrence encompasses a single pond and surrounding uplands:** pond is protected but most habitat around the pond has been converted to residential development over the past decade; recent surveys in appropriate season yielded a total of 3 egg masses in the pond. Suggested rank: D. Extremely small size and poor condition and landscape context make it highly unlikely that this occurrence will persist, let alone ever become a viable occurrence.

**Rattlesnake that uses communal hibernacula:** Museum specimens and a published account from 15 years ago document the existence of a denning population somewhere on remote Snake Mountain. Last year a well-timed, one-day survey failed to find any rattlesnakes, but much suitable, difficult-to-access habitat was not searched. Suggested rank: F. The recent brief survey does not preclude the possibility that the occurrence is still extant, so the appropriate rank is F.

**Remnant grassland butterfly:** small habitat scrap of 4 hectares of unmanaged dry native grassland, surrounded by residential development and with a cleared party spot with scraps of burned wood near the middle; absentee owner; neighbors recently started using part of the area for motorcycle recreation; the area mark-release-recapture studies estimated 30, 40, 35 and 50 adults within the past decade; 20 years ago there were three other comparable occupied habitats within 2 kilometers but now none are known within 50 km; populations of this species commonly decline (often in dry years) to as low as 10-20% of the mean during a 10-20 year period; according to old timers and anecdotal literature from several states colonies often suddenly appeared or disappeared; data indicate that immature stages are usually reduced by 90-100% following fires; a huge majority of suitable habitat patches in the state no

longer support the species. Suggested rank: D. With a mean of about 39 adults this apparently stable population is expected to fall to around 4-8 adults within 10-20 years from just routine fluctuations and certainly could not recover from two consecutive bad years, and might not from one. Furthermore, fires are nearly inevitable considering current context and uses and are most likely during already bad (dry) years. This occurrence has a high risk of extirpation during the next 20-30 years, and it appears to be implausible that the occurrence will be restored to at least fair viability through appropriate management.

**Small mammal of arid basins:** recent random surveys indicate that the occurrence extends over at least 100 square kilometers; habitat appears to be relatively unaltered, stable, and compatibly managed; population size and density are unknown, but the species is readily detected. Suggested rank: AB. This evidence suggest an at least good probability of continued occurrence persistence in the present condition or better. Nothing here appears to compromise the viability of the occurrence.

**Small mammal of coastal dunes:** occurrence extends along 3 kilometers of protected coastal dunes; surrounding areas are heavily developed (hotels, parking lots, etc.); species was first documented at the site 30 years ago; each of several live-trapping efforts in recent years yielded at least a few individuals per 100 trap-nights. Suggested rank: BC. Limited size and less than highly favorable landscape context eliminate an A rank, and documented persistence over at least 30 years indicate that the occurrence rank is better than D. Further information on population size is needed to determine whether the rank should be B or C.

**Snake of rocky desert mountains:** recent 1-day survey found 9 individuals scattered over 2 patches of talus habitat in a single remote mountain range (not readily accessible by road); suitable habitat encompasses several additional adjacent patches totaling a few square kilometers of basically undisturbed talus. Suggested rank: AB. Snakes in such habitats generally are difficult to observe in quantity, so seeing this many in one day suggests an ample population. Evidence indicates that the habitat is not subject to much disturbance and can be expected to persist in at least good condition for the foreseeable future.

**Spring-dwelling fish:** Surveys done 5 years ago documented a robust population in a natural spring-fed pool; on this basis the occurrence was ranked B. Examination of aerial photos taken last year and discussions with local residents indicate that the pool has been significantly modified in size and shape, but new fish surveys have not been conducted. Suggested rank: NR. Available information is insufficient to determine whether the changes have been positive, negative, or neutral; at one extreme, the fish may have been eradicated (perhaps in conjunction with the introduction of a predatory species in the modified habitat), or perhaps the changes have benefited the native fish population. Because of the altered conditions, the basis for the previous rank of B no longer applies, and the status of the occurrence needs to be redetermined; meanwhile, the rank should be updated to NR.

