AQUATIC FOODBASE

Joe Shannon's presentation –

They are seeing phytobenthos changes since 1995 when the reservoir "freshened."

- No *cladophora* left below Lees Ferry. Brings into question *cladophora* s the keystone taxa.

- Snail numbers are skyrocketing. There is a question whether fish are able to digest/derive nutrients from them ("trophic dead-end").

- Western Grand Canyon – saw reduced biomass in summer 2000. Responding to thermal changes? Sediment? Nutrients? We don't know.

- Since interim flows, silt/clay increasing, cobble bar area is reduced.

- Lack of information from Lake Powell – this is vital information for aquatic foodbase.

When looking at targets:

1. Variance is more important than mean.
2. Cobble bars are the key areas.
3. Should be based on energy instead of density/abundance.
4. Use categories (i.e., MAMB, macroinvertebrates)
5. Use confidence intervals (range)
6. Recognize biological response time (2 consecutive collecting trips)

Developed targets using multiple analysis of variance (MANOVA).
Came up with range –
> High targets based on years of positive fish production/growth (1996-7)
> Low targets based on 1991 – year of low production/growth

To be measured on cobble bars, at a suite of sites (separate target range for each site).

Discussion of sites revealed that AGFD sites above the Paria indicate higher numbers than Shannon et. al. sites (different philosophy underlies sampling – trout vs. longitudinal transect).

Given variation from site to site, do we
- Use a point value? (indicator approach) What about vulnerability of site over time?
- Randomly sample sites to estimate values over a reach?
- Use an indicator site backed by information from multiple sites?

Shannon had suggestions regarding the draft Management Objectives (MOs):

- Don't break out composition in targets. Look at composition only when a problem is indicated.
- Combine algae and perophyton with aquatic macrophytes to create a single category, "CMAMB" (representing carbon, or biomass). (This was discussed; B. Persons leaned toward keeping them separate for Lees Ferry reach, D. Speas indicated that perhaps there was a research question regarding whether they had different carrying capacities.)

M. Yard brought up the subject of variation within a site as a function of depth. Question about whether we have enough information to capture that in a number. Recognition that sampling is not spatially explicit, which results in a spatial bias.

We looked at MO 1, and asked first of all, is the metric right? There was some discussion regarding the element, which may be different above and below Lees Ferry. A proposal was made to make the **Element** = Algae/perophyton/macrophytes, the **Attribute** = biomass, and the **Place** = above the Paria on (1) cobble bars and (2) in pools (separate them out).

Sticking with the **Place** description, we decided to recharacterize the **Element** as "Primary producers (algae on hard substrate and rooted macrophyte on soft substrate)".

For the attribute "biomass", we decided to forward current and target levels based on two sites, the Shannon et. al. site and the AGFD site. Current level for the Shannon site, based on 1999 data, is 17.5 g/m^2. Target level, which is an average of all data from 1996 and 1997, is a range, 19.25 – 30.75 g/m^2. AGFD will provide current (1999) and target (1996 and 1997) data for their site. Both will be forwarded and considered together.

For the attribute "composition", we decided both metric and current/target levels were information needs. It was noted that Shannon has data for 1996 and 1997 on a coarse level – *cladophora, oscillatoria,* MAMB.

We decided to leave out the attribute of "production". It is difficult and expensive to monitor. It was noted that there might be a research component that addressed this attribute.

We decided that "distribution" (area) was a relevant attribute, and decided to include it with levels indicated as information needs.

We then broke out a second element, "Benthic Invertebrates" for the place "Glen Canyon Dam to the Paria". For the attribute "biomass" we used the same metric (g/m^2 at two sites. Current/target levels need to be crunched from Shannon and AGFD numbers. "Composition" was included as an attribute; current levels will be determined from 1999 data, and target is an information need. The suggestion was to break out composition by taxa, i.e. *gammarus*, gastropods, chironomids, tubificids, other OR to the finest level of common detail (comparing Shannon/AGFD data). No "production" attribute – this

would either have to be a research question, or it should only be monitored prior to an experimental flow.

Moving to below the Paria – we again decided to divide the element into "primary producers" (lumping algae and macrophytes) and "benthic invertebrates". For primary producers, the attribute "biomass" would be measured by sampling sites currently monitored by NAU, set up to bracket reaches. It would only be measured on cobble bars at the sites (value of the pools is unknown). The attribute "composition" would be handled with the same method as above the Paria, i.e. current = 1999 data, target is an information need.

