

# Update on 2003 and 2004 Mechanical Removal of Non- Native Fishes From the Colorado River

Southwest Biological Science Center

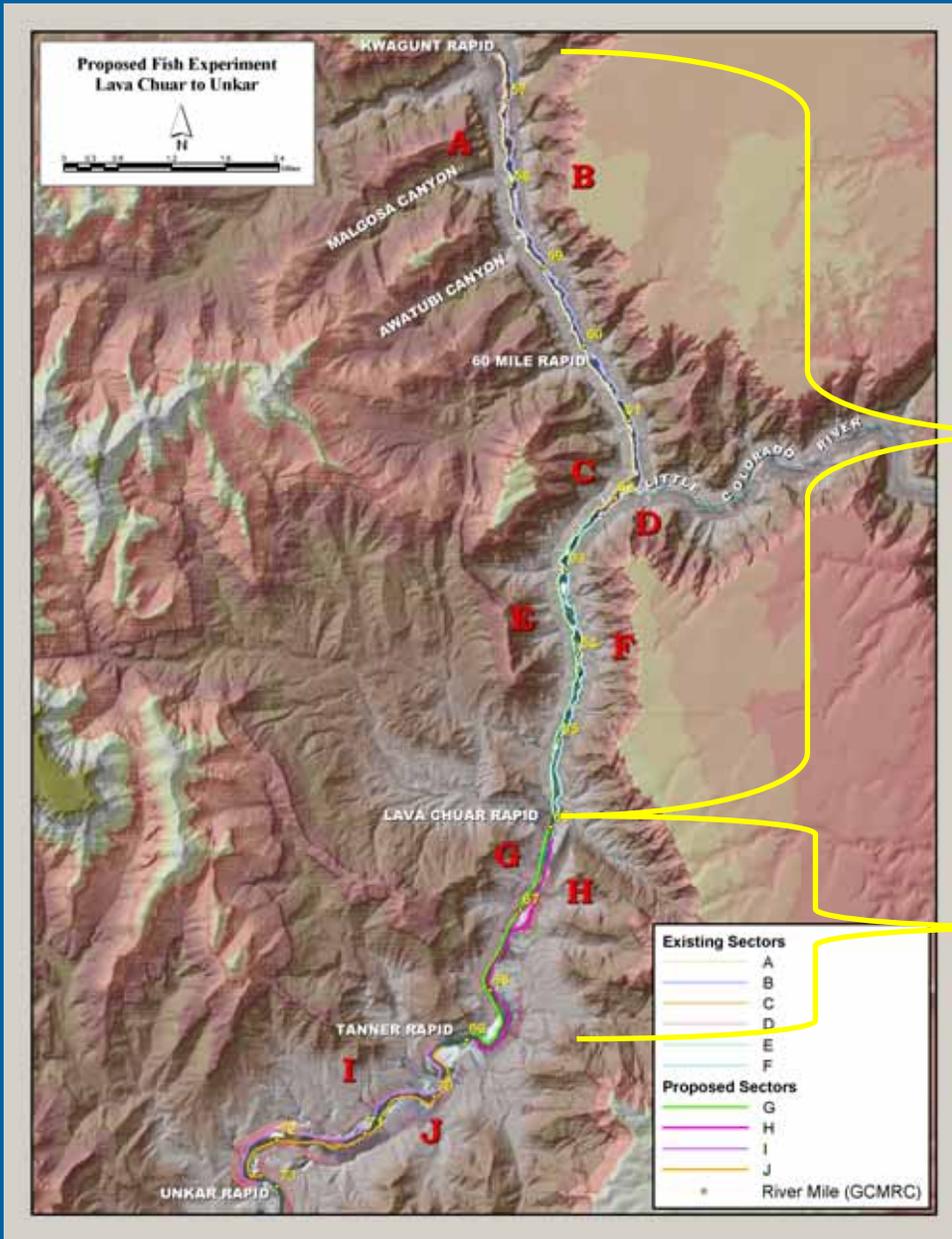
Grand Canyon Monitoring and Research Center

Lew Coggins and Mike Yard

# Objectives

- **Efficacy of Mechanical Removal of Adult RBT and BNT from the LCR Inflow Reach.**
  - **To what extent can we remove non-native fishes from a large reach of the Colorado River?**
- **Rainbow and Brown Trout Diet Analysis and Predation.**
  - **What are non-native fish eating?**
- **Effect of Adult RBT and BNT on the Population Dynamics of the LCR HBC Population.**
  - **Will humpback chub recruitment increase as a result of non-native removal?**

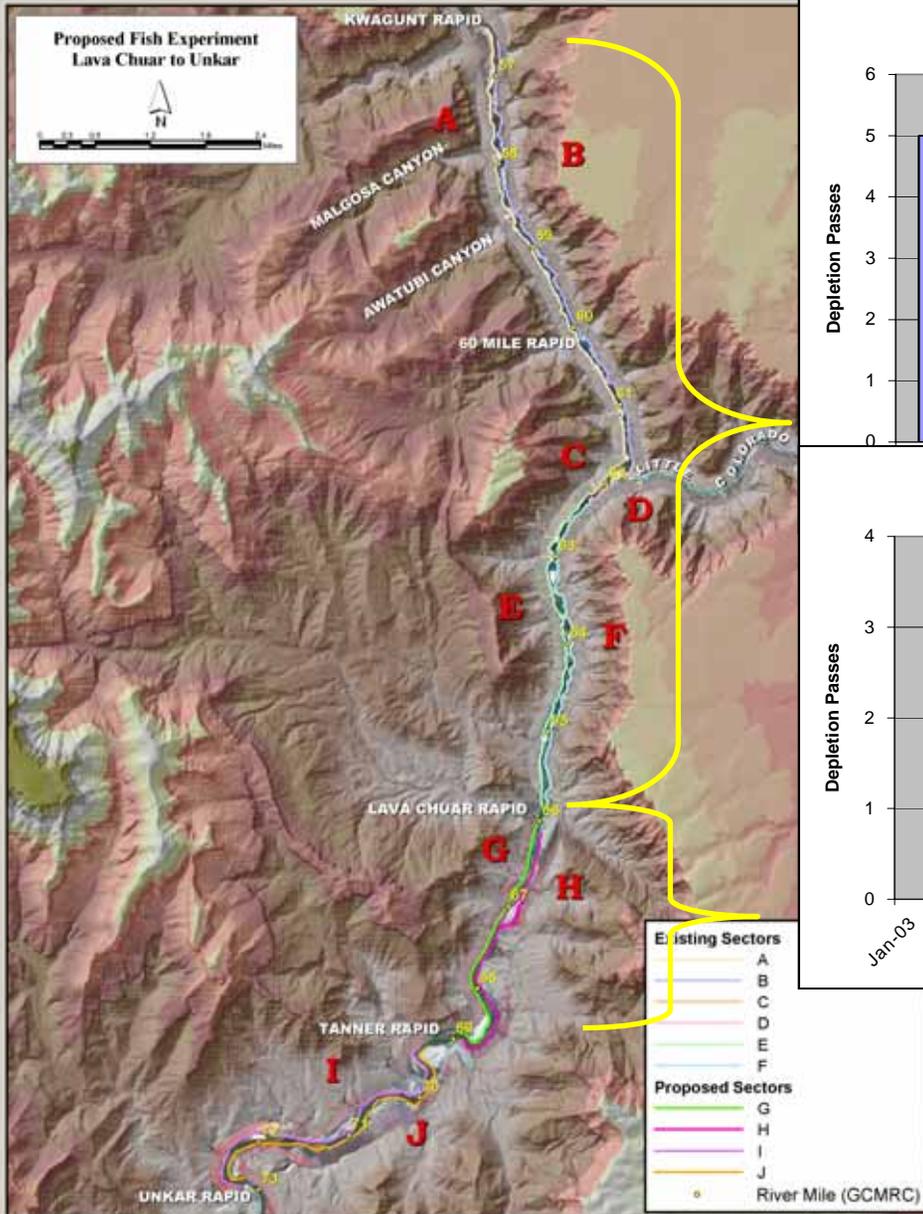
# Mechanical Removal Reaches



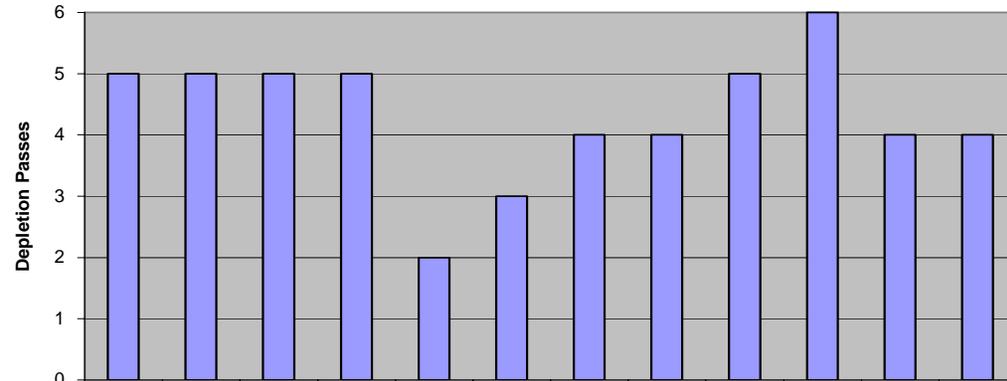
Little Colorado River Removal Reach (Kwagunt Rapid to Lava Chuar Rapid, 9.5 miles)

