Humpback chub Targets

These targets were **originally proposed by National Park Service**, and were determined by consensus to be scientifically and technically credible by the Desired Future Conditions AHG.

Short-Term Targets (10 years)

1. The Grand Canyon population is maintained as a core over a 5-year period, starting with the first point estimate acceptable to the Fish and Wildlife Service, such that the trend in adult (age 4+ years) humpback chub estimates does not decline significantly.
2. HBC population estimate is at least 6,500 adult fish, age 4+ years, and a positive trend is maintained from 2008 onwards as determined by ASMR; thus, progress towards the long-term target is being made.
3. Mean estimated recruitment of age-3 years (150–199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality.
4. All aggregations in the mainstem outside the LCR as defined in Valdez and Ryel (1995) have been maintained or restored to 1993 levels, and at least one viable spawning aggregation outside the LCR in the mainstem of at least 500 adult (age 4+ years) fish has been established so that the historic range is partially restored.
5. Develop at least one spawning aggregation in a tributary.
6. Prepare, adopt, and implement an emergency response/contingency plan, e.g., for the two Cameron bridges spanning the LCR, to protect HBC populations from hazardous material spills that could result in catastrophic loss of population.
7. Assess other emerging threats and develop a contingency plan to address them.
8. Implement the other highest priority projects listed within the HBC Comprehensive Plan that are achievable within 10 years.
9. Implement requirements of Biological Opinions, as necessary.

Long-Term Targets (more than 10 years)

1. HBC population estimate is at least 10,000 adult fish, age 4+ years, as determined by ASMR.
2. All threats criteria for this recovery unit have been met or eliminated.
3. The Fish and Wildlife Service has issued a non-jeopardy, non-adverse modification Biological Opinion on the operation of Glen Canyon Dam.
4. HBC population and distribution will meet or exceed short-term targets based on further evaluation of the CRE habitat and carrying capacity of the river and perennial tributaries.
5. A spawning aggregation of at least 1,667 adult (age 4+ years) fish has been established in the mainstem.
6. Spawning aggregations in at least three tributaries have been developed.
7. Implement the remaining projects listed within the HBC Comprehensive Plan.
8. Implement requirements of Biological Opinions, as necessary.

Assumptions and Rationale

a. If there were a lower basin recovery implementation program, and the actions listed in the recovery goals were implemented, it would assist in reaching the long-term targets.
b. Meeting the delisting criteria and issuance of a non-jeopardy opinion will contribute to meeting NPS' and other agencies' management responsibilities.
c. The HBC monitoring program will be maintained and enhanced to support evaluation of progress toward targets.
d. Establishment of in-situ refuges and translocation of HBC, and other actions, will meet NPS management policies regarding restoring historic range.

e. The long-term target of 10,000 fish as determined by ASMR will not include fish in the maintstem spawning aggregations or tributaries other than the LCR.
f. The HBC Comprehensive Plan will be finaiized and implemented, and will include in-situ refuges and translocations, and address hazardous material spills.
g. The 10-year short-term target period will begin in 2008.
h. With regard to Short-Term Target #4, the current population numbers of the mainstem aggregations are unknown. The assumption is that the target is achievable in the timeframe noted. If the target is not achievable in the short-term, it would become a long-term goal.

NOTE: Not everyone agrees with these assumptions.

Sediment Targets

These targets were **originally proposed by National Park Service**, and were determined by consensus to be scientifically and technically credible by the Desired Future Conditions AHG.

Short-Term Targets (10 years)

1. Rebuild and stabilize sandbars, campsites, and backwater habitats to 40-45,000 cfs levels, moving toward 1983-1985 post flood values (abundance, grain size, and distribution including volume and areal extent).
2. Achieve a positive mass balance of fine sediment throughout the CRE.

Assumptions – Short-Term Targets

a. Under low water conditions, dam operations (including BHBFs up to 40-45,000 cfs) can be used to achieve targets.
b. Sediment supplies will be adequate to sustain and enhance shoreline habitats and protect and enhance camping beaches and other deposits.
c. By meeting the target, we will also make sand available for aeolian transport to upper benches to enhance native riparian community function and protect cultural sites.
d. Management actions other than dam operations may be used to reach the targets.