**Tadpole shrimp of ephemeral pools:** known occurrence consists of a single 1-hectare basin in a landscape altered only by seasonal grazing of livestock, which has occurred over several decades; 25 specimens were collected from the site 20 years ago; last year a single specimen was collected (abundance unknown); the basin was dry this year; unknown whether or not there are any nearby occupied pools. Suggested rank: AC. Tadpole shrimp eggs can persist for years in a dry basin, and these shrimp can be dispersed among basins by birds and other mobile animals. In a particular location, tadpole shrimp may be present for one or more years, then absent for a variable number of years and,

when present, they may range from scarce to abundant. Presence of tadpole shrimp in a basin in multiple years over a wide time frame suggests that the basin will continue to support a population (although perhaps irregularly) for the foreseeable future, if current conditions prevail, so the rank--even for this pool alone--is better than D. Further information on population size and landscape context (e.g., presence of nearby occupied pools) might allow one to define the rank more precisely. In particular this pool might or might not prove to be merely a portion of a larger A or B quality metapopulation.

**Tiger beetle of coastal sand dunes:** cursory surveys during the appropriate season consistently yield observations suggesting that a population of at least a few hundred adults (and undetermined numbers of larvae) occupies a suitable habitat patch of 25 hectares in a national park; museum collection records for the area extend back at least 50 years; habitat has natural processes largely intact but is partially encroached on by a small asphalt parking lot that has been present for at least 30 years, and a small portion of the habitat is subject to light foot traffic by humans. Suggested rank: BC. Nonoptimal habitat conditions, and evidence of long-term persistence of a currently significant population, eliminate A and D ranks, respectively. Further information on population size and landscape context (e.g., presence of nearby occupied patches) might allow one to define the rank more precisely.

**Toad that uses ephemeral bodies of water for breeding:** Surveys in the 1970s found a several breeding toads in and around a shallow pool in a prairie landscape then used as cattle pasture. Today the site has been completely replaced by commercial development, and the former breeding site has been filled and covered with asphalt. Recent searches and examination of recent aerial photographs found no evidence of suitable breeding habitat anywhere within a few kilometers of the previous breeding site, and there are no other records of the occurrence of this species in the area. Suggested rank: X. This evidence indicates that it is appropriate to regard the occurrence as extirpated.

**Turtle of freshwater wetlands:** population of approximately 80-100 mature individuals, plus various age classes of immatures, occupies most of a 15-hectare wetland; no indication of a major increase or decline but few data are available for trend estimation; wetland is in a wildlife sanctuary and protected from outright destruction. Suggested rank: B. Ideally, A-ranked occurrences should be represented by thousands of adults, but in the case of long-lived species such as turtles, a population of hundreds of adults likely would exhibit excellent viability. This occurrence does not exhibit optimal population size for excellent viability, yet the prospects for long-term persistence without additional protection or management appear to be very good, so the rank should be less than A and higher than C.

**Wetland turtle:** Information from 10 years ago established an occurrence in a difficult-to-access wetland; this occurrence was then regarded as a viable occurrence and was ranked BC. Aerial photos taken last year indicate extensive alteration of both the wetland and upland habitat adjacent to the wetland over the past decade. Last year, a reliable person observed and photo-documented a single adult turtle on the site, but other recent information about the population is not available. Suggested rank: E. This information indicates that the rank might be as high as B (if the turtle population has not been negatively affected by the habitat changes) or as low as D (e.g., if the only suitable nesting habitat has been destroyed). An occurrence rank of BD is uninformative for conservation purposes. Because available information is too limited to determine the estimated viability of this occurrence, the occurrence should be categorized only as extant.

**Wetland turtle:** Collection information from 50 years ago established an occurrence in a difficult-to-access wetland; this occurrence was then regarded as a viable occurrence and was ranked B. No further

information about the turtle population is available. Recent aerial photos of the area indicate extensive alteration of both the wetland and upland habitat adjacent to the wetland over the past two decades. Suggested rank: H. This occurrence needs to be surveyed in order to verify that it still supports a turtle population and to determine current occurrence viability.

#### *Plant examples*

**Herbaceous plant of interior, stabilized sand dunes:** A university museum includes a specimen collected in the 1940s from a vague location in a dune area, which still exists and is largely intact. Nothing else is known about the occurrence, and the area has not been well surveyed. Suggested rank: H. This information is too old to support an occurrence rank other than H. The occurrence needs to be surveyed in order to verify that it still supports a population and to ascertain occurrence viability.