Lava Chuar to Tanner Removal Reach, 2.8 miles

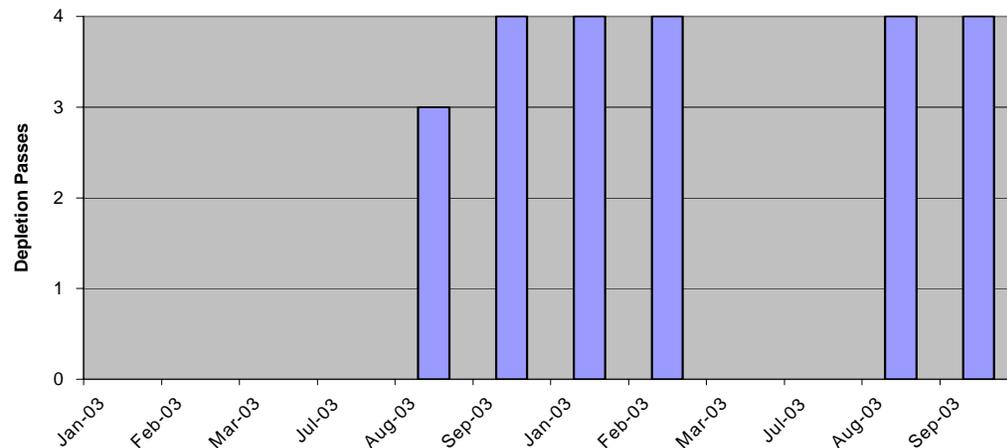
# Mechanical Removal Reach Effort



Number of Depletion Passes in the LCR Removal Reach

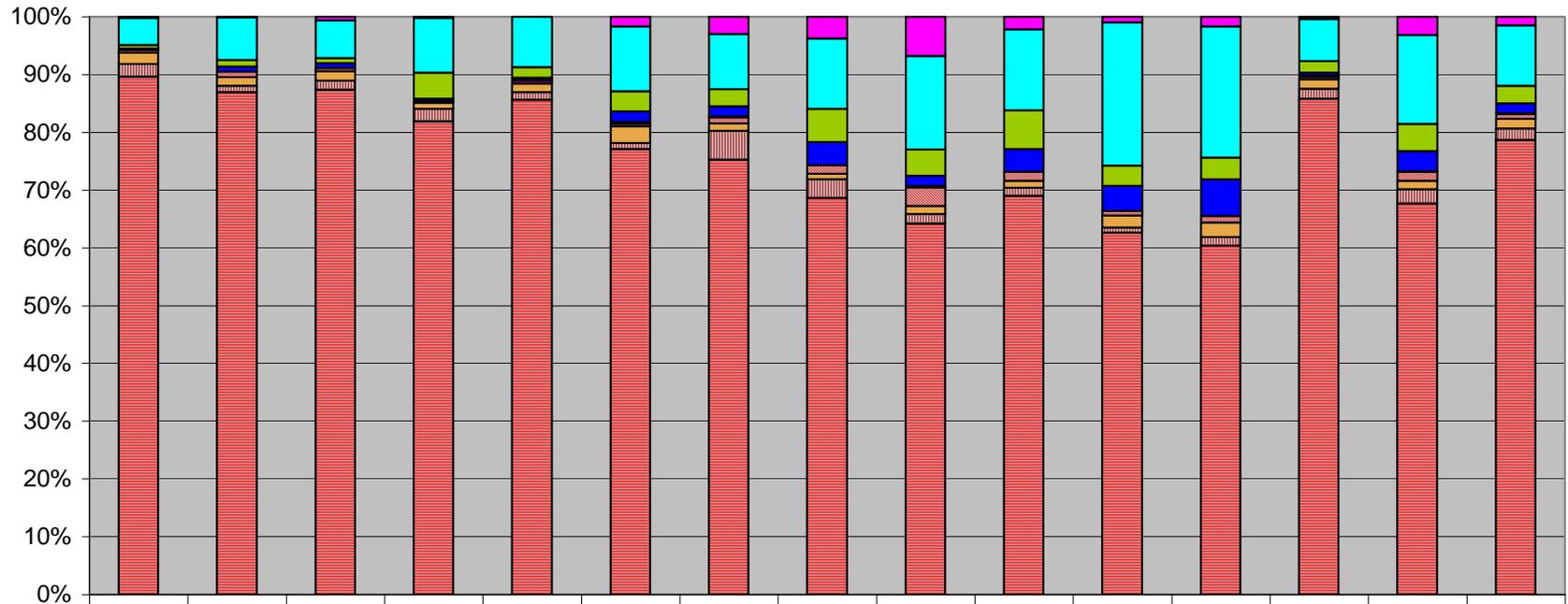


Number of Depletion Passes in the Lava Chuar to Tanner Removal Reach



# Little Colorado River Removal Reach Results

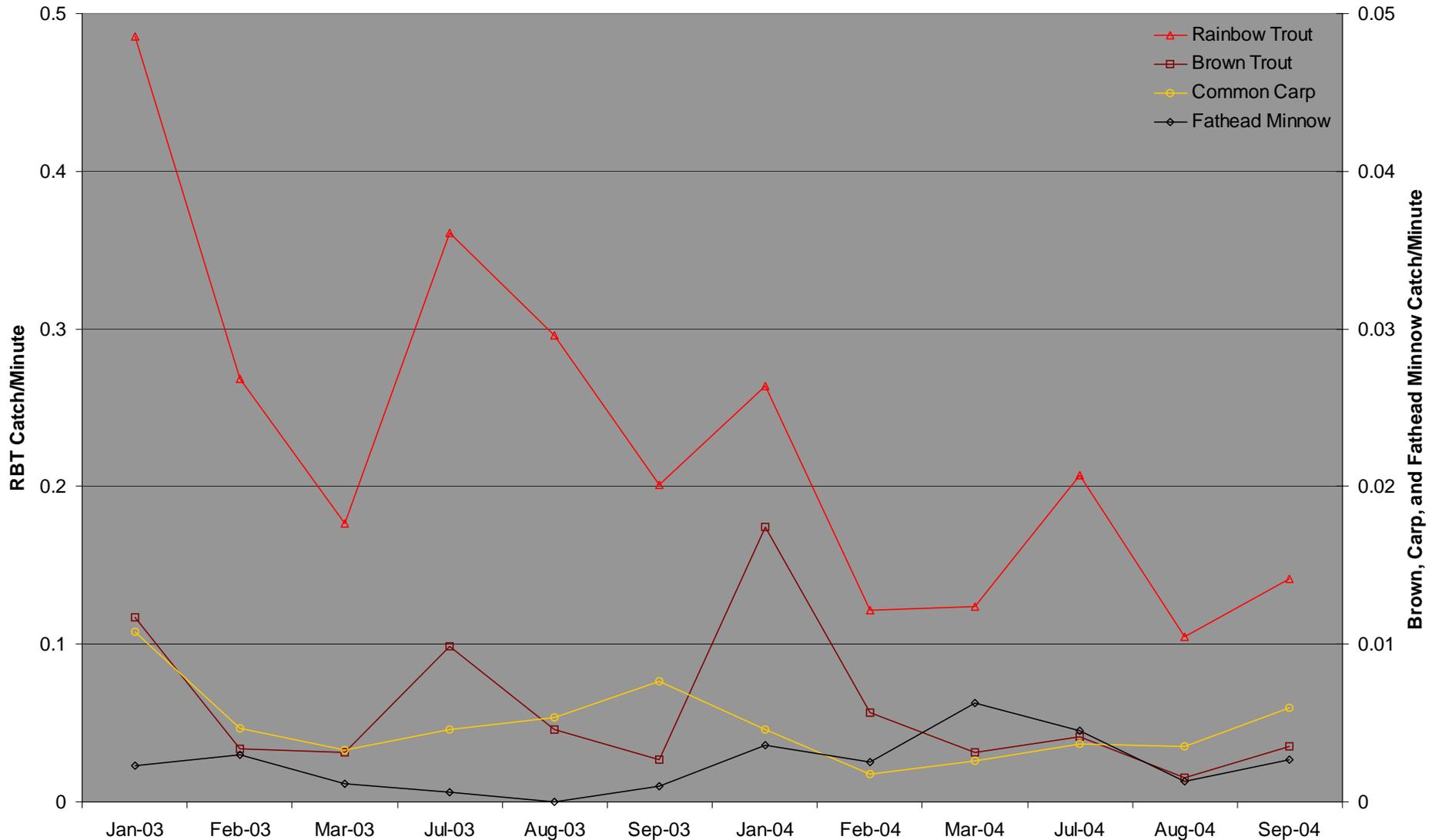
## Electrofishing Catch by Species and Month within the Little Colorado River Removal Reach



	Jan-03	Feb-03	Mar-03	Jul-03	Aug-03	Sep-03	Jan-04	Feb-04	Mar-04	Jul-04	Aug-04	Sep-04	Total 03	Total 04	Total 03-04
Speckled Dace	7	2	8	6		18	53	34	92	47	7	19	41	252	293
Flannelmouth Sucker	188	161	89	266	79	119	169	110	218	296	190	258	902	1241	2143
Humpback Chub	26	26	13	126	17	37	51	52	61	142	27	43	245	376	621
Bluehead Sucker	8	18	11	12	4	19	32	37	24	84	33	72	72	282	354
Unidentified Sucker	2	0	0	3	5	4	3	0	3	0	0	0	14	6	20
Fathead Minnow	17	21	8	4	0	4	18	13	44	32	6	13	54	126	180
Common Carp	80	33	22	29	14	31	23	9	18	26	16	29	209	121	330
Brown Trout	87	24	21	63	12	11	88	29	22	29	7	17	218	192	410
Rainbow Trout	3605	1900	1195	2298	779	818	1330	622	867	1464	480	687	10595	5450	16045

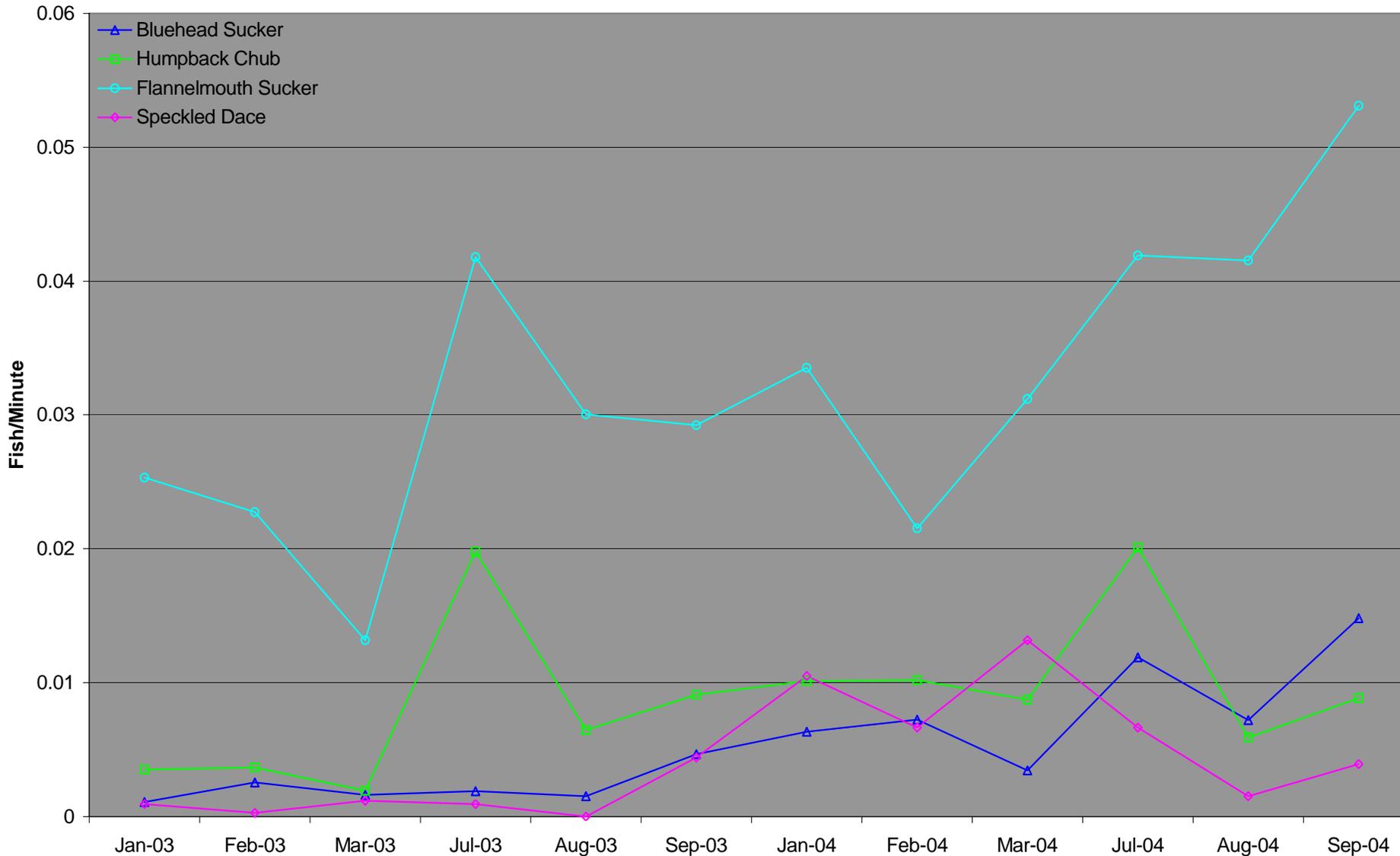
# Little Colorado River Removal Reach Results

Electrofishing Catch Rate for Non-Native Fish Species within the Little Colorado River Removal Reach

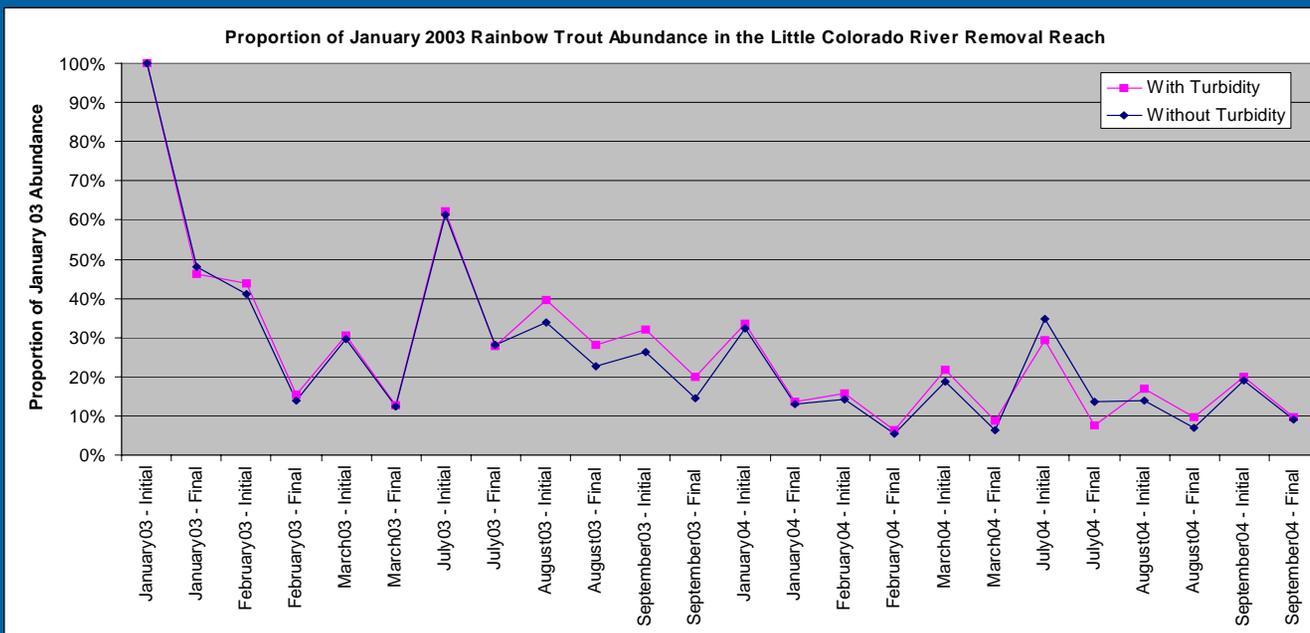
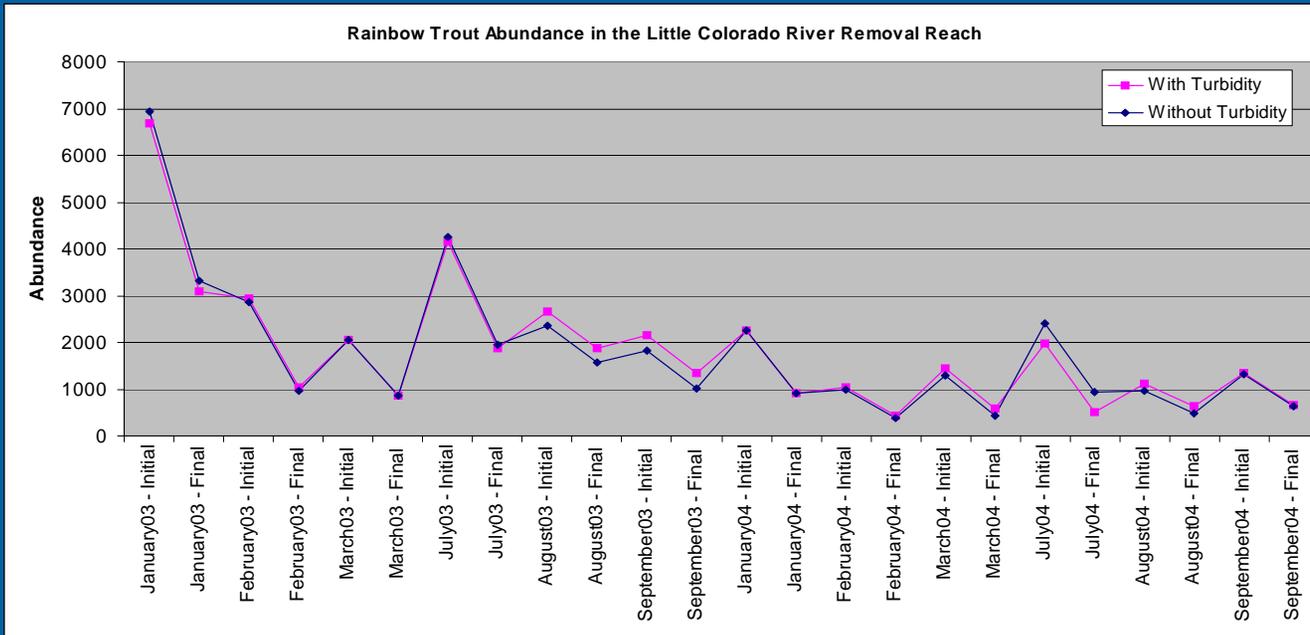


