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| TO: | GCDAMP Technical Work Group, Steering Committee AHG |
| FROM: | David Braun, Executive Coordinator/Science Advisors Program |
| DATE: | November 28, 2016 |
| RE: | Symbol set(s) for displaying Knowledge Assessment findings |

The Steering Committee Ad Hoc Group (SCAHG) of the Technical Work Group (TWG) needs to approve the symbol sets to be used to display the findings of the current Knowledge Assessment (KA). The symbol sets make it possible to translate the findings into a “scorecard” format for rapid visualization.

The KA has three components, (in shorthand) “status/trend,” “driver/constraint,” and “management/impacts.” The status/trend component comes with a “built-in” symbol set, because it largely follows the methods developed by the National Park Service for its Natural Resource Condition Assessment (NRCA) program. However, there is no built-in symbol set for the other two components of the KA, because the NRCA methodology does not address these topics.

The SCAHG has three basic options for establishing the symbol sets for the other two components of the KA: (1) repurpose the NRCA symbol set; (2) adopt a second symbol set to use with both of the latter two components; or (3) adopt a second symbol set to use with the driver/constraint scorecard, and yet a third symbol set to use with the management/impacts scorecard. There are pros and cons to each approach. This memo presents these pros and cons and possible symbol sets for the second and third options.

**The Status/Trend Symbol Set**

As noted above, the GCDAMP FY17 KA status/trend assessment *largely* follows the methods developed by the National Park Service for its Natural Resource Condition Assessment (NRCA) program. We say “largely,” because the GCDAMP FY17 KA modifies the NRCA methodology in two ways. First, it adds “Unknown” categories for rating both Status and Trend, and therefore adds symbols for these categories. Second, it refines and formalizes the definitions of “status,” “trend,” and especially “confidence” based on the methods of the Sacramento-San Joaquin Bay-Delta Ecosystem Restoration Program. The separate document, “GCDAMP 2016-17 ‘Knowledge Assessment’ Guidance,” dated November 10, 2016, presents the definitions for all rating categories for “status,” “trend,” and “confidence.”

The NRCA symbol set “works” by presenting information in a hierarchical visual system.

* All symbols have the same size and shape – a standardized circle. As a result, symbol size and shape do not convey any information other than identifying the scorecard.
* The first, most noticeable, *variable* property of each circle is its color. The symbol set uses the green-yellow-red convention for color, a convention used world-wide to indicate conditions on a scale from good to fair to poor (or go, proceed but with caution, stop). The ultimate purpose of this convention is to warn the viewer when conditions warrant caution or immediate attention.
* The second most-noticeable, *variable* property of each circle is the shape of an enclosed arrow: up, down, or left-right (indicating “neither up nor down”). The shape occurs as a silhouette imposed on top of the colored field.
* The third variable property of each circle is less readily noticeable than the other two, and consists of a circling border that varies in its texture (style): thick, thin, or intermittent.
* The eye registers these three types of variable information in the same sequence: color, enclosed arrow shape, border style. The result implies a hierarchy of importance to the information being conveyed: status, then trend, and then finally confidence.

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| **Status/Trend Symbol Set** | | | | | |
| **Resource Status** | | **Trend in Status** | | **Confidence in Status & Trend Assessments** | |
|  | Resource is in Good Condition |  | Condition is Improving |  | High |
|  | Condition Warrants Moderate Concern |  | Condition is Unchanging |  | Medium |
|  | Condition Warrants Significant Concern |  | Condition is Deteriorating |  | Low |
|  | Unknown |  | Unknown | (n/a) | |

**One versus Multiple Symbol Sets?**

The following lists summarize the pros and cons for using the NRCA symbol set not only for the KA status/trend scorecards but also for the KA driver/constraint and management/impact:

***Pros***

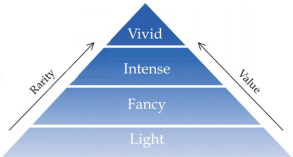
* Having one symbol set for all three scorecards keeps things simple and eliminates the possibility of confusion if viewers have to grapple with multiple symbol sets.
* Having one symbol set for all three scorecards makes it easier to generate symbol output based on the KA spreadsheet values.

