

# Mechanical Removal of Non-Native Fishes in the Colorado River within Grand Canyon: An Update on 2003 Operations and Results



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# Background

- Jan 2002, AMWG directed GCMRC to develop a plan of experimental flows: *“In concert with RPA flows for native fish during 2002-2003 request that the GCMRC, in consultation with the TWG, design an experimental flows sequence that tests hypotheses for conservation of sediment. Report to AMWG in April 2002 on the proposed flow sequence.”*
- February 2002, GCMRC proposes a 16 year study to address questions related to providing better management of Sediment **AND** Native Fish.
- April 2002, AMWG recommends that the Secretary of Interior adopt the first two years of the 16 year experiment.
- December 2002, Secretary Norton approves the AMWG recommendation.
- January 2003, Project Initiated

# What GCMRC Recommended

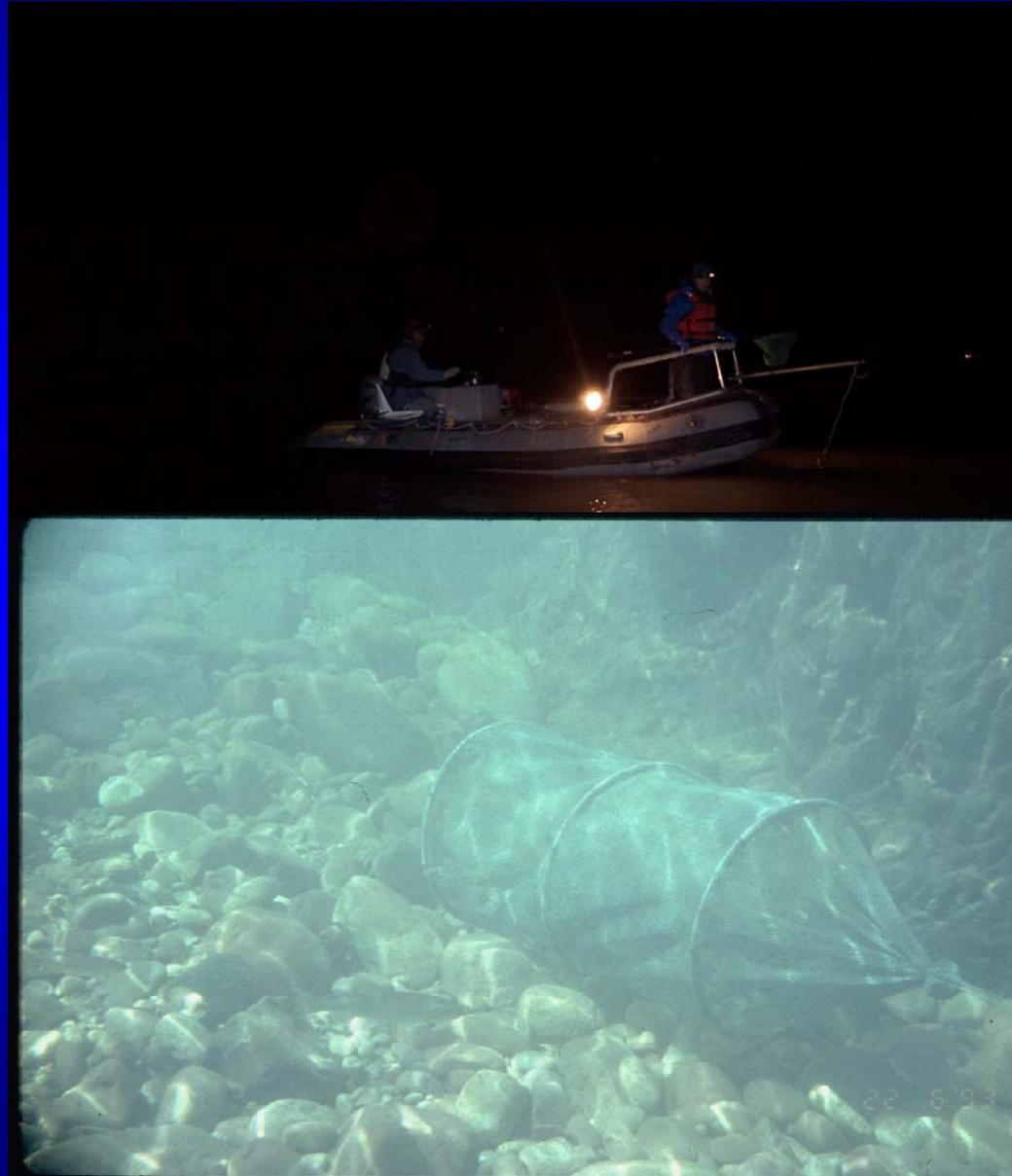
- Explore the interactions between non-native and native fish.
- Manipulate the abundance of non-native fish, primarily rainbow trout and brown trout. Do this two ways (treatments):
  - **Systemic:** Return to fluctuating flows for part of the year in order to reduce trout recruitment.
  - **Localized:** Mechanically remove non-native fish from important humpback chub habitat using electrofishing methods.
- Apply treatments in a block design to disentangle the effects of other factors.

# Objectives

- 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?
- 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? How many natives?

# Mechanical Removal Trips

- 4 years - 6 trips/year
  - Jan, Feb, Mar (Winter)
  - Jul, Aug, Sep (Summer)
- Sampling Methods:
  - Electrofishing
    - Control Reach
    - Removal Reach(s)
  - Hoopnetting
    - Removal Reaches
    - Estimate relative abundance of native fish (Juveniles).

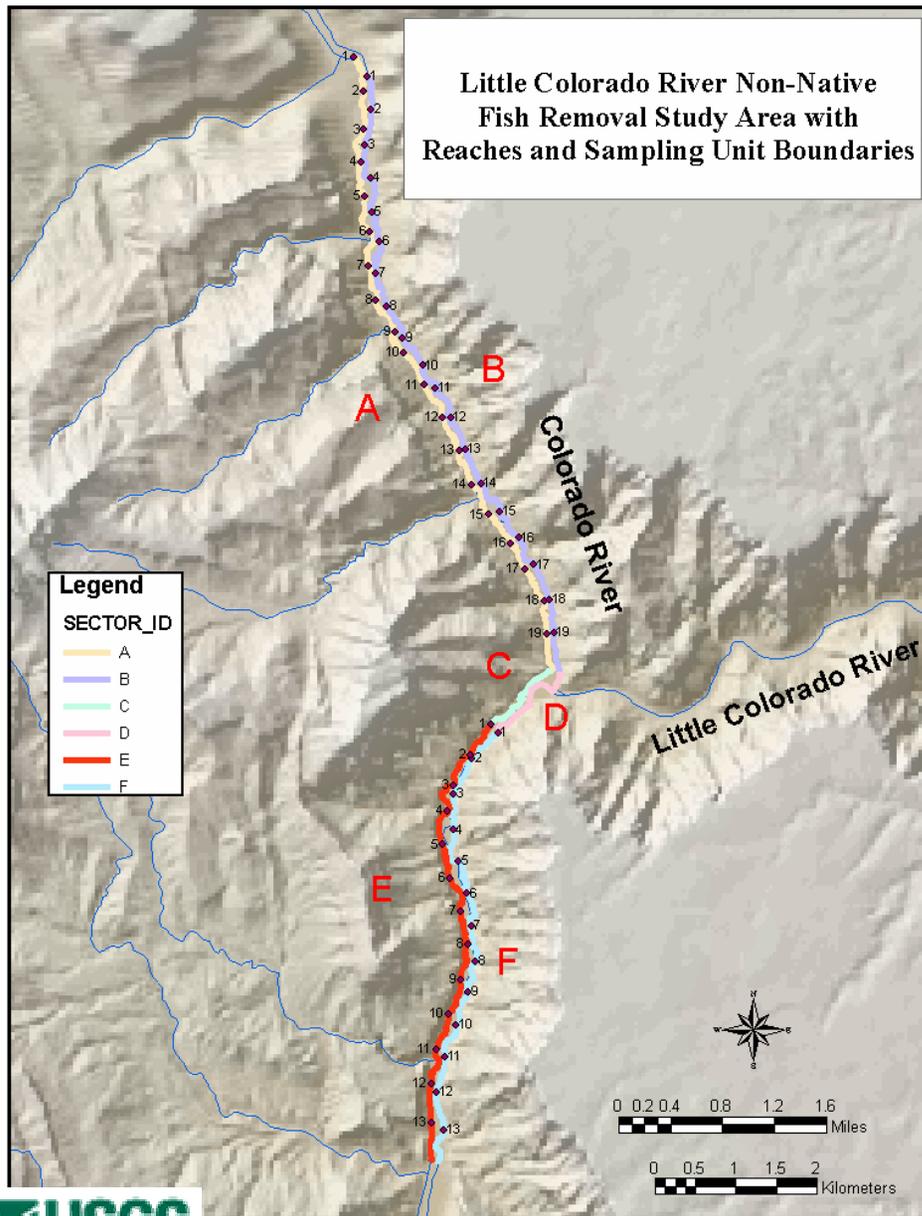


# Mechanical Removal Trips

- Depletion experimental design allows:
  - Estimate abundance of non-native fish at beginning and end of sampling trips.
  - Assess cumulative reduction of non-native fish overtime.
  - Estimate immigration rate of non-native into removal reach between trips.



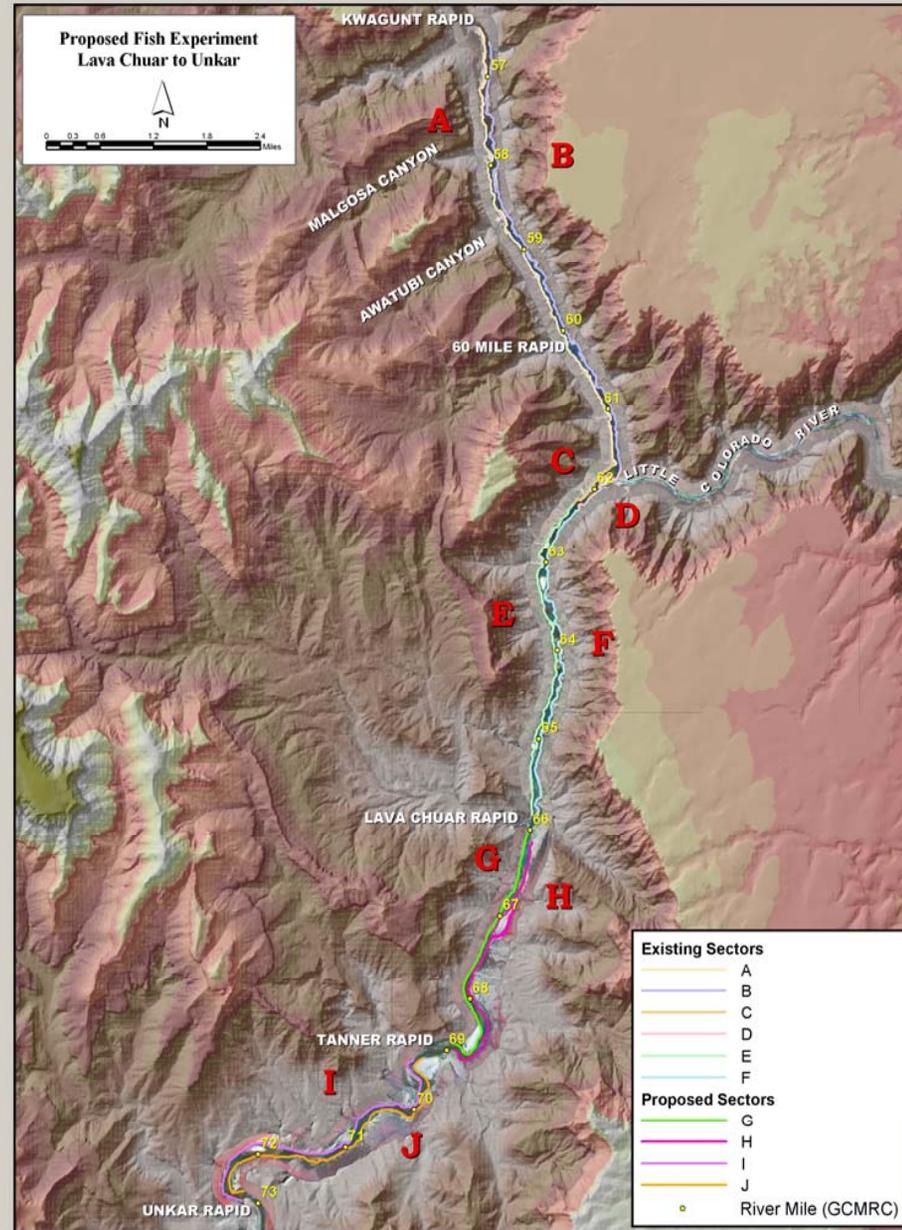
# Mechanical Removal Reach- Original Design