Long-Term Targets (more than 10 years)

1. Conserve sediment throughout the system to enhance near shore habitat and restore riparian function.
   - 'Restore' ecosystem function (elements and values TBD) that recognize specific influences on the ecosystem, such as existence of the dam and non-natives, to the extent possible through conservation of sediment.
   - Protect and maintain OHW zone/terrace deposits and vegetation.
   - Maintain a neutral mass balance in the mainstem after achievement of 1983-85 sediment deposits.
   - CRE cultural resources continue to be protected through sediment Aeolian transport and enhanced native riparian community function.
2. Rebuild and stabilize sandbars, campsites, and backwater habitats to 1983-1985 post flood values (abundance, grain size, and distribution including volume and areal extent) as hydrologic and safety conditions and operational constraints permit (e.g., 60,000-93,000 cfs releases assuming water availability).

Assumptions – Long-Term Targets

a. Assumes higher water volume availability which permits discharges greater than power plant and jet tube capacity.
b. Enough sediment will accumulate in the system to provide sufficient sediment to achieve targets.
c. Despite historical losses of sediment in the system, the dam can be operated to meet the targets.
d. Management actions other than dam operations may be used to reach the targets.

Process

Over the 10-year period beginning in 2008, determine if the short-term assumptions are valid.

NOTE: Not everyone agrees with the assumption that these targets can be met with existing sediment inputs and operational "tools.

National Park Service Desired Future Conditions

Humpback chub and Sediment

Melissa Trammell, Norm Henderson, Ken McMullen

Scientific Rationale for NPS DFC targets

- The Grand Canyon National Park (GCNP) resources staff held three one day workshops to arrive at the DFC's and targets presented to the TWG/Science Plan AHG in 2006. GCNP followed this process to develop the original DFCs:
  - Search NPS Management Policies for direction on resource management, protection, restoration and preventing impairment of park values;
  - Identify legal mandates/requirements and park compliance responsibilities with applicable legislation (e.g. Organic Act, ESA, Clean Air, Clean Water, NHPA; Trust responsibilities, etc.,);
  - Identify and comply with Park Management Plans and applicable management objectives for park and river corridor resources management, and Science and Resources Management Program direction;
  - Staff consulted with or/and utilized previous and current park Resource Management and Cultural Resource Protection plans, funded projects or/and project plans, applicable park activity plans, and research papers to arrive at specific target levels. Also, many of the individual resource projects, and all NEPA directed management plans and projects are required to develop mitigation measures and measurable values that define project or plan "success" levels;
  - These projects and implementation plans have specific methods to be used, measures and values for accomplishment, and funding and time frames for completion.
- Discussed and amended during two AHG workshops and two conference calls
- Reviewed recent research to assess feasibility

NPS Desired Future Conditions Targets for Humpback Chub

Short-Term Targets (10 years)

1. The Grand Canyon population is maintained as a core over a 5-year period, starting with the first point estimate acceptable to the Fish and Wildlife Service, such that the trend in adult (age 4+ years) humpback chub estimates does not decline significantly.
2. HBC population estimate is at least 6,500 adult fish, age 4+ years, and a positive trend is maintained from 2008 onwards as determined by ASMR; thus, progress towards the long-term target is being made.
3. Mean estimated recruitment of age-3 years (150–199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality.
4. All aggregations in the mainstem outside the LCR as defined in Valdez and Ryel (1995) have been maintained or restored to 1993 levels, and at least one viable spawning aggregation outside the LCR in the mainstem of at least 500 adult (age 4+ years) fish has been established so that the historic range is partially restored.
5. Develop at least one spawning aggregation in a tributary.