# Little Colorado River Removal Reach Results

Electrofishing Catch Rate for Native Fish Species within the Little Colorado River Removal Reach



# Little Colorado River Removal Reach Rainbow Trout Abundance

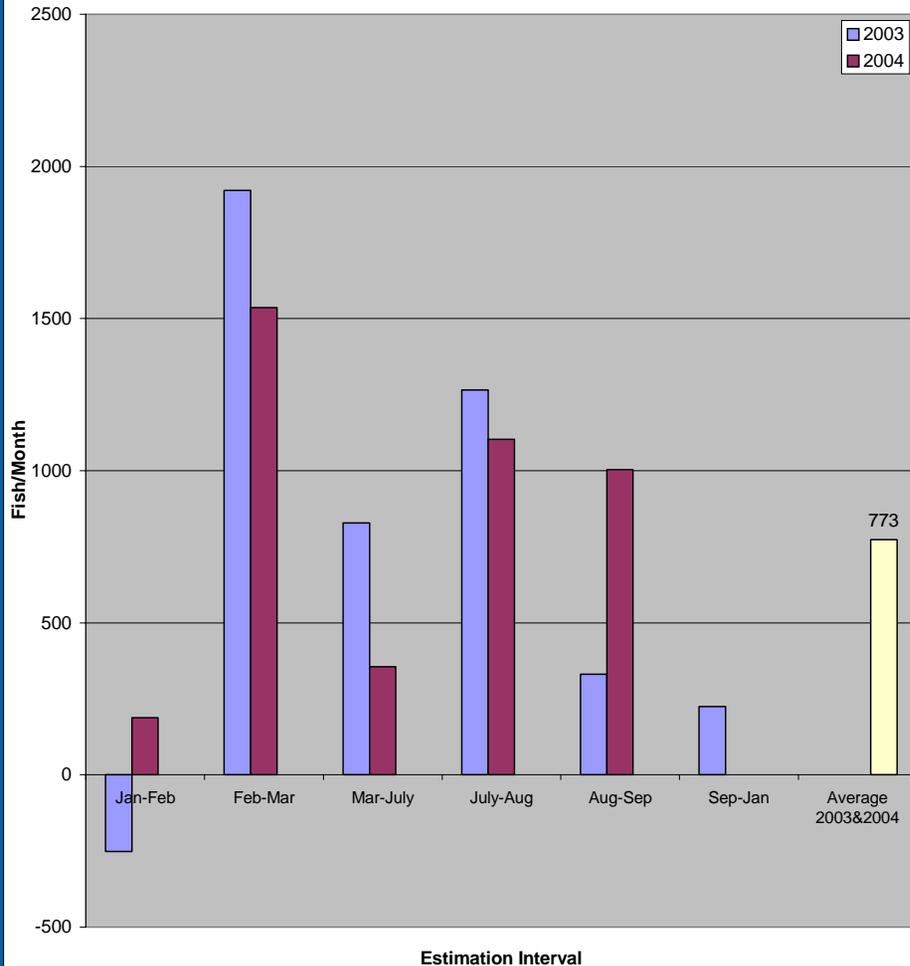


# Little Colorado River Removal Reach Rainbow Trout Removal Efficacy

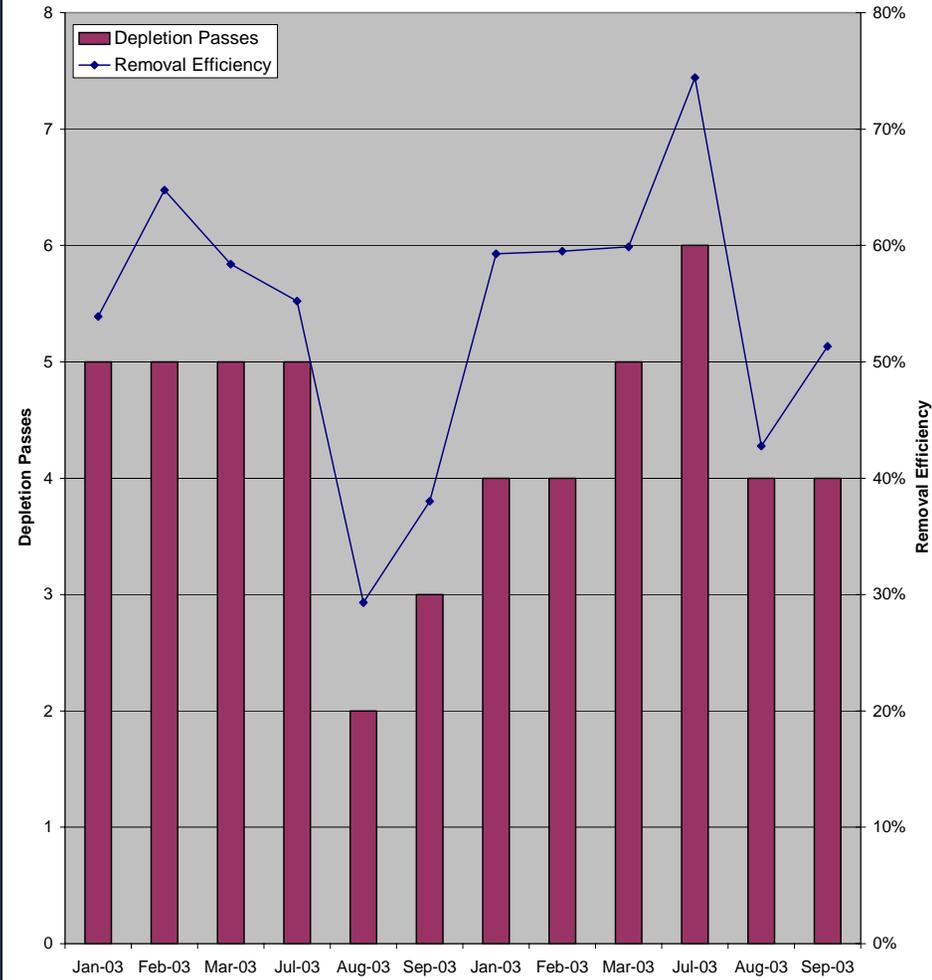
How fast they come in.... 773/mo

How fast can we take them out...12%/pass

Monthly Rainbow Trout Immigration Rate Into The LCR Removal Reach

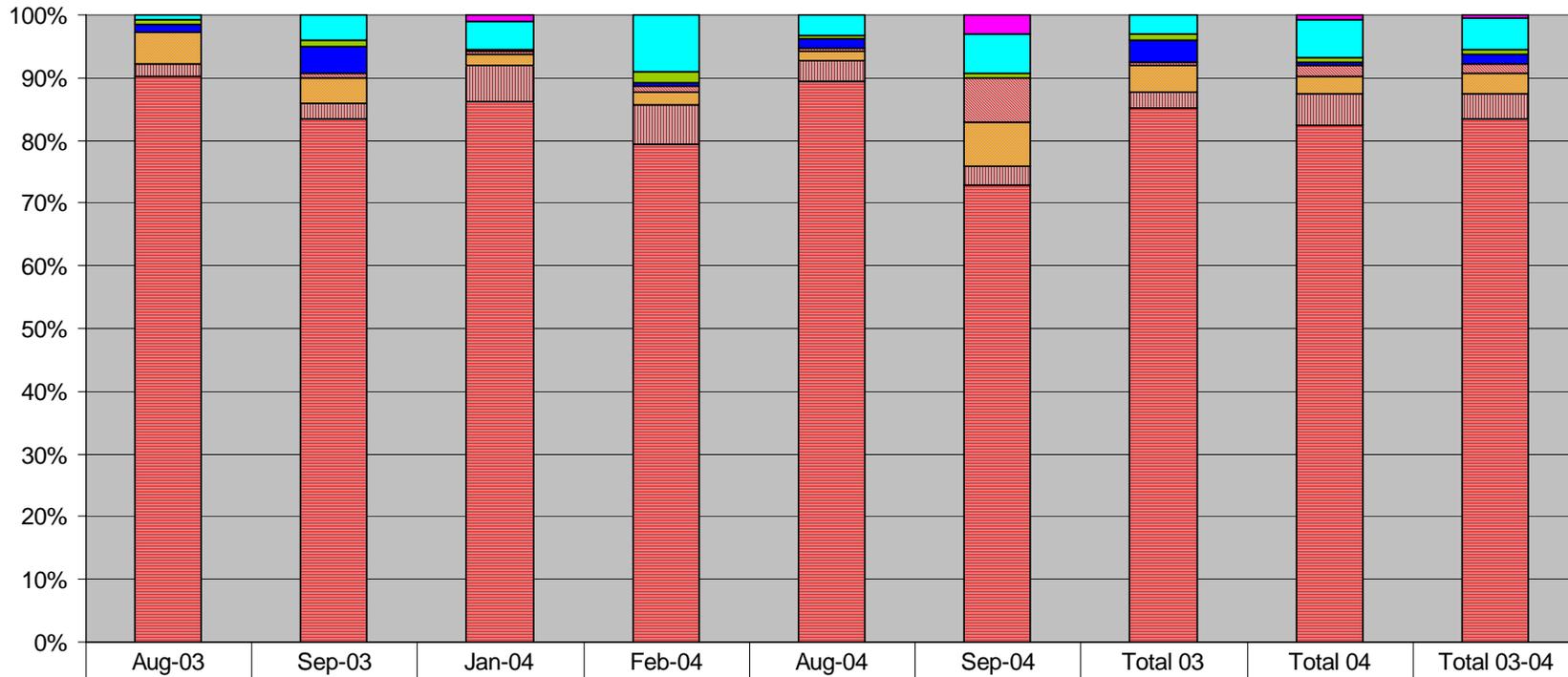


Depletion Passes versus Removal Efficiency in the LCR Removal Reach



# Lava-Chuar to Tanner Removal Reach Results

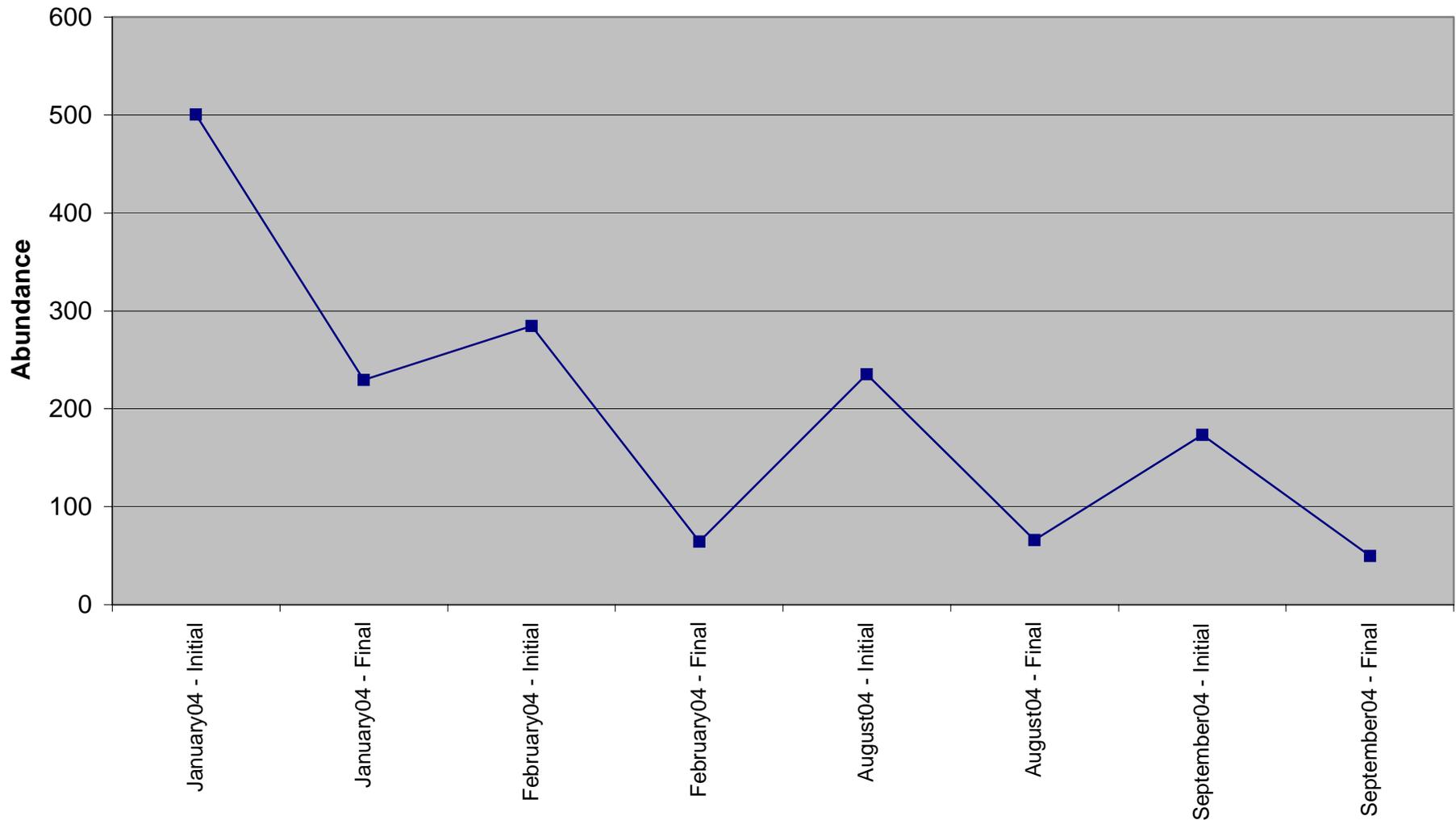
Electrofishing Catch by Species and Month within the Lava Chuar to Tanner Removal Reach