**Long-lived perennial plant of wetlands:** occurs only on the edges of wet sphagnum bogs; recent survey found 19 plants, 60% in leaf only, 40% in fruit; 40% seedlings, 20% immature, 40% mature; occupied area is less than 1 hectare; in 2005 there were three main patches of plants, and at least one subsequently was destroyed by bulldozing to expand a cranberry bog; two remaining patches are extant but need follow-up survey. Suggested rank: C or CD. The small size of this occurrence, and its poor condition and landscape context, indicate that A or B ranks are not appropriate. Under current conditions, the probability of persistence seems low, so the occurrence may warrant a rank of D, but evidence of ongoing reproduction suggests that a C rank might be appropriate, especially if only a small proportion of the remaining plants were destroyed and there is a reasonable chance that the remaining habitat can be protected and appropriately managed.

**Perennial herb of calcareous habitat:** occurrence restricted to limestone barrens on isolated peninsula of 363 hectares (864 acres) on marine coast; outlier population from main range (~1,600 kilometers away); past quarrying stopped with protection as provincial natural reserve in 1998; harsh environment resulting in short growing season but possible annual seed set and seeds dispersed by wind; no recent surveys for numbers of plants but observed sporadic distribution throughout peninsula. Suggested rank: BC. Available information indicates that this occurrence does not exhibit optimal or highly favorable size, condition, and landscape context, and it does not suggest an occurrence with a high probability of extirpation, so the A and D ranks can be ruled out. Further information on population size (100s?, 1,000s?) should allow one to define the rank more precisely.

**Perennial herbaceous plant of upland forests:** A botanist collected the species last year and deposited a specimen in an herbarium, but nothing else is known about the occurrence. Suggested rank: E. If we assume the collected specimen was not the last remaining individual, we can consider the occurrence to be extant. Further information is required in order to categorize the occurrence status more precisely.

**Perennial plant of wooded landscapes:** historical records indicate that the species was fairly common in the several hectares encompassed by the occurrence; recent targeted surveys yielded only a few individuals, all browsed by deer; deer population in the area is large and unlikely to decrease. Suggested rank: CD. Clearly not an occurrence with excellent or good estimated viability (too small, poor condition and landscape context), so not an A or B occurrence. Construction of a deer enclosure might prevent total loss of the remaining population, but otherwise the occurrence has a high probability of extirpation in the foreseeable future, so the appropriate rank is CD.

**Seed-banking annual plant of river sand bars:** isolated relict species; population of many 10,000s of mature individuals occupies much of a 90-km stretch of river corridor; abundance fluctuates greatly from year to year; population appears to be negatively affected by hydrological and sediment transport alterations associated with present dam operations. Suggested rank: BC. The occurrence exhibits good size characteristics but current circumstances indicate that a small or large decline might be occurring. Though the occurrence may persist for the foreseeable future in good or excellent condition, it is also possible that current conditions are resulting in a major decline that could significantly jeopardize occurrence viability. The combination rank reflects this substantial uncertainty.

**Short-lived perennial desert plant, emergence dependent upon spring rains:** occurrences and abundance vary widely from year to year in response to variations in precipitation): 78 plants found in intensive survey in 1989, 15 plants observed in brief 1990 survey, 4 plants in 1991 late-season survey, 5 plants observed in 1998 at peak season with fairly intensive surveys after favorable precipitation conditions; site is seasonally grazed by sheep, which decreases the abundance of the plant, and change in management is unlikely. Suggested rank: D. The small size and poor condition of this occurrence immediately rule out A and B ranks. Available data suggest a significant declining trend and high probability of extirpation if current conditions prevail.

**Wetland orchid:** In the 1960s a small population of a wetland orchid was documented on a site on private land that was formerly accessible through landowner permission. Today the site is no longer accessible due to an uncooperative new landowner. Suggested rank: H. Because this occurrence is based only on old information, the appropriate rank is H. The occurrence rank could be updated in the future if access to the site improves.

## History and Rationale

### Problems with Previous Occurrence Rank Specifications

In 2008, NatureServe zoology staff reviewed all existing occurrence rank specifications for vertebrates and invertebrates. Many of the rank specifications superficially looked good; they often included quantitative criteria that seemed to appropriately "scientific." However, on closer inspection, these occurrence rank specifications generally turned out to be arbitrary, highly subject to change, of uncertain utility for distinguishing occurrence viability, and impractical or impossible to apply. When viewed as a whole, the occurrence rank specifications lacked a clear and consistent conceptual framework.

