

To: TWG Members and Alternates
From: Barry Gold
Date: August 20, 2001
Subj: Revised Information Needs and Next Steps

First let me thank everyone who participated in the August INs Development Workshop. A tremendous amount of good work was accomplished. As I go around and meet with other adaptive management programs and listen to how they work together (or don't) I continue to be impressed with the commitment and dedication that everyone brings to this process, our ability to listen to each other and to maintain civil discourse around difficult issues. Thanks and congratulations!

Attached are the following documents resulting from the August 8-9 INs Development Workshop:

- 1) Process for completing the INs
- 2) Revised Draft INs document
- 3) Table of Comments made during the INs Development Workshop
- 4) Final Agenda from the INs Development Workshop
- 5) Participants List from the INs Development Workshop
- 6) Participants List for the Breakout Groups at the INs Development Workshop
- 7) Proposed Revisions for Goal 9 received from Linda Jalbert

As agreed to at the INs Development Workshop, GCMRC has taken all of the comments provided during the workshop and produced a Revised Draft INs document. This Revised Draft (dated 8/17/01) is in redline and strikeout so you can see that changes that were made in response to comments provided at the workshop. In addition, we have prepared a comments table for those comments that were made at the INs workshop and need to be addressed at the next TWG meeting.

We are asking you to review the Revised Draft INs document and provide written comments to Randy Peterson and me that you would like to have discussed at the September 6-7 TWG meeting. Please get your comments to us by Close of Business August 31, 2001.

In reviewing the Revised Draft INs and the Comments Table, we ask that you consider the following questions:

- 1) Do the INs for a given MO provide the information that is needed to address that MO? If not, please indicate how they should be revised and what should be added or deleted. Is the MO "SMART"? If not, what INs do we need to make the MO "SMART"? [Specific, Measurable, Achievable, Realistic, Time Sensitive]
- 2) Are the INs written at the appropriate level of detail and correctly categorized with respect to the categories of "core monitoring," "effects monitoring," "research," and "supporting"?
- 3) Taken together as a set do the INs and MOs represent the information needed to address a given goal?
- 4) Please comment on how well the INs are integrated and the adequacy of the "Supporting INs".

In addition, we received proposed revisions from Linda Jalbert for Goal 9. Since these were not discussed at the INs workshop we did not incorporate them into the Revised Draft (dated 8/17/01). We feel there is merit in many of Linda's suggested revisions but feel these need to be reviewed by the TWG before incorporating. Please review these as well and provide us with comments on what you would suggest incorporating from Linda's comments and what you would advise us to leave as is.

Thank you very much for your efforts. I think we made substantial progress at the August INs Development Workshop and look forward to developing a final set of INs over the next few months.

Process for Completing the INs

Developed at August 9, 2001 INs Review Workshop

- GCMRC will produce a redline/strikeout version of the MOs and INs and mail this revised version with comments from the August 8-9 workshop to the TWG by August 17, 2001.
- GCMRC will mail the Science Advisor's comments on the INs to the TWG when they are received by GCMRC.
- TWG will offer revisions and insertions to the INs for the September 6-7 TWG meeting. This should be sent to Barry Gold and Randy Peterson prior to the TWG meeting.
- GCMRC will produce a revised Final Draft INs document based on all comments received on the August 17, 2001 draft. These will include comments received prior to and during the September 6-7 TWG meeting and comments from the Science Advisors. This revised draft will serve as the basis for an October TWG meeting / scientists workshop.
- An October TWG meeting / scientists workshop will be held to produce a Final INs document and to work on sequencing the research INs.
- A recommendation to adopt the Final INs and revised MOs will be sought at the November TWG meeting.
- A recommendation to adopt the Final MOs and INs will be sought at the January AMWG meeting.

DRAFT INFORMATION NEEDS
for
Technical Work Group (TWG) REVIEW

August 17, 2001

Introduction

The Information Needs (INs) provided in this document represent data needed to meet management objectives and programmatic goals. The Information Needs are nested within Management Objectives and are categorized as: core monitoring information needs (CMIN), effects monitoring information needs (EIN), or research information needs (RIN), defined below. In an effort to reflect integration across resource programs, some Information Needs are supporting information needs for other resources (SIN). Information Needs that do not fit under any particular management objective, but are necessary to achieve the goal are placed above the Management Objectives for that goal.

Process

The INs have been developed through a collaborative process led by the Grand Canyon Monitoring and Research Center (GCMRC). This process was initiated with GCMRC developing a draft set of INs for review and comment at a meeting of the TWG and principal investigators held at the Phoenix Airport on April 3, 2001. A second meeting to discuss cultural INs was held in Flagstaff on May 8, 2001. Following these meetings, GCMRC revised the INs and discussed them at the May TWG meeting. Following this meeting the INs were put in a table and electronically mailed to the TWG for additional comment. Very few comments were provided by the TWG. At this point, the INs and the process for developing the INs was discussed in a number of conference calls and it was agreed that the INs would be reformatted into the nested outline form used in the current document. It was also agreed that the reformatted INs would be mailed to the TWG for review and comment and that a second workshop for reviewing and revising the INs would be held at GCMRC on August 8-9, 2001.

This current document results from the work conducted at the August 8-9, 2001 workshop. On the first day of the workshop the TWG, PIs, and GCMRC staff divided into 4 concurrent breakout groups and reviewed the draft INs. Each group addressed the following questions during their review:

- 1) Do the INs for a given MO provide the information that is needed to address that MO? If not, please indicate how they should be revised and what should be added or deleted.
- 2) Are the INs written at the appropriate level of detail and correctly categorized with respect to the categories of "core monitoring", "effects monitoring", and "research"?
- 3) Taken together as a set do the INs and MOs represent the information needed to address a given goal?

On the second day of the workshop, a representative of each breakout group presented their proposed changes to the group as a whole. In response to these comments, the INs were either modified or the comments were captured in a table for subsequent consideration.

Next Steps

This revised Draft INs document will be reviewed by the TWG and discussed at the September 6-7 TWG meeting. Additional comments will be incorporated into a revised draft that will be discussed at an October TWG meeting / Scientist's workshop. A Final Draft INs document will be presented to the TWG at their November meeting. A recommendation to the AMWG to adopt the Final Draft INs will be sought at that meeting. A recommendation from the AMWG to adopt the Final INs will be sought at their January 2002 meeting.

Definitions

Management Objectives (MOs): Management Objectives define desired future resource conditions. They should be: 1) Specific; 2) Measurable; 3) Achievable; 4) Results-oriented; 5) Time-specific; and within the legal and policy framework of the Adaptive Management Program.

Information Needs (INs): Information Needs define the specific knowledge or understanding (i.e., information) one needs for accomplishing a management objective. They define what one needs to know. The information may be needed to:

- a) quantify or define a management objective (i.e., help determine a target level);
- b) assess whether or not a management objective is being achieved (i.e., help determine why the system is not responding as predicted);
- c) develop basic understanding about cause and effect relationships;
- d) meet the legal/policy requirements of consultation; and
- e) test more effective ways to achieve desired resource conditions.

Information Needs are categorized as follows:

- *Core Monitoring (CM)*: Consistent, long-term, repeated measurements gathered in the same way at the same time of year and in the same places.
- *Effects Monitoring (EM)*: Data collection that takes place before and after an experiment, and that does not fit into the schedule of core monitoring or involves different measurements.
- *Research (R)*: Data collected to address specific hypotheses directed at determining and understanding cause and effects relationships between dam operations, or other driving variables, and resource responses. Data may also be collected to help refine Core Monitoring.

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

Research INs

~~RIN 1.1~~ What is the caloric requirement for any native fish to sustain itself and potential contribute to recruitment? What are higher trophic levels assimilating?

