Assessment of Target Viability[1] Worksheet: Conservation Project Management Workbook Versions 3 (CAP) and 4

The "Viability" worksheet in version 3 and higher of the Excel workbook for conservation project (area) planning has been improved to increase the precision of our assessment of ecological status, often referred to as "Biodiversity Health." Because of the complexity and importance of this section for defining and measuring success, complete and clear documentation is a necessity. The experts or references that helped identify Key Ecological Attributes, indicators, and quantified indicator ratings should be recorded. Note that records in this worksheet are directly linked to records in the monitoring worksheet.

Table 1 shows an example of a completed spreadsheet for reference throughout this document. More complete development of the concepts and application of Assessment of Target Viability is found in a report by Parrish et al. (2003)[1]. While the full Assessment may not be completed in early iterations of Conservation Plans, completing this page should be a goal of all planning teams.

Why has TNC changed the method for assessing target viability?

The Nature Conservancy's "Five-S" framework[2] directs us to assess the "biodiversity health" of each conservation area and the status of each conservation target. This is done by 1) rating three categories of ecological status (condition, landscape context, and size) for each conservation target on a four-part scale (Poor-Fair-Good-Very Good), and (2) using these ratings to assess the overall status ("viability") of an area's conservation targets.

The Framework does not provide detailed information on how to address four issues critical to this work: (1) How to assess condition, landscape context, or size; (2) What criteria should be used to consistently distinguish Poor, Fair, Good, and Very Good ratings from each other; (3) What methods would ensure consistency between the assessment of targets and the assessment of threat severity and scope; and (4) How to identify the right field measurements and indicators to monitor in order to establish objective information for assessing target and threat status? The "Assessment of Target Viability" tool has been developed to help address these issues. The methodology for this tool is described in this document.

Viability Assessment: A revised approach for conservation practitioners

There are three core elements of the *Viability Assessment* that apply to *all focal conservation targets* in a conservation area of any scale – whether these are individual populations or species, assemblages of species, ecological communities, or ecological systems. These elements and their function are as follows:

1) **Key Ecological Attributes –** structure, composition, interactions and abiotic and biotic processes that enable the target to persist through influence on the target's size, condition, and landscape context.

2) **Indicator –** measurable entity that is used to assess the status and trend of a Key Ecological Attribute.

3) **Indicator rating –** the ranges of variation in an Indicator that define and distinguish Very Good, Good, Fair, and Poor rating categories to provide a consistent and objective basis for assessing the status of each Indicator.

These three elements are applied in the Viability Assessment framework and Excel spreadsheet in five explicit steps:

Step 1: Identify Key Ecological Attributes (see Box 1, Fig. 1)

Consider the primary ecological processes and features that must be maintained to ensure the long-term viability of the conservation targets. A ***Key Ecological Attribute*** is a critical component of a conservation target's life history, physical processes, community interaction, habitat, or interaction with other species. To help identify these Key Attributes, consider

[1] Parrish, J.D., D.P. Braun, and R.S. Unnasch. 2003. Are we conserving what we say we are? Measuring ecological integrity within protected areas. Bioscience. In press.

[2] The Nature Conservancy. 2000. Five-S Framework for Site Conservation: A practitioner's handbook for site conservation planning and measuring conservation success. Vol. I, Second Ed. These guidelines represent an update to Sections B and C of Chapter IV (Strategies). They are designed to be used with the Excel-based Conservation Area Planning/Measures of Success Workbook, Version 3d (released March 2003).