- January Trip:
  - 5 pass depletion in original reach (A-F)
- February Trip
  - 5 pass depletion in original reach (A-F)
- March Trip:
  - 5 pass depletion in original reach (A-F)

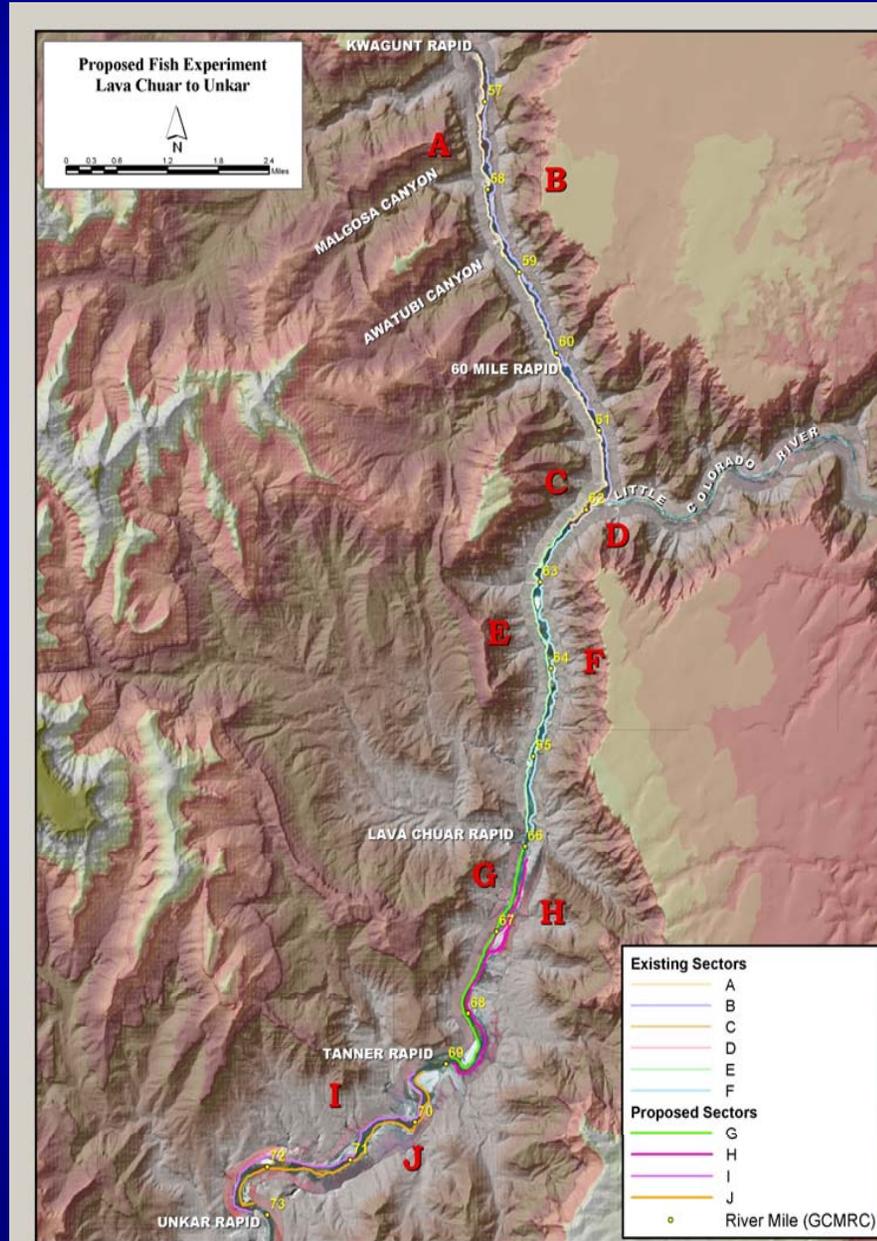
# Expanded Design

- Purpose - to increase the magnitude of the treatment effect to maximize chances for obtaining an unambiguous experimental result.
  - Increase the area where HBC and non-natives are believed to interact .
  - Provide a greater likelihood that the HBC stock assessment program will detect a change.
  - Will allow a more robust (time and area) sampling program of relative abundance (hoopnetting).



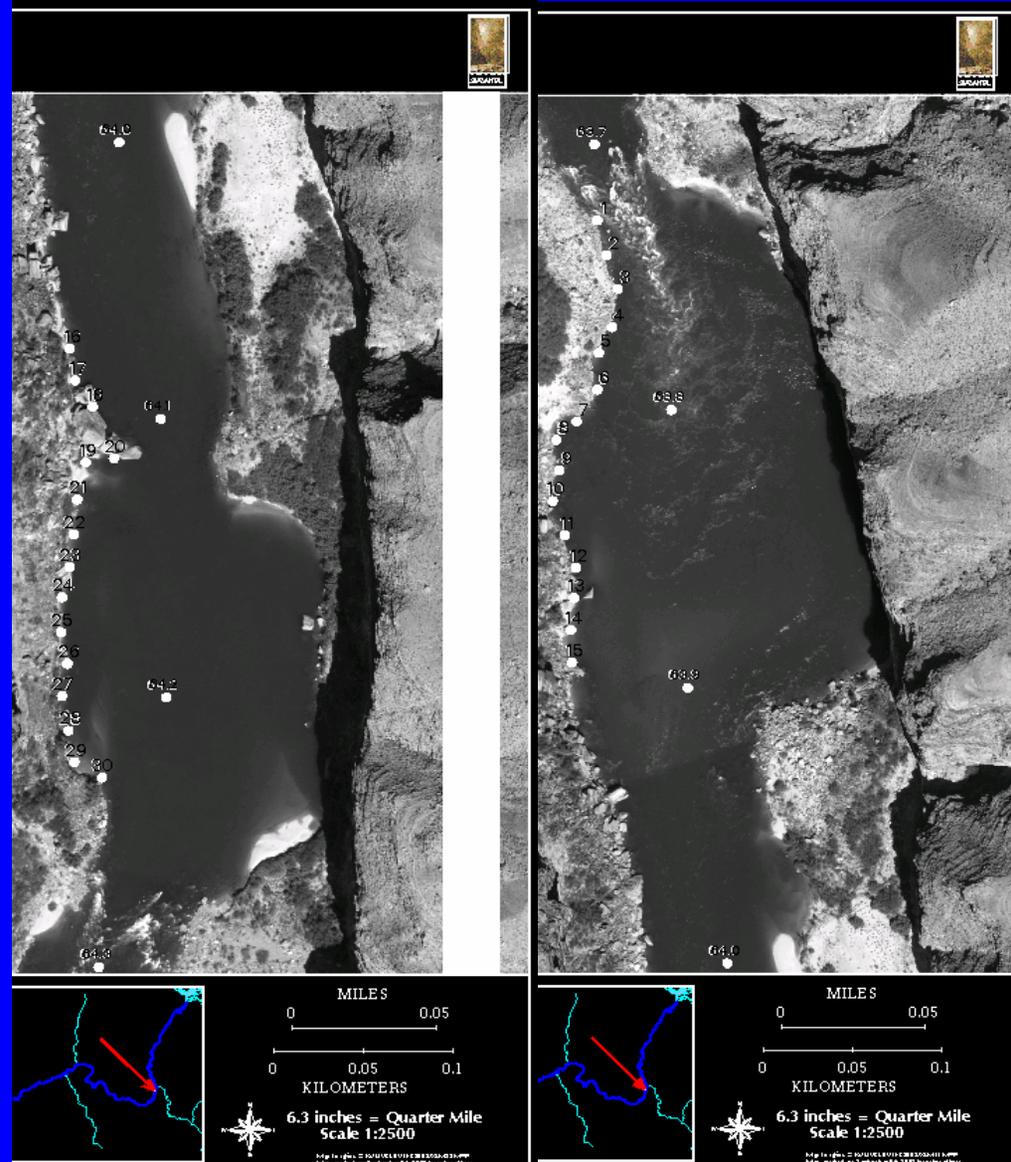
# Mechanical Removal Field Operations

- July Trip:
  - 5 pass depletion in original reach (A-F)
- August Trip:
  - 2 pass depletion in original reach (A-F)
  - 3 pass depletion in Lava Chuar to Tanner Reach (G-H)
  - 3 pass depletion in Tanner to Unkar Reach (I-J)
- September Trip:
  - 3 pass depletion in original reach (A-F)
  - 3 pass depletion in Lava Chuar to Tanner Reach (G-H).