~~RIN 1.2~~ How does primary productivity effect structuring of the benthic invertebrate community (e.g., production, composition, densities and accrued biomass)?

~~RIN 1.3~~ What foodbase standards/criteria do other agencies use to assess health.

[NOTE: Move RIN 1.3 through 1.7 to Goal 12, MO12.2.]

~~RIN 1.3~~ 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 foodbase?

~~RIN 1.4~~ What RS technologies are available to less intrusively and more cost effectively monitor the aquatic food base?

~~RIN 1.5~~ Is development of a bathymetric map of the entire CRE including characterization of the types of substrate available to support the aquatic food base needed?

~~RIN 1.6~~ What digital technologies exist and should be used to record field observations of food base data that facilitates integration into GCMRC databases and use by PI's and stakeholders?

~~RIN 1.7~~ What technologies exist to spatially reference food base data so that it can be readily integrated with other GCMRC data?

M.O. 1.1 Maintain or attain primary producers: (algae, macrophytes, diatoms) in the Glen Canyon Reach.

Core Monitoring INs

CMIN 1.1.1 Determine composition and biomass of primary producers in Glen Canyon Reach integrated with flow, nutrient, temperature, and light regime.

Research INs

RIN 1.1.1 What are the effects of grazing on the compositional structure, production and turnover rates in the phytobenthic community?

RIN 1.1.2 When do top-down effects override operational effects on foodbase productivity?

RIN 1.1.3 What is the estimated productivity for the reach between GCD and the Paria River integrated with flow, nutrient, temperature, and light regime.

M.O. 1.2 Maintain or attain benthic invertebrates in the Glen Canyon Reach

Core Monitoring INs

CMIN 1.2.1 Determine composition and biomass of benthic invertebrates in Glen Canyon Reach integrated with flow, nutrient, temperature, and light regime.

M.O. 1.3 Maintain or attain primary producers (algae, macrophytes, diatoms) in the mainstem and tributaries below the Paria.

Core Monitoring INs

CMIN 1.3.1 Determine composition and biomass of primary producers in the mainstem and tributaries below the Paria River integrated with flow, nutrient, temperature, and light regime.

Research INs

RIN 1.3.1 What is the estimated productivity for the reach between CRE below the Paria River ~~and the LCR?~~

M.O. 1.4 Maintain or attain benthic invertebrates in the mainstem and tributaries below the Paria.

Core Monitoring INs

CMIN 1.4.1 Determine composition and biomass of benthic invertebrates in the mainstem and tributaries below the Paria River integrated with flow, nutrient, temperature, and light regime.

M.O. 1.5 Maintain or attain drift (Diptera, CPOM, FPOM, DOC) in the mainstem and tributaries.

Core Monitoring INs

CMIN 1.5.1 Determine composition and biomass of drift in the mainstem and tributaries integrated with flow, nutrient, temperature, and light regime.

Research INs

RIN 1.5.1 Is invertebrate drift regulated by density dependent or density independent factors (e.g., flow velocities, substrate types, light intensity)?

RIN 1.5.2 What is the Carbon budget for the CRE?

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

[NOTE: Move the following 5 IN's to Goal 12, M.O. 12.2 and address through library research and pilot studies.]

~~IN 2.1 What RS technologies are available to monitor fish within the CRE?~~

~~IN 2.2 What RS technologies are available to characterize and map water and substrate parameters important to fish habitat?~~

~~IN 2.3 Is development of a bathymetric map of the entire CRE including characterization of the types of substrate available that provide fish habitat needed?~~

~~IN 2.4 What digital technologies exist and should be used to record field observations of fish data that facilitates integration into GCMRC databases and use by PI's and stakeholders?~~

~~IN 2.5 What technologies exist to spatially reference fish data so that it can be readily integrated with other GCMRC data?~~

IN 2.1 What are the impacts of current recreational activities on native fish?

Research INs

~~RIN 2.1 What should be the methods used to define the criteria (demographic, trophic and spatial) to determine desired population levels of native and non-native fish that are capable of being supported in the Colorado River ecosystem? What is a viable population? What is the probability of extinction over what management time period for species of concern? What is the appropriate method to assess viability?~~

RIN 2.2 What is necessary to remove jeopardy for humpback chub?

M.O. 2.1 Maintain or attain humpback chub (>150 mm) abundance in the LCR and other aggregations at appropriate target levels for viable populations and to remove jeopardy.

Core Monitoring INs

CMIN 2.1.1 What is the status and trends of HBC > 150 mm in the LCR and in the mainstem? **What is the status and trends of HBC of all size classes in the LCR and the mainstem?**

M.O. 2.2 Maintain or attain HBC (51-150mm) year class strength in the LCR and other aggregations at appropriate target levels for viable populations and to remove jeopardy.

Core Monitoring INs

CMIN 2.2.1 What is the status and trends of HBC > 51-150 mm in the LCR and in the mainstem? **What is the status and trends of HBC of all size classes in the LCR and the mainstem?** NOTE: *can only effectively monitor this in LCR.*

CMIN 2.2.3 What is LCR discharge near mouth (below springs)?

Research INs

RIN 2.2.1 At what age are small fish most likely to survive and be recruited into the mainstem population (i.e., what is the vulnerability index for any fish species including HBC)? **What is the relationship between size and mortality in the LCR and the mainstem? What are the sources of mortality?**

RIN 2.2.2 Is recruitment (esp. of native fish) enhanced by backwater availability and suitability? **What habitats enhance recruitment of native fish? What are the physical and biological characteristics of those habitats?**

M.O. 2.3 Maintain or attain HBC (>200mm) recruiting adults in the LCR and other aggregations at appropriate target levels for viable populations and to remove jeopardy.

Core Monitoring INs

CMIN 2.3.1 What is the status and trends of HBC of all size classes in the LCR and the mainstem?

M.O. 2.4 Establish HBC spawning aggregations in the CRE below GCD to remove jeopardy. (clarify objective - viable spawning aggregation)

Research INs

RIN 2.4.1 What is the genetic relationship between “aggregations” in the mainstem and LCR? (SEE DOUGLAS)

RIN 2.4.2 ~~What numbers of HBC can be sustained in the CRE, including those individuals that spawn in the LCR?~~

[NOTE: The group considered replacing this with a carrying capacity question but didn't. Perhaps this should be replaced with an “above some minimum threshold” type of question.]

RIN 2.4.3 What are the criteria for establishment of spawning aggregations (i.e., how does one determine its “established”)?

RIN 2.4.4 Is implementation and operation of a TCD and/or steady flows a ~~viable~~ practical option for mainstem spawning aggregation establishment?

RIN 2.4.5 What defines population viability, and how does this affect the objective to establish additional spawning aggregations in the CRE and removal of jeopardy?

RIN 2.4.6 Are mainstem aggregations “sinks” of the LCR? Are aggregations real or due to sampling bias?

RIN 2.4.7 Is humpback chub augmentation a viable MGT strategy to establish mainstem spawning aggregations.

RIN 2.4.8 What techniques are available to determine natal stream of native fish?

M.O. 2.5 Attain HBC condition and disease/parasite numbers in LCR and other aggregations at an appropriate target level for viable populations and to remove jeopardy. (clarify MO... Native Fish)

Core Monitoring INs

CMIN 2.5.1 What are the parasite loads on HBC found in the LCR and in the CRE?

CMIN 2.5.2 What is status and trends of HBC condition (Kn or Wr).

Research INs

RIN 2.5.1 What are HBC's tolerable limits for parasite/disease loads? (See Cole/Choudury/Hoffnagle)

RIN 2.5.2 How will warming mainstem temperatures affect the abundance and distribution of parasites/disease? (See Cole/Choudury/Hoffnagle)

M.O. 2.6 Reduce native fish mortality due to non-native fish predation as a percentage of overall mortality in the LCR and mainstem to affect native fish viability.

