REVIEW OF TERRESTRIAL MONITORING PROTOCOLS FOR THE GRAND CANYON

Report of the 2007 Protocol Evaluation Panel (PEP)

Panelists

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- Darold Batzer, Professor, Department of Entomology, University of Georgia
- Geneva Chong, Research Ecologist, US Geological Survey, Northern Rocky Mountain Science Center
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Charge to Panelists

"Review and critique the existing effort/findings and recommend long term core monitoring protocols/methods that will meet the established Core Monitoring Information Needs (CMIN) associated with terrestrial biological resources (Goal 6)."

Urquhart et al. (2000) recommended development of a comprehensive monitoring strategy with four components:

(1) endangered species assessments;

(2) monitoring for model development;

(3) inventory of plants and animals; and

(4) long-term monitoring of the main-stem corridor

Good progress on all of these 4 components

GOAL 6: Protect or improve the biotic riparian and spring communities within the Colorado River ecosystem, including threatened and endangered species and their critical habitat.

PEP*: The spring communities are not directly influenced by dam operations and management, and we recommend the removal of this community from discussion. The threatened and endangered species appear to be monitored by other entities, so they should also be removed from this discussion, but the GCMRC should collaborate with these other entities for needed data or analyses.*

MO 6.1: Maintain marsh community abundance, composition, and area in the Colorado River ecosystem in such a manner that native species are not lost.

CMIN 6.1.1: Determine and track the abundance, composition, distribution, and area of the marsh community as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.

PEP*: Many marsh communities are largely an artifact of river regulation. The reduced peak flows and higher base flows have created relatively stable hydrologic conditions favoring marsh development, and their overall abundance has likely increased relative to the pre-dam era. The PEP recommends that managers reconsider maintenance of these anthropogenically created habitats as a priority.*

MO 6.2: Maintain New High Water Zone (NHWZ) community patch number, distribution, composition, and area to be no lower than values estimated for 1984.

***PEP**: the maintenance of these patches does not appear realistic given the current nature of the riparian system. Variation in magnitude of management flows may not be sufficient to maintain a dynamic riparian system; hydrologic stabilization and flow reduction have allowed dominance of non-native species such as tamarisk and annual grasses. These non-native species may pose significant risks to the structure and function of the native riparian community (e.g., increased risk of fire, competition for space, and stabilization of soil features that were historically more dynamic). Tamarisk is not a desirable component to be maintained in the NHWZ. Detection, eradication, and monitoring for non-native species should be incorporated into the vegetation sampling and monitoring scheme. The PEP recommends vegetation restoration, including tamarisk (and other invasive non-native species) removal.*

MO 6.3: Maintain Old High Water Zone (OHWZ) community abundance, composition, and distribution in the Colorado River ecosystem.

CMIN 6.3.1: Determine and track the abundance, composition, and distribution of the OHWZ community as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.

PEP: Under the present flow regime, this goal is not attainable without planting, irrigation, and land management. The older mesquite and tamarisk in this zone will die within the coming decades and there is no recruitment of these species. This zone could only be maintained "naturally" by managed floods exceeding 90,000-100,000 cfs. If actions are taken to restore native species composition and structure (again, emphasis on native species), monitoring should be directed to evaluate the effectiveness of such actions for use in an adaptive management framework.)

MO 6.4: Maintain sand beach community abundance, composition, and distribution in the Colorado River ecosystem at the target level.

CMIN 6.4.1: Determine and track the abundance, composition, and distribution of the sand beach community as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.

***PEP**: Historically the sand beaches were essentially bare, maintained by high spring flows, and lacked developed vegetation. The PEP recognizes that determining an appropriate "target level" is challenging in a system that has moved to an alternative, stable state. Maintaining some of the features of the pre-dam system is desirable; where feasible, some vegetation reduction may be warranted on beaches. If actions are taken to reduce/remove vegetation, monitoring should be directed to evaluate the effectiveness of such actions for use in an adaptive management framework. NEED GOAL / BASELINE*

MO 6.5: Reduce invasive non-native species abundance and distribution.

CMIN 6.5.1: Determine and track the abundance and distribution of non-native species in the Colorado River ecosystem as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.