# Hoopnetting

- Relative abundance estimates for juvenile HBC and other natives.
- 30 sets/site ~
  - LCR Inflow
  - Tanner
  - Unkar



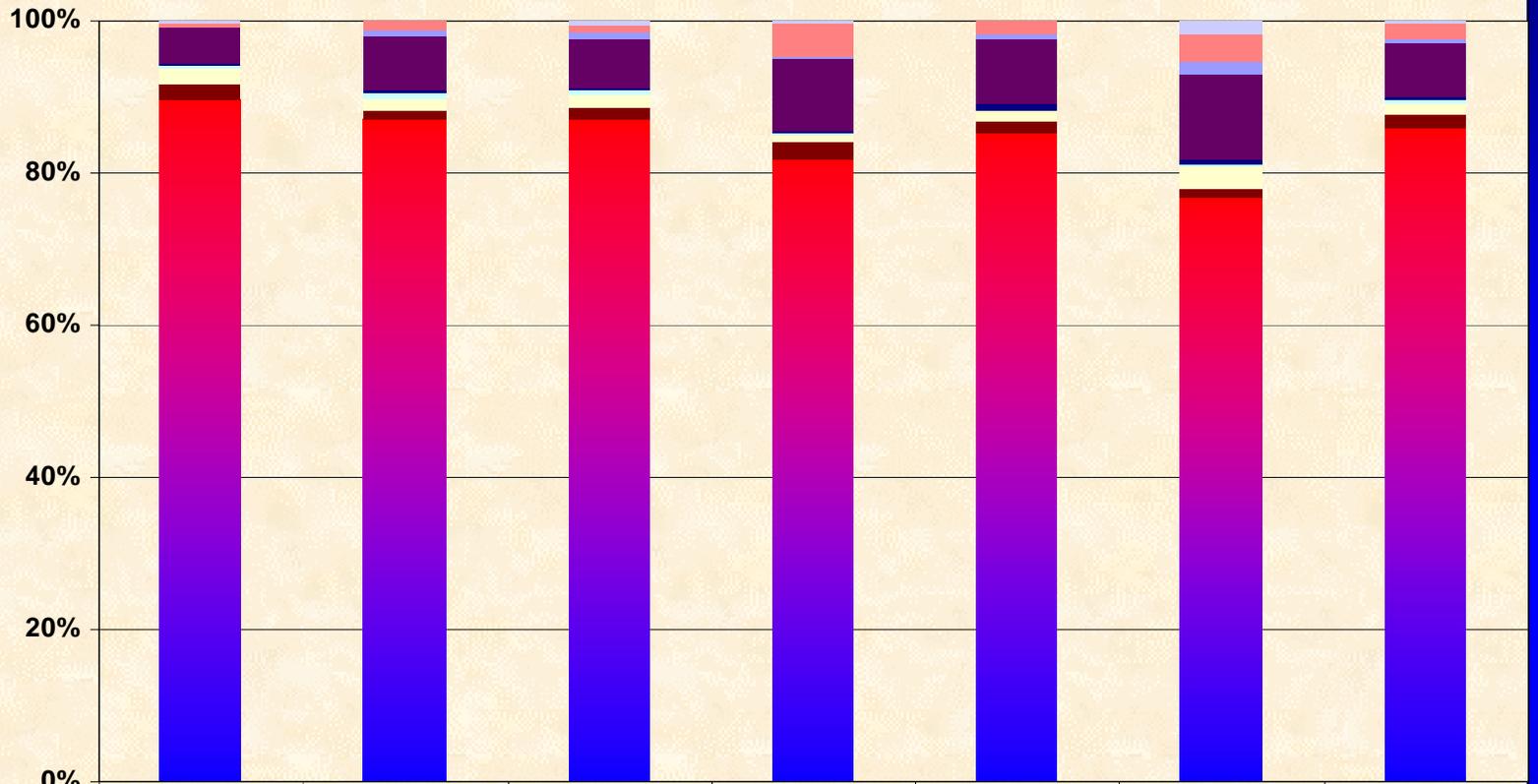
# Field Operations - Fish Disposal

- Fish Disposal and Use
  - At the takeout, the barrels are delivered to a representative of the Hualapai Nation for use as fertilizer.



# Results – Removal Reaches

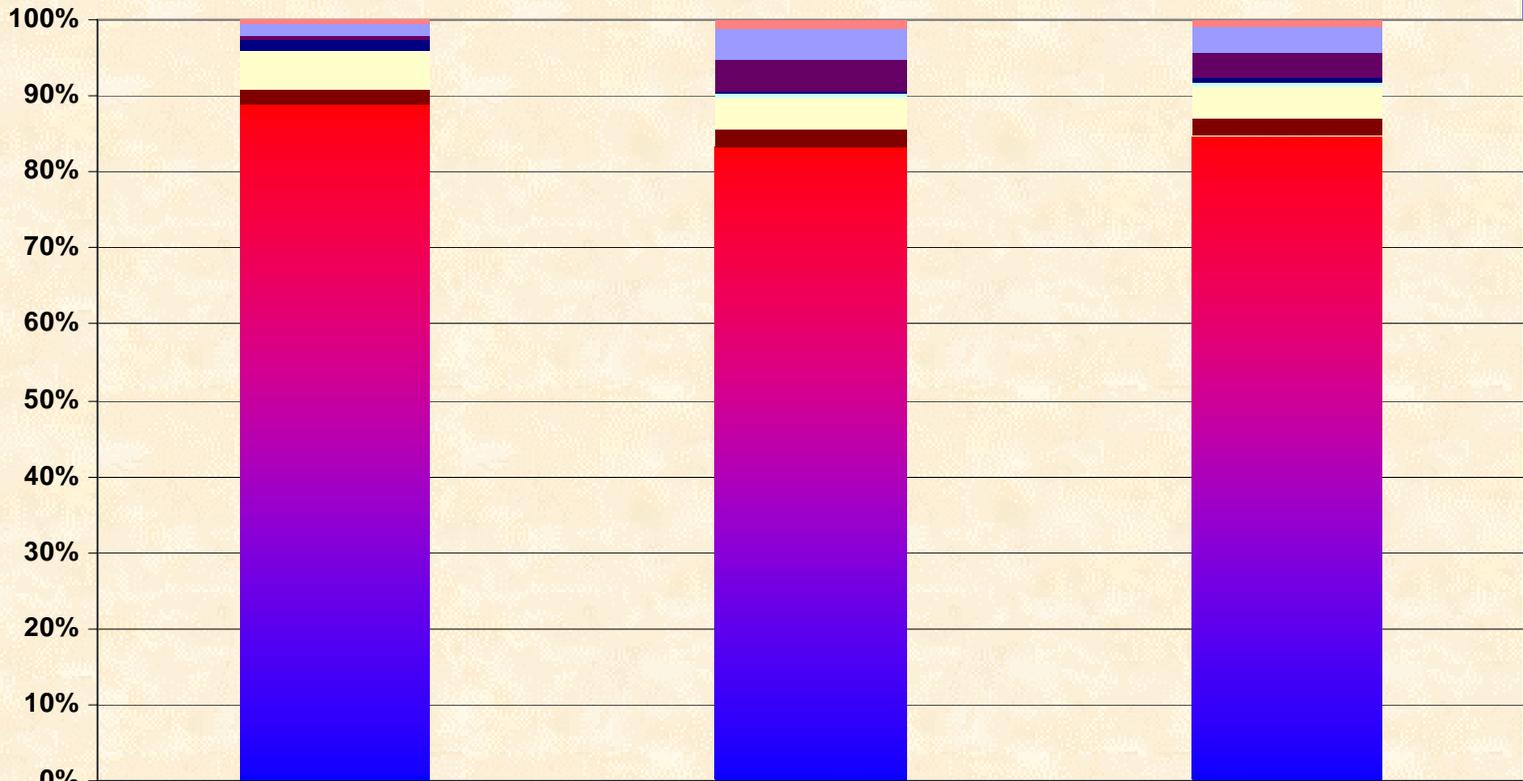
Electrofishing Catch By Month within the LCR Removal Reach (RM 56.2-65.7)



	JAN-123.7 hrs	FEB-118 hrs	MAR-112.6 hrs	JUL-106.1 hrs	AUG-43.8 hrs	SEP-67.8 hrs	Total-572.1 hrs
Speckled Dace	7	2	8	6		18	41
Humpback Chub	26	26	13	123	17	37	242
Bluehead Sucker	8	18	11	12	4	19	72
Flannelmouth Sucker	187	156	89	265	79	119	895
Other	3	1	6	8	7	8	33
Fathead Minnow	17	21	8	4		4	54
Common Carp	80	33	22	29	14	31	209
Brown Trout	87	24	21	63	12	11	218
Rainbow Trout	3,606	1,905	1,195	2,303	779	818	10,606

# Results – Removal Reaches

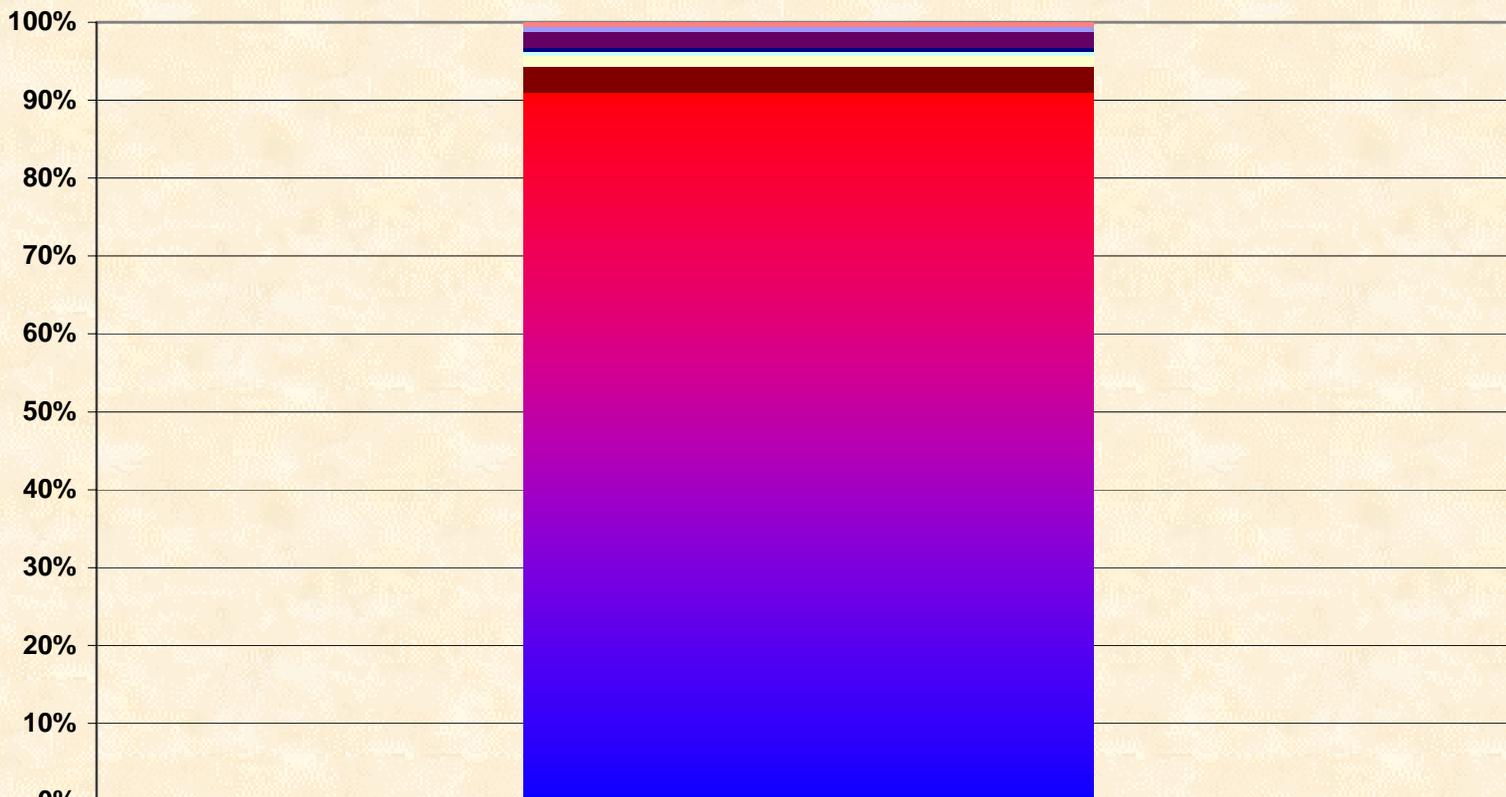
Electrofishing Catch By Month within the Tanner Removal Reach (RM 65.7- 68.5)



	AUG-16.1 hrs	SEP-23.5 hrs	Total-39.6 hrs
Speckled Dace			
Humpback Chub	1	4	5
Bluehead Sucker	2	16	18
Flannelmouth Sucker	1	15	16
Other	2	1	3
Fathead Minnow		3	3
Common Carp	7	15	22
Brown Trout	3	9	12
Rainbow Trout	128	312	440

