Draft Information Needs for 2001-2006 Strategic Plan

GCMRC
Barbara Ralston
Ted Melis

5/28/2001

Information Need Structure and Development Process

In developing information needs associated with the Glen Canyon Dam adaptive management program goals, it became clear some goals were subordinate to others, when reviewed within an ecosystem framework. To treat each goal singularly would lead to a laundry list of information needs without clear connection to other goals or management objectives. In response to the suggestions of external peer reviewers (NRC, 1999; and the various PEP final reports), GCMRC is proposing that Goals be viewed in a hierarchical manner and that information needs within goals be viewed as information needs that support needs for the overarching goal.

The relative position of a goal treated in the attached information needs is somewhat determined by biological considerations and interactions. In some cases, there are information needs that are unique to a specific goal. In this case we have placed them under the goal. The current draft of information needs is not exhaustive, but represents a consideration of the previously identified needs and the addition of other needs in light of modifications associated with management objectives.

"Overarching goals are provided at the top of each information need section. Followed by a brief interpretation of the goal in order to help clarify what information needs pertain to the goals and management objectives. For ease of working and understanding linkages, the table format that is available for goals and management objectives has been temporarily set aside. The information needs will be place within the table when completed.

Cultural and recreational needs will be integrated with these information needs in the subsequent revisions.

Aquatic Ecosystem

Goal 2. Maintain or attain viable populations of existing native fish, remove jeopardy from humpback chub and razorback sucker, and prevent adverse modification to its critical habitat.

AND

Goal 4. Maintain a wild reproducing population of rainbow trout above the Paria River, to the extent practicable and consistent with the maintenance of viable populations of native fish.

Goals 2 and 4 have similar information needs which include defining population viability for each fish species, including native fish which may include determining genetic uniqueness of the fish species relative to other populations, determining life history parameters associated with vulnerability indexes (age of greatest mortality), time at reproductive maturity and age of greatest contribution to recruitment, length of contribution, and age at death. It also requires knowledge of a population and if additional populations are possible. Beyond life history/recruitment tables for species this goal also requires knowledge of how the food base can sustain individual species and numbers of these species. This information is supported by knowledge requirement/information needs delineated in Goal 1, information about water quality parameters (Goal 7) affecting physiological responses and productivity is also needed, as well as information needs associated with sediment which is viewed in the context of habitat (Goal 8).

INFO NEEDS

A. Demographics

1. What is the status and trends of the fish community of the CRE relative to species population age- and size-class structure?
2. What are the regulating factors (ecological) and levels required to maintain naturally reproducing fish in the Colorado River ecosystem (Glen Canyon and downstream)?
3. Will the operation of a temperature control device alter the fish community in Lake Powell and downstream?
4. If native-fish spawning is detected in the mainstem then where and at what season, temperature and water clarity?
5. At what age are small fish most likely to survive and be recruited into the fish community?
6. When do the majority of reproductive activities by each species occur in the different portions of the Colorado River ecosystem?
7. Which parameters define viability and population integrity?

B. Habitat

8. What is the importance of each tributary in the recruitment of various species into the mainstem population?
9. What is the importance of backwaters relative to shoreline habitat for YOY?
10. What is the proportionate quantity of young-of-year fish (# fish/m^2) utilizing different types of rearing habitats (backwaters and near shoreline).

INFO NEEDS: Water Quality Goal 7

1. How does water temperature (absolute temperature, seasonality, rate of change, thermal banding in river profile) affect fish health, growth, behavior and reproductive success?
2. Does the temperature in the mainstem reduce parasite loads on fish species?
3. How do turbidity, temperature and conductivity vary seasonally in the mainstem and in tributaries associated with spawning?

INFO NEEDS LINKED TO SEDIMENT Goal 8

1. Can habitat designation using a GIS application be utilized as an effective method to adjust site specific population estimates (e.g., mark-recapture or depletion methods) to system-wide extrapolations by using CPUE values that are scaled relative to the proportion of different habitat types available in Glen Canyon?
2. What is the total area for different habitat types used by fish in the Colorado River ecosystem?