Box 1: How to Identify Key Ecological Attributes

The *Key Ecological Attributes* are those components that *most clearly define or characterize the conservation target, limit its distribution, or determine its variation over space and time, on a time scale of 100+ years.* The best way to identify such Key Attributes is by reviewing or developing a conceptual ecological model for the biodiversity in question. They may include:

- Major characteristics of ***biological composition*** and the ***spatial structure*** of this composition, such as:
  - characteristic and keystone species, functional groups or guilds
  - population and/or community structure, including size of a minimum viable population for species targets
  - presence and distribution of characteristic species, ecological communities, or successional (seral) stages and gradients, seed banks
  - characteristic horizontal or vertical spatial relationships among size/age cohorts, species, ecological communities, or seral stages and gradients
  - species or groups of species that have significant impacts on the distribution of biomass at different trophic levels or on the physical or chemical structure of habitat.
  - primary production / respiration balance

- ***Biotic interactions*** that significantly shape or control this variation in biological composition and its spatial structure over space and time, such as:
  - food-web dynamics: levels of predation or large-scale herbivory
  - inter-specific competition and succession
  - migration, aggregation, and dispersion
  - pathogens, infestations, invasions, and other natural biological disturbances
  - pollination, aging, and reproduction

- ***Environmental regimes and constraints*** (or abiotic interactions) that significantly shape physical and chemical habitat conditions, and hence shape variation in biological composition and structure over space and time in relation to these conditions. Both extreme environmental disturbances and "normal" variation should be considered. Examples include:
  - atmospheric temperature and precipitation (solar radiation influx)
  - disturbance regimes – minimum dynamic area of disturbance should inform size
    - – fire
    - – wind, precipitation, and flooding extremes
    - – soil erosion and accretion
    - – temperature extremes
    - – geologic events (geothermal energy)
    - – spatial extent of disturbance
  - surface and ground water hydrologic regimes
    - – soil moisture
    - – groundwater elevation and surface – sub-surface exchange
    - – snow / ice cover / ice transport
    - – freeze / thaw
    - – water mixing and circulation
    - – lake level variance
    - – inflow variation (local runoff, groundwater, riverine)
    - – water flow
    - – storm event
  - water and soil chemistry
    - – chemistry (nutrients, hydrocarbons, gases, salinity)
    - – temperature and pH
    - – particulate and dissolved organic matter
    - – water turbidity / clarity
  - geology, topography/bathymetry, and geomorphology
    - – soil structure and drainage, porosity and texture
    - – macro / micro bathymetrics and outlet morphology
    - – coarse organic debris
    - – reef topography
    - – shoreline complexity

- ***Environmental and ecological connectivity*** that affects the ability of species and groups of species or their propagules to move or be carried (e.g., by wind or water or other biota) among suitable locations on the land- and water-scape, to maintain natural variation in genetic, species, and ecological community diversity. Connectivity also affects the ability of natural environmental processes to transport habitat-forming matter across the land- and water-scape, such as dissolved nutrients, soils, stream sediments, woody debris, and other organic matter.
  - connectivity with adjacent systems (terrestrial / aquatic)
  - intra-patch connectivity (riparian corridor, within watershed)
  - fragmentation

those characteristics of the conservation target that, if degraded (e.g., water quality) or missing (e.g., pollinator), would seriously jeopardize that target's ability to persist over time. Key Ecological Attributes are the essential currency for identifying and measuring the composition, structure, and function of conservation targets at any biological or geographic scale (see column 3 in Table 1). These Key Attributes may be characterized in terms of size, condition, and landscape context. While these categories are useful to consider for every Key Attribute, each should be applied only where relevant (e.g., size is often not relevant for marine system targets). For each target, identify the *minimum* number of Key Attributes (e.g., up to 5) necessary to describe the system. As more information is learned, these Key Attributes may be refined.

<u>Step 2: Identify Indicators for the Key Attributes</u> (see Box 2)

Key Ecological Attributes are often difficult or impossible to directly measure. Where this is the case, an indicator of the Key Attribute that may be reasonably and effectively measured should be identified. In a river, for example, biochemistry may be a Key Ecological Attribute, but it is not reasonable to expect that every possible chemical parameter would be measured. A few water chemistry parameters must be selected that will give us an overall indication (indicator) of how the status of our Key Attribute (biochemistry) is changing. So the indicator may be a subset of the variables defining the Key Attribute, or a more measurable substitute (column 4 in Table 1).