# Results – Removal Reaches

Electrofishing Catch By Month within the Unkar Removal Reach (RM 68.5 – 72.7 )

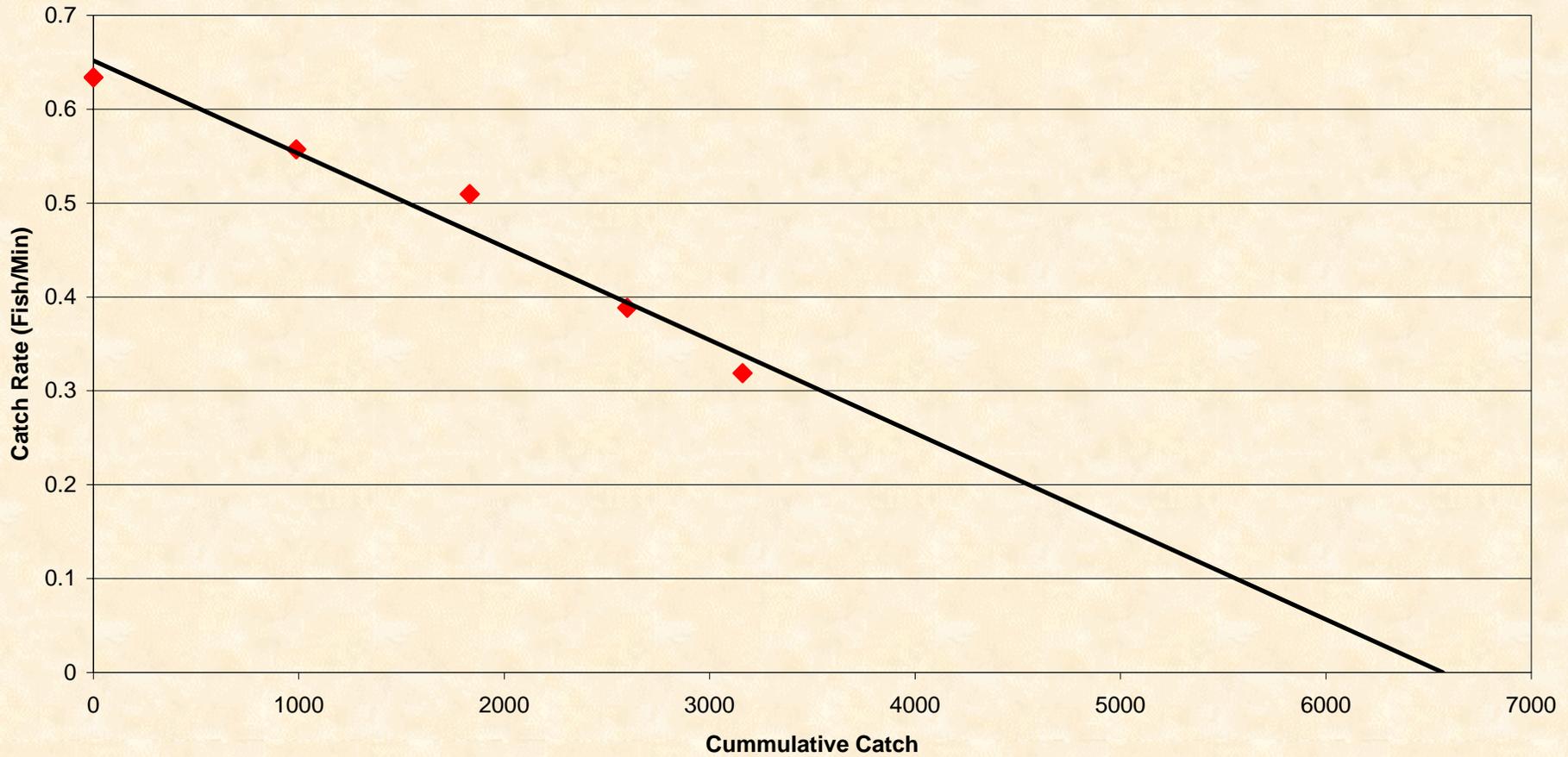


AUG-19.9 hrs

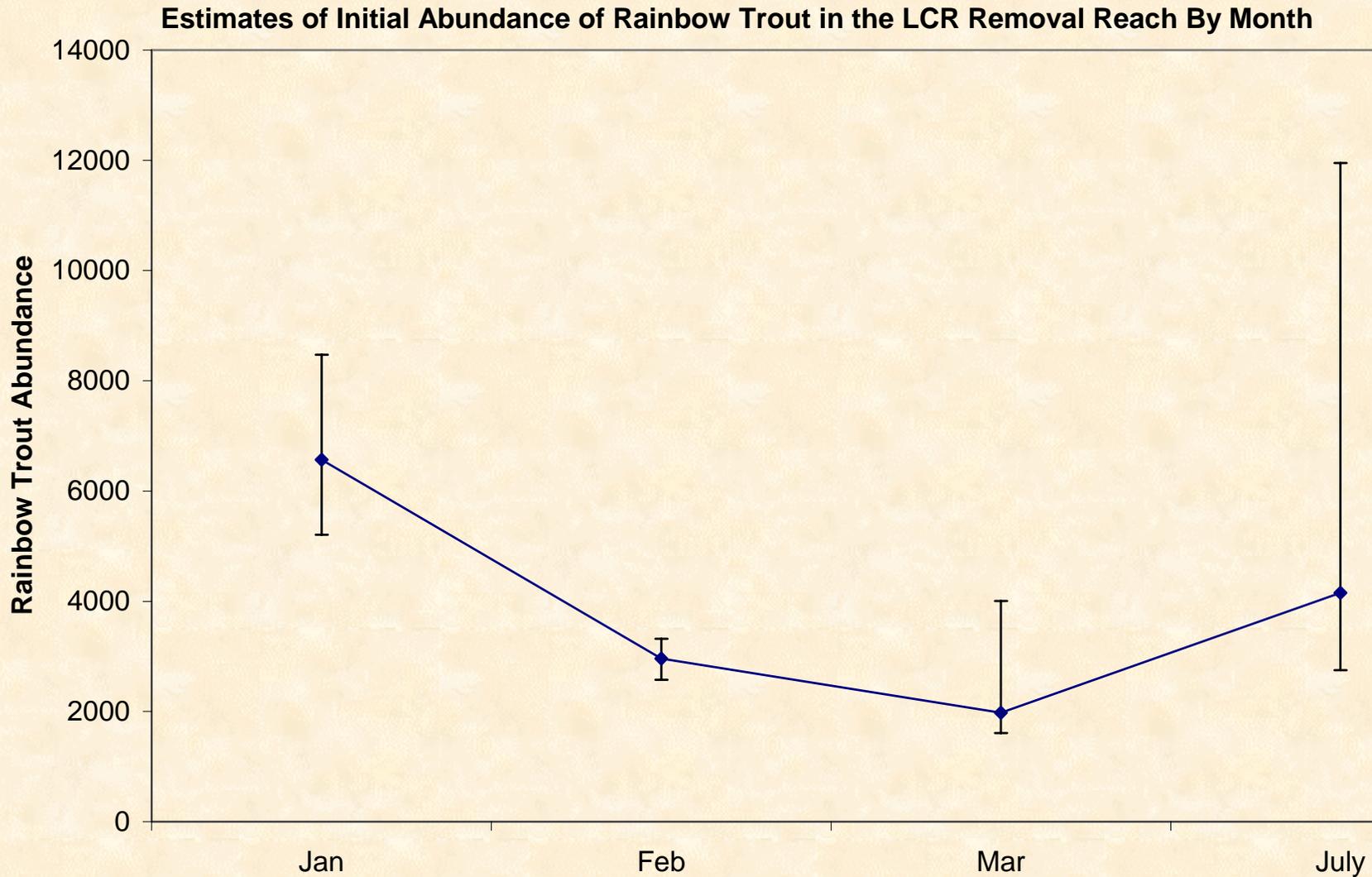
Speckled Dace	
Humpback Chub	2
Bluehead Sucker	3
Flannelmouth Sucker	8
Other	2
Fathead Minnow	2
Common Carp	6
Brown Trout	13
Rainbow Trout	364