One of the major problems involved the use of specific measures of abundance, such as catch or observation rates, to distinguish occurrence viability. Catch rates are known to vary greatly with surveyor, methods, season, or other factors, and so the resulting data may not accurately reflect abundance. Consequently, it is generally unreliable to use such data for determining occurrence ranks. Strict adherence to specified sampling protocols might alleviate this problem, but in the real world such consistency rarely occurs.

Another problem with using quantitative occurrence rank criteria derives from the demographic characteristics of various plant and animal species. In many species, substantial variations in population size occur over periods of multiple years. If we establish precisely defined population criteria (e.g., >1,000 = B, < 1,000 = C) for ranking occurrences, we cannot simply use current population size to rank occurrences because the rank of some occurrences would change through the course of normal annual

population fluctuations. Additionally, occurrences may be incorrectly ranked because the year or years sampled represent extreme conditions. One could circumvent this problem by using averages or modal or worst-year conditions, but such information is rarely if ever available. In fact, most of the occurrence rank specifications that were written in the past often appear to be unusable for most occurrences because the required information does not exist, rarely will be obtained, and sometimes cannot be obtained by known methodologies.

Even if abundance could be determined in a meaningful, repeatable way, we would still lack a secure scientific basis for specifying precisely defined, objective occurrence viability criteria. Conservation biologists have had enormous difficulty in determining or agreeing on quantitative population viability criteria for various taxonomic groups. And long-term population trends from the real world frequently are at odds with theoretical considerations.

Because of these factors, past efforts to establish useful, reliable, and stable occurrence rank criteria were largely unsuccessful.

### A Simplified Approach

NatureServe scientists have concluded that elaborate or highly specific quantitative criteria are not required in order to rank species occurrences usefully for conservation purposes. Instead, categorical, qualitatively defined rank guidelines should be sufficient for most occurrence ranking. For a small minority of well-studied species or groups of species it may be possible to develop and employ meaningful, quantitative occurrence rank criteria, and the generic occurrence rank guidelines described in the following section do not preclude the use of more quantitative alternatives. In fact, for some particular species or species groups, the previously existing occurrence rank specifications were modified and retained. Many of these specifications basically offer suggestions as to how to apply the generic concepts to the species or group. When species- or group-specific occurrence rank specifications are available they should be consulted, and the ranker should decide whether these or the generic guidelines (or a combination) work best for the information at hand.

### Advantages of Generic Occurrence Rank Guidelines

The generic occurrence rank guidelines for species address the problems mentioned above, and they circumvent additional problems. For example, for some species, the viability of populations of equal size may not be the same in two different regions or even in different habitats of the same region. The qualitative generic criteria deal effectively with species that exhibit substantial ecogeographical variations in demographic characteristics and eliminate the need to write multiple occurrence rank guidelines for single species. By focusing on probability of persistence, the criteria should work equally well for occurrences that attempt to represent populations as well as those that are arbitrary conservation units (e.g., occurrences of many migratory birds). Also, the generic criteria allow one to consider all of the variables that affect occurrence viability without having to anticipate them or incorporate them into the occurrence rank criteria. The generic occurrence rank guidelines are much less susceptible to change than are specific quantitative (but arbitrary) criteria. Additionally, the generic occurrence ranking guidelines make it likely that occurrences can be assigned to a rank other than "E," particularly if combination ranks (e.g., AB, AC) are employed.

Most importantly, we believe that the occurrence ranks derived from the generic criteria will be sufficient for conservation prioritization – for identifying a set of target occurrences for conservation

action. They should allow users of the ranks to distinguish among occurrences with excellent viability, other robust (good viability) occurrences, occurrences with fair viability, and poor occurrences that have a high risk of extirpation.