Any target's Key Ecological Attributes (and therefore their indicators) will vary over time in a relatively undisturbed setting. This variation is not random, but limited to a particular range that we recognize as either a) natural and consistent with the long-term persistence of each target, or b) outside the natural range because of human influences (e.g., fire suppression in fire maintained systems). We consider managing for an acceptable range of variation for each target's Key Ecological Attributes to be the soundest strategy for biodiversity conservation at any scale.

- At a *minimum*, one Key Attribute and one indicator with measurable rating criteria should be developed for each target (see Box 3). For additional indicators of Key Attributes for which you have insufficient information to independently rate status in the steps below, you can conduct a *preliminary analysis* in the integrity worksheet as described below. You are likely to make this decision for some Key Attributes of some focal targets. If you have made this decision, you can skip the remaining steps of this Assessment for that Key Attribute. This approach is often preferable as a preliminary step before inviting expert review. It may be more effective and efficient for experts to critique a preliminary version than to generate a novel indicator rating from scratch.

Box 2. Characteristics of Efficient and Effective Integrity Indicators

All indicators should be *measurable*, *precise*, *consistent*, and *sensitive*. To ensure that indicators are also meaningful and effective for TNC's conservation work, they need to be:

1. *Biologically relevant* (i.e., represent an accurate assessment of biodiversity health)
2. *Socially relevant* (i.e., value is recognized by stakeholders)
3. *Sensitive to anthropogenic stress* and reflective of changes in stress without extreme variability
4. *Anticipatory*, providing early warning (i.e., indicate degradation before serious harm has occurred)
5. *Measurable* (i.e., capable of being operationally defined and measured using a standard procedure with documented performance and low error)
6. *Cost-effective* (i.e., inexpensive to measure, providing the maximum amount of information per unit effort)

Indicators are monitored to track the status of a conservation target, and ultimately to measure the success of our conservation strategies. While the indicators identified may not meet all of these criteria, select those that satisfy the largest possible number (or a complimentary set) and proceed with a strategy for monitoring. Under the premise of Adaptive Management, we can refine the list of indicators as more is learned about the ecological system.

<u>Step 3: Rating Indicator Status</u>

We can now define "***conserving*** conservation targets" as ***maintaining each target's Key Ecological Attributes within their acceptable ranges of variation***. The viability assessment framework therefore emphasizes the importance of identifying the ranges of variation that define the categories of Very Good, Good, Fair, and Poor for indicators of the status of the categories of size, condition, and landscape context (columns 5-8 in Table 1).

Box 3. Guidance for Selecting Key Ecological Attributes and Indicators

1. *Minimum* assessment requirements for every target:

   - Specify at least one indicator for one Key Attribute with measurable (but not necessarily numerical) rating criteria. For example, consider upstream and downstream connectivity as a key ecological attribute for a specific aquatic system. An indicator for this Key Attribute could be the number of dams that serve as barriers to biota movement. In deciding on a rating scheme, setting the extremes is often the best place to start. At one extreme, all would agree that no barriers to movement of biota would be considered Very Good status for a given river system. At the other extreme, many barrier dams would be considered Poor status. Only one dam on a single tributary might still lead to a Good assessment, and a few dams might define Fair. In this way, the rating scheme is easily measurable. We do not really know how the number of dams translates to target viability and we would replace these broad categories with more specific and quantitative ones as we learn more.
   - If project teams are unable to identify criteria for each rating category (Poor through Very Good) of an indicator, rate your best assessment of the current status of the indicator with sufficient justification that someone else would be able to identify a change in the status of that indicator. When assigning the current indicator status, try to consider the concept of natural, or acceptable, range of variation as a guidepost to separate "conserved" (Good or better) versus "not conserved" (Fair or worse). Document how the current status was determined and include a strategy to improve understanding of how to rate status of that target in the workbook.

2. Where the data that would clearly establish criteria for viability are not available, document the opinions or best guesses of experts and consider the indicator ratings as hypotheses that we hope to refine over time.