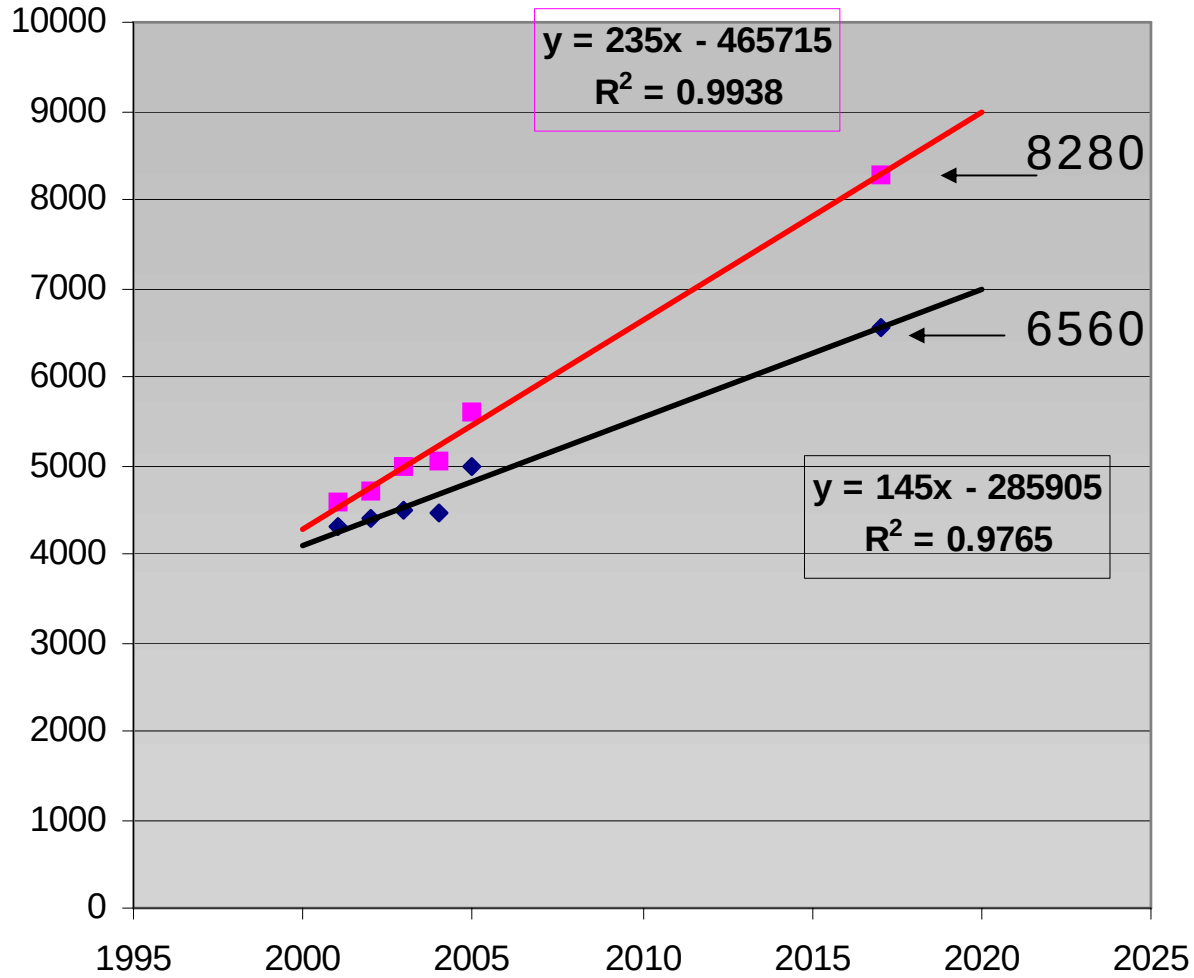
Additional short-term Targets

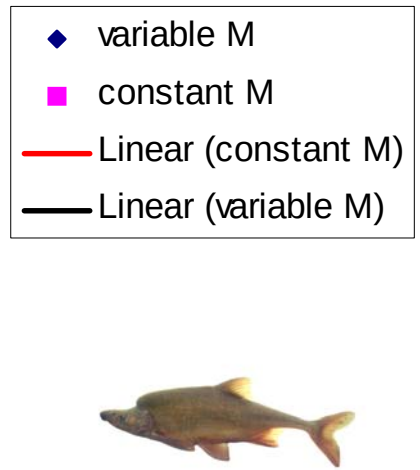
6. Prepare, adopt, and implement an emergency response/contingency plan, e.g., for the two Cameron bridges spanning the LCR, to protect HBC populations from hazardous material spills that could result in catastrophic loss of population.
7. Assess other emerging threats and develop a contingency plan to address them.
8. Implement the other highest priority projects listed within the HBC Comprehensive Plan that are achievable within 10 years.
9. Implement requirements of Biological Opinions, as necessary.