Core Monitoring INs

CMIN 2.6.1 What is the status and trends of predatory fish species in the CRE?

Research INs

RIN 2.6.1 ~~What effect does predator suppression that is in place to affect at least one year class cohort (e.g., 3-4 years for BRT, RBT) have on native fish population trends?~~ **What is the most effective predator control method?**

RIN 2.6.2 Does predator suppression benefit native fish?

RIN 2.6.3 To what degree, which species, and where in the system are exotic fish a detriment to the existence of native fish?

M.O. 2.7 Attain Razorback sucker abundance in the CRE below GCD.

Research INs

RIN 2.7.1 Will the introduction of razorback suckers into the CRE compromise the genetic integrity of flannelmouth suckers due to hybridization?

RIN 2.7.2 What is the suitability of habitat in the CRE for razorback sucker?

RIN 2.7.3 Determine feasibility of augmenting razorback sucker including technical/legal/policy constraints (library).

RIN 2.7.4 Determine advisability of augmenting razorback sucker.

M.O. 2.8 Maintain (FMS, BHS and SPD) abundance and distribution in the CRE below GCD for viable populations.

Core Monitoring INs

CMIN 2.8.1 What is the status and trend of FMS, BHS and SPD in the CRE?

Research INs

RIN 2.8.1 ~~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?~~ **What is a viable population? What is**

the probability of extinction over what management time period for species of concern? What is the appropriate method to assess viability?

~~RIN 2.8.2~~ What parameters define viability?

~~RIN 2.8.32~~ What is the proportionate quantity of young-of-year fish (# fish/m²) utilizing different types of rearing habitats (backwaters and near shoreline). **What habitats enhance recruitment of native fish? What are the physical and biological characteristics of those habitats?**

~~RIN 2.8.43~~ What is the age structure of native fish populations? Develop an age/life table for each species that projects life history information into recruitment/populations estimates. **What is the age structure, including relationship between age and size, of native fish in CRE.**

~~RIN 2.8.5 4~~ What is the relationship between age and size for native fish? Use mark/recapture data to determine the growth of native fish relative at time of tagging for fish tagged in mainstem associated with population estimate work

~~RIN 2.8.6 5~~ Understand movement with respect to mainstem catch information and tributary spawning effort, particularly for flannelmouth suckers life history and tributary fidelity.

~~RIN 2.8.7 6~~ At what age are small fish most likely to survive and be recruited into the mainstem population (i.e., what is the vulnerability index for any fish species including HBC)? **What is the relationship between size and mortality for all native fish in the CRE? What are the sources of mortality?**

~~RIN 2.8.8-7~~ How does temperature modification in the mainstem affect native fish vulnerability index for fish originating from tributary spawning efforts?

Goal 3. Restore populations of extirpated species, as feasible and advisable.

M.O. 3.1 Restore Colorado pikeminnow, bonytail, and roundtail chub and river otter abundances in the CRE as feasible and advisable.

Research INs

3.1.1 Determine feasibility of restoring extirpated species including technical/legal/policy constraints (library).

3.1.2 Determine advisability of restoring extirpated species.

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.

M.O. 4.1 Maintain or attain RBT abundance, PSD, length at age, condition, whirling disease and other parasitic infections, spawning habitat, natural recruitment.

Core Monitoring INs

CMIN 4.1.1 ~~What are the status and trends of the RBT in the Glen Canyon Reach?~~ Determine annual population estimate for age II+ rainbow trout in the Lee's Ferry Reach.

CMIN 4.1.2 Estimate size class/age class of trout in the Glen Canyon Reach. Determine annual PSD of rainbow trout in the Lee's Ferry Reach.

CMIN 4.1.3 Determine annual rainbow trout growth rate in the Lee's Ferry Reach.

CMIN 4.1.4 Determine annual standard condition (Kn) and Relative Weight of rainbow trout in the Lees Ferry Reach.

CMIN 4.1.5 Determine if whirling disease is present in the Lees Ferry reach. Determine annual incidence and relative infestation of trout nematodes in rainbow trout in the Lees Ferry reach.

CMIN 4.1.6 Determine quantity and quality of spawning habitat for rainbow trout in the Lees Ferry Reach on a 5 year basis.

CMIN 4.1.7 Determine annual percentage of naturally recruited rainbow trout in the Lees Ferry reach.

Research INs

RIN 4.1.1 How does age structure affect sustainability of the trout population and how can it be used as a predictor for management actions? What is a target Proportional Stock Density?

RIN 4.1.2 What are the regulating factors (ecological) and levels required to maintain naturally reproducing trout in the Glen Canyon? What are trade-offs between numbers and size of rainbow trout in the Lees Ferry reach? (See Speas)

M.O. 4.2 Limit Lees Ferry RBT distribution below the Paria River of the CRE to reduce competition or predation on downstream native fish.

Research INs

RIN 4.2.1 What is the number of recaptures of RBT in the mainstem that originate from Lees Ferry? What is the rate of emigration of rainbow trout from the Lees Ferry reach?

RIN 4.2.2 ~~Is there a genetic mark or isotope signal that can be used to determine RBT origin of trout found in the mainstem?~~ **What is the most effective method to detect emigration of rainbow trout from the Lees Ferry reach.**

~~**RIN 4.2.3** What are factors responsible for displacement or active dispersal of trout that leads to their additive contribution to other downstream trout populations. What / how do management actions affect Lees Ferry Rainbow trout displacement below the Paria River?~~

Goal 5. Maintain or attain viable populations of Kanab ambersnail.

IN 5.1 What is the taxonomic status of the entity at Vasey's Paradise?

~~**IN 5.2** What is the age structure/life history table information associated with the snail taxon at Vasey's Paradise?~~

~~**IN 5.3-5.2** Are there other populations of the Vaseys Paradise taxons? What is the distribution of the Vasey's Paradise snail taxon throughout its range?~~

IN 5.3 What is the historic range of *Oxyloma haydeni*?

~~**IN 5.4** What RS technologies are available to less intrusively and more cost effectively characterize and monitor KAS habitat (vegetation type and distribution)? [NOTE: Move to Goal 12, M.O. 12.2.]~~

IN 5.4 What actions are necessary to avoid jeopardy for KAS?

MO 5.1: Attain and maintain KAS population at Vasey's Paradise from the current level to the target level.

Core Monitoring INs

CMIN 5.1.1 What is the annual status and long-term population trend of the population size of the KAS at Vasey's Paradise?

Effects Monitoring INs

EIN 5.1.2 What is the population size of KAS at Vasey's paradise immediately following the scour of its habitat following a test flow?

Research INs

RIN 5.1.3 What parameters have the greatest influence on population viability of KAS at Vaseys Paradise (e.g., parasites, predation, discharges, habitat size and quality). Define population viability of the KAS at Vasey's Paradise?

RIN 5.1.4 What is the minimum viable population size for the KAS at Vasey's Paradise?

RIN 5.1.4 Develop a population dynamic model to predict KAS viability under different flows and environmental conditions (incorporating IN 5.2 -age structure life history table information associated with the snail taxon at Vaseys paradise).

RIN 5.1.5 If the pdm predicts lost of population viability or monitoring discovers substantial habitat or KAS population declines, identify and evaluate alternative MA's to ensure viability.

MO 5.2 Maintain KAS habitat at Vasey's Paradise from the current level to the target level.

Core Monitoring INs

CMIN 5.2.1 Annually determine the size and composition of the potential habitat used by KAS at Vasey's Paradise? [NOTE: Should potential be retained?]

IN 5.4 becomes CMIN 5.2.2 What RS technologies are available to less intrusively and more cost effectively characterize and monitor KAS habitat (vegetation type and distribution)?