# Results – Abundance Estimates

January LCR Inflow Reach Depletion Abundance Estimate for Rainbow Trout

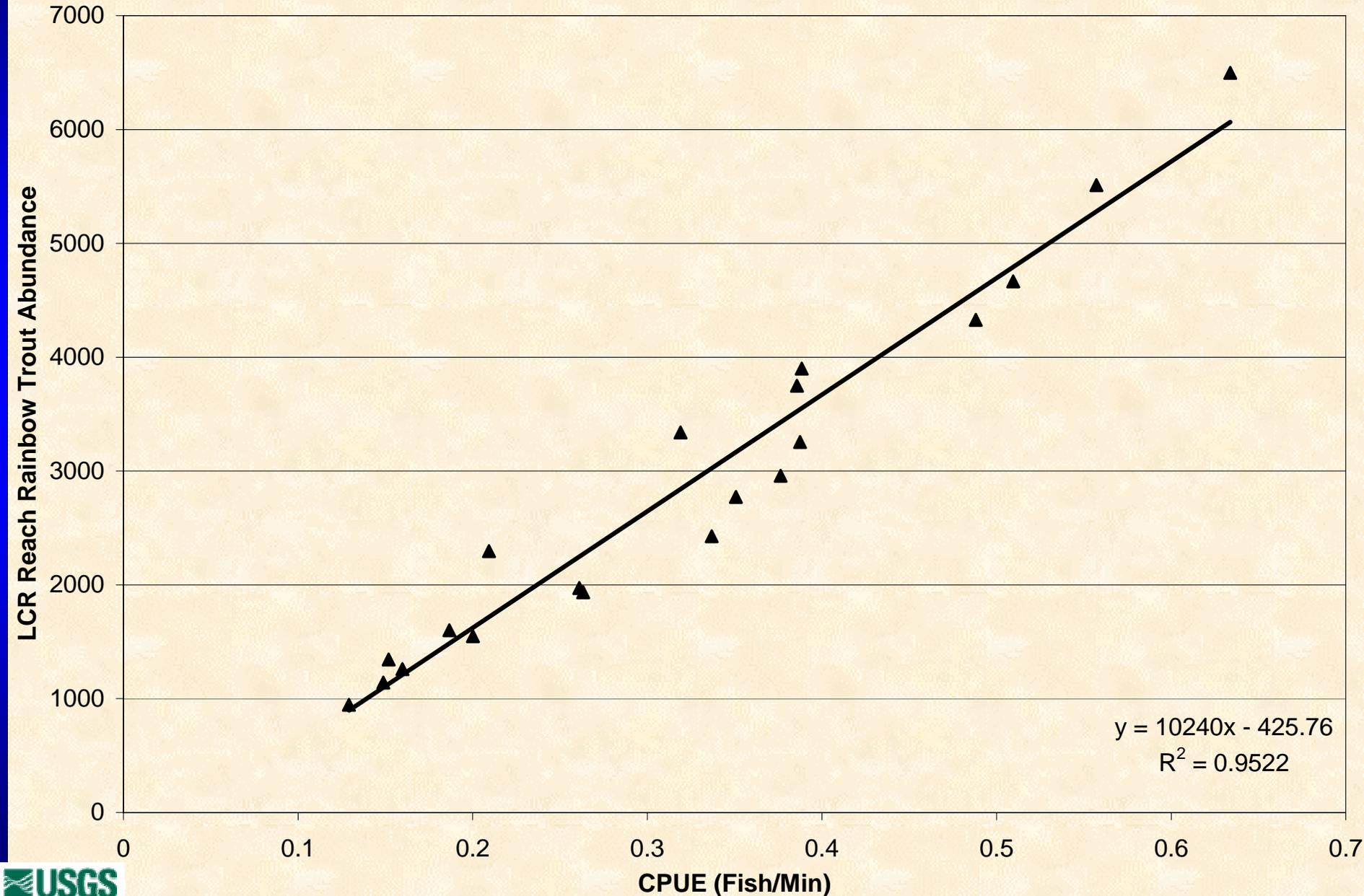


# Results – Abundance Estimates



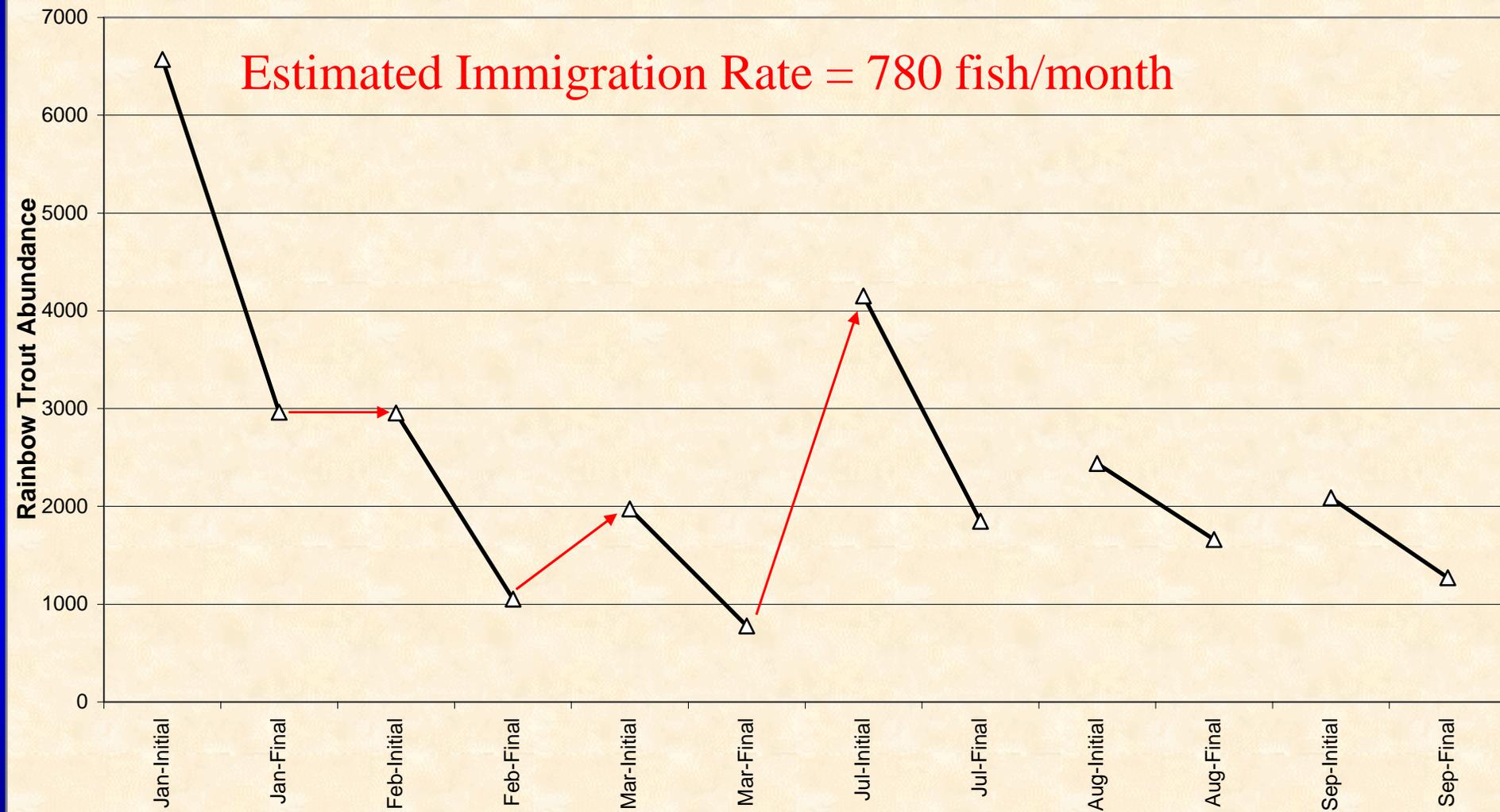
# Results – Abundance Estimates

Rainbow Trout Catch-Rate to Abundance Calibration



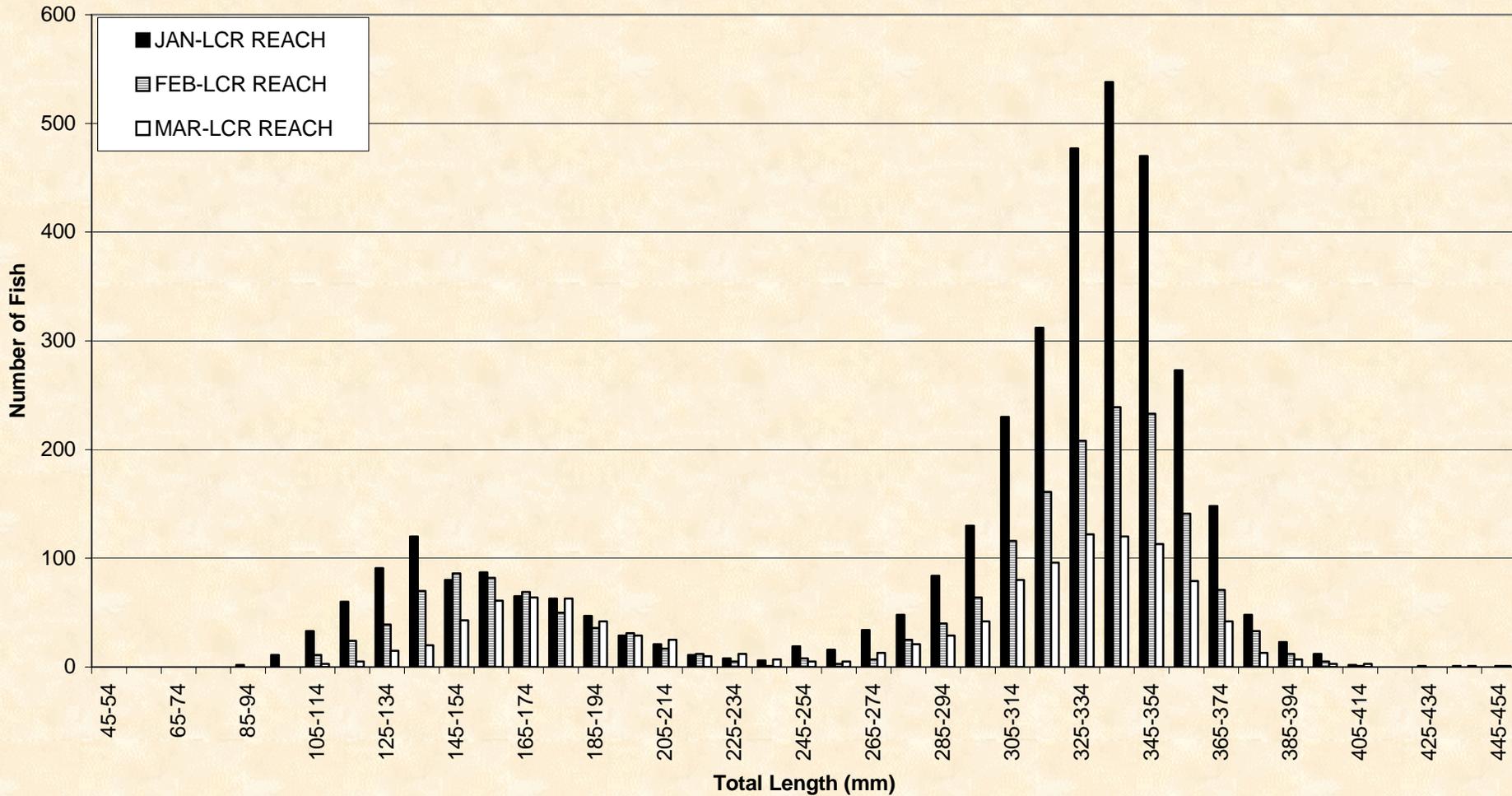
# Results – Abundance Estimates

Estimated Initial and Final Abundance of Rainbow Trout in the LCR Removal Reach by Month



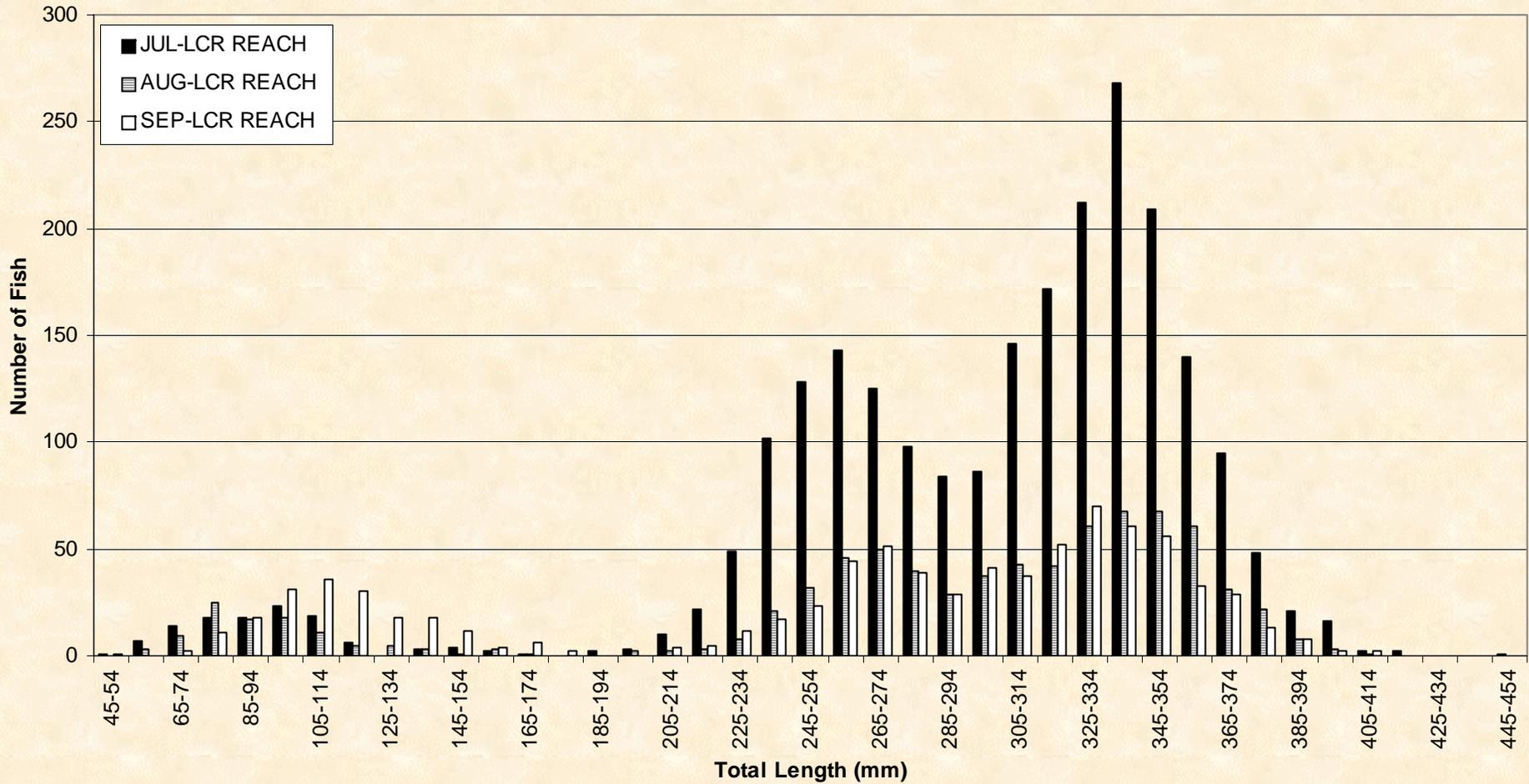
# Results – Rainbow Trout Length Frequency Distribution