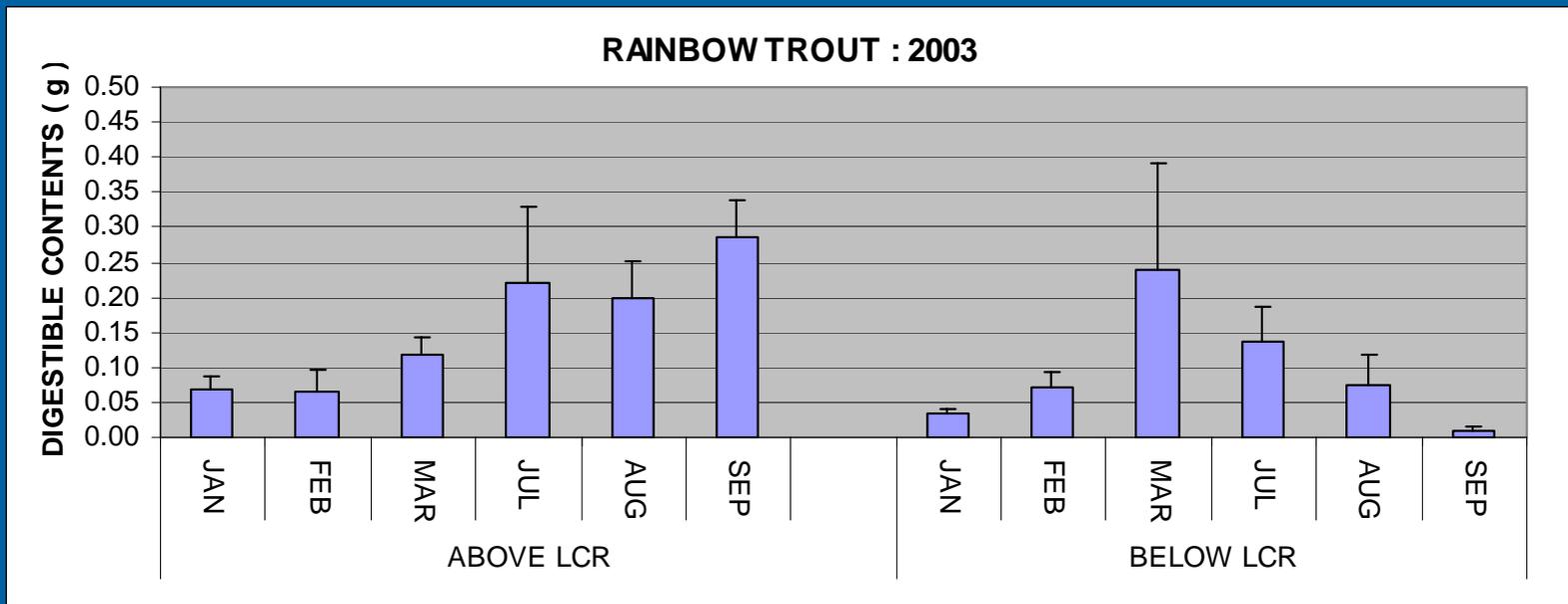
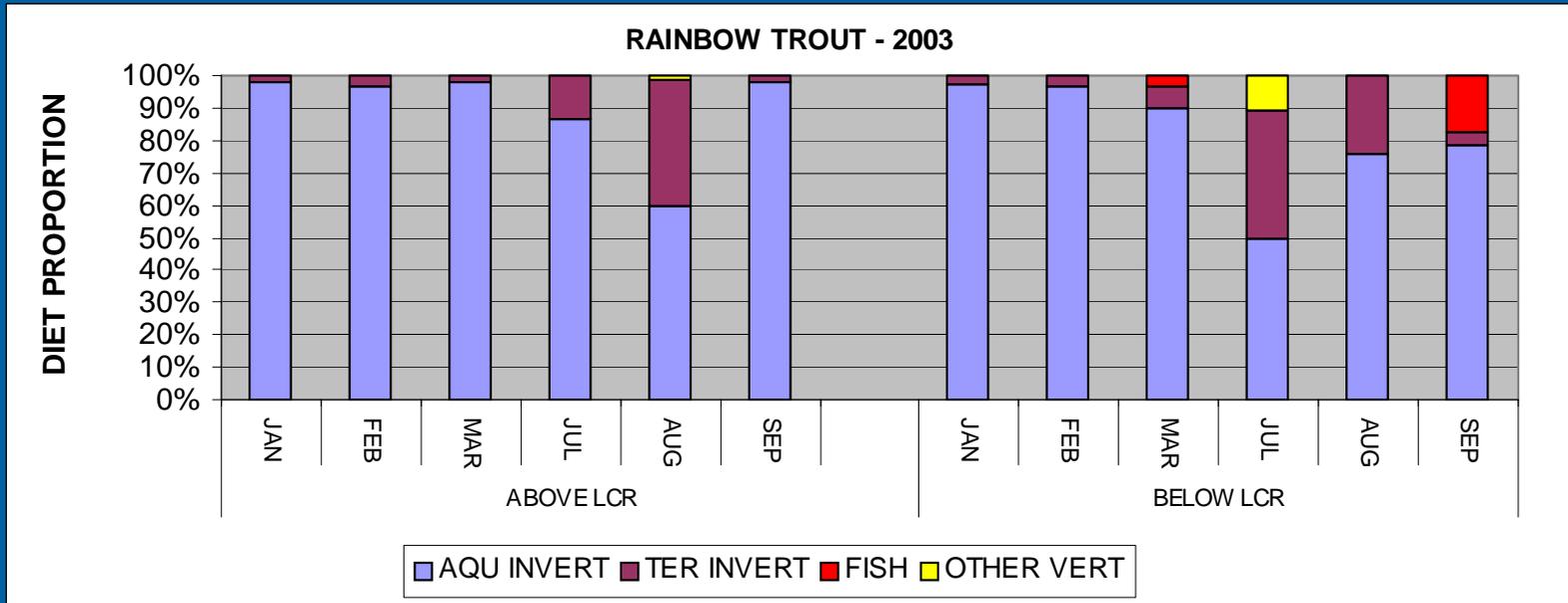
	Aug-03	Sep-03	Jan-04	Feb-04	Aug-04	Sep-04	Total 03	Total 04	Total 03-04
Speckled Dace			3			5	0	8	8
Flannelmouth Sucker	1	15	14	25	6	11	16	56	72
Humpback Chub	1	4	1	5	1	1	5	8	13
Bluehead Sucker	2	16		1	3		18	4	22
Fathead Minnow		3	2	3	1	12	3	18	21
Common Carp	7	15	5	6	3	12	22	26	48
Brown Trout	3	9	18	17	6	5	12	46	58
Rainbow Trout	128	312	271	220	169	124	440	784	1224

# Lava Chuar to Tanner Removal Reach Rainbow Trout Abundance

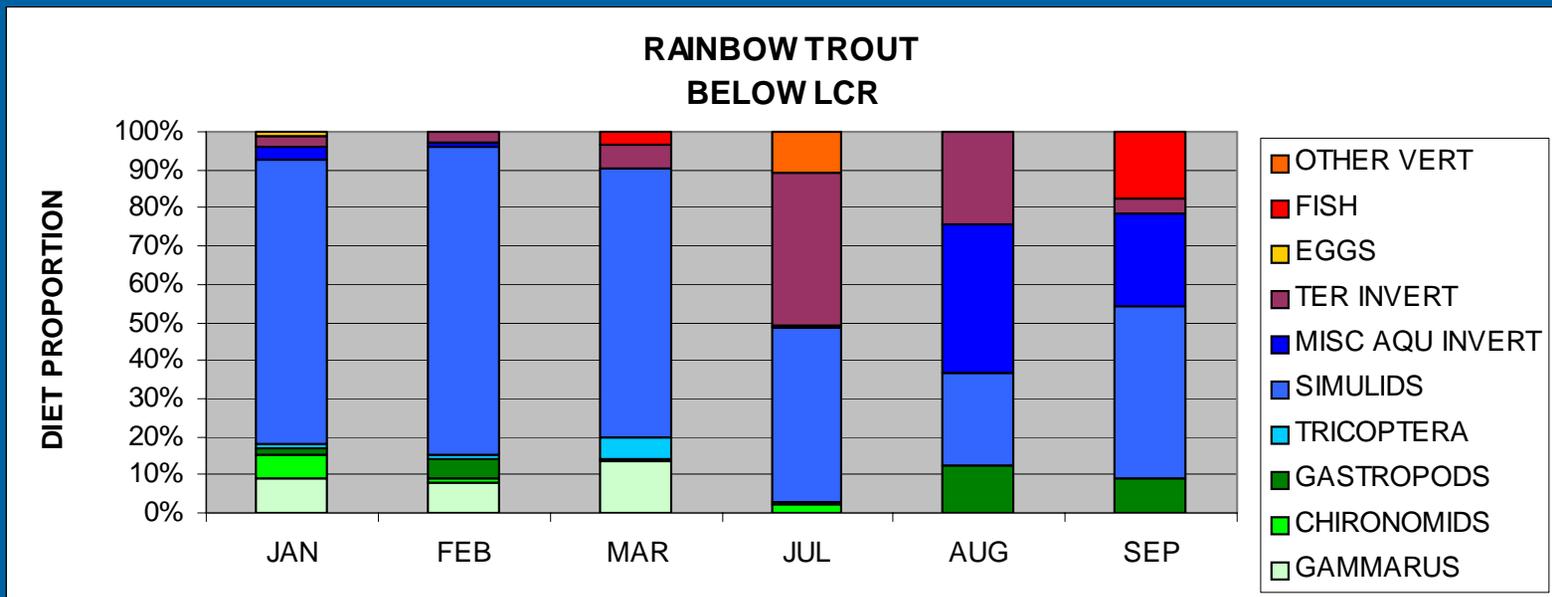
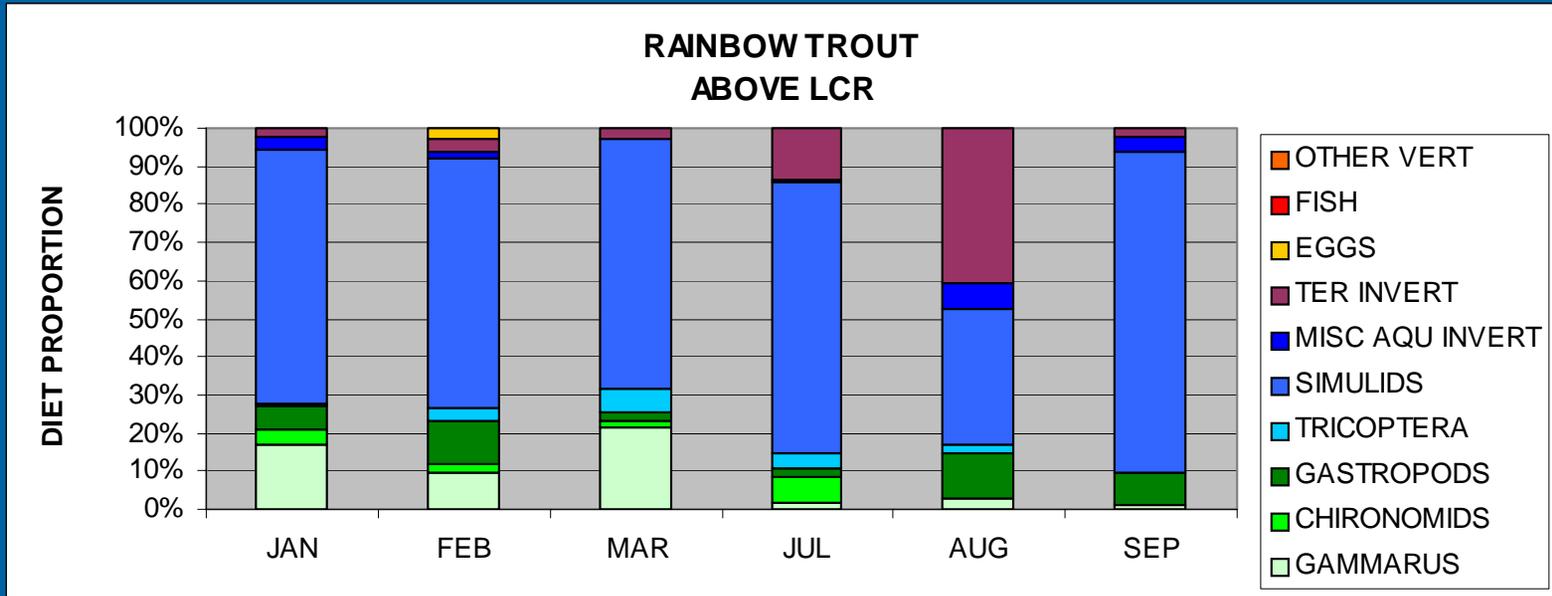
Rainbow Trout Abundance in the Lava-Chuar to Tanner Removal Reach