Effects Monitoring INs

EIN 5.2.2 What is the size of the habitat used by KAS at Vasey's paradise immediately following the scour of the habitat following a test flow? What is the size of KAS habitat loss and recovery time following test flows or natural scours? How does the size and quality of KAS habitat change following test flows, natural scours, and other operations? [NOTE: Might want this second question to be a CMIN.]

Research INs

RIN 5.2.3 What are the minimum habitat requirements for a viable population of KAS at Vasey's Paradise?

RIN 5.2.4 What is the recovery time for the habitat in the event of scour from either the river or from high discharges associated with the springs at Vasey's Paradise?

RIN 5.2.5 How does the habitat use of KAS at Vasey's Paradise shift with the age of the snail?

Supporting INs

[Goal 6 INs support Goal 5]

[Goal 7 INs support Goal 5]

Goal 6. Protect or improve the biotic riparian and spring communities, including T&E species and their critical habitat.

[NOTE: Attributes are not used consistently in 6.1-6.4]

CMIN 6.1 Determine the community composition of vascular plants, vertebrates, arthropods and mollusks to an appropriate taxonomic level and frequency.

IN 6.1 What were the 1984 community levels (OHWZ / NHWZ / Marsh / beach community)?

~~**IN 6.2** What data sets currently exist to determine historic biotic riparian and spring communities? [NOTE: Move to Goal 12, M.O. 12.2.]~~

~~**IN 6.3** What remote sensing data is available or can be obtained that will support the production of a system wide vegetation map? [NOTE: Move to Goal 12, M.O. 12.2.]~~

~~**IN 6.4** Is development of a GIS coverage layer of natural communities in the CRE to use in identification of status and trends, the entire CRE identifying and characterizing springs (flows, water quality, vegetation, etc.) needed?~~

~~**IN 6.5** What (preferably automated) methods can be used to distinguish and map exotic species using remote sensing technologies?~~

~~**IN 6.6** Is development of an exotic vegetation map of the entire CRE including characterization of the types of habitat that supports exotic species needed?~~

RIN 6.7 Do we need a new community classification system?

IN 6.7 RIN 6.7.2 What is the seasonal patterns of abundance associated with the supporting foodbase and vertebrate consumers in the different communities?

New RIN 6.? Understand the community dynamics in response to physical processes.

M.O. 6.1 Maintain marsh community abundance, composition and area in the CRE in such a manner that native species are not lost.

Core Monitoring INs

CMIN 6.1.1 What is the composition and extent of marsh habitat on a 5-year schedule?

Research INs

RIN 6.1.1 How does riparian vegetation change within marsh community following disturbance?

RIN 6.1.2 How does marsh vegetation change on a decadal or 5 year time scale?

RIN 6.1.3 What is the acceptable detection level for change?

[NOTE: Move to Goal 12]

M.O. 6.2 Maintain NHWZ community patch number and distribution, composition and area to be no lower than values estimated for 1984.

Core Monitoring INs

CMIN 6.2.1 What is the composition and extent of NHWZ community on a 5-year schedule?

Research INs

RIN 6.2.1 How has the NHWZ community changed system-wide since 1984- 1963 levels?

RIN 6.2.2 How does riparian vegetation change within NHWZ community following disturbance (Flooding primarily)?

RIN 6.2 How does NHWZ vegetation change on a decadal or 5 year time scale?

M.O. 6.3 Maintain OHWZ community abundance, composition and distribution in the CRE.

Core Monitoring INs

CMIN 6.3.1 What is the composition and extent of OHWZ community on a 5-year schedule?

Research INs

RIN 6.3.1 How has the OHWZ community changed system-wide since 1984 1963 levels?

RIN 6.3.2 What Management actions have the potential to maintain OHWZ communities at current or lower stage elevations?

M.O. 6.4 Maintain sand beach community abundance, composition and distribution in the CRE from some benchmark (19??) year. [NOTE: Community includes flora and fauna.]

Core Monitoring INs

CMIN 6.4.1 What is the composition and extent of sand beach community on a 5-year schedule?

Research IN

RIN 6.4.1 How have the sand beach community attributes changed since 1963?

M.O. 6.5 Reduce invasive non-native species abundance and distribution.

Core Monitoring INs

CMIN 6.5.1 What is the distribution and abundance of exotics canyon-wide?

Research INs

RIN 6.5.1 Are exotic species expanding or contracting at a local scale (patch or reach)

RIN 6.5.2 What management actions have the potential to increase or decrease non-native species distribution and abundance?

Moved from IN 6.6 Is development of an exotic vegetation map of the entire CRE including characterization of the types of habitat that supports exotic species needed?

RIN 6.5.3 IN 6.6 Is development of an exotic vegetation map of the entire CRE including characterization of the types of habitat that supports exotic species needed?

M.O. 6.6 Maintain spring and wetland habitat occupied by rare and endemic species in the CRE.

Core Monitoring INs

CMIN 6.6.1 What are the culturally important biotic and spring communities? Incorporated into CMIN 6.6.4

Change to RIN 6.6.3 **CMIN 6.6.2** What are the attributes of these resources- ~~habitats~~ communities that are important and are these attributes affected by dam operations?

CMIN 6.6.3 If so, do these impacts affect resource integrity and/or use?

CMIN 6.6.4 What is the composition and extent of spring and wetland communities on a 5 year schedule including culturally important sites

Research INs

RIN 6.6.1 How does habitat quality and quantity change through the year and over several years?

RIN 6.6.2 How does discharge from the spring at Vasey's Paradise affect habitat utilized by the snail taxon at Vasey's Paradise?

RIN 6.6.3 What is the composition of the habitat used by the snail taxon at Vasey's Paradise?

M.O. 6.7 Maintain riparian habitat in the CRE capable of supporting Southwest willow flycatcher.

Core Monitoring INs

CMIN 6.7.1 What is the status of SWWF in the CRE

CMIN 6.7.2 What is the foodbase that supports birds (SWWF & other surrogate riparian species) and other vertebrates?

CMIN 6.7.3 What is the distribution of terrestrial species and their abundance along the river corridor?

Research INs

RIN 6.7.1 What is the function of the CRE as a migratory corridor for SWWFL?

RIN 6.7.1 What is the function of the CRE as a migratory corridor for passerines?

~~RIN 6.7.2 What is the seasonal pattern associated with the supporting foodbase and vertebrate consumers? MOVE to IN 6.7 and add seasonal patterns of abundance in the different communities.~~

~~RIN 6.7.3 How much allochthonous material from the terrestrial system goes into the aquatic system and vice versa? [NOTE: **Move to Goal 1 but identify as a SIN here.**]~~

~~RIN 6.7.4 What constitutes high-quality suitable SWWF habitat?~~

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

[NOTE: Move IN7.1 to Goal 12, M.O. 12.2.]

~~IN 7.1 What remote sensing technologies are available to less intrusively and more cost effectively monitor certain water quality parameters in the CRE?~~

M.O. 7.1 Attain water temperature ranges and seasonal variability in the mainstem for biological resources (e.g., native fish, foodbase and trout).

Core Monitoring INs

~~CMIN 7.1.1 What is the yearly range of mainstem temperature under ROD operations? Measure the water temperature dynamics throughout the CRE.~~

~~CMIN 7.1.2 Measure water temperature dynamics in the tributary mouths, back-waters, and near-shore areas.~~

CMIN 7.1 What are the water temperature dynamics in the mainstem, tributary mouths, back-waters, and near-shore areas throughout the CRE? [NOTE: **Should this be stated as, “what are the desired ranges of water temperatures for the desired CRE?”**]

Research INs

~~LRIN 7.1.1 What is the baseline condition for water quality parameters in Lees Ferry and below the Paria River? What are the desired ranges of temperatures for targeted resources?~~

M.O. 7.2 Maintain water quality in the mainstem of the CRE.