Rainbow Trout Length Frequency Distributions by Month in the LCR Removal Reach



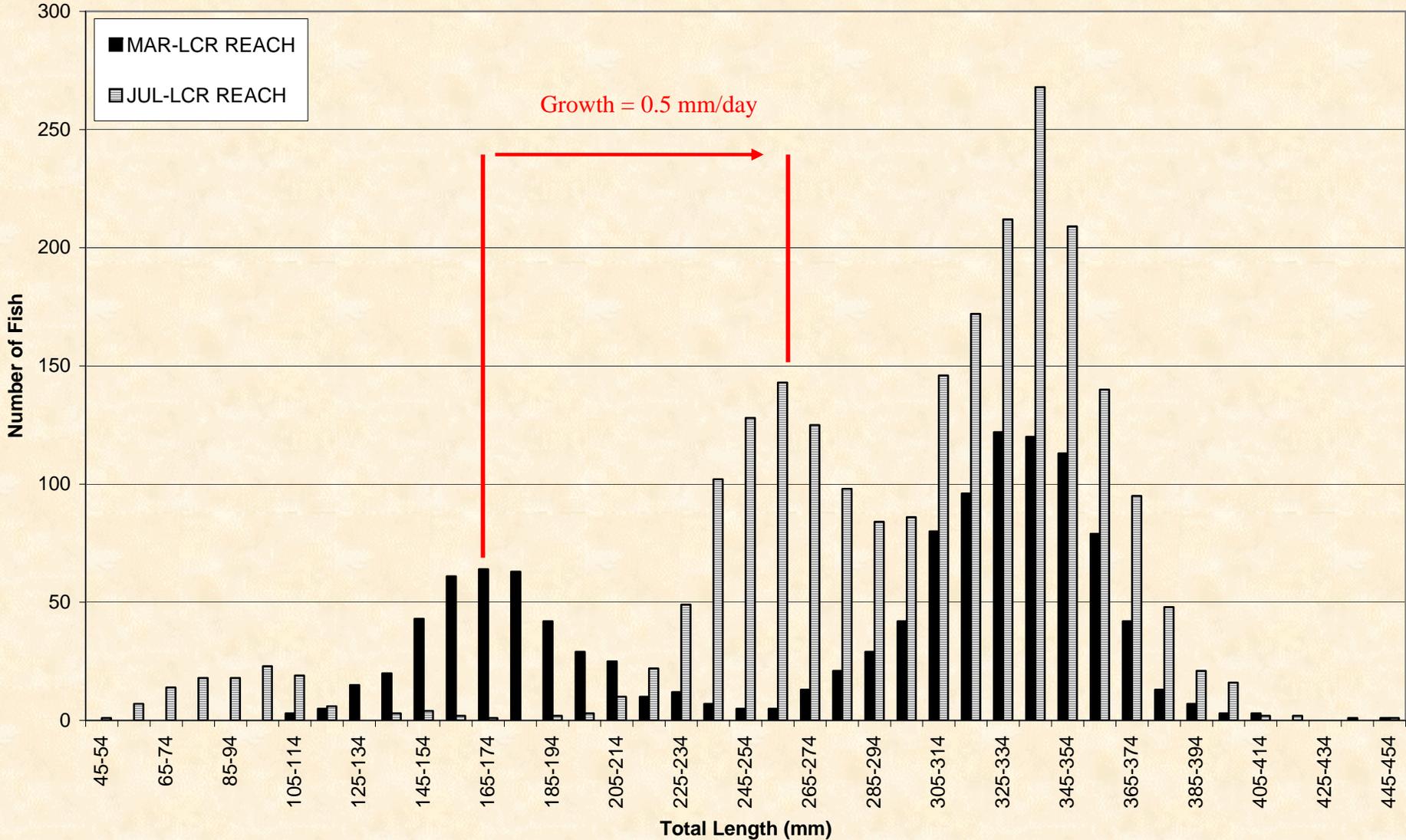
# Results – Rainbow Trout Length Frequency Distribution

Rainbow Trout Length Frequency Distributions by Month in the LCR Removal Reach



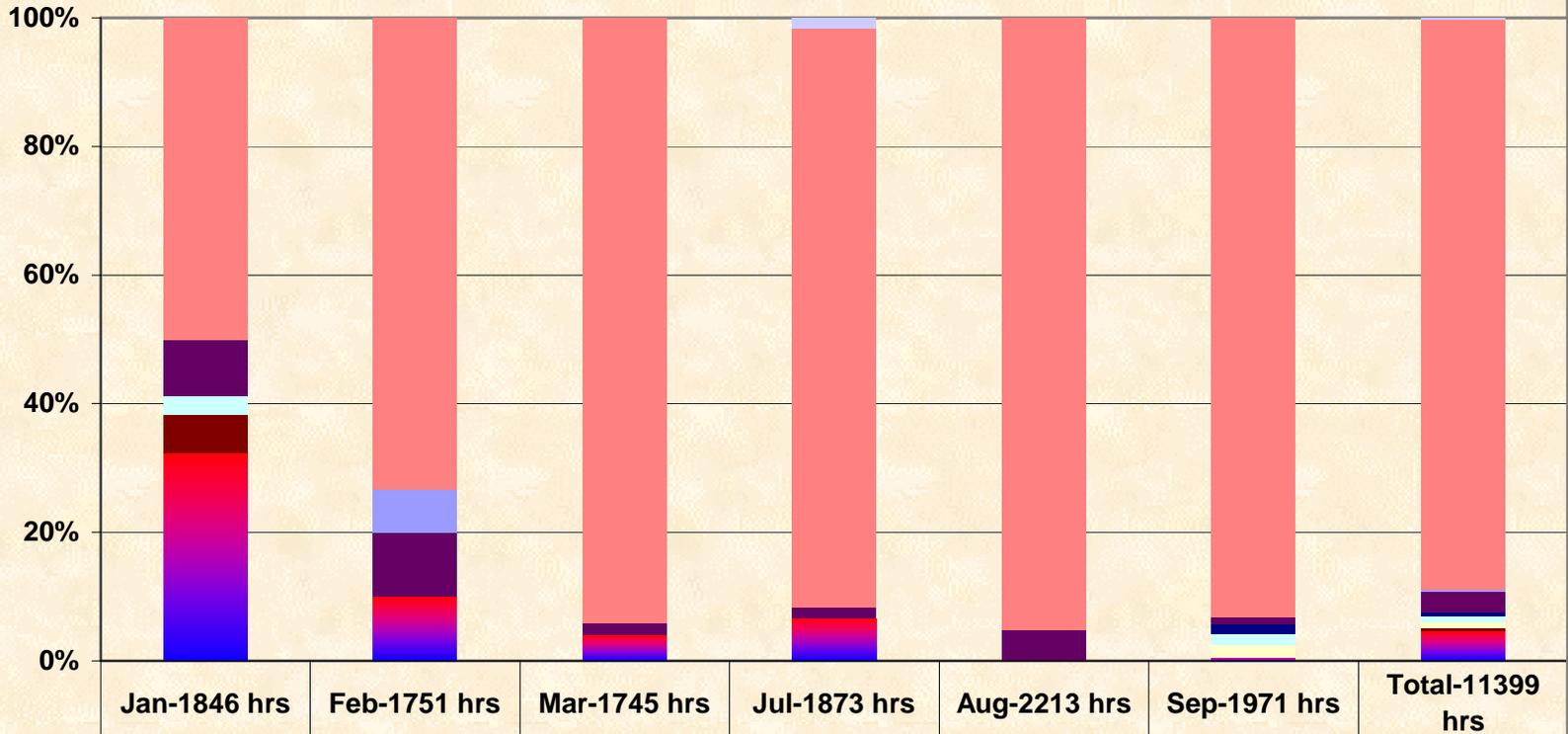
# Results – Rainbow Trout Length Frequency Distribution

Rainbow Trout Length Frequency Distributions For March and July in the LCR Removal Reach



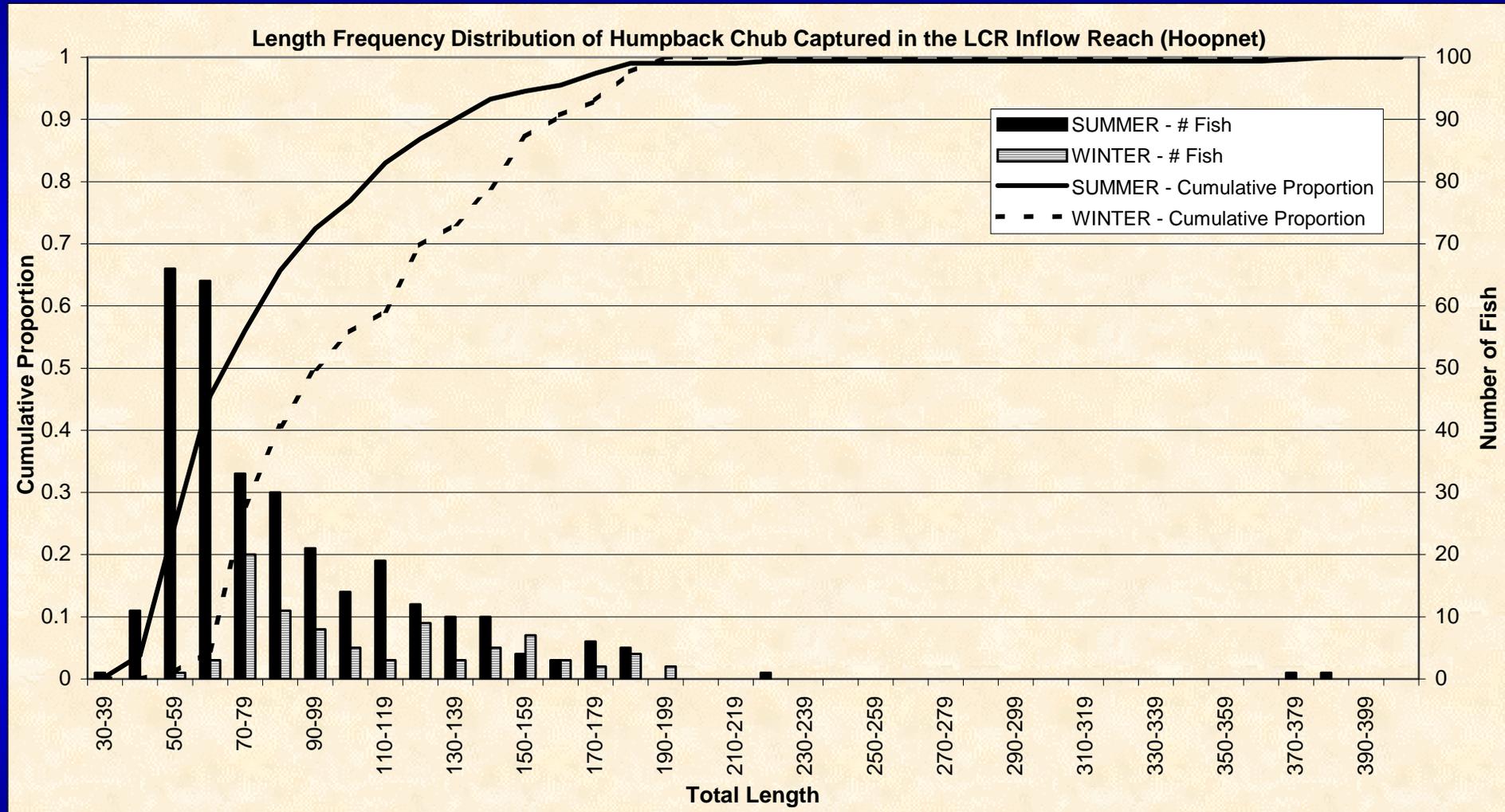
# Results – Hoopnetting

Hoopnet Catch By Month within the LCR Inflow Reach (RM 63.7-64.2)