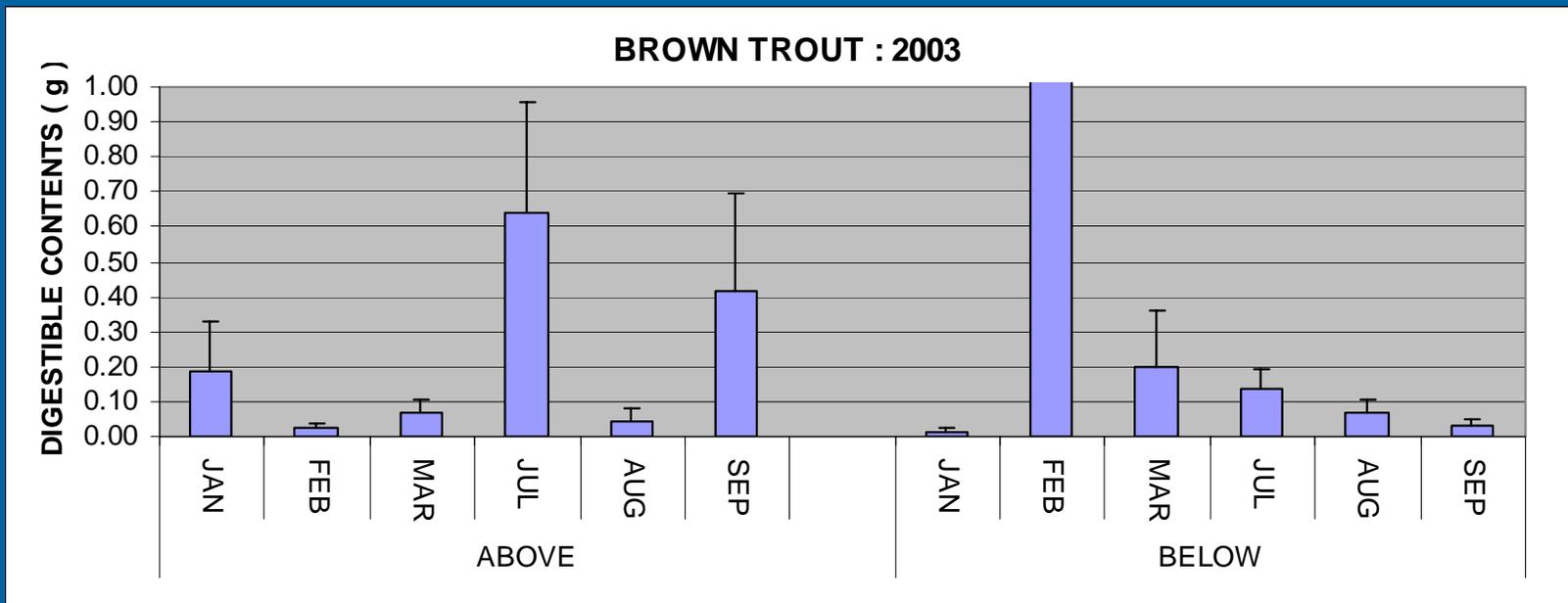
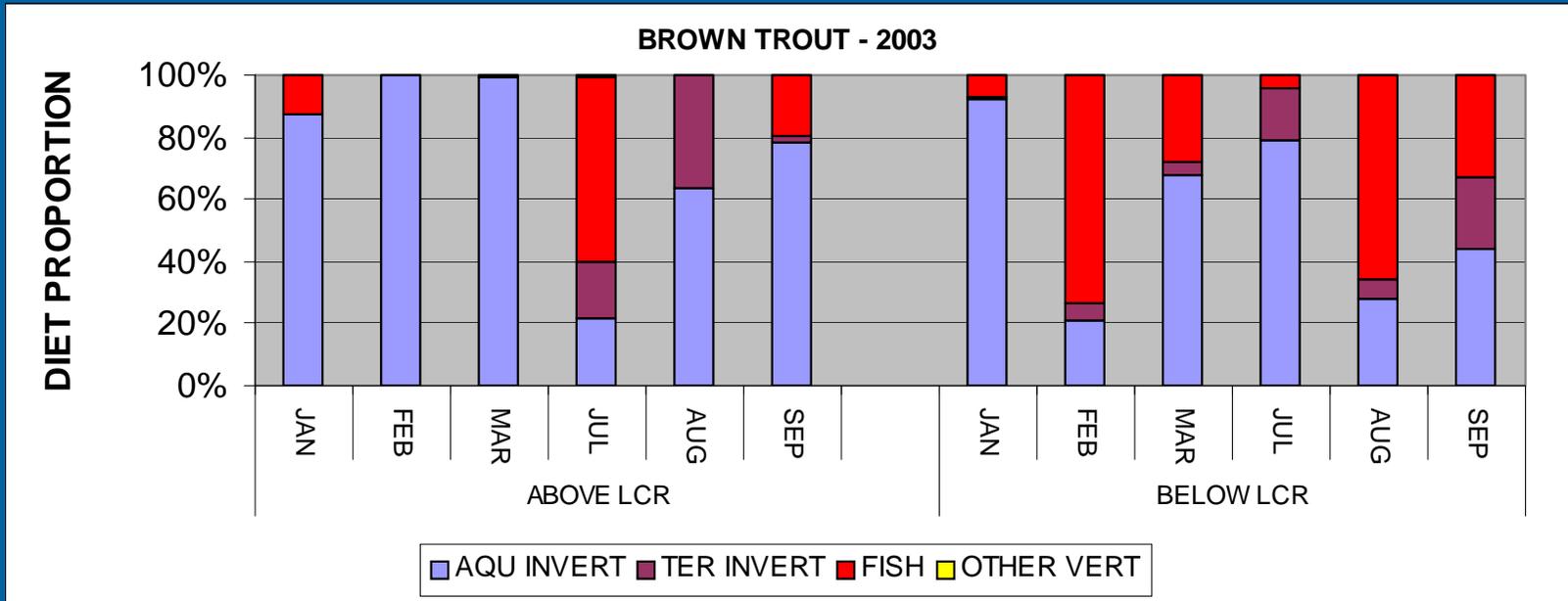
# Rainbow Trout Diet



# Rainbow Trout Diet

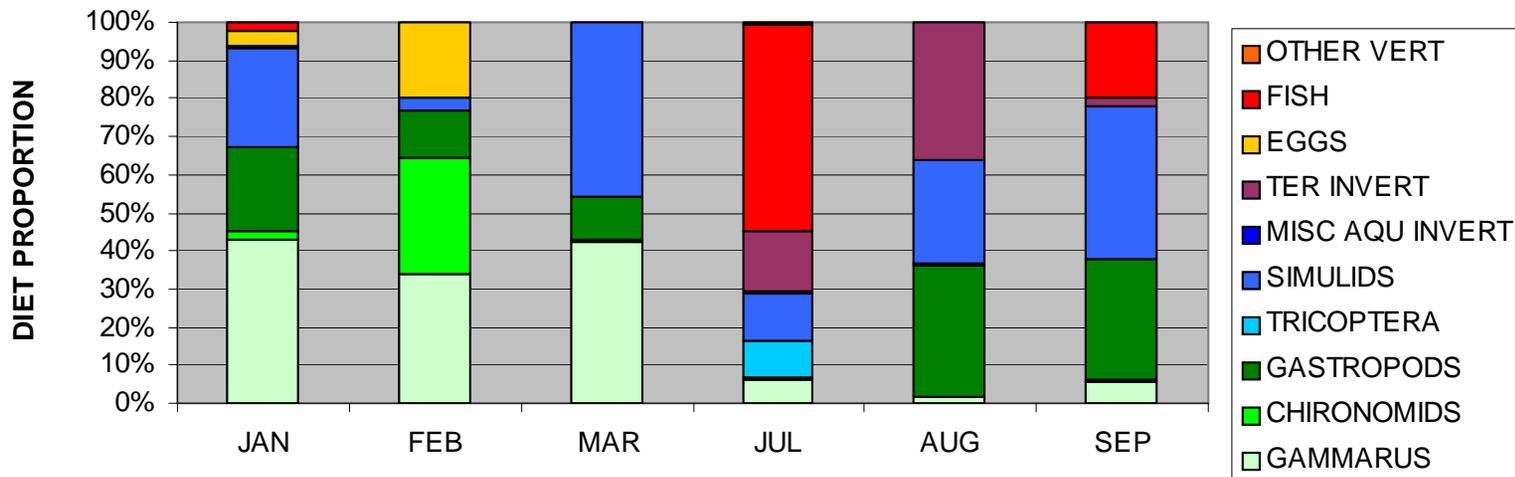


# Brown Trout Diet

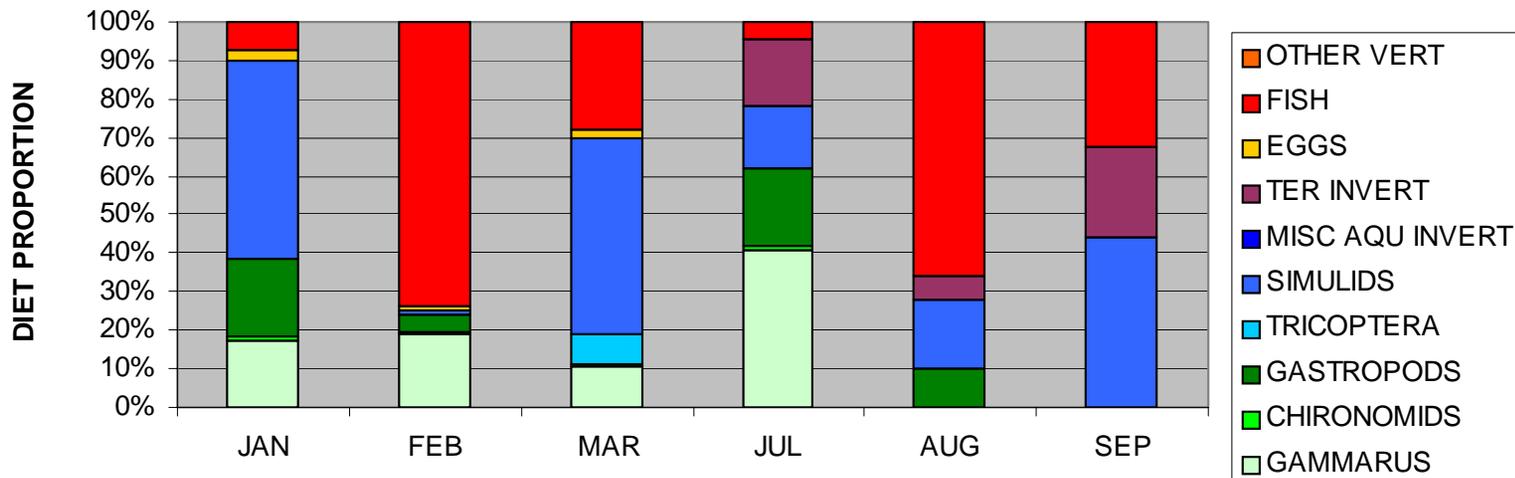


# Brown Trout Diet

## BROWN TROUT ABOVE LCR

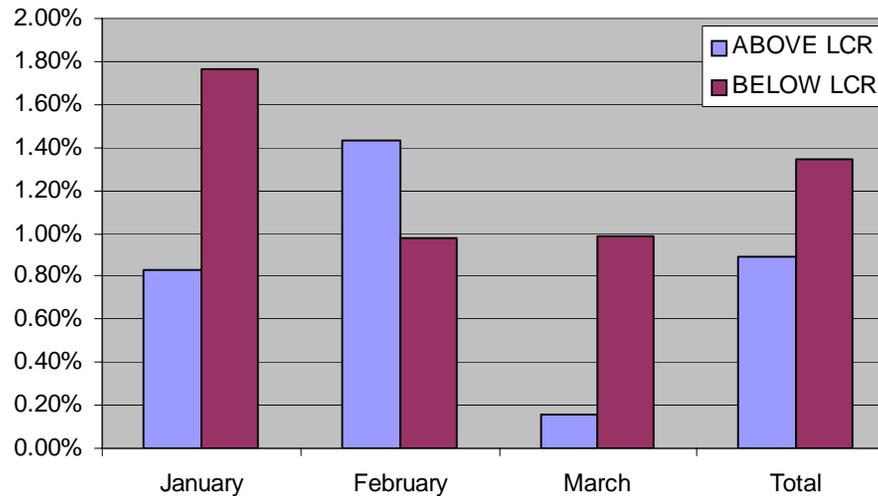


## BROWN TROUT BELOW LCR



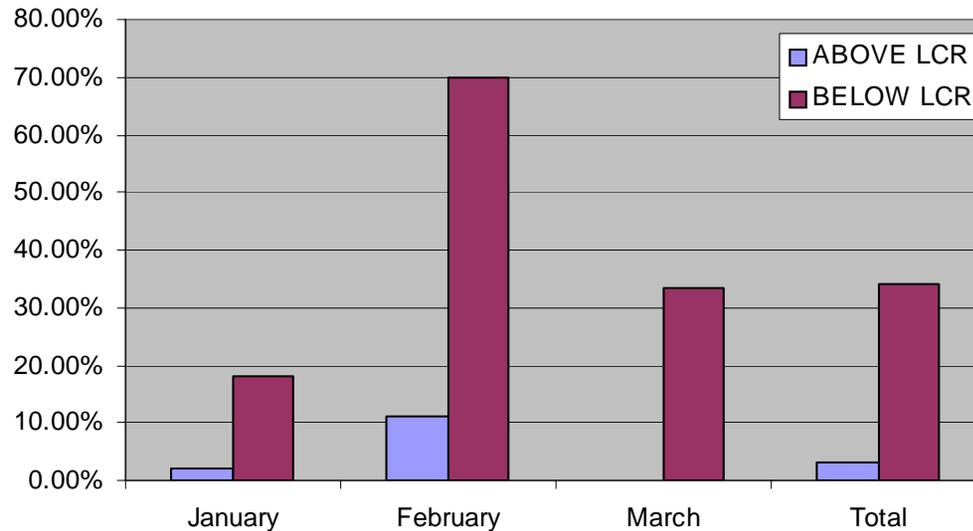
# Predation Assessment Results: Rainbow Trout

