

**Estimated Effects on Downstream Resources from Short Duration (2-4 days), 45,000 cfs releases from Glen Canyon Dam, Between the Months of January to July**

**Introduction**

Weather conditions conducive to higher than normal spring run-off in the Upper Colorado River Basin are predicted for 1998. In light of potential high inflows to Lake Powell, the Adaptive Management Work Group is examining alternative hydrograph scenarios for Glen Canyon Dam for the months of January through June. One scenario involves a "beach/habitat building" flow at a discharge of up to 45,000 cfs for 2-4 days. ~~The Grand Canyon Monitoring and Research Center (GCMRC) has been requested by~~ the Adaptive Management Work Group (AMWG) to evaluate the effects of short duration, sustained high flows on downstream resources for these months. The resources of concern are the biological, physical, and cultural/socioeconomic resources located between the forebay of Glen Canyon Dam and the western boundary of Grand Canyon National Park.

Program managers from the GCMRC canvassed researchers familiar with these downstream resources and asked them evaluate the potential effects (+3 strongly positive to -3 strongly negative) of this flow on resources for the months of January to July. The researchers were required to provide literature that supported their estimates. Attempts were made to have several researchers provide input for each identified resource and these data were subsequently consolidated. Therefore estimated effects on single resources represent an average of all contributing researchers' views.

The following is a summary of the estimated effect on resources subjected to a short duration, 45,000 cfs flow. Average values for each resource were recorded (Table 1) and graphed (Figs. 1,2) for each month. For each month, a narrative highlights the resources identified as potentially negatively impacted by this flow. The degree of negative impact ranges from values that are less than -1 to values of -3. Values in the resource matrix (Table 1) represent averages and the "N" is the number of respondents who provided input for that resource. Values of "0" for a particular month represent no impact and do not appear graphically, although the resource may be included on the legend in figures 2 and 3.

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Literature citations that were provided by the researchers for each resource

accompany this summary. These citations and the results from the matrix survey represent an initial attempt at determining the effects of a short duration high flow on downstream resources.

**Resources of Concern by Month**

**January** - Resources that are shown to have an negative effect in January include: fishing, over wintering birds, raptors/bald eagles, waterfowl, Southwestern Willow Flycatcher (SWWF) habitat, Kanab Ambersnail (KAS), humpback chub, flannelmouth sucker and trout spawning, larval and juvenile trout survivorship, channel sand storage and economic costs. Estimated negative impacts for these resources range from -.3 for native fish spawning and -.5 for raptors and bald eagles and economic costs to -2.0, -2.3, and -2.5 for fishing, trout spawning, KAS, and channel sand storage.

Concerns associated with those resources that have impacts greater than -2 (i.e., approaching -3 values) are: U.S. Fish and Wildlife Biological Opinion Statements that

prohibit 45,000 cfs flows until one other KAS population is established or discovered in Arizona, and the loss of KAS individuals in habitats below 45,000 cfs stage at Vaseys Paradise. Rainbow trout spawning in the Glen Canyon Reach begins in mid-November and continues through mid-March, and high flows in January would affect larval and juvenile fish either by dispersal of small fish downstream, stranding during the downramping or through predation. Associated with trout is the fishing industry at Lees Ferry. January is a month within the prime trout fishing season (October - May), and a 45,000 release would result in days of lost revenue to fishing guides. Lastly, sand in the channel bed would be lost at 45,000 cfs, but this sediment would be stored to some extent in sandbars and channel margin deposits, if the flow was of short duration. Otherwise, high sustained flows from 20k - 30k cfs, or higher will result in a loss of this resource.

**February** - Negative impacts in February are those already noted for January with the addition of impacts to riparian habitat, and breeding birds. Impacts diminish slightly in February for trout spawning and juvenile trout survivorship, decreasing from -2 to -1 and from -1.5 to 1.25 respectively. Concerns for KAS remain at the same value.

**March** - Resource effects become more negative for native fish spawning and survivorship of larval (FMS larval = -1) and juvenile stage fish. Trout survivorship remains a concern, and March is shown as having a most negative impact for fishing, changing from -2 to -3. Concerns about the risk of tamarisk germination (-1) begin in March, as well.

**April** - Negative impacts are associated with more biological resources including juvenile age-classes for native fish (FMS larval = -1.5, HBC larval = -1.0), riparian and SWWF habitat and woody plants become more negatively affected, and the probability

for tamarisk germination increases (-1 to -2). Avifauna are estimated to become more affected by flows in April (breeding birds -.5 to -2; breeding waterfowl -.5 to -2).