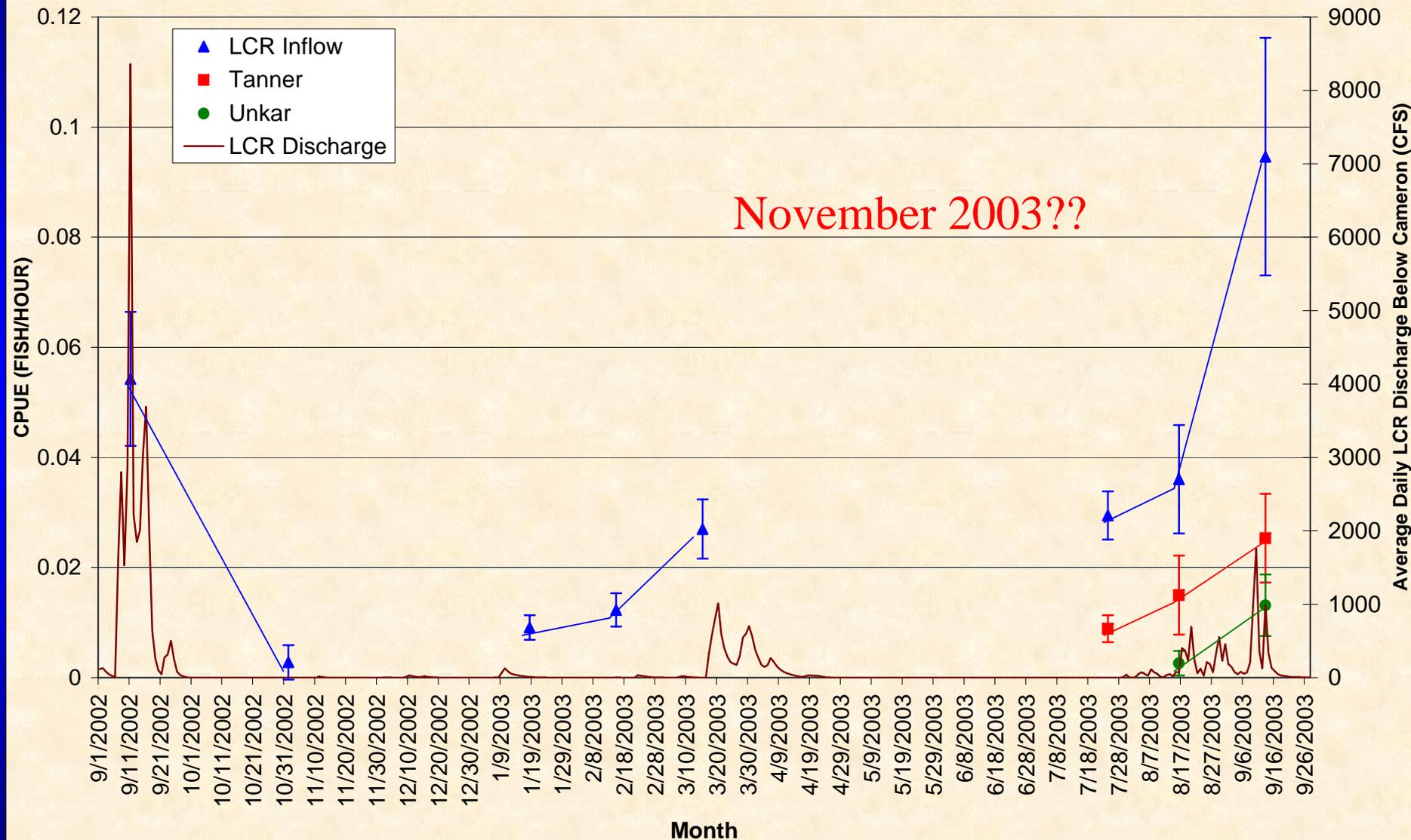
	Jan-1846 hrs	Feb-1751 hrs	Mar-1745 hrs	Jul-1873 hrs	Aug-2213 hrs	Sep-1971 hrs	Total-11399 hrs
Speckled Dace				1			1
Humpback Chub	17	22	47	54	79	179	398
Bluehead Sucker		2					2
Flannelmouth Sucker	3	3	1	1	4	2	14
Other						3	3
Fathead Minnow	1					3	4
Common Carp						4	4
Brown Trout	2						2
Rainbow Trout	11	3	2	4		1	21

# Results – Humpback Chub Length Frequency Distribution



# Results – Humpback Chub Relative Abundance

Humpback Chub Catch Rate in the Hoopnet Monitoring Below LCR



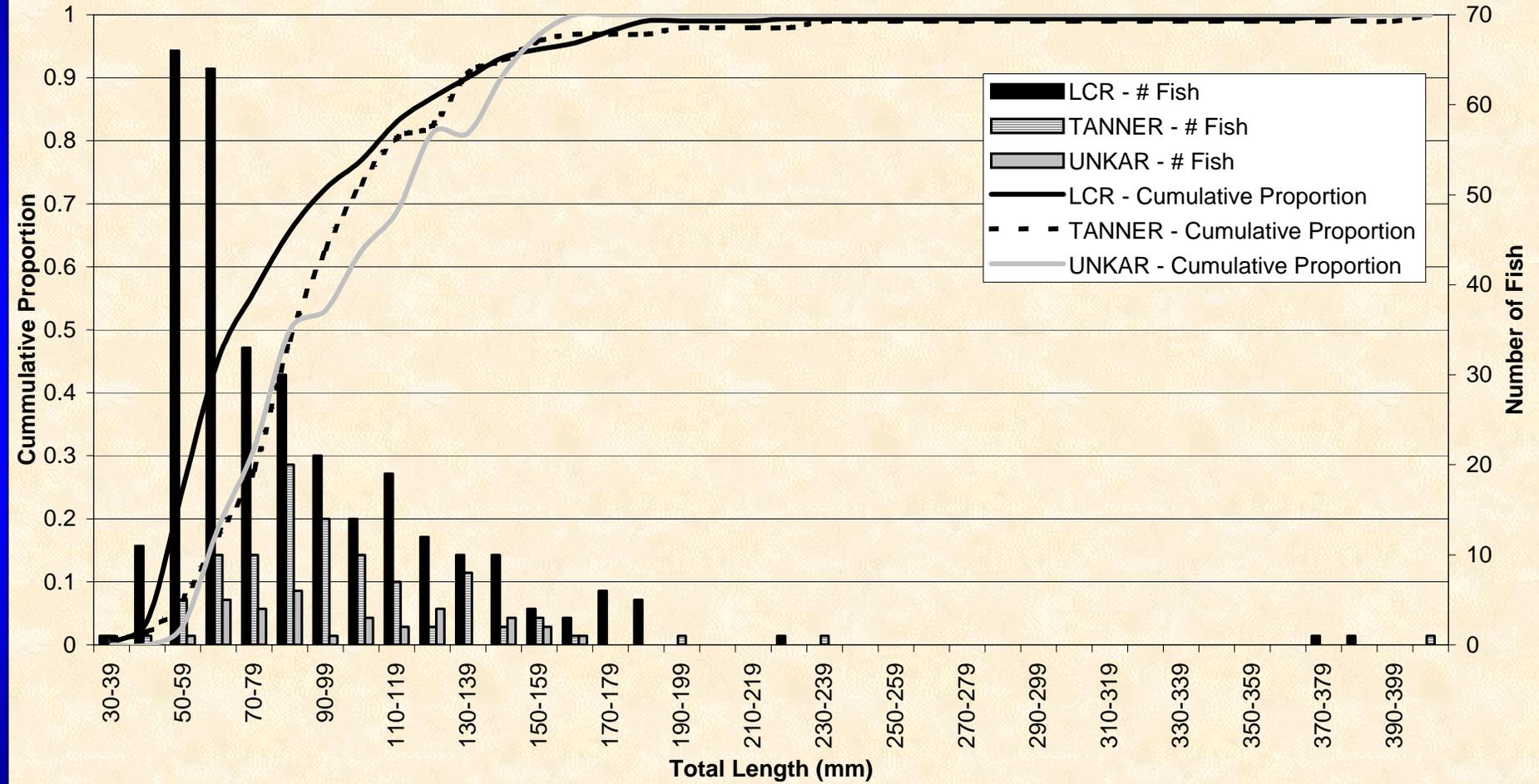
# Conclusions

- Non-native removal efforts appear to be much more effective than anticipated. > 50% efficiency for Rainbow Trout.
- Immigration rate approx 780 fish/month in the LCR Inflow Reach.
- Hoopnet catches of HBC may indicate a habitat/survival response by HBC following non-native removal. Stay Tuned for November 2003 data.
- Relationship between turbidity and catchability needs to be defined more rigorously.
- Opportunities for further modeling to obtain better estimates of rainbow trout growth and mortality.