INFO NEEDS: Aquatic Food Base Goal 1 in support of Goal 2&4.

1. What are the ecological processes that effect the status and trends of the aquatic food base in the CRE?
2. What is the trophic relationship that exists between fish species and the aquatic food base (i.e., production of biomass) required to maintain desired population levels of native and non-native fish in Glen Canyon?
3. Which fish and size classes are eaten by which fish species?
4. To what degree, which species, and where in the system are exotic fish a detriment to the existence of native fish?

Aquatic Food Base Goal 1:

Goal 1. Protect or improve the aquatic foodbase so that it will support viable populations of desired species at higher trophic levels.

Goal 1 requires a knowledge of how the composition of algae and invertebrates is related to sustainability of the fish community and if changes in the foodbase are directly relatable to changes in the fish community.

INFO NEEDS

1. What are the ecological processes that effect the status and trends of the aquatic food base in the Colorado River ecosystem?
2. What has the effects from past, present, and future dam operations had on the status and trends of the aquatic food base (e.g., species distribution, composition, population structure, biomass accrual and invertebrate densities) in the Colorado River ecosystem?

3. Does the Glen Canyon reach represent the productivity budget for the Colorado River?

B. Sampling/ Technological/Analytical Information

1. What is the most appropriate field sampling method(s) (e.g., sampling size, spatial and temporal distribution, analysis, explicit assumptions, limitations and uncertainties) to monitor the status and trends of the aquatic food base?
2. What should be the method used to define the criteria (demographic, trophic and spatial) for determining desired population levels of native and non-native fish that are capable of being supported in the Colorado River ecosystem?

GOAL 3 Restore populations of extirpated species, as feasible and advisable.
Goal 3 is a long-term goal that relates to management of additional species. At this time, we recommend deferring development of information needs for this goal until information needs for the existing ecosystem are developed and implemented.

Terrestrial Ecosystem

Goal 5 Maintain or attain viable populations of Kanab ambersnail.

Goal 5 requires a clarification of the taxon at Vaseys Paradise and subsequently determining what constitutes viability. Being knowledgeable about the populations structure and trends associated with that population are also required. Related to this are habitat requirements for the snail, which is related to Goal 6 regarding riparian and spring communities.

Information needs
Taxonomic and demographic

1. What is the taxonomic status of the entity at Vaseys Paradise?
2. What are the status and trends of the snail at Vaseys Paradise?
3. What is the age structure/life table information associated with the taxon at Vaseys Paradise?

Habitat

1. What are the minimum habitat requirements for a viable snail population?
2. What is the potential extent of habitat utilized by the snail at Vaseys Paradise?
3. What is the recovery time for habitat in the event of scour from either the river or from high discharges associated with the springs?

Goal 6 Information needs in support of Goal 5

1. How does discharge from the spring affect habitat utilized by the snail at Vaseys Paradise?

Goal 7 Information needs in support of Goal 5

1. How do operations (volume and velocity) affect habitat used by snails at Vaseys Paradise?

Goal 6 Protect and improve the biotic riparian and spring communities, including threatened and endangered species and their critical habitat. (This goal is intended to help achieve the biological, cultural and recreational goals).

Goal 6 involves understanding the dynamics between plant establishment and successional change associated with riparian and spring communities. Included in this understanding is how sediment texture, and depositional patterns associated with discharge volume and release pattern effects germination and seedbank storage (Goal 8). How water quality (temperature, nutrients) also effects plant community establishment and change. Moving up the trophic ladder, protecting and improving the communities requires knowing what other entities comprise the riparian community and how their dynamics (kinds, distribution and abundance) are linked to changes in the plant communities. Information needs associated with higher trophic levels may mimic those found in the aquatic system. Likewise, the terrestrial community may also provide inputs into the aquatic system with respect to food base (Goal 1) and water quality inputs (Goal 7).