PEP*: Because of the large effort necessary, natural resource managers should determine which nonnative species can be controlled or eradicated, and prioritize where such efforts will be directed. Tamarisk is highly invasive in the Grand Canyon and can change ecosystem functioning; the PEP recommends that reduction of this species should be a high priority. Tamarisk eradication efforts are ongoing in the Grand Canyon but have not targeted the Colorado River corridor. If actions are taken to reduce and control non-native species, monitoring should be directed to evaluate the effectiveness of such actions for use in an adaptive management framework.*

MO 6.6: Maintain seep and spring habitat in the Colorado River ecosystem

CMIN 6.6.1: Determine and track the abundance, composition, and distribution of spring and seep communities as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.

***PEP**: These habitats are largely independent from dam operations, and it appears that other agencies are now targeting seeps and springs in the Grand Canyon. We recommend that sampling for this CMIN be discontinued by GCMRC, and instead rely on information from other agencies.*

MO 6.7: Maintain riparian habitat in the Colorado River ecosystem capable of supporting southwestern willow flycatcher.

CMIN 6.7.1: Determine and track the abundance, distribution, and reproductive success of southwestern willow flycatcher in the Colorado River ecosystem.

***PEP**: It appears that other agencies are now targeting the southwestern willow flycatcher in the Grand Canyon. We recommend that sampling for this CMIN be discontinued by GCMRC, and instead rely on information from other agencies.*

1) Vegetation mapping: develop a repeatable, accurate approach to create vegetation maps that can be compared over time to monitor changes in area and location of vegetation types and to provide a base layer for designing terrestrial monitoring and analyzing terrestrial monitoring data.

2) Vegetation monitoring: develop a repeatable, accurate approach to quantify changes in native and non-native plant species composition and structure (cover and height) and their interactions with other taxa, and provide ground-truth data for vegetation mapping.

3) Habitat analyses: develop a repeatable, accurate approach to quantify interactions between abiotic and biotic habitat characteristics and associated vertebrate and invertebrate animals or taxonomic groups of interest.

Vegetation Mapping

A system for creating vegetation base maps is needed to quantify changes in location and area of vegetation types over time. We believe the process and database (map) described in Ralston et al. (in review) provide an adequate baseline to guide near-term sampling efforts and quantify the extent of several vegetation types at the time the data were collected. However, changes in available technology since that work was initiated in 2002, and changes expected in the future, remind us that the vegetation mapping process is not static, and improvements should be made continuously.

- Overall panel liked the approach for vegetation mapping used by Ralston et al.

Remote Sensing for Veg. Mapping

- Airborne high resolution digital imagery and airborne discrete-return light detection and ranging (LIDAR) data
- Helicopter mounted cameras to analyze river corridor
- Hyperspectral imagery: 200 bands of visible and near infrared and short wave infrared (SWIR)

Vegetation Classification for Mapping

- TWINSPAN used to develop classification from plot data (Kearsley)
- Suggest agglomerative cluster analysis is more accurate
- Resample on schedule that reflects anticipated rate of change – event driven

Vegetation Monitoring - GRTS

- Generalized random tesselated sample design suggested by Urquhart (NPS I&M nationwide)
- Spatially balanced analysis allows inference across entire study area
- 702 reaches of GC established and 150 chosen for sampling by GRTS.
- No stratification of landscape prior to selection of reaches
- Within each reach, one sample point selected along which a transect perpendicular to the river was established

Vegetation Monitoring

- Along transect plots in pre-determined river stage heights: 15k, 25k, 35k, 45k, and 60k cfs,
- Location: transect lines with permanent end points and benchmarks, plots relocated by surveying
- Plots are permanent vertical points, not move based upon change in stage/discharge relations
- Frequency: Research to determine rate of vegetation change since dam completion, and recent decades. Use rate of change analysis to determine frequency of resamples, ie. 5 yr

- Analysis with NPMANOVA to compare metrics among plots within zones and across zones investigate directional change in vegetation composition
- Explicit questions would help focus the analyses:
  - Is NHWZ becoming similar to OHWZ?
  - During drought how does each zone change?