Core Monitoring INs

CMIN 7.2.1 How do the seasonal and yearly trends in turbidity, temperature, conductivity, DO, pH, nutrients, major ions, and appropriate metals change in the mainstem throughout the CRE?

CMIN 7.2.2 Assess threats to human health from water borne pathogens.

Research INs

[In support of goals 1-4]

RIN 7.2.1 Which major ions should be measured? How often?

RIN 7.2.2 Which nutrients should be measured? How often?

RIN 7.2.3 Which metals should be measured? How often?

RIN 7.2.1 Do the hydrodynamics and stratification of Lake Powell influence the food base or fisheries downstream?

RIN 7.2.4 How do turbidity, temperature and conductivity, DO and pH vary seasonally in the mainstem and in tributaries associated with spawning? How do water quality variables influence food base and fisheries in the CRE?

[In support of springs/habitat goal 6]

7.2.3 and 7.2.4 moved to Goal 6

RIN 7.2.3: How do operation (volume and velocity) affect the quantity and quality of the habitat utilized by the snail taxon at Vasey's Paradise?

RIN 7.2.4: Does Colorado River water quality affect the quality and quantity of the habitat used by the snail taxon at Vasey's Paradise?

NOTE: There are no management objectives for Lake Powell reservoir. Below are information needs for the reservoir.

RIN 7.2.1 Do the hydrodynamics and stratification of Lake Powell influence the food base or fisheries downstream?

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?

M.O. 7.3 Maintain flow dynamics associated with power plant operations, BHBF and habitat maintenance flows.

IN 7.3.1 Measure release from the dam under the conditions. How often should you do these flows? When should you do these flows?

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

M.O. 8.1 Maintain or attain fine sediment abundance, grain-size, distribution in the main channel below 5,000 cfs

Core Monitoring INs

CMIN 8.1.1 What are the *biennial* sand-bar area *fine-sediment*, volume and grain-size changes below 58,000 cfs stage, by reach?

CMIN 8.1.2 What are the *monthly* sand *and silt/clay* -export volumes and grain-size characteristics, by reach, as measured at Lees Ferry, Lower Marble Canyon, Grand Canyon and Diamond Creek Stations?

CMIN 8.1.3 What are the *monthly* sand *and silt/clay* -input volumes and grain-size characteristics, by reach, as measured at the Paria and Little Colorado River Stations?

CMIN 8.1.4 What are the *monthly* silt/clay -export volumes and grain-size characteristics, by reach, as measured at Grand Canyon and Diamond Creek Stations?

CMIN 8.1.5 What are the *monthly* silt/clay -input volumes and grain-size characteristics, by reach, as measured at the Paria and Little Colorado River Stations?

CMIN 8.1.6 What are the *monthly* sand and silt/clay-input volumes and grain-size characteristics, by reach, as estimated and measured from "Lesser" Tributaries?

CMIN 8.1.4 What are the *monthly* sand and silt/clay-input volumes and grain-size characteristics, by reach, as estimated and measured from other major tributaries, such as Kanab and Havasu Creeks?

~~**CMIN 8.1.8** What are "*event-driven*" sand export volumes and grain-size characteristics from the Glen Canyon reach, as measured periodically at the Lees Ferry gage?~~

Research INs

RIN 8.1.1 What is the ~~historical and ongoing~~ longitudinal variability of fine-sediment inputs, *by reach*?

RIN 8.1.2 What is the spatial/temporal fate of individual fine-sediment inputs under ROD operations, *by reach*?

~~**RIN 8.1.3** What is the historical and ongoing temporal variability of fine-sediment inputs, by reach?~~

M.O. 8.2 Maintain or attain fine sediment abundance, grain-size, distribution channel margins (not eddies) from 8,000 5,000 to 25,000 cfs

Core Monitoring IN

CMIN 8.2.1 What are the *biennial* sand-bar area, volume and grain-size changes *outside of eddies* between 8,000 5,000 and 25,000 cfs stage, by reach?

M.O. 8.3 Maintain or attain fine sediment abundance, grain-size, distribution, eddies below 25,000 cfs

Core Monitoring INs

~~**CMIN 8.3.1** What ~~are is~~ the *biennial* sand-bar area, volume and grain-size changes *within eddies* below 25,000 cfs stage, by reach?~~

M.O. 8.4 Maintain or attain fine sediment abundance, grain-size, distribution within eddies between 5,000 to 25,000 cfs

Core Monitoring IN

CMIN 8.4.1 What are the *annual* sand-bar area, volume and grain-size changes *within eddies* between 5,000 and 25,000 cfs stage, by reach?

M.O. 8.5 Maintain or attain fine sediment abundance, grain-size, distribution, shorelines between 25,000 cfs and uppermost effects of maximum dam release

Core Monitoring INs

CMIN 8.5.1 What are the *biennial* sand-bar area, volume and grain-size changes above 25,000 cfs stage, by reach?

Research INs

RIN 8.5.1 What elements of ROD-*dam* operations (*ROD, load following, HMF, BHBF, etc*) are most/least critical to conserving new fine-sediment inputs, and stabilizing ~~terrestrial sand bars~~ sediment deposits above the 25,000 cfs stage?

~~**RIN 8.5.2** What is the historical and ongoing temporal variability of fine-sediment inputs, by reach? (*moved to M.O. 8.1*)~~

RIN 8.5.2 What is the reach-scale variability of fine-sediment storage throughout the main channel?

RIN 8.5.3 What is the maximum fine-sediment storage potential, per reach, under current ROD operations?

RIN 8.5.4 What is the pre- and post-dam range of grain-size in fine-sediment deposits, by reach?

RIN 8.5.5 What is the significance of aeolian processes in terrestrial sand-bar reworking, ~~and sand delivery to the river?~~

RIN 8.5.6 How do ROD operations affect sand-bar grain-sizes and fine-sediment distribution?

Proposed New RIN 8.5.7

What are the historic and ongoing longitudinal trends of fine-sediment storage, above 25,000 cfs?

Effects Monitoring INs

EIN 8.5.1 What relationships exist between the timing, frequency and magnitude of fine-sediment inputs, Record-of-Decision operations and the timing, frequency and magnitude of Beach/Habitat-Building Flows and Habitat-Maintenance Flows?

Supporting INs

[Goal 8 INs that support Goals 1-6]

SIN 8.5.1 Do sand-bar textures influence biological processes, if so, then how?

SIN 8.5.2 What is the relationship between the fine-sediment budget and turbidity?

SIN 8.5.3 What is the relationship between turbidity and biological processes?

SIN 8.5.4 Can turbidity be managed to achieve biological objectives?

SIN 8.5.5 Can the ongoing fine-sediment supply be managed to achieve sustainable habitats?

SIN 8.5.6 What are the grain-size characteristics of sand bars associated with designated riparian vegetation zones?

~~SIN 8.5.7 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 catch per unit effort values that are scaled relative to the proportion of different habitat types available in Glen Canyon? [NOTE: Move to Goal 12.]~~

SIN 8.5.8 What is the minimum quantity and quality of spawning substrate necessary for maintaining an existing naturally spawned rainbow trout fishery?

SIN 8.5.9 What are the limiting factors that regulate substrate availability and its distribution?

SIN 8.5.10 What is the total area of different aquatic habitat types (cobble, gravel, sand, talus, etc.) in the Colorado River ecosystem?

[Goal 8 INs that support Goal 11]

SIN 8.5.11 Are sand-bar textures related to cultural site stability, if so, then how?

[Goal 8 INs that support Goal 9]

SIN 8.5.12 Are sand-bar textures related to recreational site stability, if so, then how?