### Acknowledgements

We thank Marilyn Anions, Bill Bosworth, Sara Cairns, Nicole Capuano, Anne Chazal, Karen Cieminski, Leo Collins, Pat Comer, Todd Crabtree, Melissa Cullina, Jeremy Deeds, Phillip deMaynadier, Erik Endrulat, Don Faber-Langendoen, Mark Ferguson, Gretchen Fowles, Chris Frye, John Gamon, Kelly Gravuer, Steve Grund, Steve Hall, Ron Hellmich, Julie Holling, Dale Jackson, Amy Jenkins, Colin Jones, Jimmy Kagan, Doug Keinath, Harry LeGrand, Suzanne Mason, Larry Master, Kat Maybury, Roger McCoy, Dawn McKay, Sarah McRae, James Morefield, Bill Nichols, Mike Oldham, Leah Oliver, Tom Patrick, Eric Peterson, Bob Popp, Ken Popper, Rich Ring, Dan Salzer, Mike Schaeffe, Matthew Schlesinger, Sue Schuetze, Tim Simmons, Tim Smith, Beth Swartz, Jeffrey Tash, Deborah White, Erin White, Steve Young, and others behind the scenes for their thoughtful comments on previous versions of the generic rank guidelines.

## Applying the Generic Approach: Decision Key and Guidance

### Introduction

The purpose of this key is to aid the user in assigning estimated viability ranks to Element Occurrences (EOs) by providing a step-by-step guide to applying the Generic EO Ranking Approach.

The generic EO ranking approach was developed to address the challenge of assigning ranks on the basis of minimal data and encourages the use of combination ranks (specifically AB, AC, BC, or CD) to better represent the uncertainty of occurrence persistence. While the generic approach to ranking EOs is used for most species, specific criteria for assigning ranks have been developed for particular species or groups of species and should be used instead of the generic approach when they exist. Before using the Decision Key for ranking occurrences, the user should first determine whether specific EO rank specifications exist for a species by reviewing either the EO Rank Specifications records in Biotics or the Population Viability section of a Comprehensive Report generated for the species using NatureServe Explorer.

Because EO ranks provide an assessment of the estimated viability (likelihood of persistence for the foreseeable future [i.e., at least 20 - 30 years] in the present condition or better) of occurrences based on current status information, future potential threats to an EO should not be used to raise or lower its rank. However, ongoing events (e.g., successional changes, favorable or unfavorable management) that are resulting in the improvement or decline of occurrence quality should be considered in assigning a rank. Occurrences that cannot be ranked A (excellent viability) through D (poor viability) or some combination rank may be assigned an E (verified extant), H (historical), F (failed to find), X (extirpated), U (unrankable), or NR (not ranked) value, as appropriate. Definitions of these ranks may be found on [page 2](#). The rationale for each rank assigned should be documented in an EO Rank Comments field.

To help ensure consistency in ranking among NatureServe member programs, review the ranking examples beginning on [page 5](#). (“Hypothetical Examples of Occurrences with Suggested Ranks.”)

### Occurrence Ranking Key for Applying the Generic Approach

1	a	No attempt has been made to assess the viability of the EO, or the existing EO rank no longer applies.	NR: Not Ranked
	b	An attempt has been made, or is being made, to assess the viability of the EO.	2
2	a	EO has been recently (i.e., within last 20 years or an appropriate interval for the taxon) verified as extant.	3
	b	EO has not been recently (i.e., within last 20 years or an appropriate interval for the taxon) verified as extant	9
3	a	Sufficient information (some aspect[s] of size, condition, and /or landscape context) is not available to assess EO viability. [Note: In this case, use an E rank rather than the AD or BD combination ranks].	E: Verified Extant
	b	Sufficient information (some aspect[s] of size, condition, and /or landscape context) is available to assess EO viability.	4
4	a	If current conditions prevail, EO persistence for the foreseeable future (i.e., at least 20 - 30 years) is reasonably certain. EOs with low or declining quality may be included if they still appear to have reasonable prospects for persistence for the foreseeable future. In	AC: Excellent to Fair viability continue to 5 if