**May** - High flows in May are estimated to slightly affect marsh and woody plants, and have a greater negative impact on riparian habitats (-1 to -1.3). Cultural resources are estimated to be slightly negatively impacted from May through July. Day rafting becomes more impacted (-1 to -1.3). Native fish spawning and survivorship of larval and juvenile stages are also increasingly negatively affected.

**June** - Greatest resource impacts from a high flow in June are on breeding birds, native fish larval and juvenile stages (HBC larval = -2.5; FMS larval = -2.3; juvenile = -1.5) and a high probability of tamarisk seedling germination (-2.3). SWWF habitat also becomes

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increasingly negatively affected by a June high flow. An additional resource that becomes negatively affected in June is the aquatic food base.

**July** - Resources affected by a high flow in June remain affected by July high flows.

Additionally, native and non-native fish habitat become negatively affected by high flows in July.

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Table 1.

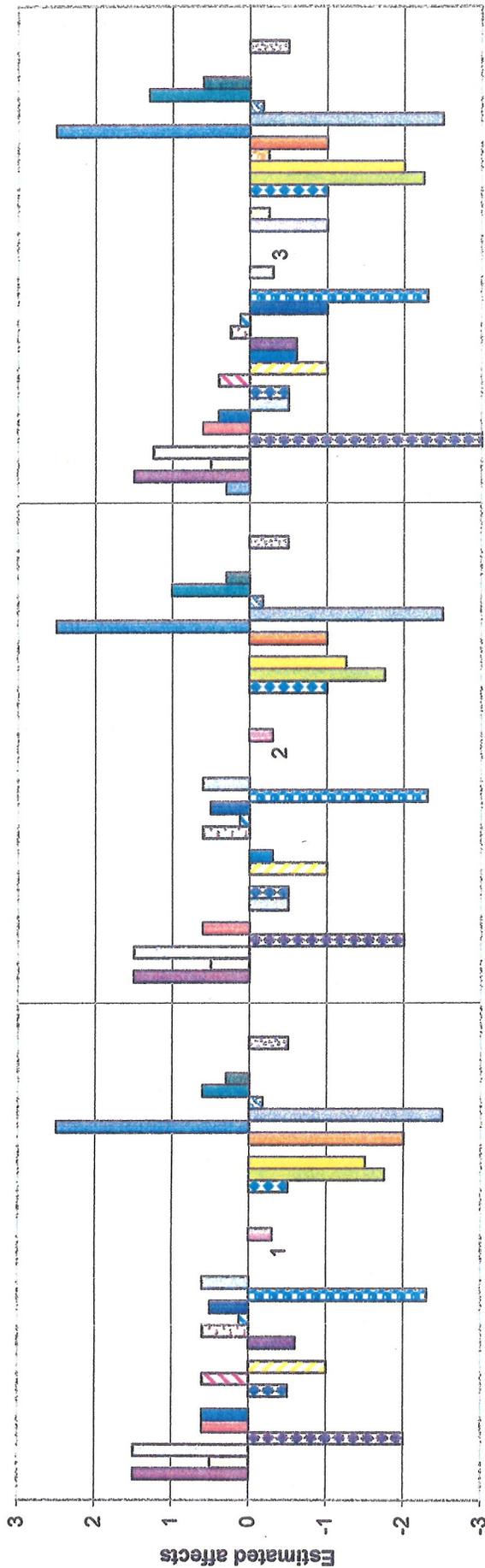
HIGH FLOWS (>POWERPLANT CAPACITY) EFFECTS ON COLORADO RIVER RESOURCES

SCALE: -.3 = STRONG NEGATIVE IMPACT, 0 = NO IMPACT, .3 = STRONG POSITIVE IMPACT

RESOURCE CATEGORY	INDIVIDUAL COMPONENTS	MONTH						
		JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY
WATER	Streamflows							
	Lake Powell Stratification N=2	0.6	1	1.3	1.3	1	0.6	0.6
	Downstream Water Quality N=3	0.3	0.3	0.6	1.6	1.3	1.3	1.3
	Riverbed sand N=2	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5
	After 20 years							
	After 50 years							
	Sand bars N=3	2.5	2.5	2.5	2.5	2.75	2.75	2.75
	Aquatic food base N=5	0.6	0.6	0	0	-0.2	-0.4	-0.4
	Native Fish habitat N=3	0	0.4	0.5	0.3	0.3	0.3	-0.3
	Non-native fish habitat N=3	0.6	0	0.4	0.5	0.3	0.3	-0.3
SEDIMENT	Humpback Chub Spawning N=2	-0.3	-0.3	0	0	0	0	0