***Cons***

* The status/trend scorecards must convey information on status and trend in resource condition, and confidence in these estimates. In contrast, the driver/constraint and management/impact scorecards must convey information on the strengths of causal relationships, the directions of these effects, and confidence in this knowledge. If the present KA repurposes the symbol set from the status/trend scorecards, and uses the same methods for symbolizing direction and confidence as in the status/trend scorecards, the KA is forced to use the green-yellow-red scale to symbolize the strength of causation. Depending on how the TWG chooses to set things up, green would then have to be used to symbolize either strong or weak causation, and red conversely used to symbolize either weak or strong causation. This would depart strongly from the meanings for green and red in the status/trend scorecards, leading to significant confusion.
* The driver/constraint and management/impact scorecards have different information hierarchies, compared to the status/trend scorecard. For the driver/constraint and management/impact scorecards, questions of causal strength, direction of effect, and confidence in this knowledge have equal importance: The GCDAMP very much needs to know equally about causal strength *and* direction of effect *and* confidence. For example, does driver X have a strong or weak effect on resource A, is the effect harmful or beneficial to achieving a desired resource condition, and how confident are we in this knowledge? This information provides crucial guidance on needs for monitoring and research to address knowledge gaps and weaknesses. The status/trend scorecards do not convey this kind of equality of importance among the symbolized variables.
* The generation of symbol outputs for the scorecards based on the KA spreadsheet values will be done automatically. As a result it is no more or less easy to use one or many symbol sets for the three scorecards.

**Alternative Symbol Sets for Driver/Constraint and Management/Impact Scorecards**

If the SCAHG decides to consider alternative symbol sets for the driver/constraint and management/impact scorecards, it has a range of options:

1. The driver/constraint and management/impact scorecards could use one same symbol set in common, or each could have its own symbol set. We recommend having one shared symbol set for both the driver/constraint and management/impact scorecards, because they assess the same three variables: causal strength, direction of effect, and confidence.
2. Changing the shape of the scorecard symbols would immediately distinguish the status/trend scorecards (with their circular symbols) from the driver/constraint and management/impact scorecards. Hexagons, squares, and diamonds all clearly differ from circles. However, diamonds provide limited internal space for shapes to indicate the direction of effect, and we do not recommend them. In contrast, any viewer seeing a hexagon or a square would know they were looking at a different kind of scorecard – not a status/trend scorecard.
3. Changing the color of the primary (most visually distinctive) variable would also immediately tell a viewer that they were looking at a driver/constraint or management/impact scorecard, not a status/trend scorecard. As noted above, the green-yellow-red color scale conventionally conveys a message of warning: yellow and especially red tell the viewer that there is something to be concerned about. The driver/constraint and management/impact ratings do not need to convey any such warning. We therefore recommend avoiding the green-yellow-red color scale.
   1. One option for an alternative color scale is to select one base color and use variation in its intensity to convey information on causal strength, analogous to the “Strength of Color” scales used by the Natural Color Diamond Association (see pyramid image above). The color could be any other than the versions of green, yellow, or red used in the status/trend symbols. I show two blues here, one in the “diamond strength of color” diagram and one in a possible version for the KA. Blue has the advantage that it is not conventionally associated with warnings. [A medium blue also does not overpower the visibility of the shape border].
   2. Another option for an alternative color scale is to select a different set of three colors to represent the scale. This is a bit more difficult, since you don’t want any colors that are similar to those in the status/trend scorecards. However, it is difficult to identify a set of three colors that conveys a message of varying “strength.” As shown by the example here, a scale using different colors does not easily convey information about strength unless it uses colors that conventionally do that for us, such as the green-yellow-red combination.
4. If the SCAHG decides to change symbol shape and use a different color scale to convey information about the strength of causal relationships, it has two options for conveying information in the driver/constraint and management/impact scorecards about direction of effect and confidence:
   1. Stick with the existing (NRCA) methods for conveying information about direction and confidence. In the context of a different symbol shape and different color scale, this should not result in any confusion.
   2. Come up with alternative methods for conveying information about direction and confidence. We have not attempted to come up with any options here.

If the SCAHG goes with options 2, 3a, and 4a, we would end up with symbols such as the following (these are examples, pending a decision on color scale):

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| **Driver/Constraint and Management/Impact Symbol Set** | | | | | |
| **Strength of Effect** | | **Direction of Effect** | | **Confidence in Strength & Direction Assessments** | |
|  | Strong |  | Positive Effect |  | High |
|  | Moderate |  | No Effect |  | Medium |
|  | Weak |  | Negative Effect |  | Low |
|  | Unknown |  | Unknown | (n/a) | |