For benthic invertebrates, they would be measured on both cobble bars and pools at longitudinal sites (NAU sites?), biomass measured in g/m^2, categories for composition suggested to be *gammarus*, gastropods, chironomids, tubificids, other, and current levels would be derived from 1999 data, target levels derived from 1996 and 1997 data.

There was discussion about including backwaters (area and abundance) as part of the foodbase analysis. It was decided that it would fit better under fish.

We then discussed drift, with the need for a longitudinal component. We decided to report drift the same way as other information – longitudinally at a series of sites. Current levels derived from 1999 data, target levels derived from 1996 and 1997 data. Data is available for current levels, although it does not include DOC, just FPOM and CPOM. Discussion revealed that collection methods are different for NAU and AGFD. NAU measures *gammarus*, *diptera*, other bugs (= Mass); *cladophora*, MAMB, detritus (= CPOM); and FPOM. Recommend we include DOC.

We discussed whether there was a need for a MO for foodbase in the LCR. Is it food limited? Is it within our ability to affect through dam operations? Not being able to get past these questions, we put the issue in the BIN.

TROUT

D. Speas presented some information/analysis. He questioned the target level of 100,000 Age II+ fish under the abundance attribute – thought perhaps it should be 100,000+. He also said that the growth rate target of 18" by age III might not be achievable at an abundance target of 100,000, which begs the question, which is more important? Discussion raised questions including, can we deal with this by using ranges? What about keying into angler satisfaction (they are now less concerned with size…)?

AGFD mentioned that abundance is not measured on an annual basis. There was a question as to whether we could substitute CPUE (electrofishing) and angler catch/hr for an actual abundance measurement?

When the abundance numbers that were in the table were questioned, the 100,000 level was identified as being the abundance level in 1990, and the 262,000 current level was identified as the 1998 level. Although abundance is not measured annually, length and condition data are collected annually.

The following question was raised: what is the potential for exporting trout downstream of Lees Ferry based on abundance upstream? This generated discussion on "leakage" of trout from the Lees Ferry reach to places downstream. Not all trout are coming from the Lees Ferry reach – there is spawning and recruitment taking place downstream (aided by ROD flows??) The issue of "leakage" was identified as an information need – we need to find out how much of the trout populations downstream of the Paria is coming from local spawning and recruitment, and how much is being contributed from the Lees Ferry reach. We talked about a new MO that would deal with minimizing "leakage", but decided that we needed to answer the question about whether predation was a problem first.

We then went back to the abundance issue. There was a suggestion to set a floor (100,000) and take a shot at an upper limit (near 1998 levels with an error value, perhaps ±30,000). We struggled with the fact that the relationship between abundance, growth rate, and condition is not well correlated for the purposes of developing targets.

One suggestion was to set targets as follows:
Abundance: 100,000 - 250,000 (using CPUE and angler catch rates as surrogates)
Growth rate: > 15"
Condition: 0.90

We noted that we needed to add an electrofishing CPUE for the trout goal, and an angler CPUE to the recreation goal.

L. Coggins suggested adding Proportional Stock Density (PSD) as an attribute. This gives a way to index "quality" fish in proportion to catchable fish. The following equation was developed:

$$\text{PSD} = \frac{\text{\# of fish} > 16\text{" (406 mm)}}{\text{\# of fish} > 12\text{" (305 mm)}} \quad \text{(AGFD estimate of "quality" fish)}$$

Current level could be derived from 1998 data, but target level would be an information need.

It was agreed that PSD should be used. Using it will largely defined target population size and growth rate (growth rate is really a length at age measure).

The group looked at a "health" objective, and decided that the real consideration is whirling disease. The metric should be presence/absence of whirling disease and other parasitic infections. The current level is "absent" and the target level is also "absent".

The group looked at the "spawning" objective, and decided that the issue is really recruitment. They decided to change "spawning" to "spawning habitat", where the quality and abundance of habitat would be measured. They then added "natural recruitment", with a current level = 100% and the target level = 100%.

The group considered adding an objective to deal with diet & food, but determined that the issue was contained in MO 1. They suggested we include language there about the need for developing a bioenergetics model.

We then went back to the issue of "leakage" and decided we should add a MO about minimizing "leakage" of RBT from the Lees Ferry reach. Attribute would be "distribution", Element would be "Lees Ferry RBT below the Paria", current level would be "unknown" and target level would be "minimal" (information need).