	Larval N=3	0	0	-0.3	-1	-2	-2.6	-2.3
	Juvenile N=3	0	0	0	-0.3	-0.6	-1	-1.6
	Adult N=3	0	0	0	0	0	0	0
	Flannelmouth Sucker spawning N	-0.5	-1	-1	-1	0	0	0
	Larval N=4	0	0	-1	-1.5	-2.2	-2.5	-2.5
	Juvenile N=4	0	0	-0.25	-0.25	-0.25	-1.5	-1.75
	Adult N=4	0	0	0	0	0	0	0

RESOURCE CATEGORY	INDIVIDUAL COMPONENTS	MONTH						
		JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY
AQUATIC RESOURCES	Trout							
	Spawning N=1	-2	-1	-1	0	0	0	0
	Larval N=4	-1.75	-1.75	-2.25	-2	-1.5	-1.25	-1.25
	Juvenile N=4	-1.5	-1.25	-2	-2	-1.5	-1.5	-1.5
	Adult N=4	0	0	-0.25	-1.3	-1.3	-1.3	-1.3
VEGETATION	Emergent marsh plants N=4	0.6	0.6	0.25	0.12	-0.37	-0.6	-0.6
	Woody Plants N=4	0.12	0.12	0.12	-0.12	-0.6	-0.6	-0.6
	Preventing Tamark Germ n N=3	0.5	0.5	-1	-2	-2	-2.5	2.5
	Riparian habitat N=2	0	-0.5	-0.5	-1	-1.5	-1.5	-1.5
	Waterbirds N=3	-0.6	0	-0.6	-2	-2.3	-2.3	-1.6
WILDLIFE & HABITAT	Terrestrial Invertebrates							
	Breeding birds N=3	0	-0.3	-0.6	-2	-1.85	-2.17	-2
	Overwintering birds N=3	-1	-1	-1	-0.5	0.5	0	0
	Bald Eagle/Peregrine Falcon N=3	0	-0.5	-0.5	-1	-1.5	-1.5	-1.5
	Kanab Ambersnail+Habitat N=3	-2.3	-2.3	-2.3	-2.3	-2.6	-2.6	-2.6
LISTED & SPECIAL STATUS SPECIES	SW Willow Flycatcher+Habitat N=	-0.17	-0.17	-0.17	-0.5	-0.5	-0.8	-1
	Archeological sites N=2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Traditional cultural properties N=2	1.5	1.5	1.5	1.5	0	0.5	1
	Traditional cultural resources N=2	0.6	0.6	0.6	0.3	-0.3	-0.3	-0.3
	Regional air quality N=1	0	0	0	0	0	0	0
CULTURAL,SOCIO. RESOURCES	Fishing N=2	-2	-2	-3	-3	-2.5	-2	-1.5
	Day rafting N=3	0	0	0.3	0	-1.3	-1.3	-1.3
	Whitewater boating N=3	1.5	1.5	1.25	0.5	0	0	0
	Economic benefits N=1	0	0	0	0	0	0	0
	Annual economic costs N=1	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
AIR QUALITY	Wholesale rate N=1	0	0	0	0	0	0	0
	Retail rate N=1	0	0	0	0	0	0	0
	ALL RESOURCES	-5.2	-4.95	-10.9	-17.65	-23.22	-26.97	-27.05
	POWER							
	RECREATION							