INFO NEEDS

Riparian vegetation

1. What is the structure and composition of vegetation that supports the riparian community?
2. What is the linkage of vegetation change to operations?
3. What is the status (number of individuals?) of invasive species within the CRE?
4. How does riparian vegetation composition change within riparian zones following a disturbance (debris flow, management action) event? And on a decadal and longer-term scale?
    a. Is the OHWZ changing? What are the trends based on 1984 levels?
5. What is the area that is covered by vegetation compared to open beach available for camping/recreation.
6. What is the status of culturally significant plants?
7. What is the link of OHWZ to the stability of archaeological resources?

INFO NEEDS LINKED TO SEDIMENT Goal 8

1. What is the texture of sediment associated with designated riparian vegetation zones?
2. How does velocity and discharge pattern affect grain size deposition?

Higher trophic elements within Goal 6

1. What is the food base that supports birds and other identified terrestrial resources.
2. What is the seasonal pattern associated with the supporting food base?

3. Among the riparian zone vegetation which species support the food base that is used most by birds or other animals.
4. As vegetative communities shift how does the food base change and how does this affect birds and other animals?
5. What is the distribution, species and abundance of riparian birds and waterfowl along the river corridor.

Integrated Aquatic/Terrestrial Ecosystem

(Physical-Science Information Needs that Generally Support Aquatic and Terrestrial Biological, Cultural and Recreational Resources)

Goal 7. Establish water temperature, quality, and flow dynamics to achieve GCDAMP ecosystem goals.

Goal 7 needs criteria for water quality and flow dynamics. Parameters in water quality are physical, chemical, and biological characteristics of a given body of water. How these parameters interact with other resources as well as how they exist at any point in time are information needs that might be addressed under goal 7. The INs that follow oar those INs that are inherent to water quality. Other INs for water quality appear as supporting INs for other goals.

1. What is the quality of source water in Lake Powell for Glen Canyon Dam releases? (Links to Goals 1,2,4,7,10,12)
2. What are the dynamics of stratification, circulation, and advective flow patterns in Lake Powell and their effect on potential reservoir releases.
    a. What is the heat budget and temperature available for releases?
    b. How do salinity and major ion concentration change?
    c. What are the patterns of nutrient concentration associated with releases?
    d. What are the values for dissolved oxygen concentrations?
    e. How do chlorophyll, phytoplankton and zooplankton respond to physical chemical reservoir dynamics?
3. How accurately can modeling predict reservoir dynamics and operational scenarios?
4. How do operations affect reservoir limnology?
5. How do historic reservoir conditions relate to present and future inflow/reservoir dynamics in a modeling framework?
6. How do climate and hydrology affect the water quality of the reservoir and below the dam?
7. How do nutrient, major ion concentrations, and biological parameters change relative to biological processes.
8. What is the baseline condition for water quality parameters in Lees Ferry and below the Paria River?

Goal 8. Maintain or attain levels of sediment storage within the main channel and along shorelines to achieve GCDAMP ecosystem goals.

GCMRC Comments Regarding Goal 8 -

Comment #1 - The fine-sediment budget for the ecosystem is divided into major contributing sediment-yield reaches: A) Glen Canyon Dam to Paria River, B) Paria River to Little Colorado River, C) Little Colorado River to Bright Angel Creek, D) Bright Angel Creek to Kanab Creek, E) Kanab Creek to Havasu Creek, F) Havasu Creek to Diamond Creek, and G) Diamond Creek to Grand Wash. Additionally, there are reaches (mostly tied to wide versus narrow channel conditions) with differing channel geomorphic characteristics that influence how both fine- and coarse-sediment are storage with respect to stage and flow. As a result of the combined influence of these two physically constraining conditions, management outcomes for any given dam operation strategy will vary from reach to reach, as well as longitudinally. Any target levels set for conservation of sediment, or dependant related resources, will need to carefully consider such physical constraints.

Comment #2 - The MO's for sediment are currently tied to only fine sediment; although Goal 8, refers generally to "levels of sediment storage," taken to mean all sediment size classes. Biological linkages to physical habitat are one area of concern, but such habitats include areas related to both fine- and coarse-grained deposits. Recreational resources are also closely tied to both fine- and coarse-grained sediments. To make the list of Management Objectives complete, there needs to be additional MO's under Goal 8 that relate to coarse-grained sediment, such as gravel deposits that support benthic organisms, or that are related to fish spawning habitats.