   Project teams should increase the level of detail above the recommended minimum (i.e., one attribute and indicator per target) over time. Project teams also might consider first identifying one target (e.g., coarse-scale ecological system) and completing a thorough assessment that considers key attributes and indicators for size, condition, and landscape context. The experience gained from initially focusing on a single target may promote a more efficient and accurate assessment for the remaining targets. Project teams should periodically reevaluate whether the addition of a more comprehensive list of Key Attributes and further indicators is necessary. Several important conditions to consider that influence the urgency of developing additional indicators are:

   - The viability of the target is clearly threatened over the short-term as indicated by the threats analysis. Sufficient Key Attributes and indicators will be necessary to ensure that threats are being abated by strategies.
   - The team has developed strategies, objectives, and/or actions designed to improve the status of a target. For every action taken designed to improve target viability, the project team needs to have identified the Key Attributes and indicators with ratings that will respond to that action (and link those to the workplan and monitoring page).
   - The project team is concerned about risk incurred if the assumptions of target viability are incorrect. These risks may be to the target (i.e., extinction, collateral damage from conservation action directed to abate threats (like non-target herbicide effects), or to the program (i.e., public relations or political damage, legal or financial liability). If risk is high, project teams need to think more comprehensively about multiple Key Attributes across size, condition, and landscape context and their indicators.

Project planning/measures teams should *always* identify the minimum number of Key Ecological Attributes and indicators that allow viability to be assessed, rather than an exhaustive list.

Assessing the status of each indicator involves two tasks: (1) assembling and analyzing the appropriate monitoring data for the indicator; and (2) using the results of the analysis to determine the appropriate rating for the indicator. This step is an important component of the overall measurement of conservation success. Note that in some cases where human disturbance has had a profound impact for a long time, it may be more appropriate to locate a “reference condition” (an example of the target that is close to the desired future condition) that has been relatively unaltered to provide data on good or very good ranges of variation for the indicators selected. The status rating categories are defined as:

Very Good: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to “natural” as possible and has little chance of being degraded by some random event).

Good: The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.

Fair: The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation.

Poor: Allowing the indicator to remain in this condition for an extended period will make restoration or prevention of extirpation of the target practically impossible (e.g., too complicated, costly, and/or uncertain to reverse the alteration).

The Current Status rating category and date of this assessment are entered (indicated by shading in columns 5-8 of Table 1 with date in col. 9). A companion documentation field needs to be filled out, providing the basis for this current status rating and additional resolution on the current status. For example, the third row of the sample table shows the current status of the connectivity of vernal pools complexes to be somewhere between 50-74%. If the actual current status is 70% as determined by GIS analyses, this information should be specified in the companion documentation field for the Current Status.

Indicators should have measurable (but not necessarily numerical) rating criteria, that are based on the concept of natural or acceptable range of variation to ensure consistent interpretation of status ratings. For example, consider upstream and downstream connectivity as a Key Ecological Attribute for a specific aquatic system. An indicator for this Key Attribute could be the number of dams that serve as barriers to movement. Use the extreme situations to develop the rating criteria. At one extreme, all would agree that no barriers to movement of biota would be considered Very Good status for a given river system. At the other extreme, many barrier dams would be considered Poor status. Only one dam on a single tributary might still lead to a Good assessment, as acceptable flow rates remain for the maintenance of the aquatic biodiversity. Similarly, more than one dam might define Fair status, as we understand that some aquatic biodiversity is compromised and the flow patterns are unacceptable. In this way, the rating scheme, although not quantifying actual flow regime quantities and patterns, is still easily measurable. We do not really know how the number of dams translates to target viability and we would ultimately replace these broad categories with more specific and quantitative ones as we learn more.

When project teams are unable to identify criteria for each rating category of an indicator, ratings should reflect the best assessment of the current status of the indicator and include sufficient justification that someone else would be able to identify a change in the status of that indicator. When assigning the current indicator status, try to consider the concept of natural, or acceptable, range of variation as a guidepost to separate "conserved" (Good or better) versus "not conserved" (Fair or worse). Document how the current status was determined and include a strategy to improve understanding of how to rate status of that target.

Because conservation strategies are most likely to focus on moving indicator ratings from “Fair” to “Good” or maintaining a Key Attribute at “Good” or “Very Good” (see Fig. 1), the Good and Fair ratings are generally the most important to define. However, if a factor is rated “Poor”, focus on differentiating between the Poor and Fair ratings.

