GCDAMP Knowledge Assessment: Effects of Experimental & Management Actions

Resource Topic:	Rainbow trout fishery
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Resource Characteristic	Specific Measure	Management Action	Strength	Direction	Confidence	Rationale: Strength & Direction	Rationale: Confidence	Recommendations
Rainbow Trout Maximum Size	Maximum predicted mass (g) of an average individual in the population based on bioenergetic model (Dodrill et al. 2016)	Macroinvertebrate production flows	Strong	Positive Effect	Medium	Increasing the production of drifting invertebrates would likely benefit rainbow trout growth and ultimately maximum size. Increasing the diversity of invertebrates, particularly larger taxa, would benefit rainbow trout growth.	Empirical observations of rainbow trout growth and condition in relation to invertebrate drift, along with modelling efforts support the links between increased growth and invertebrate drift. It is less certain how rainbow trout population responses will moderate the effects of increased drift on individual trout growth.	Consider implementation of these flows and experimentally examine how flows influence the foodbase, which influences invertebrate drift availability and ultimately trout growth.
Lees Ferry Rainbow Trout Sport Fishery - Abundance	Abundance	Mechanical removal of rainbow trout from LCR reach	Moderate	Positive Effect	Low	See data on non-native fish removal in the LCR inflow area (2003-2006) (Coggins et al. 2011). Efficacy of electrofishing is contingent on a number of factors, including (1) initial abundance, (2) recruitment (reproduction + immigration), and (3) capture efficiency. These depletion efforts can be costly and ineffective if the desired population size is untenably small. Rating for strength reflects averaging of "strong" effect when removal is effective and "weak" effect when removal is not, due to contingent factors noted here.	Knowing the desired target level is critical for assessing use. Extended use is likely to have a by-catch effect associated with other resources of concern. Public knowledge and support are strongly advisable.	Useful if population parameters are understood
Lees Ferry Rainbow Trout Sport Fishery - Recruitment	Annual recruitment	Proactive Spring HFEs ≤ 45,000 cfs in April, May, or June	Moderate	Unknown	Low	High-flow experiments (spring) and storage equalization flows will likely increase rainbow trout recruitment (Korman 2012). Metadata analysis for rainbow trout in tailwaters across western North America showed that recruitment was negatively correlated with high annual, summer, and spring flow and dam latitude, and positively correlated with high winter flow, subadult brown trout catch, and reservoir storage capacity (Dibble et al. 2015).	High flows should provide a benefit for the tailwater fishery, but the net effect on native fish is uncertain. Larger rainbow trout will be more effective predators and competitors of native fish (Yard et al. 2011), and increased condition may lead to local reproduction and increased abundance near the LCR. Alternatively, increased condition of trout in Glen and Marble canyons may limit the extent of downstream dispersal, thereby reducing trout abundance at the LCR and lowering the extent of competition and predation on native fish (Coggins et al. 2011).	Continue to monitor trout population dynamics both in the LCR inflow area and the Lees Ferry Sport Fishery.
Lees Ferry Rainbow Trout Sport Fishery - Age0 abundance	RTELSS Age0 abundance (Avery et al. 2015)	Spring HFEs ≤ 45,000 cfs in March or April	Strong	Positive Effect	Medium	Age-0 abundance in July 2008 was over fourfold higher than expected given the number of viable eggs that produced these fish. A hatch date analysis indicated that early survival rates were much higher for cohorts that hatched about 1 month after the Controlled HFE (~April 15, 2008) relative to those that hatched before this date. Assessment based on trout response to Spring HFE in 2008, reported in Korman et al. 2011, entitled "Effects of Fluctuating Flows and a Controlled Flood on Incubation Success and Early Survival Rates and Growth of Age-0 Rainbow Trout in a Large Regulated River"	Weak understanding of spring HFEs (N=1) in CRe, but metadata analysis of western US tailwater fisheries suggests strong relationship (see Drivers & Constraints: driver = High winter flow and/or low spring flow)	Require additional replication to assess Spring HFE

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LCR Inflow Area & Marble Canyon Rainbow Trout Fishery - Abundance	Multi-state Jolly-Seber open population model implemented in a robust design framework	Trout management flows	Unknown	Negative Effect	Low	The quantity of Age0 Rainbow trout dispersing into Marble Canyon is hypothesized to be proportional to the size of annual recruitment occurring in the Lees Ferry Sport Fishery.	This hypothesis remains uncertain; however, is one of the primary assumptions underlying the LTEMP modeling efforts.	
Lees Ferry Rainbow Trout Sport Fishery - Age0 survival	Fall abundance of surviving recruits for Age0	Trout management flows	Unknown	Negative Effect	Low	Strength of effect depends closely on when and how a TMF is carried out, so not possible to assess strength is a general matter. Increased flow fluctuations targeting fish after initial recruitment critical period, which occurs in May and June, are likely to be more effective at regulating rainbow trout abundance in the Lees Ferry reach than the January–March NFSFs evaluated here. High flows during and shortly after the peak emergence period (May–July) may also be effective at reducing rainbow trout abundance by limiting the availability of the low-velocity nearshore habitat that is critical for recently emergent fish.	Flow changes that affect incubating life stages are unlikely to have a significant effect on juvenile abundance because of strong density dependence during and shortly after emergence. Redd dewatering will not be a significant factor controlling population abundance if the majority of redds are not dewatered or if there is a strong density-dependent survival response after the dewatering event.	Control of rainbow trout recruitment will be most effective when additional mortality is applied to older life stages after the majority of density-dependent mortality has occurred.
Lees Ferry Rainbow Trout Sport Fishery - RTELSS Age0 recruitment	RTELSS Age0 abundance (Avery et al. 2015)	Trout management flows	Unknown	Negative Effect	Low	Strength of effect depends closely on when and how a TMF is carried out, so not possible to assess strength is a general matter. Hypothesized that trout management flows timed to strand age 0 fish may be effective at reducing recruitment.	In theory, this management action should effectively strand age 0 fish, reducing overall recruitment.;	Use targeted trout management flows to test hypothesis, when conditions are appropriate (i.e. Brown trout control).
Lees Ferry Rainbow Trout Sport Fishery - Spawning magnitude/hatch success	RTELSS Redd counts (Korman et al. 2011; Avery et al. 2015)	Trout management flows	Unknown	Negative Effect	Low	Korman and Others 2011 have shown trout management flows are highly effective at reducing hatch success. However, strength of effect will depend closely on when and how a TMF is carried out, so not possible to assess strength is a general matter.	Data presented in Korman and others 2011 show clear reduction in hatching success due to trout management flows	
Lees Ferry Rainbow Trout Sport Fishery - Survival	90-day apparent survival rate based on the null model	Trout management flows	Unknown	Negative Effect	Low	Stranding of Age1+ or greater: Effect on population remains unknown, however, past dewatering events have shown minimal effect on stranding of larger sized trout per Batham and Davis (2003), "Stranding of rainbow trout during experimental fluctuating releases from Glen Canyon Dam on the Colorado River."		