Proposed New M.O. (for coarse sediment (greater than 2 mm))

M.O. 8.6 Maintain or attain coarse sediment abundance, grain-size and distribution throughout the Colorado River Ecosystem needed to achieve other resource goals

CMIN 8.6.1 Do ongoing inputs of coarse-sediment from tributaries influence storage of fine sediment within pools, runs and eddies throughout the Colorado River ecosystem?

CMIN 8.6.2 Do ongoing inputs of coarse-sediment from tributaries alter the distribution of main channel habitats needed by benthic organisms within pools, runs and eddies throughout the Colorado River ecosystem?

CMIN 8.6.3 Do ongoing inputs of coarse-sediment from tributaries diminish navigability of rapid throughout the Colorado River ecosystem?

GOAL 9: Maintain or improve the quality of recreational experiences for users of the Colorado River ecosystem, within the framework of GCDAMP ecosystem goals.

M.O. 9.1: Maintain visitor physical access and physical safety (other than whitewater boating) in the mainstem to minimize river-related injuries and deaths within the capacity of the Colorado River Ecosystem to absorb visitor impacts consistent with the GLCA and CRCA Management Plans. [Whitewater boating is addressed in M.O. 9.4]

Core Monitoring INs

CMIN 9.1.1: What is the current level/baseline for river user access to the river?

CMIN 9.1.2: What is the current accident rate for visitors participating in river related activities?

CMIN 9.1.3: What are the causes of these accidents?

CMIN 9.1.4: How do these rates compare with other NPS areas?

CMIN 9.1.5: What are possible strategies to reduce river-related injuries and deaths?

M.O.9.2: Maintain or improve the quality and quantity of recreational opportunities in Glen and Grand Canyons within the capacity of the Colorado River Ecosystem to absorb visitor impacts consistent with the GLCA and CRCA Management Plans.

Core Monitoring INs

CMIN 9.2.1: What are the river related recreational opportunities in each of the Canyons?

CMIN 9.2.2: What is the frequency and scheduling of river related use patterns?

CMIN 9.2.3: What are the visitor capacities for these activities consistent with NPS management plans?

CMIN 9.2.4: What is the level of satisfaction for river related opportunities?

CMIN 9.2.5: What are the causes of satisfaction/dissatisfaction of user experiences?

CMIN 9.2.6: What are the attributes of the recreation experience that define the quality of the experience?

M.O. 9.3: Increase the size, quality and distribution of camping beaches in critical and non-critical reaches in the mainstem within the capacity of the Colorado River Ecosystem to absorb visitor impacts consistent with the GLCA and CRCA Management Plans.

Core Monitoring INs

CMIN 9.3.1: What is the distribution of camping beaches by size and stage level in Glen and Grand Canyons?

~~CMIN 9.3.2: What is the distribution of camping beaches by size based on flow levels? Combined with CMIN 9.3.1~~

CMIN 9.3.2: What is the quality of the camping beaches (where "quality" is defined on the basis of physical and other characteristics)?

~~CMIN 9.3.3: How is quality defined and how is quality affected by flow regimes? (The quality component to be included in the above CMIN)~~

CMIN 9.3.3: What is the desired target level of camping beaches (i.e., increase beaches to a certain percentage), by reach?

~~M.O. 9.4: Improve navigability and whitewater boating safety in rapids in the mainstem across a range of flows allowed within the ROD to minimize river-related injuries and deaths.~~

Core Monitoring INs

CMIN 9.4.1: What are the incident data at rapids at flow levels?

CMIN 9.4.2: Is there a relationship between equipment type, operator experience, flow level, and accident/incident rate at a range of flows?
[NOTE: Move INs under MO 9.2]

M.O. 9.5: Maintain or enhance the wilderness experience in the Grand Canyon, while considering the GRCA Management Plan. ~~for parameters for primitive~~

character, unconfined experience, undeveloped natural and wild character, opportunities for solitude, sounds of nature and scenic beauty while considering the GRCA Management Plans that are in progress.

Core Monitoring IN's

CMIN 9.5.1: What are the elements of wilderness experience and how are these measured? [NOTE: Change to RIN 9.5.1]

~~CMIN 9.5.2: Can these elements be prioritized?~~

~~CMIN 9.5.2:~~ Are we meeting the goals of the GRCA management plans relative to providing the desired wilderness experience?

CMIN 9.5.3: What effect do dam ROD operations have on these elements?

CMIN 9.5.4: What effect do other AMP operations/activities have on elements of the wilderness experience?

Effects IN's

~~EIN 9.5.4: What effect do dam operations have on these elements?~~
[NOTE: Move the above EIN under M.O. 9.5, as a CMIN, and delete the other EIN entirely]

~~EIN 9.5.1: What elements are not affected by dam operations?~~

Goal 10: Maintain power production capacity and energy generation, and increase where feasible and advisable, within the framework of GCDAMP ecosystem goals.

M.O. 10.1 Maintain or increase power with respect to marketable capacity and energy at Glen Canyon Dam

CMIN 10.1.1 What is the effect of the ROD on marketable power?

Research IN's

RIN 10.1.1. What is are the impact effects on downstream resource of increasing or decreasing the daily fluctuation limit?

RIN 10.1.2. What is are the impact effects on downstream resource of increasing or decreasing the upramp and downramp limit?

RIN 10.1.3. What is are the impact effects on downstream resource of raising or lowering the maximum flow limit ~~about~~ **above** 25,000 cfs?

RIN 10.1.4 What is are the impact effects on downstream resource of raising or lowering the minimum flow limit below 5,000 cfs?

RIN 10.1.5 *What are the effects of power-marketing contract provisions on Glen Canyon Dam releases?*

M.O. 10.2 Maintain power within the existing emergency criteria for WAPA Western Area Power Administration systems.

Core Monitoring IN's

CMIN 10.2.1 What are the effects of reserve group obligations?

M.O. 10.3 Maintain power within the existing emergency criteria for WSCC western interconnected electrical system.

Core Monitoring IN's

CMIN 10.3.1 *What are the full range of effects of Glen Canyon Dam responses to western interconnected electrical system emergencies?*

Research IN's

RIN 10.3.1 *What are the effects of providing financial exception criteria?*

M.O. 10.4: Maintain power regulation at GCD-Glen Canyon Dam.

Core Monitoring IN's

CMIN 10.4.1 *What are the effects of current parameters for Automatic Generation Control?*

Research IN's

RIN 10.4.1 What is are the impact effects on downstream resource of increasing or decreasing AGC Automatic Generation Control?

Goal 11: Preserve, protect, manage and treat cultural resources for the inspiration and benefit of past, present and future generations.

[NOTE: Move to Goal 12, M.O. 12.2.]

IN 11.1 What is are the most appropriate data structure and parameters for inventorying cultural resources strategies to integrate and analyze cultural resource data?

IN 11.2 What is are the appropriate resolution of RS data needed to map and monitor cultural resources and the processes that adversely affect them technologies to inventory, map and monitor cultural resources and the processes that affect them?

M.O. 11.1 Preserve the National Register integrity of register-eligible properties in the area of potential effect via protection, management, and/or treatment (e.g., data recovery) for the purpose of federal agency compliance with NHPA, and AMP and AMWG compliance with GCPA.

Core Monitoring INs

CMIN11.1 What is the current number of National Register (NR) eligible properties within the APE?

11.1A For each tribe, what is the current inventory of Traditional Cultural Properties (TCPs); what is their significance (i.e., their contributing elements) and their NR eligibility status?

CMIN 11.1.2 What are the associative values of sites or contributing elements under the criteria?

11.1.2A What is the information potential of sites under criterion D?

11.1.2B What are the potential threats to sites relative to integrity and significance?

CMIN 11.1.4 What are the sources of impacts to National Register eligible sites that link loss of integrity to ~~dam~~ ROD operations?