Step 4: Establish Desired Status Rating

The ratings identified in Step 3 for each Key Ecological Attribute and its indicators provide an explicit description of the desired rating for each conservation target (indicated by italics in columns 5-8 of Table 1). If the Desired Status is different than the Current Status, a Desired Status Date should be entered in column 10 that specifies the time frame for improving the Key Ecological Attribute and Indicator status. Ideally, restoration or maintenance would bring all Key Attributes to a “Very Good” rating. However, maintaining or restoring Key Attributes in at least “Good” status is more realistic. Many landscapes are so altered by human impacts that optimal viability is not possible even if it were understood. Further, the cost and feasibility of moving a Key Attribute from “Good” to “Very Good” must be considered before such an effort is undertaken. When compared to the current status of each Key Attribute, the Desired Status provides a sound and explicit basis for gauging *how much* improvement may be required to conserve each target. The Desired Status Rating is likely to evolve, as the landscape changes and knowledge of each target and Key Attribute improves.

Identifying Key Ecological Attributes, indicators, and ratings for each conservation target also provides a crucial and powerful means for integrating the assessment of target status *and* threats. Using the Viability worksheet, a “stress” to a conservation target can now be defined explicitly as *any alteration of a Key Ecological Attribute that can result or has resulted in that Key Attribute declining below a “Good” rating*. The indicators selected (Step 2) for tracking the status of Key Attributes therefore will also track “stresses” to these Key Attributes. Further, the ranges of variation specified for each indicator rating provide the basis for determining *how much* abatement of each stress is needed to meet conservation objectives.

Step 5: Integrating Indicator Ratings to Rate Key Ecological Attributes and Target Status (Box 4)

Having identified and assessed the status of each indicator, the last step is to determine the target status. The workbook automatically generates the ratings of Key Attributes, Key Attribute rating categories, and targets based on defined rules. Users can over-ride these defaults if necessary. This automatic process involves: 1) rating condition, landscape context, and size based on the Key Ecological Attributes already identified; 2) rating each Key Attribute based on its indicators; and 3) assessing where each of the indicators lie relative to the defined ratings. Box 3 illustrates how target viability ranking is based on the ratings of indicators of the Key Ecological Attributes.

Box 4. Integration of Indicator Ratings with Target Ratings in the Excel Workbook[1]

This Measurement Level…	**…informs the Rating of…**	**…by Applying this Rule:**
Indicators	Key Attribute Status	If a single indicator is used to inform the status of a Key Ecological Attribute, its rating is directly translated to the Key Attribute status. If there are multiple indicators for one Key Ecological Attribute, an average rating is calculated (where VG = 4.0, G = 3.5, F = 2.5, P = 1.0). The grade for the Key Ecological Attribute is derived from the average of these numeric values for the Indicators.
Key Attribute Status	Viability Category (Size, Condition, Landscape Context) for each target	• If any Key Attribute = *Poor,* category is *Poor*. • If any Key Attribute = *Fair*, category is *Fair* • If the Key Attributes are all ranked *Good* and/or *Very Good*, use the majority rating. In the case of an even split between *Good* and *Very Good*, the rating would be *Good*.
Viability Categories	Target Viability (overall)	Use existing rule from the Five-S Framework, which allows weighting of integrity categories. If the weighting is other than the default, explanatory documentation is required.
Target Viability	Conservation Area / Project Biodiversity Health Measure	Use existing rule from Five-S Framework.

[1.] See the Conservation Project Management Excel Workbook for a full explanation of the weighting and averaging process that results in overall ratings.

The spreadsheet has columns for storing comments for documenting the following four decisions: (1) the rationale behind Key Ecological Attribute selections; (2) the rationale behind Indicator selections and the basis for defining Indicator Ratings; (3) the basis for the Current Rating determination; and (4) the basis for the Future Rating determination. Documentation is critical for tracking the basis of decisions over time and personnel, allowing revision as more information is available, and learning from subsequent iterations of the Plan.