Rationale

- 6,500 short term target
  - Point is not to predict exact number, but to show that a substantial increase is technically feasible

Linear Extrapolation of current trend in HBC adult abundance





Melis et al. 2006

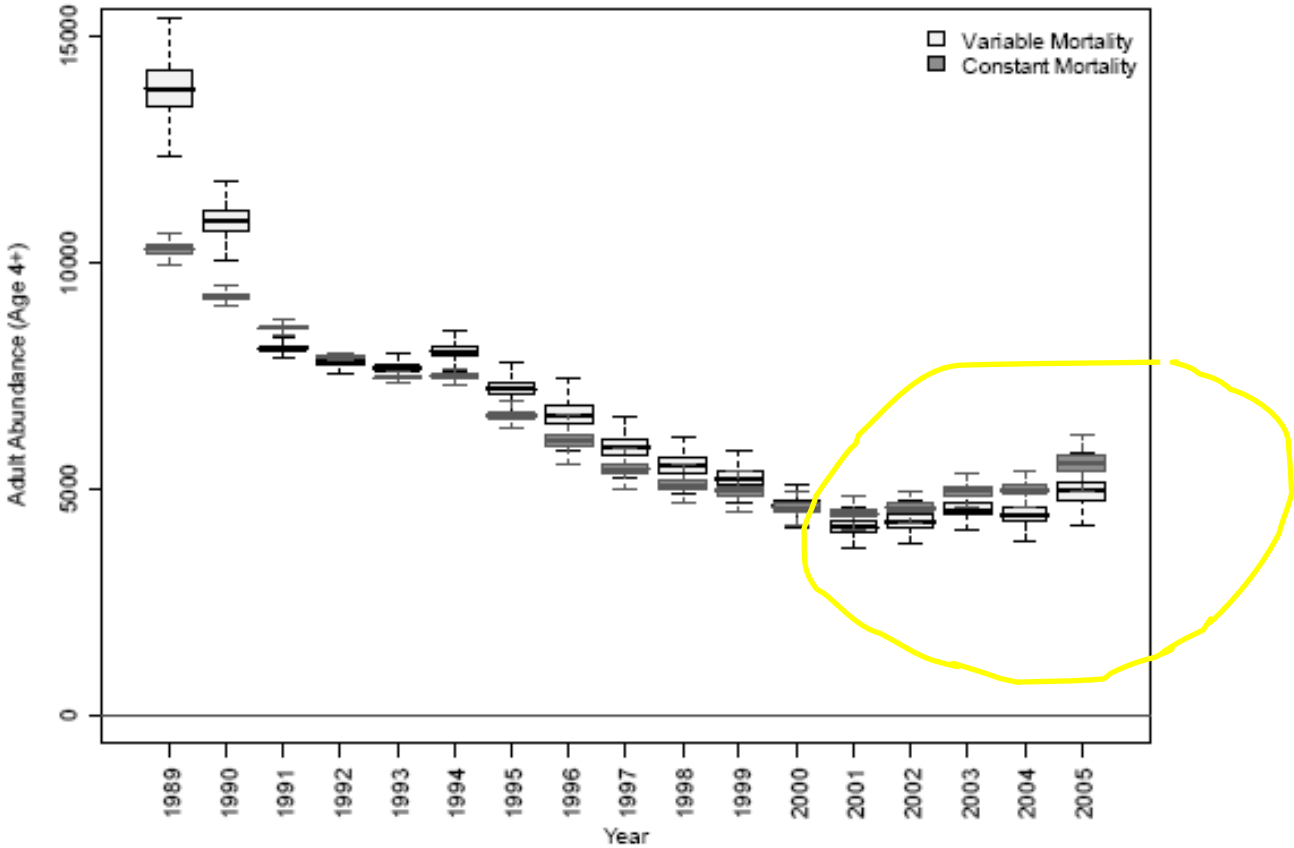
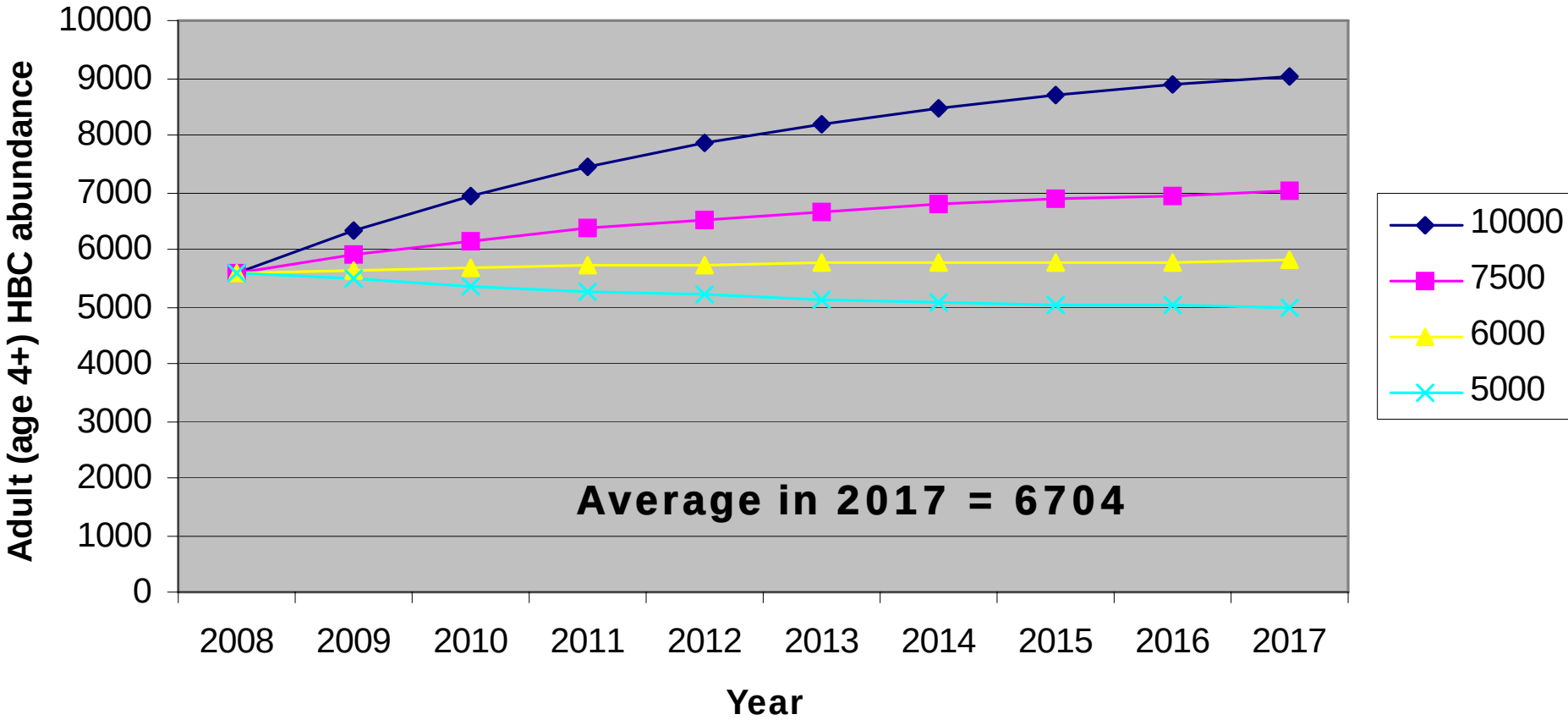