CMIN 11.1.5 What are the thresholds for impacts that threaten their integrity?

11.1.5A Are the current monitoring programs collecting the necessary information to assess resource integrity?

Research INs

RIN 11.1.3 What and where are the geomorphic processes that link loss of integrity with dam operations as opposed to dam existence or natural processes?

11.1.3a What are the terrace formation processes and how do dam operations affect current terrace formations processes?

11.1.3b Where can we identify effects of dam operations?

RIN 11.1.6 What are appropriate strategies to preserve resource integrity?

CMIN 11.1.6a How effective are the treatment methods for mitigation of adverse effects to cultural resources?

M.O. 11.2 Preserve resource integrity and cultural values of traditionally important resources within the Colorado River Ecosystem.

Core Monitoring INs

CMIN 11.2.1 What are the traditionally important resources and locations for each tribe and other groups?

CMIN 11.2.2 What are the cultural attributes or criteria to measure resource integrity and cultural value for resources?

CMIN 11.2.3 What is the baseline measure for resource integrity? What are acceptable methods to preserve these resources?

CMIN 11.2.4 What are acceptable methods to preserve these resources? Is there a baseline measure for resource integrity and value?

CMIN 11.2.5 If so, has there been a change in resource integrity and value?

CMIN 11.2.6 What are the sources of resource change?

M.O.11.3 Protect and maintain physical access to traditional cultural resources through meaningful consultation on AMP activities that might restrict or block physical access by Native American religious and traditional practitioners.

Effects INs

EIN 11.3.1 Do AMP actions restrict access?

EIN 11.3.2 What are the range of activities that may potentially restrict tribal access?

EIN 11.3.3 Are there reasonable management actions that can or should be taken that are reasonable given the laws and policies to facilitate tribal access?

Goal 12: Maintain a high-quality monitoring, research, and adaptive management program.

IN 12.1 What contracting methods exist for more dependably assessing remote sensing contractors for their ability to do work in the Grand Canyon?

IN 12.2 What is the most effective way to distribute information to our stakeholders and the public in a secure and accessible fashion?

M.O. 12. 1 Maintain or attain socio-economic data about tribal and spiritual values for adequate decision-making.

Core Monitoring INs:

CMIN 12.1.1 What is the necessary quantity and quality of cultural information for adequate decision-making?

M.O. 12.2: Attain or improve monitoring and research programs to achieve the appropriate scale and sampling design needed to support science-based adaptive management recommendations.

[NOTE: Moved from Goal 1.]

RIN 1.3 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 foodbase?

RIN 1.4 What RS technologies are available to less intrusively and more cost effectively monitor the aquatic food base?

RIN 1.5 Is development of a bathymetric map of the entire CRE including characterization of the types of substrate available to support the aquatic food base needed?

RIN 1.6 What digital technologies exist and should be used to record field observations of food base data that facilitates integration into GCMRC databases and use by PI's and stakeholders?

RIN 1.7 What technologies exist to spatially reference food base data so that it can be readily integrated with other GCMRC data?

[NOTE: Moved from Goal 2.]

IN 2.1 What RS technologies are available to monitor fish within the CRE?

IN 2.2 What RS technologies are available to characterize and map water and substrate parameters important to fish habitat?

IN 2.3 Is development of a bathymetric map of the entire CRE including characterization of the types of substrate available that provide fish habitat needed?

IN 2.4 What digital technologies exist and should be used to record field observations of fish data that facilitates integration into GCMRC databases and use by PI's and stakeholders?

IN 2.5 What technologies exist to spatially reference fish data so that it can be readily integrated with other GCMRC data?

[NOTE: Moved from Goal 5.]

IN 5.4 What RS technologies are available to less intrusively and more cost effectively characterize and monitor KAS habitat (vegetation type and distribution)?

[NOTE: Moved from Goal 6.]

IN 6.2 What data sets currently exist to determine historic biotic riparian and spring communities?

IN 6.3 What remote sensing data is available or can be obtained that will support the production of a system-wide vegetation map?

[NOTE: Moved from Goal 6, M.O. 6.1.]

RIN 6.1.3 What is the acceptable detection level for change?

[NOTE: Moved from Goal 7.]

IN 7.1 What remote sensing technologies are available to less intrusively and more cost effectively monitor certain water quality parameters in the CRE?

[NOTE: Moved from Goal 8, M.O 8.5.]

SIN 8.5.7 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 catch-per-unit-effort values that are scaled relative to the proportion of different habitat types available in Glen Canyon?

[NOTE: Moved from Goal 11.]

IN 11.1 ~~What is~~ are the most appropriate data structure and parameters for inventorying cultural resources strategies to integrate and analyze cultural resource data?

IN 11.2 ~~What is~~ are the appropriate resolution of RS data needed to map and monitor cultural resources and the processes that adversely affect them technologies to inventory, map and monitor cultural resources and the processes that affect them?

M.O. 12.3: Attain or maintain an integrated and synthesized "ecosystem-science"-based adaptive management program.

M.O. 12.3a Maintain or attain the participation of externally funded investigators

M.O. 12.4: Foster effective two-way communication between scientists, external reviewers, managers, decision-makers and the public.

M.O. 12.4a Build AMP public support through effective public outreach

M.O. 12.4b Attain and maintain effective consultation and communication with other resource management programs in the Colorado River basin to ensure inclusion of their values and perspectives into the AMP and vice versa.

And/or

Attain and maintain effective communication and coordination with other environmental and recovery programs outside the AMP

M.O. 12.5: Attain and maintain an effective adaptive management program, composed of informed stakeholders.

M.O. 12.5a Maintain or attain funding from multiple sources

M.O. 12.6 Attain and maintain effective tribal consultation to ensure inclusion of tribal values and perspectives into the AMP.

Core Monitoring INs:

CMIN 12.56.1 What are the current strategies to achieve tribal consultation?

CMIN 12.56.2 Do these strategies meet legal and AMP protocols?

M.O. 12.7 Attain and maintain tribal participation in the AMP research and long-term monitoring activities.

M.O. 12.8 Conduct experimental flows and other management actions for flow dynamics in the mainstem to gain critical understanding of ecosystem function under different dam operations, e.g., BHBF's, HMF's, biological opinion flows, and financial exception criteria flows.

Research INs:

RIN 12.7.1 What is the impact on downstream resources of short-term increases to maximum flow, daily fluctuations and downramp limits?

GCDAMP Information-Needs Development Workshop II

August 8 – 9th, 2001
Grand Canyon Monitoring and Research Center
2255 N. Gemini Drive - Bldg. #3 Conference Room
Flagstaff, AZ 86001

FINAL

Day 1 – Wednesday, August 8, 2001

- 8:00 – 9:00 a.m.** -Introductions and Housekeeping
 -Workshop Goals
- 1) Do the INs for a given MO provide the information that is needed to address that MO? If not, please indicate how they should be revised and what should be added or deleted.
 - 2) Are the INs written at the appropriate level of detail and correctly categorized with respect to the categories of "core monitoring", "effects monitoring", and "research"?
 - 3) Taken together as a set do the INs and MOs represent the information needed to address a given goal?
- 9:00 – 10:00 a.m.** -Review IN comments and input from Science Advisors
- 10:00 – 10:15 a.m.** **BREAK**
- 10:15 - Noon** -Concurrent Breakout sessions – Session I. **The charge is to discuss the need to revise, add, or delete IN's.**
Group A – Goals 1-4 & 7
Group B – Goals 5-6
Group C – Goals 8-10, MO 12.3 & MO 12.9,
Group D – Goal 11, MO 12.2, MO 12.5, & MO 12.6
[Note: Remainder of Goal 12 MOs to be addressed in writing or by any Group that completes its assigned tasks.]
- [Noon-1:30 p.m.]** **LUNCH ON YOUR OWN**
- 1:30-3:30 p.m.** -Concurrent Breakout sessions for individual goals –
Session II – The charge is to continue your review of the need to revise, add, or delete INs. In addition, you should now begin discussing the appropriate sequence to the INs based on a scientific perspective of what information one needs to have first.