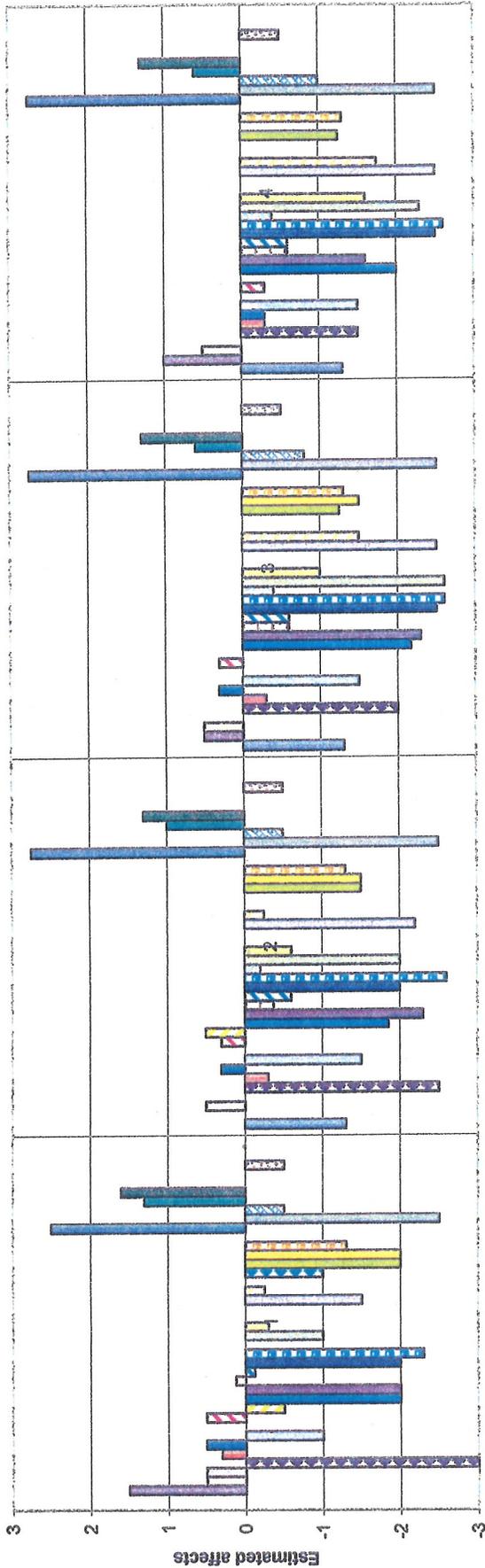
# Resources of Concern (January - March)



## Months (1-3)

- Day Rafting N=3
- Cultural resources N = 3
- Overwintering birds
- Tamarisk germination N = 3
- HBC adult N = 3
- FMS spawning N = 2
- Sandbars N = 3
- Economic benefits N = 1
- Cultural properties N = 2
- Native fish habitat N = 3
- Breeding birds N = 3
- Kanab ambersnail N = 3
- HBC spawning N = 2
- Trout larval N = 4
- Channel sand N = 2
- regional Air Quality N = 1
- Archeology sites N = 2
- Riparian habitat N = 2
- Waterfowl N = 3
- Aquatic food base N = 5
- FMS larval N = 4
- Trout juvenile N = 4
- SWWF habitat
- Economic costs N = 1
- whitewater rafting N = 3
- Raptors/BE N = 3
- Marsh N = 5
- HBC larval N = 3
- FMS juvenile N = 4
- Trout adult N = 4
- Lake Powell stratification N = 3
- Wholesale rate N = 1
- Fishing N = 2
- Non-native fish N = 3
- Woody plants
- HBC juvenile N = 3
- FMS adult N = 4
- Trout spawning N = 1
- Downstream WQ N = 3
- Retail rate N = 1

Resources of Concern (April - July)



Month (1 - 4)

- |                            |                            |                                  |                       |
|----------------------------|----------------------------|----------------------------------|-----------------------|
| Day Rafting N=3            | Cultural properties N = 2  | Archeology sites N = 2           | Fishing N = 2         |
| Cultural resources N = 3   | Native fish habitat N = 3  | Riparian habitat N = 2           | Non-native fish N = 3 |
| Overwintering birds        | Breeding birds N = 3       | Waterfowl N = 3                  | Woody plants          |
| Tamarisk germination N = 3 | Kanab ambersnail N = 2     | Aquatic food base N = 5          | HBC juvenile N = 3    |
| HBC adult N = 3            | HBC spawning N = 2         | FMS larval N = 4                 | FMS adult N = 4       |
| FMS spawning N = 2         | Trout larval N = 4         | Trout juvenile N = 4             | Trout spawning N = 1  |
| Sandbars N = 3             | Channel sand N = 2         | SWWF habitat                     | Downstream WQ N = 3   |
| Economic benefits N = 1    | regional Air Quality N = 1 | Economic costs N = 1             | Retail rate N = 1     |
|                            |                            | whitewater rafting N = 3         |                       |
|                            |                            | Raptors/BE N = 3                 |                       |
|                            |                            | Marsh N = 5                      |                       |
|                            |                            | HBC larval N = 3                 |                       |
|                            |                            | FMS juvenile N = 4               |                       |
|                            |                            | Trout adult N = 4                |                       |
|                            |                            | Lake Powell stratification N = 3 |                       |
|                            |                            | Wholesale rate N = 1             |                       |