## GCDAMP Knowledge Assessment: Status & Trend

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| Resource Topic: | Riparian vegetation |
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| Version Date: | 1/11/2017, with rating values and additional notes and edits by D. Braun & Seth Shanahan 3/16-21/17 |

| Resource Characteristic | Specific Measure | Status | Trend | Confidence | Rationale: Status/Trend | Rationale: Confidence | Recommendations |
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| Species richness | Number of plant species recorded | Moderate Concern | Unknown | Medium | Between 2012 and 2015, riparian monitoring recorded 230 species along the entire CRe and new species are recorded every year. The 2014 data alone indicate there are approximately 156 species just between Lees Ferry and river mile 240.<br>Note 1: The original assessment team assessed status and trend as “unknown” for this and many other resource characteristics because of a lack of clear objectives for resource condition. For example, although the data indicate that vegetation is increasing, it is not possible to say if this is a desirable condition or trend, since increased vegetation is good for birds but bad for camping area. As a result a resource characteristic or its specific measure(s) can have an “unknown” status and trend, but a high degree of confidence.<br>Note 2: The Knowledge Assessment guidance defines the Riparian Vegetation resource as follows: “Integrity of native vegetation communities and wildlife habitat, stand maturity, species diversity, overall abundance, and recruitment.” Ratings for status and trend thus should address this definition and not consider other resource values such as recreation (campsite area) or archaeological site condition. The field data on riparian vegetation indicate a large number of plant species, but not necessarily of the best composition (e.g., presence/abundance of non-natives such as salt cedar) or canopy or patch structure for wildlife, and beaver can have severe impacts on planted native trees. This | Estimating the number of species that occur in this study is problematic in that a large portion (around 40%) of the recorded species have only been recorded once. This high proportion of uncommon species makes estimating species richness unreliable. For example, However, questions were brought up about richness being an important resource characteristic because it can be difficult to tie to specific ecological goals. We have retained it, since it can, over time, suggest major changes to the ecosystem (long-term declines or increases), which could then be further investigated, and is easy to track given our current monitoring program. | Moderate amounts of disturbance (all kinds) tend to increase species richness , but this has not been studied along the river in Grand Canyon. We recommend continued ground-survey and aerial image monitoring of changes to herbaceous and woody species. We could compare the CRe flora to that of Cataract Canyon to get an general idea of how these somewhat similar sections of the Colorado River compare - would require extra field work and collaboration with Canyonlands NP and the Northern Colorado Plateau Network. |

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| Total vegetation cover | Sampled total vegetation cover | Good Condition | Improving | High | Vegetation cover, particularly woody vegetation cover, has more than doubled in most hydrologic zones since 1965.<br>Note 1: The original assessment team assessed status and trend as “unknown” for this and many other resource characteristics because of a lack of clear objectives for resource condition. For example, although the data indicate that vegetation is increasing, it is not possible to say if this is a desirable condition or trend, since increased vegetation is good for birds but bad for camping area. As a result a resource characteristic or its specific measure(s) can have an “unknown” status and trend, but a high degree of confidence.<br>Note 2: The Knowledge Assessment guidance defines the Riparian Vegetation resource as follows: “Integrity of native vegetation communities and wildlife habitat, stand maturity, species diversity, overall abundance, and recruitment.” Ratings for status and trend thus should address this definition and not consider other resource values such as recreation (campsite area) or archaeological site condition. The field data on riparian vegetation indicate increasing cover, even if (a) this cover does not have an ecologically desirable composition (e.g., presence/abundance of non-natives such as salt cedar) or canopy or patch structure for wildlife, and (b) the expansion of vegetation has potentially deleterious effects on other resources. This situation suggests ratings of “Good Condition” for status | We are very confident that vegetation cover has increased and will continue to do so under the current and proposed future flow regimes. | Continued stabilized flows and HFE's less than or equal to 45,000 cfs will continue to increase vegetation cover. Very large (>80,000 cfs) floods, prolonged flooding (> 1 month), or very low flows (<2,000 cfs) for long periods of time followed by flooding would likely reduce vegetation. General observations suggest that flows over 55,000 cfs uproot and transport vegetation from the lower riparian zone. We recommend continued ground-survey and aerial image monitoring of changes to herbaceous and woody species. |
| Functional group cover | Areal cover of different functional groups | Unknown | Unknown | Low | The specific measure focuses on the areal cover of different vegetative functional groups, such as broad riparian guilds, species scored for USDA wetland status, etc. The investigators are in the process of studying this and should have results later this year and next year. In the meantime, it is not yet possible to provide an assessment of status or trend for this resource characteristic (see “Rationale: Confidence" for further discussion). When analysis results become available, future knowledge assessments will need to focus on the definition of Riparian Vegetation as an LTEMP resource topic: “Integrity of native vegetation communities and wildlife habitat, stand maturity, species diversity, overall abundance, and recruitment.” Ratings for status and trend thus should address this definition and not consider other resource values such as recreation (campsite area) or archaeological site condition. | We are in the process of studying this and should have results this year and next year. Functional groups should have detectable responses to various disturbances (depending on how good the classification is) and should be easier to detect than with individual species. Using groups or guilds decreases the variance in the data and reduces the complexity of the data. We should be able to assess how species that function similarly change in relation to dam operations. | Continue work using flow-response guilds to examine likely functional group changes due to different flow regimes and likely functional group changes that impacted historic sandbar change (two current projects). |