Figure 2. Adult humpback chub abundance estimates (1989-2005) for the Little Colorado River population from the age-structured mark-recapture (ASMR) model with mortality rate either constant or variable among years (for methods and assumptions, see Coggins et al., 2006a). Upper and lower bounds of plots are 95% Bayesian credible intervals.

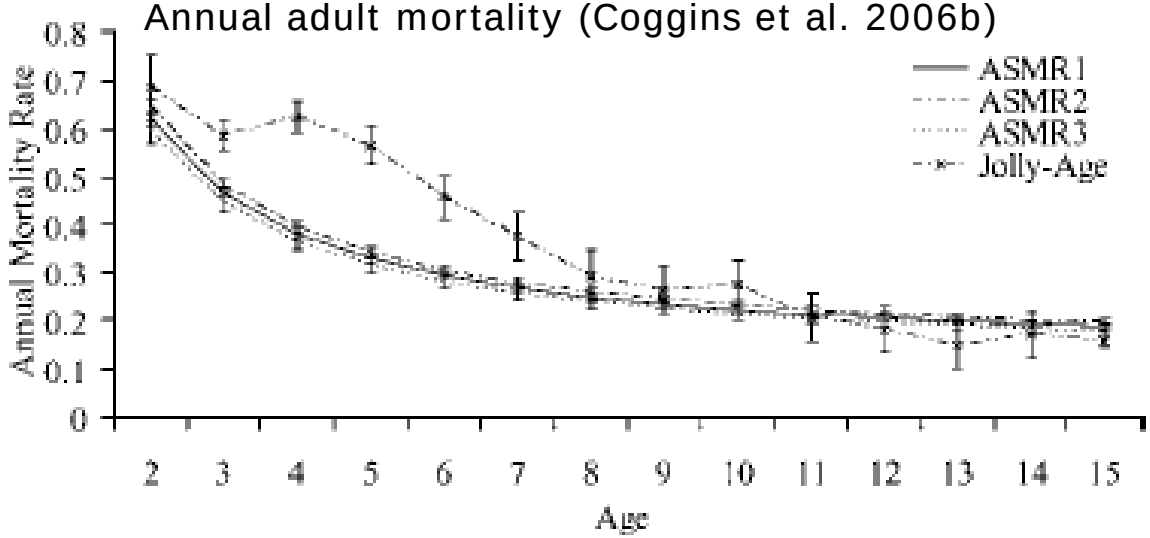
Projected adult HBC abundance based on number of Age 1 recruits (Coggins et al. 2006a) and annual mortality rate (Coggins et al. 2006b)



Simulated age 1 recruits (Coggins et al. 2006a)

FIGURE 1.—Estimated recruitment over time for simulated data sets assuming stable recruitment before 1989 and error in age assignment due to variation in the simulated growth patterns. Individual growth variation was simulated by setting length at age for each simulated fish i to $l_i(a) = (l_\infty + d_i)(1 - e^{-k(i + 0.42)})$, with the deviations in asymptotic length d_i normally distributed with mean zero and standard deviation 30. Each symbol type represents results for a different simulated data set incorporating stochastic error in age assignment.

Annual adult mortality (Coggins et al. 2006b)



Rationale

- 6,500 short term target
- Restore all aggregations; one aggregation of 500 spawning adults