Day 1 – Wednesday, August 8, 2001 continued

- 3:30 – 3:45 p.m.** **BREAK**
- 3:45 - 5:00 p.m.** -Continue working in concurrent Breakout Groups.
Prepare red-line and strikeout version of the Draft INs for presentation on Day 2.

Day 2 – Thursday, August 9, 2001

- 8:00 - 10:00 a.m.** -Rapporteur for each Breakout Group reports on their work to the Group as a whole. Each group will present their proposed revisions to the INs, including their rationale for the proposed changes. Where workshop participants concur with the proposed changes they will be accepted as part of the revised draft to be produced following this workshop. Where workshop participants do not concur, “comments” will be captured on flip charts that need to be addressed during TWG review.
- 10:00 – 10:15 a.m.** **BREAK**
- 10:15 - Noon** -Continue Breakout Group Presentations.
- Noon - 1:00 p.m.** **LUNCH - Order Out at the GCMRC**
- 1:00 - 3:00 p.m.** -Continue Breakout Groups Presentations.
- 3:00 – 3:15 p.m.** **BREAK**
- 3:15 - 4:30 p.m.** -Discuss Next Steps for completing the INs
- 4:30 – 4:45 p.m.** Wrap-up and Adjourn

**Information Needs Workshop II
August 8 & 9, 2001**

Participants List

Paul Barrett - FWS
Emma Benenati - NAU
Kerry Christensen - Hualapai
Lew Coggins - FWS
Dave Cohen - TU
Wayne Cook - NM
Nancy Coulam - BOR
Jonathan Damp - Zuni
Bill Davis - CREDA
Kurt Dongoske - Hopi
Christopher Flaccus - GCMRC
Dave Garrett - M3 Research
Barry Gold - GCMRC
Lloyd Greiner - UAMPS
Amy Heuslein - BIA
Loretta Jackson - Hualapai
Linda Jalbert - NPS
Rick Johnson - SW Rivers
Matt Kaplinski - GCRG
Dennis Kubly - BOR
Ruth Lambert - GCMRC
Lisa Leap - NPS
Michael Liszewski - GCMRC
Ted Melis - GCMRC
Don Metz - FWS
Steve Mietz - GCMRC
Sharon Mingus - GCMRC
Clayton Palmer - WAPA
Bill Persons - AGFD
Randy Peterson - BOR
Barbara Ralston - GCMRC
Joseph Shannon - NAU
Dennis Stone - FWS
David Topping - USGS
Robert Winfree - NPS
Michael Yeatts - Hopi

**Information Needs Workshop II
August 8-9, 2001**

Concurrent Breakout Groups

Group A Goals 1-4 & 7	Group B Goals 5 & 6	Group C Goals 8-10, MOs 12.3 & .7	Group D Goal 11 MOs 12.2, .5, & .6
Facilitator: Bill Persons	Facilitator: Bob Winfree	Facilitator: Matt Kaplinski	Facilitator: Amy Heuslein / Kurt Dongoske
Rapporteur: Dennis Kubly	Rapporteur: Barbara Ralston	Rapporteur: Randy Peterson	Rapporteur: Lisa Leap
Paul Barrett	Kerry Christensen	Wayne Cook	Jonathan Damp
Emma Benenati	Rick Johnson	Nancy Coulam	Loretta Jackson
Lew Coggins		Lloyd Greiner	Ruth Lambert
Dave Cohen		Linda Jalbert	Michael Liszewski
Bill Davis		Ted Melis	Sharon Mingus
Don Metz		Steve Mietz	
Joseph Shannon		Clayton Palmer	
Dennis Stone		David Topping	
		Michael Yeatts	

GOAL 9: Maintain or improve the quality of recreational experiences for users of the Colorado River ecosystem, within the framework of GCDAMP ecosystem goals.

MO 9.21: Maintain or improve the quality and ~~quantity~~ range of opportunities in Glen and Grand Canyons within the capacity of the Colorado River ecosystem to absorb visitor impacts consistent with the ~~GLCA and GRCA~~ NPS Management Plans.

CMIN 9.1.1 What are the river-related recreational opportunities and current use levels in each of the Canyons?

CMIN 9.1.2: What are the frequency and scheduling of river-related use patterns?

CMIN 9.1.3: What are the visitor capacities for these activities consistent with NPS management plans?

CMIN 9.1.4: What is the level of satisfaction for river-related opportunities in each Canyon?

CMIN 9.1.5: What ~~are the causes~~ attributes contribute to satisfaction/dissatisfaction of ~~user~~ visitor experiences?

RMIN 9.1 What are the attributes of a quality river experience? (*How do you define a quality river experience?*)

NOTE: The Science Advisors suggested combining 9.1 and 9.4 – the review group suggested putting safety under MO 9.1 – here’s an attempt to combine the safety aspects using language similar to MO above...

MO 9.2: Maintain or improve the quality and range of opportunities in Glen and Grand Canyons in consideration of visitor safety, and the inherent risk of river-related recreational activities.

CMIN 9.2.1: (*previously 9.1.2*) What is the current accident rate for visitors participating in river-related activities in each Canyon?

CMIN 9.2.2: (*previously 9.1.3*) What are the causes and location (i.e. on-river or off-river) of these accidents?

CMIN 9.2.3: (*previously 9.1.4*) How do these rates compare with other similar NPS areas and comparable federally managed rivers?

CMIN 9.2.3: (*previously 9.4.1*) What are the accident/incident data at rapids at various flow levels?

CMIN 9.2.4 (*previously 9.4.2*) ~~Is there a~~ What is the relationship between equipment type, operator experience, ~~flow level~~, and accident/incident rate at various flow levels? ~~range of flows?~~

NOTE: suggest deleting old 9.1.5: possible strategies for reducing accidents is not an IN

M.O. 9.3: Increase the size, quality and distribution of camping beaches in critical and non-critical reaches in the mainstem within the capacity of the Colorado River Ecosystem to absorb visitor impacts consistent with GLCA and GRCA Management Plans.

CMIN 9.3.1: What is the distribution of camping beaches by size and stage level in Glen and Grand Canyons?

CMIN 9.3.2: What is the quality of the camping beaches at various stage levels (where quality is defined on the basis of physical and other characteristics)?

CMIN 9.3.3: What is the desired target level of camping beaches by reach? (*this IN doesn't seem to fit the definition*)

RMIN 9.3.1: How do ROD operations, BHBF, BMF and other experimental flows effect the size, quality, and distribution of camping beaches in the Colorado River ecosystem?

M.O. 9.4: Maintain or enhance the wilderness experience in Grand Canyon National Park in consideration of NPS management plans.

CMIN 9.4.1 (*previously 9.5.1*) What are the elements of wilderness experience and how are these measured?

CMIN 9.4.2 (*previously 9.5.1*) What effects do dam operations have on these elements?

NOTE: *suggest deleting old 9.5.3 since target goals of GRCA plans are the elements to be monitored as described in 9.4.1 above, and delete old 9.5.2 since prioritizing is not an IN*

M.O. 9.5 Enhance visitor experiences as a result of GCDAMP research and monitoring activities.

CMIN 9.5.1: What is the frequency and scheduling of research and monitoring activity in Glen and Grand Canyons?

CMIN 9.5.2: What is the current level of information, education, and outreach provided for Glen and Grand Canyon river users and the general public?

CMIN 9.5.3: What effects do administrative trips, including research and monitoring activities have on recreational users?

RMIN: To what extent does the public understand and support the GCDAMP?