Comment #3 – One of the overall objectives of the long-term monitoring program is to track the sediment mass balance for the ecosystem. Hence, many information needs relate to efforts to understand how all size classes of sediment move into and through the main channel. Following each of the Goal 8 IN's is an indication of how much is already known [much, some, little, none], and the type of activity required to further develop that information level [monitoring, research and synthesis, modeling].

IN's associated with MO's (8.1 – 8.4) for Fine-Grained Sediment (grain sizes less than 2 mm):

1 – On an ongoing basis, what are the monthly volume and grain-size values for inputs of fine-sediment from a) major tributary sources (Paria and Little Colorado Rivers), and b) what are long-term yield estimates for other sources (lesser tributaries)? [a) much, b) some] and [a) monitoring and modeling, b) monitoring and research]

2 – For each of the Sediment-Yield and Geomorphic Reaches, what is the maximum and minimum historically known area and volume distribution of fine-sediment deposits for each elevation-range identified in the Management Objectives (8.1 through 8.4)? [some] and [research and synthesis]

3 – What are the pre-dam versus post-dam grain-size characteristics associated with fine-sediment deposits within the a) channel, b) eddys and c) shorelines? [a) much, b) some, c) much] and [a-c) monitoring, research and synthesis]

4 – What, if any, relationships exist between grain-size characteristics of fine-sediment deposits throughout the channel, eddys and shorelines, and physical-habitat requirements of biological organisms of interest; including terrestrial vegetation, fisheries reproduction, food base dynamics, etc? [some] and [research and synthesis, monitoring]

5 - What, if any, relationships exist between grain-size characteristics of fine-sediment deposits throughout the channel, eddys and shorelines, and physical-habitat requirements of recreational users (camping areas)? [some] and [research and synthesis, monitoring]

6 - What, if any, relationships exist between grain-size characteristics of fine-sediment deposits throughout the channel, eddys and shorelines, and physical requirements for in-situ preservation of cultural resources associated with pre-dam terraces? [much] and [modeling, research and synthesis, monitoring]

7 – What is the fate (by geomorphic reach) of new fine-sediment inputs from tributary sources, say for an average Paria River flood? [much] and [monitoring, research and synthesis, modeling]

8 - What, if any, relationships exist between grain-size characteristics of fine-sediment deposits throughout the channel, eddys and shorelines, and their stability or ability to resist rapid erosion? [some] and [monitoring, research and synthesis]

9 – How does the grain-size distribution of sediment supply in the main channel (bed material) vary in response to tributary floods and dam operations? [much] and [research and synthesis, monitoring, modeling]

10 – What are the volume and grain-size characteristics of monthly fine-sediment loads exported from the ecosystem? [much] and [monitoring]

11 – What is the relationship between tributary inputs of fine-sediment, dam operations and turbidity? [some] and [monitoring]

12 – What is the range of sediment-supply variability for the main channel, with respect to suspended-sediment concentration and grain-size? [much] and [research and synthesis]

IN's associated with Coarse-Grained Sediment [no MO's exist] (grain sizes greater than 2 mm):

1 – What is the spatial distribution of coarse-grained deposits throughout the ecosystem? [some] and [research and synthesis]

2 – What are the grain-size characteristics of the various types of coarse deposits? [some] and [research and synthesis, monitoring, modeling]

3 – What are the flow-depth and velocity relationships associated with coarse-grained deposits relative to dam operations? [some] and [research and synthesis, monitoring, modeling]

4 – What flow conditions within rapids related to recreational whitewater are considered not suitable for navigation, and to what degree can they be mitigated by managed floods? [some] and [research and synthesis, monitoring, modeling]

5 – How do tributary debris flows impact coarse- and fine-grained physical habitats throughout the ecosystem under regulated flows? [little] and [research and synthesis, monitoring, modeling]

6 – What percentage of the overall sediment budget of the ecosystem is contributed by tributary debris flows versus stream floods? [some] and [monitoring]