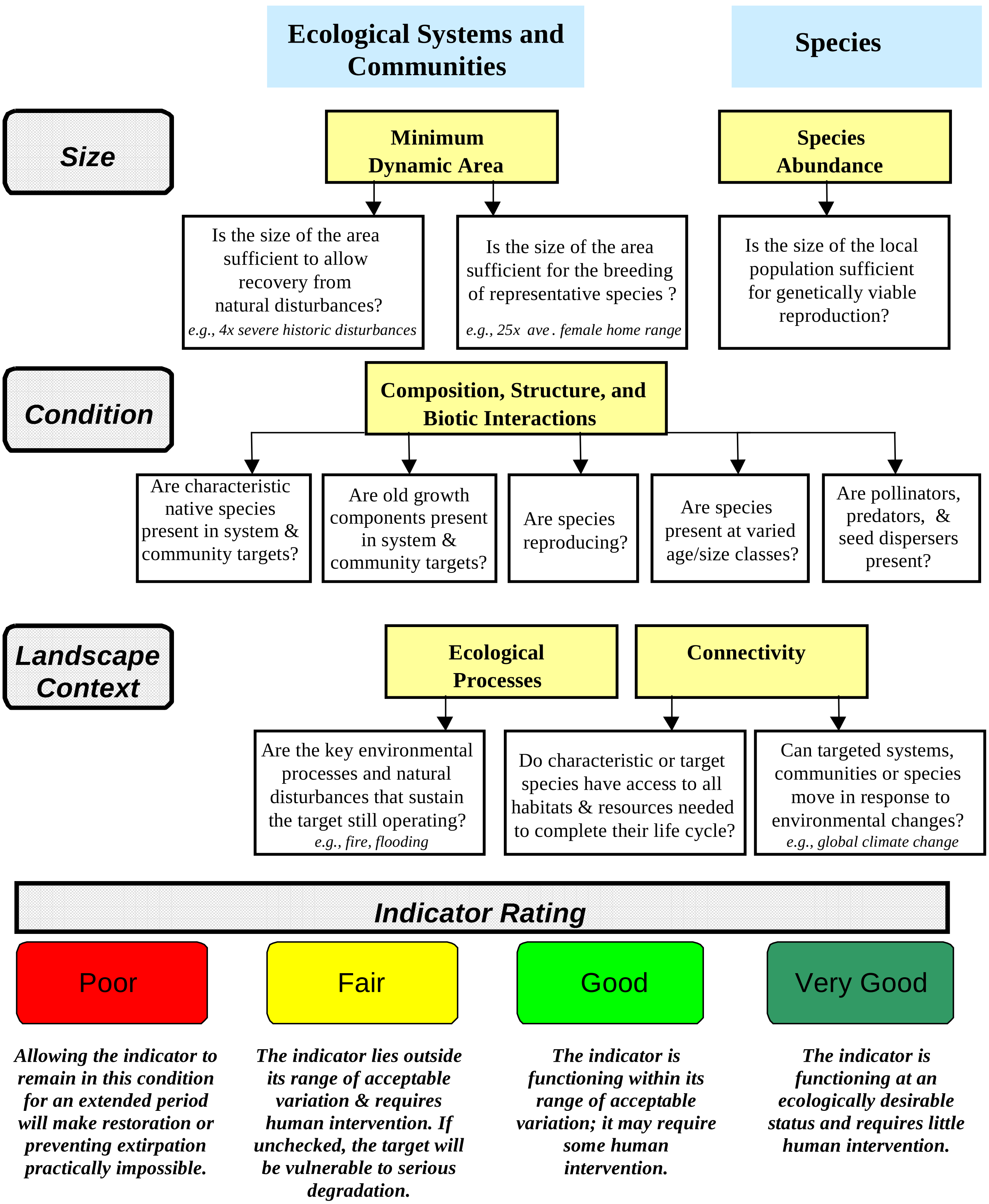
You will likely have varying levels of confidence about different targets, Key Attributes, and documentation entered into the spreadsheet fields. The best approach may be to make sure you have a good combination of field-based knowledge, literature review, and expert opinion. Make sure to carefully document information gaps. Those gaps may be extensive enough that addressing them will become a high priority action in the work plan. To prioritize among the gaps, identify where you are most “vulnerable” in the Assessment of Target Viability. That vulnerability might be: (1) where you are uncertain if you have selected the best Key Attributes; or (2) where you have a high level of uncertainty differentiating between poor and fair ratings (and secondarily fair and good ratings). As experimental examples are likely to be few, planning teams will need to search for ways to engage the scientific community to address the most critical information needs to complete this Viability page. Above all, recognize that this Assessment will require iterative revision as more information becomes available.