- Debris fan eddy complex units were not identified and used in GRTS stratification
- Vegetation of pools vs. debris fans very different
- Close integration of physical and biotic resources of GC is goal of GCMRC, recommend identifying which geomorphic unit of fan-eddy complex each transect is in prior to analyze vegetation and animal biota
- GRTS sample sites + Legacy data sites

Animal Monitoring

- *CMIN 6.1.1.* The abundance, composition, distribution, and area of animals in the marsh community were not addressed directly. It does not appear that marshes were identified as a distinct habitat type for sampling, although there is some notion that these are subsumed by a “shoreline” category. We recommend explicitly addressing this ambiguity.

- *CMIN 6.4.1.* The composition, abundance, and distribution of animals in sand beach habitats were not completely addressed because the differences among sand beaches, marshes, and NHWZ habitats are unclear.

Monitoring of Particular Animal Taxa

- We concur with many of the conclusions reached by Kearsley et al. (2006) for monitoring of animal taxa
- Analyses to have focused on inventory
- For invertebrates a wide range of techniques were used: light traps, sweep nets, malaise traps, targeted sampling
- Taxa ID to species

Recommend

- Future work is on monitoring, not inventory
- ID to genus or family only
- Limit methods to sweep netting and include other methods only where necessary to facilitate analysis of many sites and improve statistical rigor

- Birds are important biota in Grand Canyon
- PEP not entirely sure what methods were being used
- Small mammals intensively sampled and good indicators of zones and vegetation composition – should be continued
- Distribution of beaver may be related to dam management – analyses should be continued

Animal Summary

- Impressed with sampling program for riparian zone animals
- Past attempts to link animal and plant distribution patters was useful for exploring ecological mechanisms
- However, past level of sampling may not be sustainable because many projects remain incomplete even four years after sampling ended.

- GCMRC efforts should now focus on monitoring not inventory
- Choose indicator, keystone, or umbrella species to monitor, despite their shortcomings as representatives.
- Vegetation monitoring program should remain a framework for animal monitoring to facilitate understanding their ecological connections and joint responses to dam operation.

NEED A RESEARCH PROGRAM TO DIRECT TERRESTRIAL MONITORING ACTIVITIES

- Statistics: How large do changes need to be for detectability?
- Need specific goals for statistical power and amount of change that you wish to detect
- Given variability in GC is design powerful enough to detect change?

Need for A Reference Standard

- the effects of dam operations cannot be fully appreciated unless sampling is conducted in portions of the river system that are not affected by the dam

- Need baseline to understand what change has occurred in all river stage zones and along upstream-downstream continuum

Research Needs

- Pre-dam aerial photos of the canyon may help characterize pre-dam vegetation distribution/composition
- Colorado River through Cataract Canyon may provide suitable reference site for riparian vegetation
- Other minimally regulated or unregulated rivers in the Southwest already being monitored might also be used for reference. These smaller rivers must occur in arid region canyons dominated by fan eddy complexes, and support intact vegetation and animal communities

1. The Management Objectives (MOs) and Core Monitoring Information Needs (CMINs) developed to direct GCMRC actions need re-evaluation as some are unrelated to dam operations, others seem unrealistic, and others need clarification.
2. We recommend that CMINs 6.6.6 (seeps and springs) and 6.6.7 (SW willow flycatcher) be discontinued by the GCMRC, and that the GCMRC arrange to receive data being collected by other agencies on these topics.
3. Vegetation maps need to be finalized.
4. A schedule and strategy for repeat mapping and change detection analyses developed.
5. Vegetation monitoring plot design should be modified as discussed in the vegetation summary.

6. The suite of biota chosen for monitoring can be reduced to include only organisms conducive to rigorous sampling and methods conducive to rigorous analyses.
7. The absence of monitoring sites outside of Grand Canyon reduces the strength of inferences about the effects of dam operations. Reference sites not subject to the flow regime imposed by Glen Canyon Dam are necessary, but their location may vary depending on the suite of monitoring variables under consideration.

8. Publication of results in peer reviewed journals should be a priority, as there is a large audience interested in how flow regulation affects Grand Canyon habitats, and the journal review process is a valuable mechanism for quality control

9. Sampling frequency should be determined both by expected rates of change and expected drivers of change (e.g., natural droughts, management high-flow events).