HBC aggregations as described in Valdez and Ryel 1995

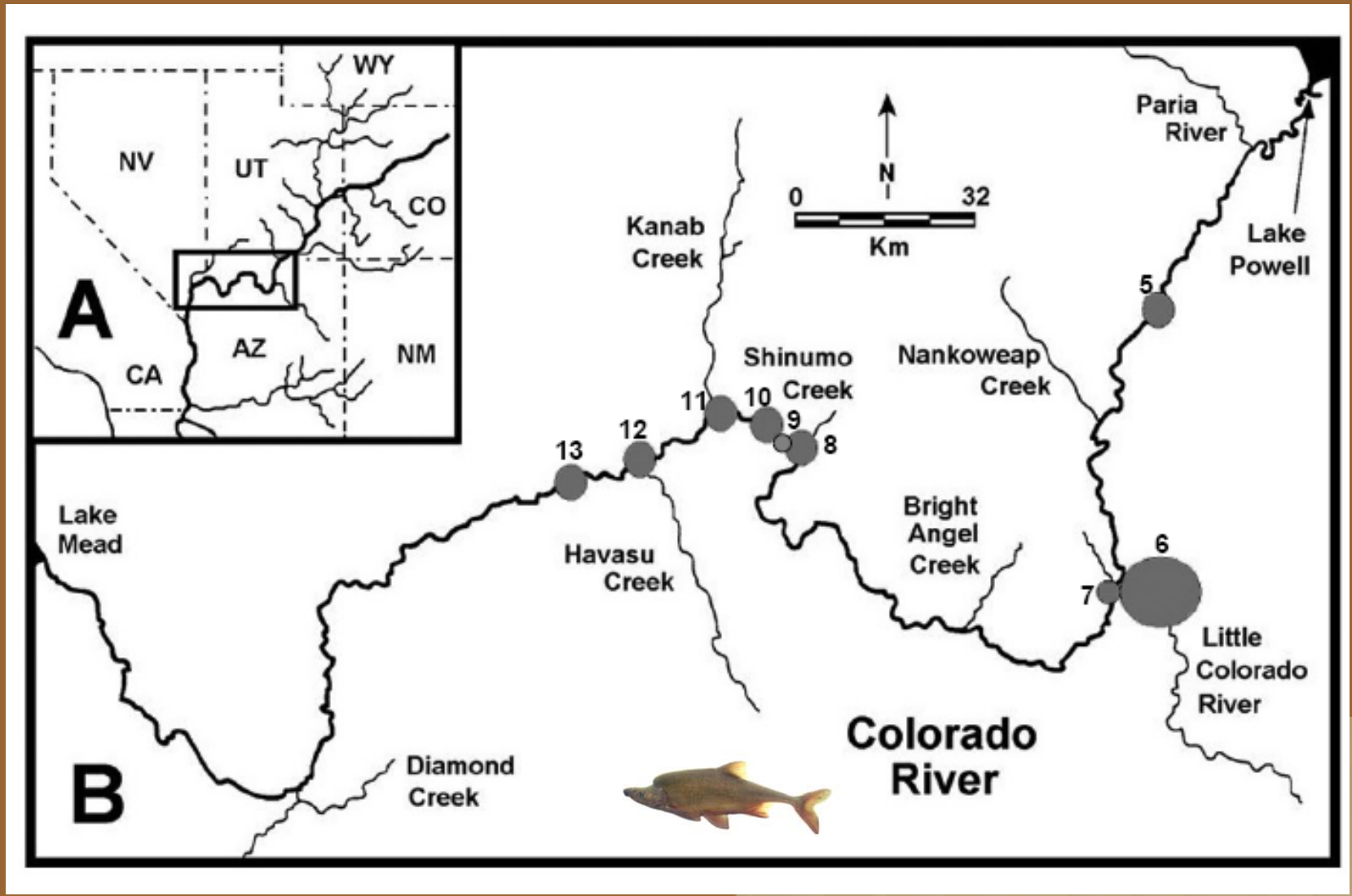
RM	Aggregation	No. Adults captured	No. Adults recaptured	N	SE(N)	Range of 95% CI
29.8-31.3	30-Mile	26	6	52	23	28-136
6557-65.4	LCR Inflow	1524	280	3482	408	2682-4281
65.7-76.3	Lava to Hance	15	3	-	-	-
83.8-92.2	Bright Angel inflow	9	1	-	-	-
108.1-108.6	Shinumo inflow	27	6	57	26	31-149
114.9-120.1	Stephen Aisle	17	2	-	-	-
126.1-129	Middle Granite Gorge	124	48	98	19	74-153
155.8-156.7	Havasu Inflow	7	1	13	12	5-70
212.5-213.2	Pumpkin Spring	6	2	5	2	54-16

Bright Angel Creek inflow is the Type locality (Miller 1945)

Douglas and Douglas (2006)

- only five (of nine) “aggregates” may have actual validity as independent assemblages of *G. cypha*. These are:
  - 30-mile Springs (river mile 30),
  - Shinumo Creek (river mile 108),
  - Middle Granite Gorge (river mile 126),
  - Havasu Creek (river mile 156), and
  - Pumpkin Springs (river mile 213)
- Others ‘collapsed’ or eliminated including Bright Angel Creek inflow

HBC aggregations as described in Douglas and Douglas (2007)



HBC Desired Distribution

- HBC were more widely distributed in the CRE in the early 1990's
- NPS desires to restore the distribution of HBC in the CRE
- Aggregations in Valdez and Ryel (1995) meet this goal better than Douglas and Douglas (2006)
  - e.g. Because it is the type locality, Bright Angel Creek inflow area should not be eliminated
- Middle Granite Gorge or 30-mile likely candidates for 500 spawning adults in 10 years.
  - MGG population nearly doubled from 1993 to 2000, from 98 to 180 adults
  - 30-mile experienced recent reproduction

Rationale

- 6,500 short term target
- Restore all aggregations; one aggregation of 500 spawning adults
- Spawning tributary aggregation
  - NPS, with cooperation from FWS and AGFD is planning on translocating HBC into Shinumo Creek to begin this process

Long-Term Targets (more than 10 years)

1. HBC population estimate is at least 10,000 adult fish, age 4+ years, as determined by ASMR.
2. All threats criteria for this recovery unit have been met or eliminated.
3. The Fish and Wildlife Service has issued a non-jeopardy, non-adverse modification Biological Opinion on the operation of Glen Canyon Dam.
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Assumptions

a. If there were a lower basin recovery implementation program, and the actions listed in the recovery goals were implemented, it would assist in reaching the long-term targets.

b. Meeting the delisting criteria and issuance of a non-jeopardy opinion will contribute to meeting NPS' and other agencies' management responsibilities.

c. The HBC monitoring program will be maintained and enhanced to support evaluation of progress toward targets.