		addition, EOs that may persist for the foreseeable future with appropriate protection or management may be included if that management or protection is currently ongoing.	rank may be further refined
	<b>b</b>	If current conditions prevail, EO persistence for the foreseeable future (i.e., at least 20 - 30 years) is uncertain because of small population size or area of occupancy, deteriorated habitat, poor conditions for reproduction, ongoing inappropriate management that is unlikely to change, or other factors.	Fair to Poor viability continue to 6 if rank may be further refined
<b>5</b>	<b>a</b>	Some aspect(s) of size, condition, landscape context, population size and/or quality and quantity of occupied habitat are optimal, exceptional, or highly favorable. EO is expected to persist in its current condition or better. EO has highly favorable and higher quality characteristics.	AB: Excellent to Good viability continue to 7 if rank may be further refined
	<b>b</b>	Some aspect(s) of size, condition, landscape context, population size and/or quality and quantity of occupied habitat are not optimal or exceptional. EO may or may not persist in its current condition or better. EO has favorable to lower quality characteristics.	BC: Good to Fair viability continue to 8 if rank may be further refined
<b>6</b>	<b>a</b>	EO has some risk of extirpation in the foreseeable future (i.e., at least 20 - 30 years) but restoration is deemed feasible and plausible, or stochastic events that would extirpate the population are of low probability within 20 - 30 years	CD: Fair to Poor viability
	<b>b</b>	EO has a high risk of extirpation in the foreseeable future (i.e., at least 20 - 30 years). Restoration is not feasible and/or not plausible. Stochastic events that would extirpate the population are expected to occur within 20 - 30 years.	D: Poor viability
<b>7</b>	<b>a</b>	Most aspects of size, condition, landscape context, population size and/or quality and quantity of occupied habitat are optimal or exceptionally favorable. EO is very likely to persist for the foreseeable future (i.e., at least 20 - 30 years). These EOs have characteristics that make them relatively invulnerable to extirpation or sustained population declines even if they have declined somewhat relative to historical levels. If population size is unknown, area of occupied habitat is exceptionally favorable; or the EO has excellent condition and landscape context and a long history of persistence. In most cases these EOs occupy natural habitats; however, EOs somewhat modified by human actions may still be included if they otherwise meet the criteria.	A: Excellent viability
	<b>b</b>	Some aspect(s) of size, condition, landscape context, population size and/or quality and quantity of occupied habitat are favorable. EO is likely to persist for the foreseeable future (i.e., at least 20 - 30 years) in its current condition or better. This category includes EOs that contribute importantly to maintaining or improving the conservation status of declining or threatened species but do not meet A criteria.	B: Good viability
<b>8</b>	<b>a</b>	Some aspect(s) of size, condition, landscape context, population size and/or quality and quantity of occupied habitat are favorable. EO is likely to persist for the foreseeable future (i.e., at least 20 - 30 years) in	B: Good viability

		its current condition or better. This category includes EOs that contribute importantly to maintaining or improving the conservation status of declining or threatened species but do not meet A criteria.	
	<b>b</b>	Few aspect(s) of size, condition, landscape context, population size and/or quality and quantity of occupied habitat are favorable. There may be some uncertainty about the long-term persistence of the EO (i.e., for at least 20 - 30 years), or the EO may be expected to persist but not necessarily maintain its current quality.	C: Fair viability
<b>9</b>	<b>a</b>	Appropriate surveys or other persuasive evidence indicate the EO no longer exists.	X: Extirpated
	<b>b</b>	EO may still exist.	10
<b>10</b>	<b>a</b>	An appropriate survey was conducted but the EO was not found.	11
	<b>b</b>	No appropriate survey has been conducted but the EO is possibly extirpated due to a known major disturbance or general habitat loss/degradation, or the existence of the EO has not been reconfirmed for 40 or more years. This category includes EOs based on old information that cannot be surveyed because of access issues as well as EOs with locational information too imprecise to reconfirm. [Note: With very few exceptions, occurrences are to be regarded as H after 40 years without confirmation, even with no effort to locate the taxon. Exceptions can be found in the Generic EO Ranking Approach document].	H: Historical
<b>11</b>	<b>a</b>	One to a few surveys have been conducted which failed to locate the EO, but additional negative survey(s) are needed to provide sufficient evidence that the EO should be considered historical or extirpated.	F: Failed to find
	<b>b</b>	There have been sufficient surveys to justify considering the EO possibly extirpated. This category includes EOs that have not been reconfirmed for 20 or more years (or an appropriate interval for the taxon). [ Note: With very few exceptions, occurrences are to be regarded as H after 40 years without confirmation, even with no effort to locate the taxon. Exceptions can be found in the Generic EO Ranking Approach document].	H: Historical

Note: In rare situations where there is a lack of sufficient information to rank an EO using the key above, the occurrence may be ranked U: Unrankable. However, use of this rank is discouraged. EOs with unknown viability should be ranked H, F, or NR, unless confirmed extant in which case the EO should be ranked E.