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| Community heterogeneity | Number of community types/river mile (high Beta diversity) | Unknown | Unknown | Low | Current and past community heterogeneity has not been explicitly studied, except for fluvial marshes (1% of the corridor in the early 1990's) prior to 1995. The investigators state that they may be able to analyze aspects of community heterogeneity using the riparian vegetation monitoring data, but this has not been done yet. In the meantime, it is not yet possible to provide an assessment of status or trend for this resource characteristic (see “Rationale: Confidence" and "Recommendations" for further discussion). When analysis results become available, future knowledge assessments will need to focus on the definition of Riparian Vegetation as an LTEMP resource topic: “Integrity of native vegetation communities and wildlife habitat, stand maturity, species diversity, overall abundance, and recruitment.” Ratings for status and trend thus should address this definition and not consider other resource values such as recreation (campsite area) or archaeological site condition. | Questions were brought up about the utility of measuring community heterogeneity, since it is a vague term. We refer to community heterogeneity here as an umbrella for characteristics that we could calculate such as alpha, beta, and gamma diversity, species turnover (spatially and over time), functional diversity and exchangability, etc. - essentially a host of measures that attempt to measure how complex the ecosystem is. | Measures of community heterogeneity need to be tied to a specific management question, so an appropriate measure can be used. We recommend continued ground-survey and aerial image monitoring of changes to herbaceous and woody species. |
| Native to non-native ratio | Proportion of native to non-native species cover | Moderate Concern | Improving | Low | A desired ratio of native to non-native species has not been determined. There are far more native species occurring in the riparian area than non-native, but a few non-native species (e.g., Tamarix spp., Bermuda grass) cover large areas. Current monitoring data indicates that the riparian area in Grand Canyon has a large proportion of its cover comprised of native species. The river corridor overall, however, has a high percentage of all the non-native species that occur in the region and likely acts as a dispersal corridor for them.<br>Note 1: The original assessment team assessed status and trend as “unknown” for this and many other resource characteristics because of a lack of clear objectives for resource condition. For example, although the data indicate that vegetation is increasing, it is not possible to say if this is a desirable condition or trend, since increased vegetation is good for birds but bad for camping area.<br>Note 2: The Knowledge Assessment guidance defines the Riparian Vegetation resource as follows: “Integrity of native vegetation communities and wildlife habitat, stand maturity, species diversity, overall abundance, and recruitment.” Ratings for status and trend thus should address this definition and not consider other resource values such as recreation (campsite area) or archaeological site condition. The field data on riparian vegetation indicate large proportions of non-native vegetation overall and particularly outside the Grand | This ratio is currently changing as the Tamarisk beetle affects the extent of Tamarix spp., new non-native species are introduced, and already occurring non-native species expand. | Increased disturbance will probably increase non-native species occurrence, but this has not been studied in Grand Canyon. Increased disturbance may also increase native species occurrence. We recommend continued ground-survey and aerial image monitoring of changes to non-native spp. (e.g., changes to tamarisk due to the beetle). |