Rainbow Trout (>250 mm)		Observations		Estimated Parameters			Predator Characteristics		Population Characteristics	
Date	Location	$x_p$	N	Pred %	SE <sub>p</sub>	C <sub>v</sub>	Mean TL <sub>PREP</sub>	Median TL <sub>PREP</sub>	Mean TL <sub>POP</sub>	Median TL <sub>POP</sub>
JANUARY	Above LCR	18	2177	0.83%	0.094%	0.235	346	337	334	336
	Below LCR	9	510	1.76%	0.338%	0.330	344	339	330	333
FEBRUARY	Above LCR	16	1120	1.43%	0.178%	0.248	350	353	335	337
	Below LCR	1	205	0.98%	0.579%	0.704	315	-	286	324
MARCH	Above LCR	1	637	0.16%	0.157%	0.999	340	-	333	334
	Below LCR	1	101	0.99%	0.988%	0.995	470	-	329	330
COMBINED	Total	46	4750	0.97%	0.055%	0.147	342	338	334	335
	Above LCR	35	3934	0.89%	0.062%	0.168	340	338	330	332
	Below LCR	11	816	1.35%	0.222%	0.299	350	337	334	336

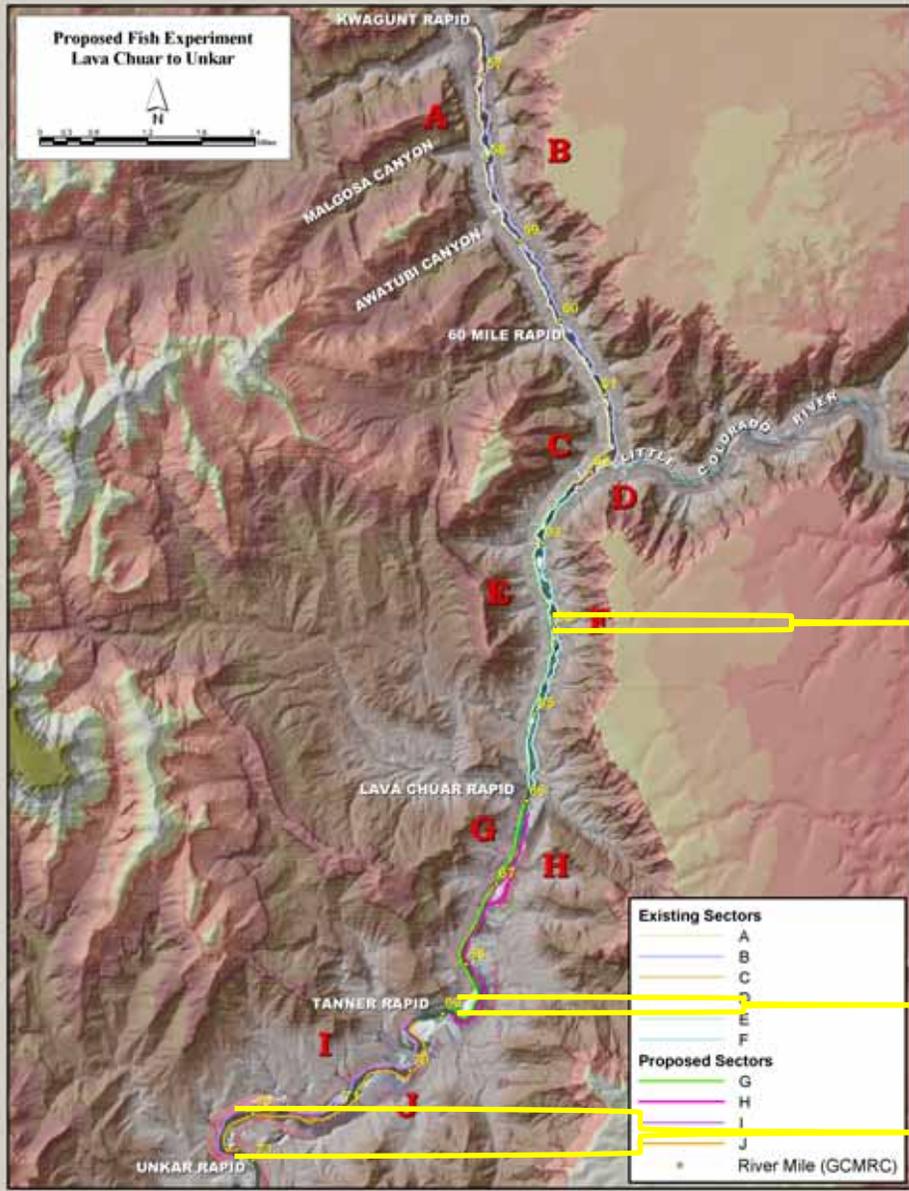


# Predation Assessment Results: Brown Trout

Brown Trout (>250 mm)		Observations		Estimated Parameters			Predator Characteristics		Population Characteristics	
Date	Location	X <sub>P</sub>	N	Pred %	SE <sub>P</sub>	C <sub>V</sub>	Mean TL <sub>PRED</sub>	Median TL <sub>PRED</sub>	Mean TL <sub>POP</sub>	Median TL <sub>POP</sub>
JANUARY	Above LCR	1	49	2.04%	2.03%	0.990	414	414	304	295
	Below LCR	4	22	18.18%	6.11%	0.452	376	395	312	286
FEBRUARY	Above LCR	1	9	11.11%	10.79%	0.943	407	437	386	356
	Below LCR	7	10	70.00%	12.04%	0.207	434	457	394	357
MARCH	Above LCR	0	6	0.00%	-	-	-	-	378	295
	Below LCR	3	9	33.33%	13.21%	0.471	385	384	340	297
COMBINED	Total	16	105	15.24%	1.83%	0.230	409	426	329	302
	Above LCR	2	64	3.13%	1.84%	0.696	426	-	322	303
	Below LCR	14	41	34.15%	4.25%	0.217	407	415	338	298



# Hoopnet Sampling Reaches



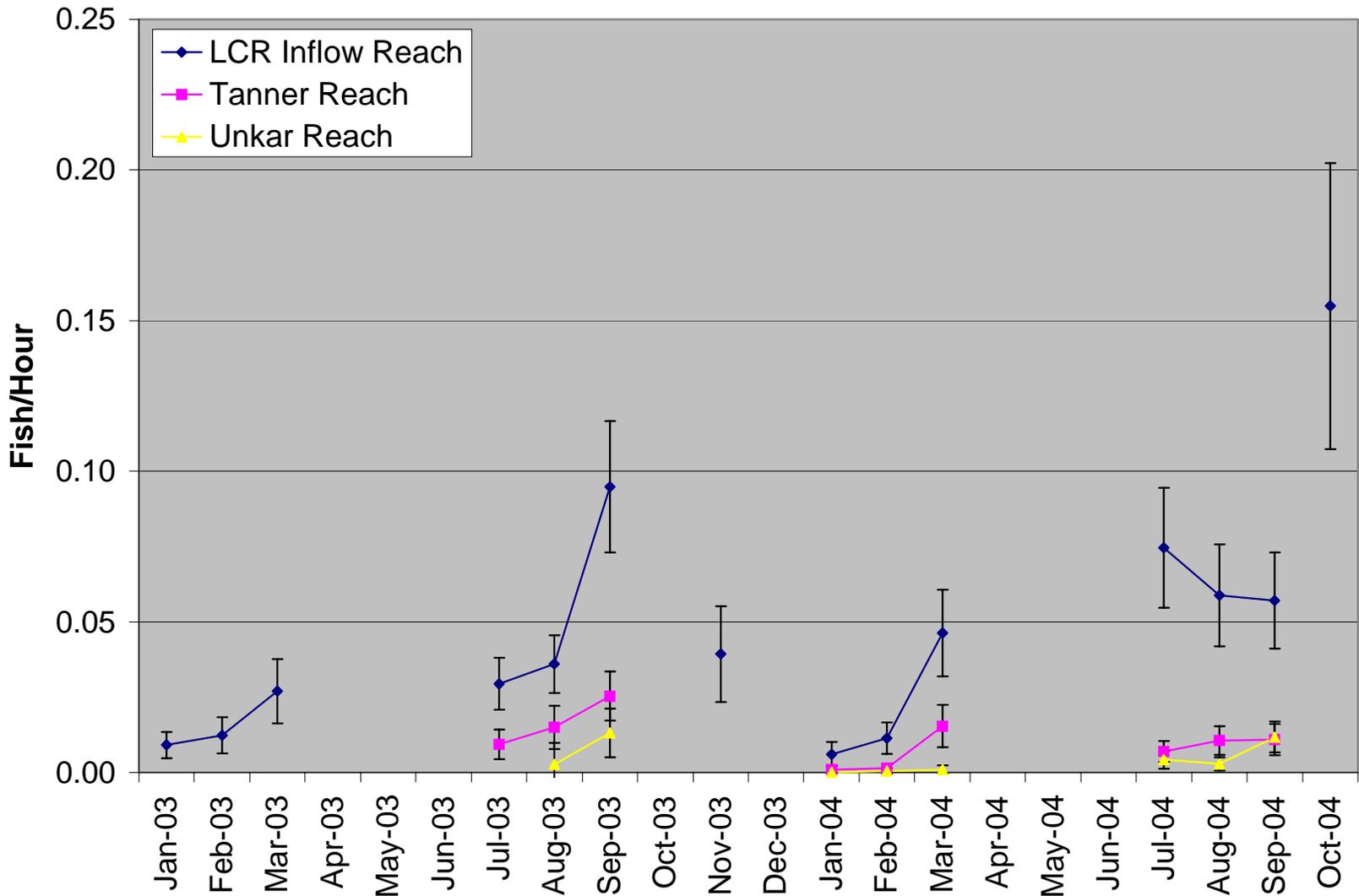
Little Colorado River Inflow  
Hoopnet Sampling Reach

Tanner Hoopnet Sampling  
Reach

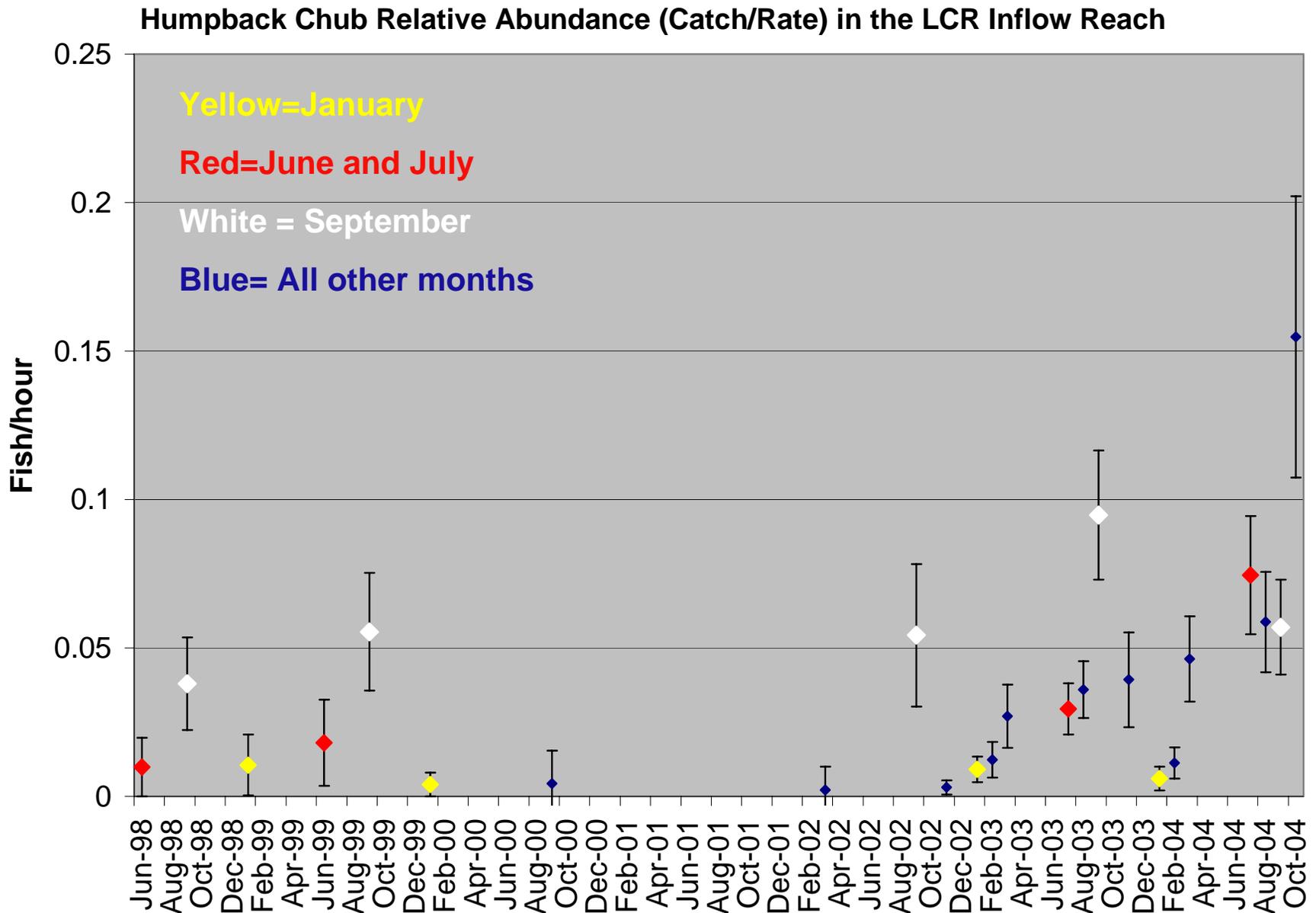
Unkar Hoopnet Sampling  
Reach

# Hoopnet Sampling Results

## Humpback Chub Relative Abundance (Catch/Rate)



# Hoopnet Sampling Results



## Additional Work

- Continue development of abundance estimator to incorporate turbidity
- Construct Jolly-Seber abundance estimator in Control Reach
- Complete Diet and Predation sample processing and analyses for 2004

# 2003-04 Preliminary Conclusions

- **Non-native Removal Efficacy**

- Reduction of non-native catch composition proportion from ~95% to ~65%
- Continued persistent reduction of RBT to between 10% and 30% of January 2003 abundance.