We wrapped up the discussion of trout by AGFD noting that they are working on growth parameters for wild-spawn trout.

NATIVE FISH

Humpback chub –

There is not currently agreement between FWS Regions 2 and 6 on draft recovery goals.

Questions regarding PVA and N_e – difficult to say what a viable population there is. Countless tools out there to measure viability. How to resolve approach? Get an expert to look at it – Russell Landy (sp?) suggested. There is no agreement on any single PVA method. There also has been no assessment of extinction risk – need to do that.

To determine PVA, need data on
- Population size
- Population size variance
- Recruitment
- Growth rate
- Mortality
- Colonization
- etc.

Some of these parameters are very difficult to collect.

Relative importance of following factors is debated:
- Genetics
- Demographic stochasticity
- Environmental stochasticity
- Catastrophic events.

Draft recovery goals place genetics at top (others might be inclined to place higher priority on catastrophic events).

Some suggestions made:
1. Use Draft recovery goal targets and indicate that these numbers need to be reassessed.
2. Have target be "maintain or increase current levels".

Group felt that the size split was good, and that the LCR/Other split was good. The group identified the 150 mm size split as being based on the ability to PIT tag. Not tied to survivability or adulthood. A footnote was to be added to indicate that the length split related to "taggability" rather than distinct biological considerations.

Young HBC *abundance* might not be as relevant as a *recruitment* measure.

The group noted that the current level for >150 mm in the table (8096) seems wrong – probably adding LCR estimates and mainstem estimates, and there is an overlap (not currently teased apart). It was suggested that we cite numbers separately for the LCR and mainstem, footnote the overlap and identify an information need for determining the % overlap in order to come up with a single number.

Discussing the issue further, the group decided to use the Marsh and Douglas numbers for current levels in the LCR (4330 – 4811). The "at some place" would be split into "LCR aggregation" and "8 other aggregations in the mainstem". Current levels would reflect LCR numbers from Marsh and Douglas, information need to add the mainstem element. There is no agreement on target level, so that needs to be left as an information need.

There was a suggestion to add "size structure" as an attribute to be measured.

Regarding HBC 51 – 150 mm, the group decided to change the "abundance" attribute to "year class strength". The "at some place" would again be split into "LCR" and "8 other aggregations." For current level, the metric is an index based on CPUE for different year classes, which should be reflected on the table as an information need. The target level would be an index that indicated spawning success. There was a suggestion to change the size to < 90 mm.

The group discussed adding a MO on "recruitment". The element would be new HBC $\geq$ length at which 50% of fish are sexually mature (thought to be ~ 200 mm). Target level would be level necessary to sustain viable population.

MO 10 deals with removal of jeopardy. Target – make language consistent with language of the BO.

MO 11 deals with HBC condition and health. Regarding "health", suggested metric is loads of disease and parasites. Both metric and numbers are probably information needs. The group decided to change "health" to "disease and parasites".

Lots of discussion on "condition", and whether to use the methodology and/or numbers from Meretsky et. al. Conclusion was to leave the attribute in, but to have the method be an information need. Also the target level, which might be best expressed as a threshold. The group felt that the upcoming fish PEP should evaluate this. It was noted that condition might be more of a concern in the small size class.

The group agreed to delete the MO on spawning.

MO 13 on reducing non-native predation and competition – the group felt that the metric for the predation attribute should be rate of predation. They suggested we leave current and target levels as information needs (the target level will reflect an upper limit threshold). There was a suggestion to look at ALL mortality factors (beyond just predation from non-natives). Another suggestion was to focus in on % loss of vulnerable size class to predators.

This led to a suggestion to change the element to "native fish", the attribute to "mortality due to fish predation as a % of overall mortality", and to divide the "at some place" into (1) LCR and (2) mainstem. Current and target levels would both be information needs.

The group then decided to take out the "competition" attribute and identify it as a research need.

Razorback sucker –

The issue is removal of jeopardy in Grand Canyon. The group felt we should keep the target level as an information need.

Flannelmouth, Bluehead, Speckled Dace –

The group decided to keep the abundance attribute and add an attribute of distribution. Current levels need work, target levels are information needs. Methods discussed included (1) PIT tag data, (2) stock assessment modeling, (3) CPUE (numbers are in Gorman and Coggins (2000 – in review)).