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e. The long-term target of 10,000 fish as determined by ASMR will not include fish in the mainstem spawning aggregations or tributaries other than the LCR.

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g. The 10-year short-term target period will begin in 2008.

h. With regard to Short-Term Target #4, the current population numbers of the mainstem aggregations are unknown. The assumption is that the target is achievable in the timeframe noted. If the target is not achievable in the short-term, it would become a long-term goal.

Differences and Similarities

- Similarities
  - NPS and Western both begin with Recovery Goal language
  - Include targets for adults and for recruitment at or above present levels
- Differences
  - NPS sets both short-term and long-term targets for adults at levels higher than present levels (“improve resources” GCPA 1992)
  - NPS sets targets for additional spawning aggregation (1994 Biological Opinion RPA)
  - NPS sets targets for restoring distribution by restoring or maintaining additional aggregations as described in Valdez and Ryel (1995); NPS Management Policies (2006)

NPS Desired Future Condition Targets for SEDIMENT

Sediment

- **Short-Term Targets (10 years)**
  1. Rebuild and stabilize sandbars, campsites, and backwater habitats to 40-45,000 cfs levels, moving toward 1983-1985 post flood values (abundance, grain size, and distribution including volume and areal extent).
  2. Achieve a positive mass balance of fine sediment throughout the CRE.
- **Assumptions – Short-Term Targets**
  a. Under low water conditions, dam operations (including BHBFs up to 40-45,000 cfs) can be used to achieve targets.
  b. Sediment supplies will be adequate to sustain and enhance shoreline habitats and protect and enhance camping beaches and other deposits.
  c. By meeting the target, we will also make sand available for aeolian transport to upper benches to enhance native riparian community function and protect cultural sites.
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Sediment

- **Long-Term Targets (more than 10 years)**

1. Conserve sediment throughout the system to enhance near shore habitat and restore riparian function.
   - 'Restore' ecosystem function (elements and values TBD) that recognize specific influences on the ecosystem, such as existence of the dam and non-natives, to the extent possible through conservation of sediment.
   - Protect and maintain OHW zone/terrace deposits and vegetation.
   - Maintain a neutral mass balance in the mainstem after achievement of 1983-85 sediment deposits.
   - CRE cultural resources continue to be protected through sediment Aeolian transport and enhanced native riparian community function.
2. Rebuild and stabilize sandbars, campsites, and backwater habitats to 1983-1985 post flood values (abundance, grain size, and distribution including volume and areal extent) as hydrologic and safety conditions and operational constraints permit (e.g., 60,000-93,000 cfs releases assuming water availability).

Sediment

- **Assumptions – Long-Term Targets**
  a. Assumes higher water volume availability which permits discharges greater than power plant and jet tube capacity.
  b. Enough sediment will accumulate in the system to provide sufficient sediment to achieve targets.
  c. Despite historical losses of sediment in the system, the dam can be operated to meet the targets.
  d. Management actions other than dam operations may be used to reach the targets.
- **Process**
  – Over the 10-year period beginning in 2008, determine if the short-term assumptions are valid.

Sediment Rationale

- Short-term
  - The present conditions could be improved by additional BHBF tests, thus making progress towards the long-term goal
  - Much remains to be learned about sediment management in the Grand Canyon that would benefit from additional BHBF tests
- Long-term
  - The conditions immediately following the 1983-84 flood were acceptable and NPS would like to restore the beaches and backwaters in the CRE to that condition, in keeping with our mandate to improve resources.
  - It should be possible to establish measurable criteria for aspects of distribution, abundance, area, etc using past aerial photos and data collection


Monitoring Programs

Sediment Differences and Similarities

- Similarities
  - NPS and Western both include targets for number, distribution, volume and areal extent of sediment (and associated beaches and habitat)
- Differences
  - NPS sets both short-term and long-term targets at levels higher than present levels (“improve resources” GCPA 1992)
  - Western sets target to ‘slow or reverse the rate of decline)
  - NPS assumes that improvement is possible under present sediment input levels, and that despite historical losses of sediment in the system, the dam can be operated to meet the targets
  - Western assumes that decline may only be slowed.


Thank you
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