- **Diet and Predation**

- RBT Dominant Prey item aquatic invertebrates (Simuliids, Black Flies)
- Temporal and spatial changes in RBT diet
  - Increased terrestrial component in summer
  - Increased biomass consumed above the LCR
- BNT dominant prey item variable (aquatic invertebrates and fish)
- Temporal and spatial changes in BNT diet
  - Increased terrestrial component in summer
  - Less piscivorous above the LCR (likely related to native fish abundance below the LCR)
  - Highly variable total biomass consumed related to composition of fish
- Predation assessment lab work still ongoing
  - Results for all of 2003-04 be presented at the October Science Symposium

## 2003-04 Preliminary Conclusions

- **Effect of Non-Native Removal on Humpback Chub Population Dynamics**
  - Relative abundance assessments (hoopnetting catch-rate) no substitute for stock assessments to determine recruitment. Assessment of 2003 cohort will require 2006 and 2007 monitoring data.
  - Largest relative abundance of juvenile humpback chub observed in last 6 years occurred in Fall 03 and Fall 04. Additionally, FMS and BHS displaying overall positive trends in relative abundance.
  - However, these trends could be unrelated and spuriously correlated with mechanical removal (increased temperature). Must contrast (turn off) mechanical removal to find out.

# Uncertainties and Recommendations

- At this point in time we do not have conclusive data to suggest that mechanical removal efforts are providing any positive trends in HBC recruitment
- Recommend continuing mechanical removal for at least one additional year with ultimate length of this treatment block determined within the context of a blocked experimental design
- We recommend discontinuing mechanical removal within the context of a well designed experiment in order to increase the power of detecting a response of this treatment factor.
- We recommend that the LTEP ad hoc consider the potential for confounding in subsequent experimental planning efforts
  - Examples of Confounding Factors:
    - Unanticipated increase in water temperature associated with low reservoir level
    - Variability in LCR juvenile HBC production
    - Variability in timing, magnitude, and duration of LCR flooding



# Results of Hoopnet Sampling to Examine Changes in Juvenile Humpback Chub Abundance and Size Before and After the 2004 Experimental High Flow

Lew Coggins, GCMRC

Bill Persons, AGFD

Mike Yard, HSS

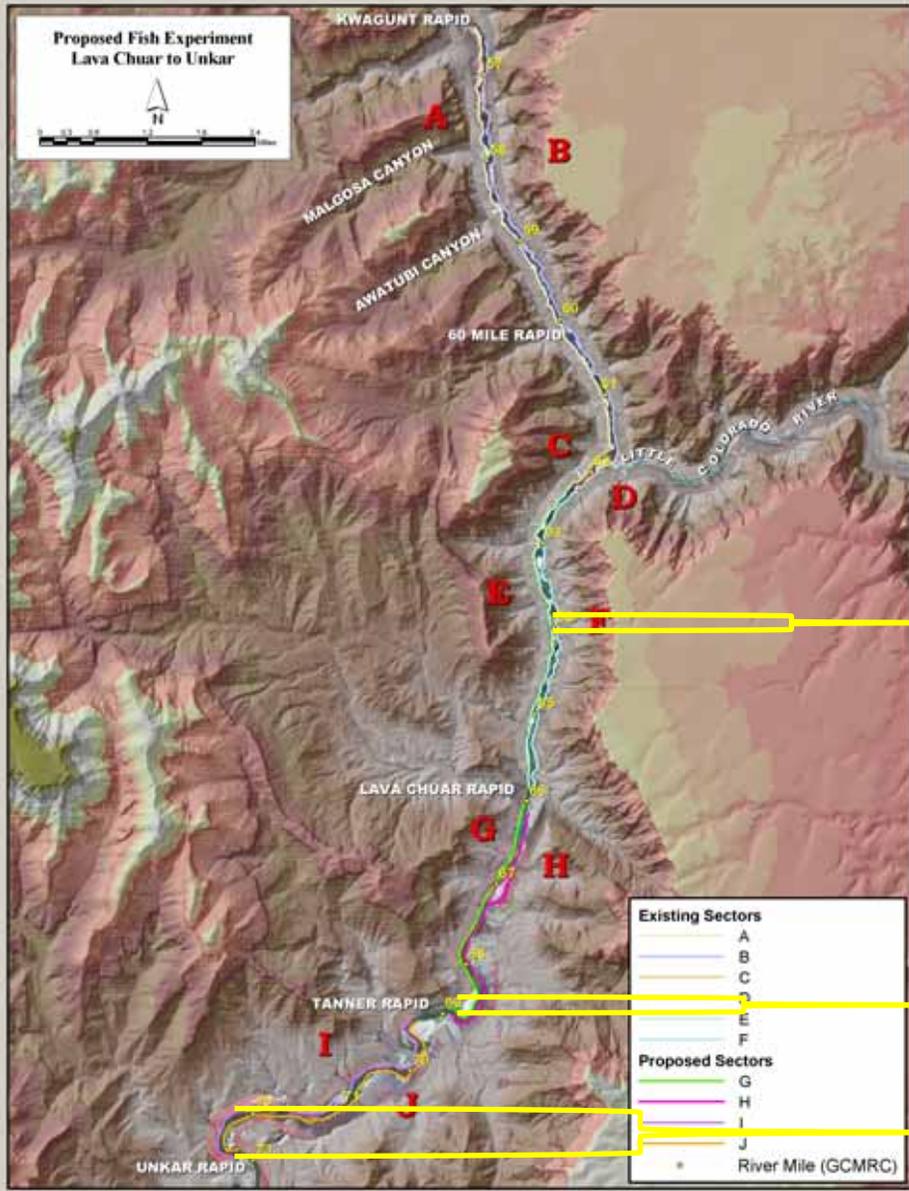
Randy Van Haverbeke, USFWS

Josh David, USFWS

## Experimental Design

- Hoopnet sampling to be conducted for three days before and after the experimental high flow.
- Sampling locations and protocols identical to those used during mechanical removal operation.
- Dam releases constant 8000 cfs during both sampling events.

# Hoopnet Sampling Reaches



Little Colorado River Inflow  
Hoopnet Sampling Reach

Tanner Hoopnet Sampling  
Reach

Unkar Hoopnet Sampling  
Reach

# Hoopnet Sampling Results – Catch Composition

## Pre EHF Catches by Location

Location	Species										
	HBC	FMS	BHS	RBT	BNT	FHM	CCF	BBH	YBH	CRP	
LCR	208	4	3	3	0	3	0	0	0	0	
Tanner	92	9	4	1	0	5	0	0	0	0	
Unkar	12	15	2	3	3	0	0	0	0	0	
<b>Total Pre</b>	<b>312</b>	<b>28</b>	<b>9</b>	<b>7</b>	<b>3</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	

## Post EHF Catches by Location

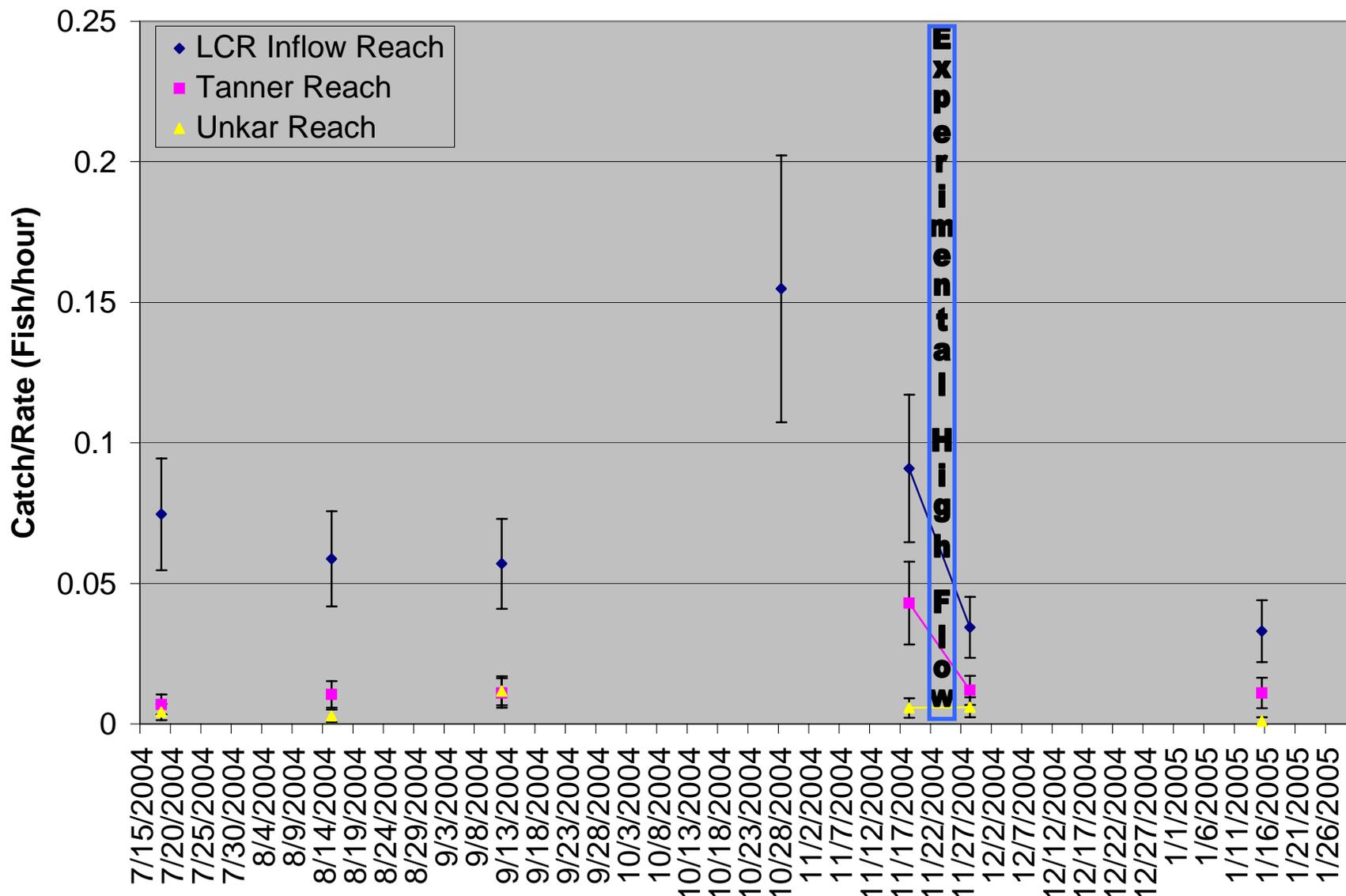
Location	Species										
	HBC	FMS	BHS	RBT	BNT	FHM	CCF	BBH	YBH	CRP	
LCR	75	5	2	0	0	6	4	0	0	0	
Tanner	26	1	2	0	0	3	1	0	1	1	
Unkar	13	5	1	4	0	0	3	1	0	0	
<b>Total Post</b>	<b>114</b>	<b>11</b>	<b>5</b>	<b>4</b>	<b>0</b>	<b>9</b>	<b>8</b>	<b>1</b>	<b>1</b>	<b>1</b>	