Table 1. Partial viability assessment table for the *Xeric Upland Matrix* and *Florida Scrub-jay* targets modified from the Lake Wales Ridge Large-scale Conservation Area Plan.

Conservation Target	Category	Key Ecological Attribute*	Indicator*	Indicator Ratings* **Categorical** Current state: shaded; *Italics* = Desired Rating				Date of Current Rating*	Date of Desired Rating*
				Poor	***Fair***	***Good***	***Very Good***		
Xeric Upland Matrix	Landscape Context	fire regime	fire frequency	< 60% of area burned within 5-15 yrs	60-80% of area burned within 5-15 yrs	*>80% of area burned within 5-15 yrs*	n/a	Feb - 03	Dec - 13
Xeric Upland Matrix	Condition	community structure - sandhill	% cover of shrub midstory (1-3 m)	> 75%	51-75%	26-50%	*25% or less.*	Feb - 03	Dec - 15
Xeric Upland Matrix	Condition	community structure - scrub	% oak composition of shrubs within scrub-jay habitat	< 20%	20-35%	36-50%	*> 50%*	Feb - 03.	Dec - 15
Xeric Upland Matrix	Condition	community structure - sandhill	% cover native herbaceous layer	0-4% cover	5-10% cover	*11-30% cover*	> 30% cover	Feb - 03	Dec - 15
Xeric Upland Matrix	Condition	community structure - scrub	% cover bare soil	0-9% or > 80%	10-15% or 51-80%	16-25%	*26-50%*	Feb - 03	Dec - 15
Xeric Upland Matrix	Condition	community structure - scrub	mean shrub height	< 0.5 m or > 4 m	3-4 m or 0.5-1 m	2-3 m	*1-2 m*	Feb - 03	Dec - 15
Xeric Upland Matrix	Size	area	area in protected status	All natural uplands as of 2003 that are at least 1000 ac are protected	All natural uplands as of 2003 that are at least 500 ac are protected	All natural uplands as of 2003 that are at least 200 ac are protected	*All natural uplands as of 2003 that are at least 100 ac are protected*	Feb - 03	Dec - 08
FL scrub-jay	Landscape Context	connectivity	distance between scrub habitat (>1 km forest)	12 km or more	*> 4 and < 12 km*	2-4 km	< 2 km	Feb - 03	Dec - 08
FL scrub-jay	Condition	recruitment	mean # juveniles / breeding group per site in July	<0.5 within majority of sites within a t least 3 yrs of any 5 yr period	0.5-1 within majority of sites within a t least 3 yrs of any 5 yr period	1-1.5 within majority of sites within a t least 3 yrs of any 5 yr period	*>1.5 within majority of sites over at least 3 yrs of any 5 yr period*	Jul - 02	Dec - 13
FL scrub-jay	Size	population size	# territories / site	<15 contiguous territories in natural habitat	*15-20 contiguous territories in natural habitat*	20-29 contiguous territories in natural habitat	30 or more contiguous territories in natural habitat	Feb - 03	Dec - 17

* Indicates that there is a field for entering supporting documentation for these cells.

Figure 1. Example Indicators of Key Ecological Attributes[1]. Indicators will vary by attribute and target. Sample types of questions below are illustrative only: they do not represent an exhaustive list.



Modified from Low, G. 2002. Landscape-scale, Community-based Conservation. TNC.