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| Area of woody vegetation | Areal cover of woody vegetation | Moderate Concern | Improving | Medium | This resource characteristic addresses the areal cover of woody vegetation assessed from digital imagery polygons. Woody vegetation is increasing, which provides habitat for animals, including migratory birds.<br>Note 1: The original assessment team assessed status and trend as “unknown” for this resource characteristic because of a lack of clear objectives for woody vegetation cover. For example, although the data indicate that woody vegetation is increasing, it is not possible to say if this is a desirable condition or trend, since increased vegetation is good for birds but also encroaches on campsites and alters fluvial and aeolian sediment transport.<br>Note 2: The Knowledge Assessment guidance defines the Riparian Vegetation resource as follows: “Integrity of native vegetation communities and wildlife habitat, stand maturity, species diversity, overall abundance, and recruitment.” Ratings for status and trend thus should address this definition and not consider other resource values such as recreation (campsite area) or archaeological site condition. The digital imagery data on woody vegetation indicate increasing woody vegetation cover, which the investigators note benefits riparian birds, but the AMP has not yet specified what would constitute “too much” woody vegetation. This situation suggests a rating of “Moderate Concern” for status and “Improving” for trend but with "Medium" confidence due to tension between the lack of clear objectives and | We are very confident that woody vegetation has increased and will continue to do so under the current and proposed future flow regimes. | Continued stabilized flows and HFE's less than or equal to 45,000 cfs will continue to increase woody vegetation. Very large (>80,000 cfs) floods, prolonged flooding (> 1 month), or very low flows (<2,000 cfs) for long periods of time followed by flooding would likely reduce woody vegetation. We recommend continuing research and monitoring that improves our understanding of how vegetation impacts fluvial and aeolian sediment transport. |

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| Area of herbaceous marsh habitats | Areal cover of herbaceous marsh vegetation | Moderate Concern | Deteriorating | Low | This resource characteristic addresses the areal cover of herbaceous marsh vegetation assessed from digital imagery polygons. The area of herbaceous marsh habitats definitely increased between 1965 and 1991 (other than a scour of vegetation in 1983). However, it is unknown if this trend has continued, and there are indications that there has been a decrease in marsh habitat since the interim flows of the early 1990s.<br>Note 1: The original assessment team assessed status and trend as “unknown” for this resource characteristic because of a lack of clear objectives for herbaceous marsh vegetation area (see Rationale: Status/Trend discussions for other resource characteristics in this spreadsheet).<br>Note 2: The Knowledge Assessment guidance defines the Riparian Vegetation resource as follows: “Integrity of native vegetation communities and wildlife habitat, stand maturity, species diversity, overall abundance, and recruitment.” Ratings for status and trend should address this definition and not consider other resource values such as recreation (campsite area) or archaeological site condition. The digital imagery data on herbaceous march vegetation suggest decreasing cover in this vegetation class since ca. 1991, but the AMP has not yet specified what would constitute “too little” herbaceous marsh vegetation. This situation suggests a rating of “Moderate Concern” for status and “Deteriorating” for trend but with "Low" confidence (the | We are confident the area of herbaceous marsh habitats increased between 1965 and 1991 (other than a scour of vegetation in 1983). It is unknown if this trend has continued, and there are indications that there has been a decrease in marsh habitat since the interim flows of the early 1990's. | We could reexamine the areal extent and composition of marsh habitats using the more recent areal imagery and ground-surveys. The GCMRC veg program has already been discussing revisiting the Stevens et al. 1995 paper on marshes to see how dam operations have altered that habitat over the last 20 years. |

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| Vegetation structure (vertical layering) | Total vegetation volume or other canopy volume measure | Unknown | Unknown | Low | Data for assessing this resource characteristic would consist of data on total vegetation volume or other canopy volume measure(s). Data on vegetation structure was collected in the mid- to late 1990's, but has not been collected recently. Tamarix defoliation and subsequent infilling (undergrowth) will alter vegetation structure. Woody vegetation has expanded since the 1990's, but we do not know if structural complexity has declined, stayed the same, or increased. Current riparian vegetation monitoring does not include a vegetation structure component. An attempt was made in 2015 to include a vegetation structure component in the monitoring, but was dropped due to time/personnel/monetary constraints. As a result, it is not possible to assess the current state of (or trend in) vertical layering, which is generally correlated with increased abundance of many wildlife species. Decreased vegetation cover would likely decrease vegetation structure. Increased vegetation cover could increase with low structure (only sedges/grasses/forbs) or could have high structure (combination of grasses/shrubs/ trees (see “Rationale: Confidence” and “Recommendations” for further discussion). When data and analysis results become available, future knowledge assessments will need to focus on the definition of Riparian Vegetation as an LTEMP resource topic: “Integrity of native vegetation communities and wildlife habitat, stand maturity, species diversity, overall | Data on vegetation structure was collected in the mid- to late 1990's, but has not been collected recently. Tamarix defoliation and subsequent infilling (undergrowth) will alter vegetation structure. Woody vegetation has expanded since the 1990's, but we do not know if structural complexity has declined, stayed the same, or increased. | If this considered important to study, we would have to add another riparian vegetation river trip or double the size of the current river trip in order to collect this data. Extra staff would need to be hired to collect/enter/manage/analyze the extra data. |