## Post/Pre Fraction

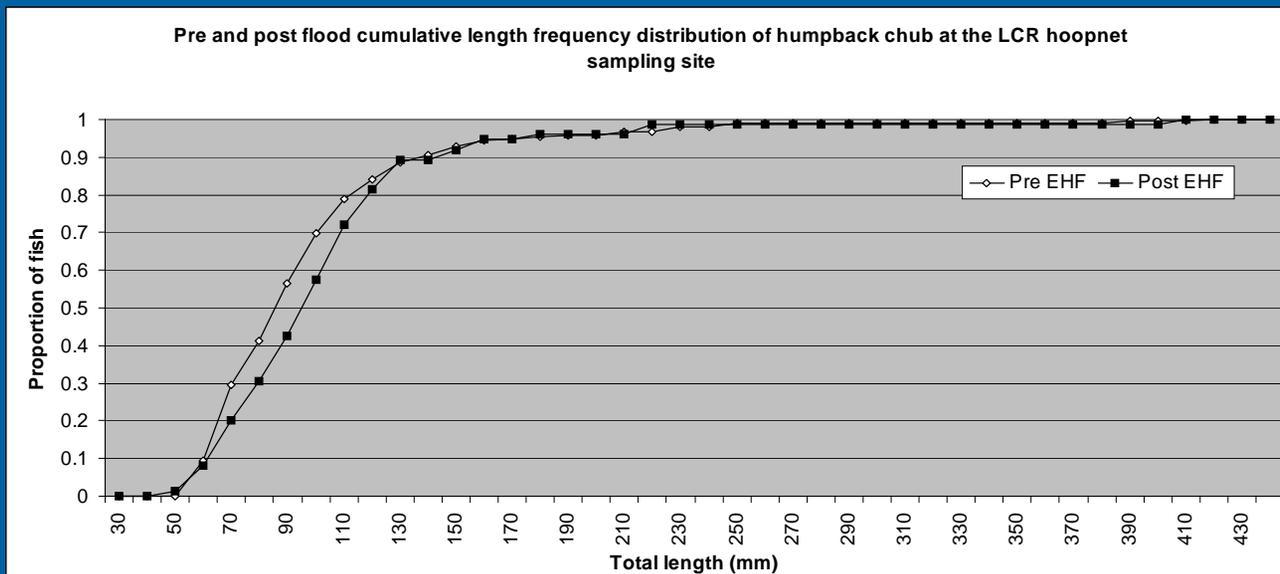
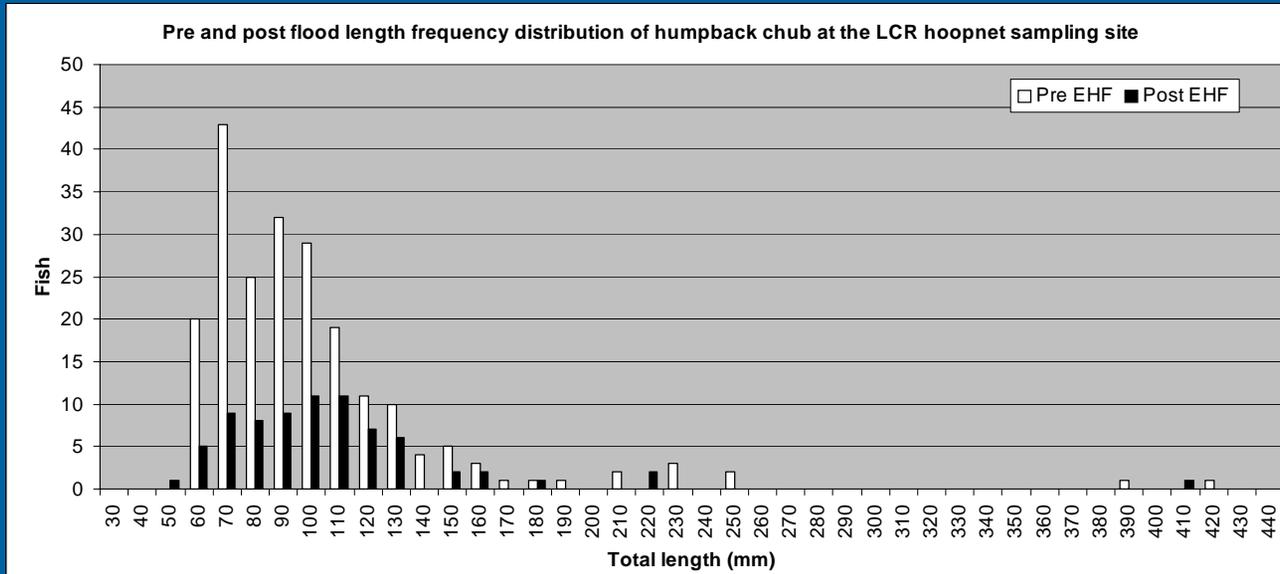
Location	Species										
	HBC	FMS	BHS	RBT	BNT	FHM	CCF	BBH	YBH	CRP	
LCR	36%	125%	67%	0%		200%					
Tanner	28%	11%	50%	0%		60%					
Unkar	108%	33%	50%	133%	0%						
<b>Total Post</b>	<b>37%</b>	<b>39%</b>	<b>56%</b>	<b>57%</b>	<b>0%</b>	<b>113%</b>					

# Hoopnet Sampling Results - Abundance

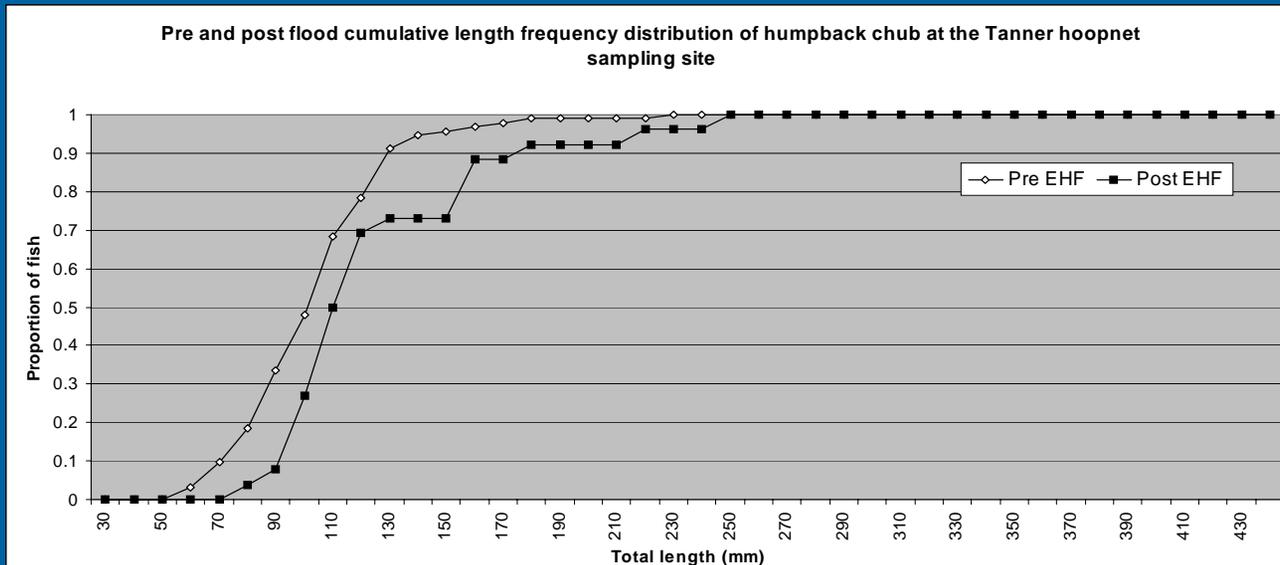
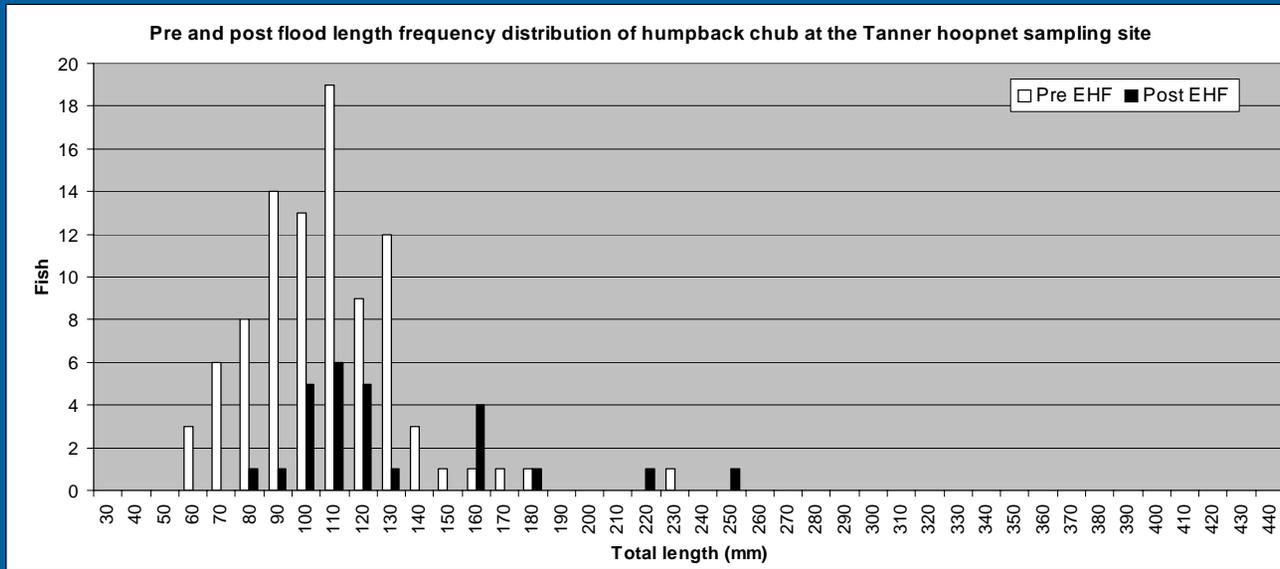
## Humpback Chub Relative Abundance (Catch/Rate)



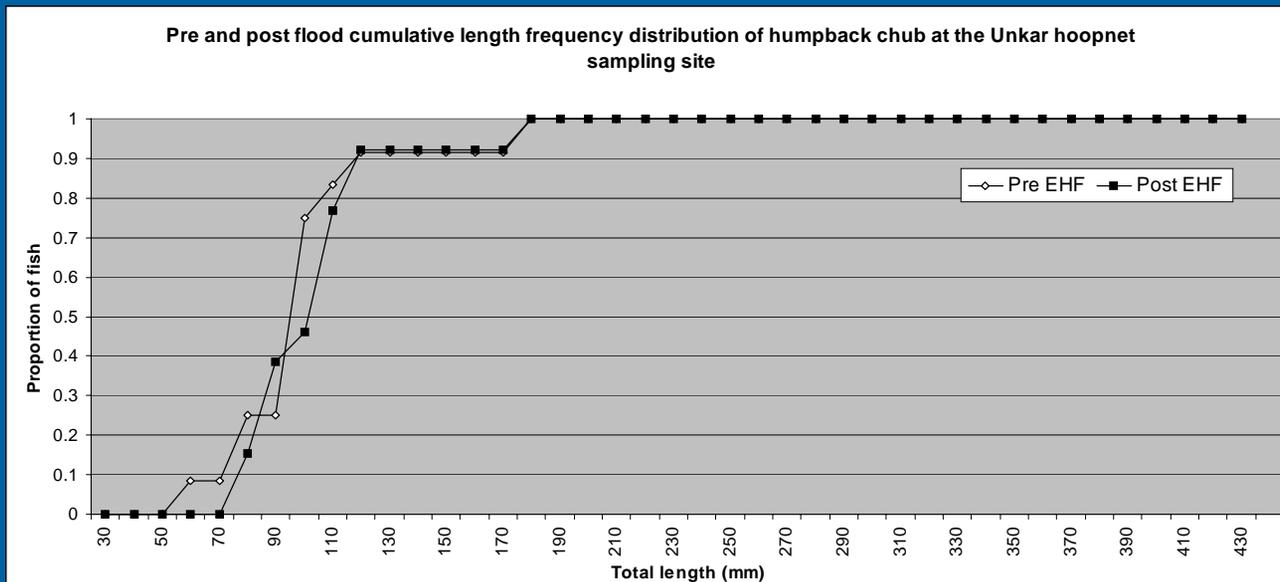
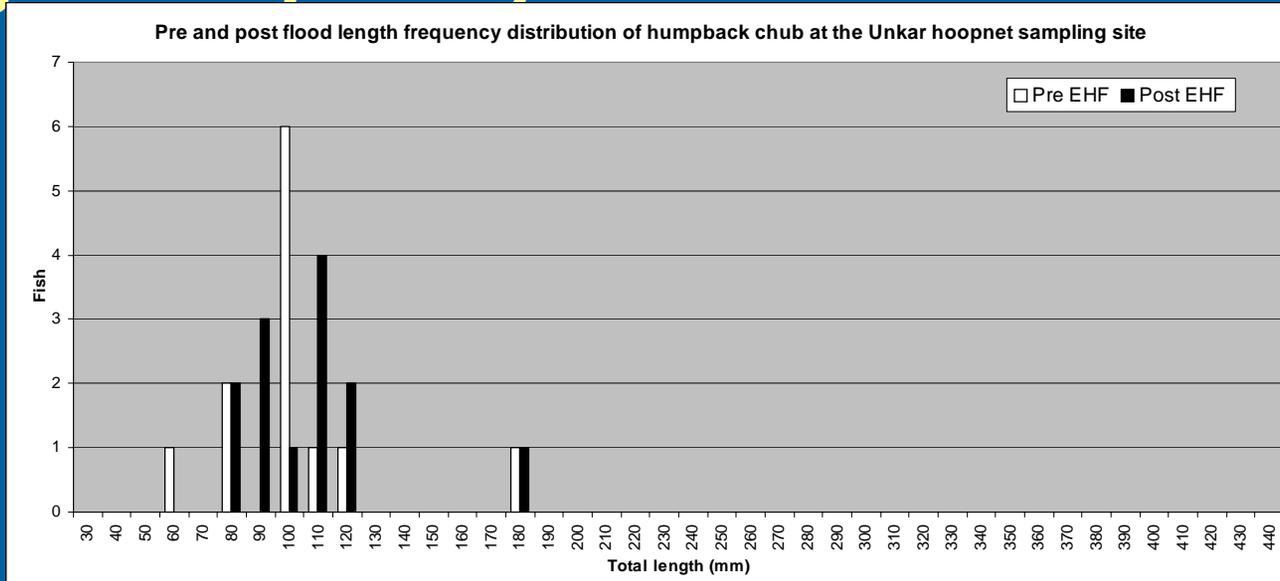
# Hoopnet Sampling Results – LCR Length Frequency



# Hoopnet Sampling Results – Tanner Length Frequency



# Hoopnet Sampling Results – Unkar Length Frequency



# Preliminary Conclusions

- Relative Abundance of HBC declined by approximately 2/3 before and after the EHF in the LCR and Tanner reaches. Relative abundance of HBC was unchanged in the Unkar reach before and after the EHF.
- Length frequency distribution of HBC in the LCR and Tanner reaches was shifted to larger fish before and after the EHF suggesting a reduction in smaller fish following the EHF.
- Caveat: Concurrent with the EHF the LCR flooded. Therefore, sampling conditions were not identical before and after the EHF (elevated turbidity in the Colorado River).

# Preliminary Conclusions

- Preliminary results suggest that the EHF may have been detrimental to juvenile HBC rearing in the LCR and Tanner Reaches
- Adaptive Management Practitioners should be cognizant of the potential detrimental affects of EHF's on juvenile HBC in the mainstem Colorado River.
- The EHF may make it more difficult to determine the effect of mechanical removal on the population dynamics of HBC unless an adequate long term experimental design is adopted to disentangle the affects of multiple types of experimental actions.

# Power Analysis for Estimating a Binomial Proportion