# Results – Humpback Chub Length Frequency Distribution

Length Frequency Distribution of Humpback Chub Captured during Summer (Hoopnet)



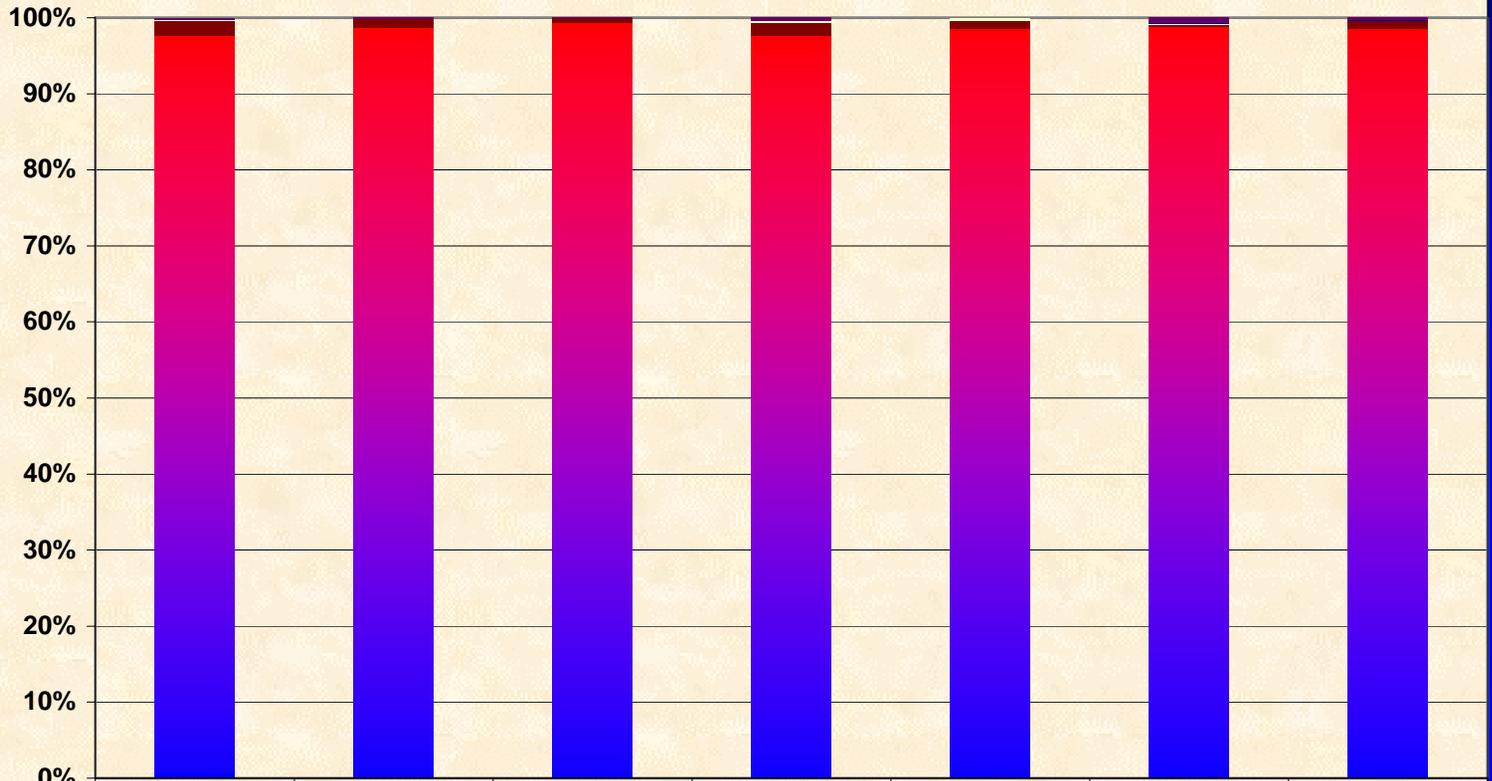
# Control Reach

- Control Reach (RM 44-52)
  - Purpose is to evaluate changes in trout abundance and size distribution that are a result of factors other than mechanical removal (e.g. fluctuating flows)
  - Each trip, 24 500m sampling units are randomly selected and electrofished to estimate catch-rate.
  - All RBT and BNT  $\geq$  200mm are fitted with a floy-tag to assess movement and estimate abundance.



# Results – Control Reach

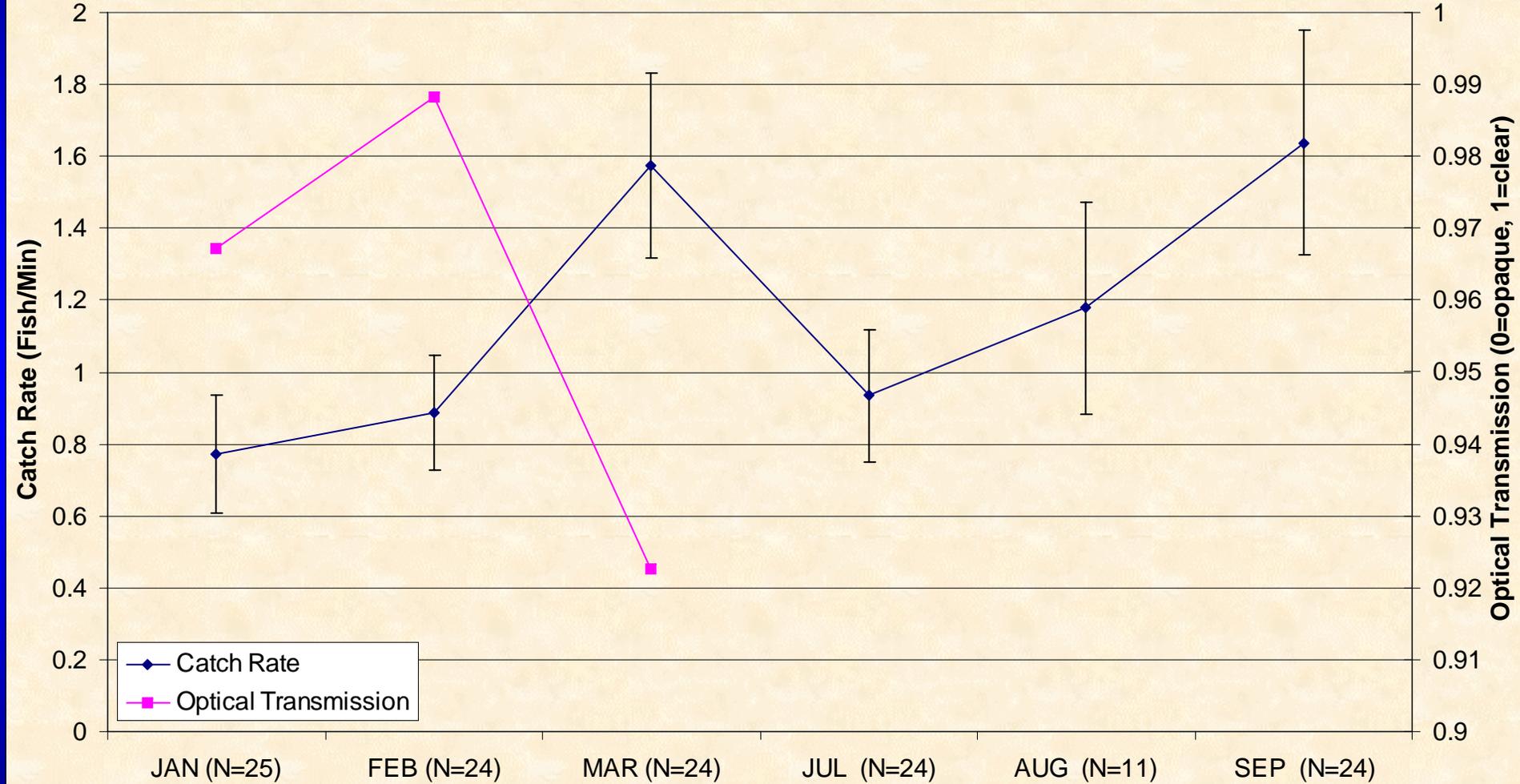
Electrofishing Catch By Month within the Control Reach (RM 44-52)



	JAN-9.9 hrs	FEB-10.5 hrs	MAR-9.8 hrs	JUL-7.6 hrs	AUG-3.5 hrs	SEP-9.9 hrs	Total-51.2 hrs
Speckled Dace							
Humpback Chub							
Bluehead Sucker							
Flannemouth Sucker	1	1	1	2		7	12
Other						1	1
Fathead Minnow							
Common Carp	1			1	1	1	4
Brown Trout	9	6	5	7	3	3	33
Rainbow Trout	446	549	887	418	257	982	3,539

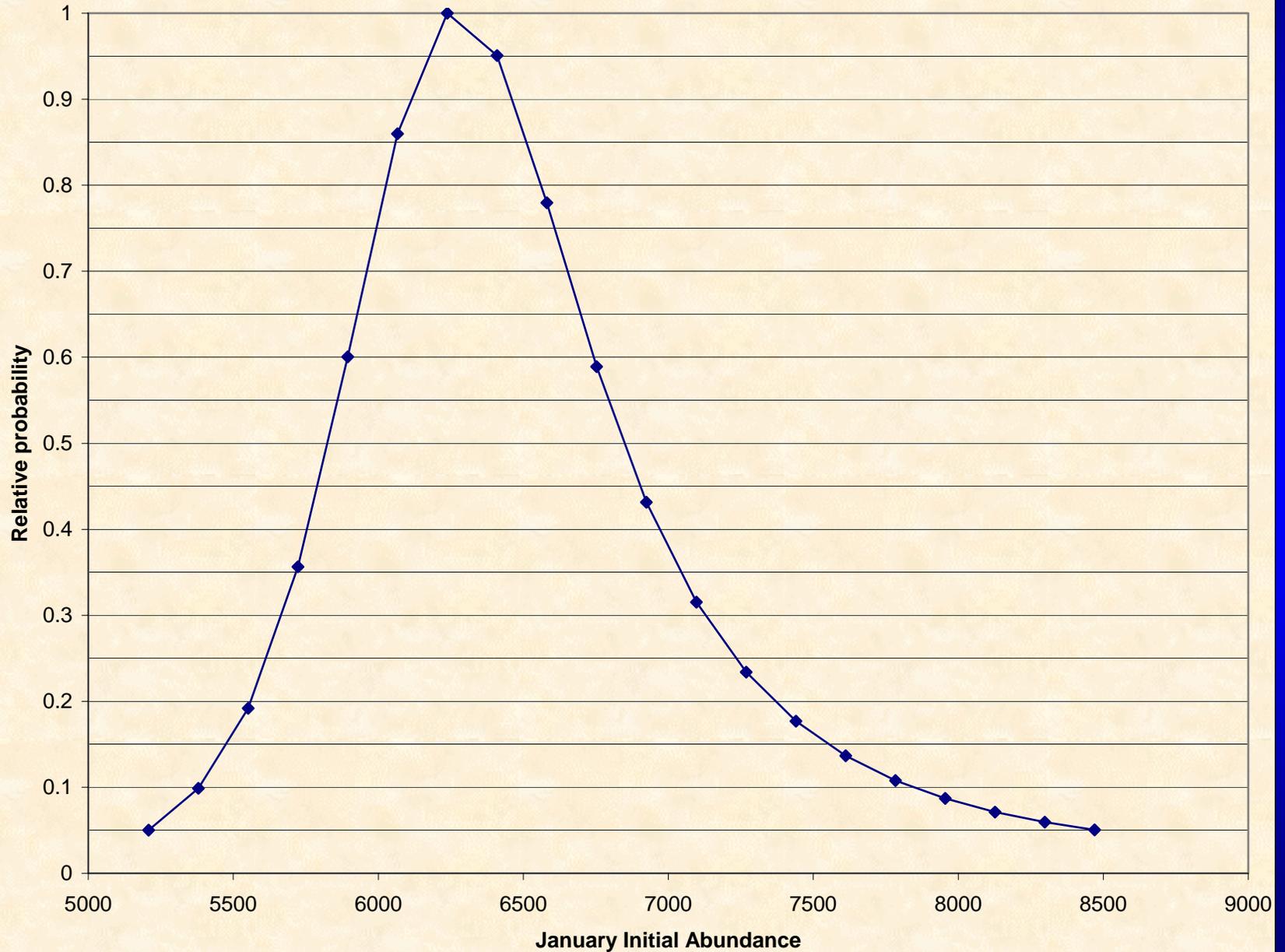
# Results – Control Reach

Rainbow Trout Catch Rate and Optical Transmission in the Control Reach



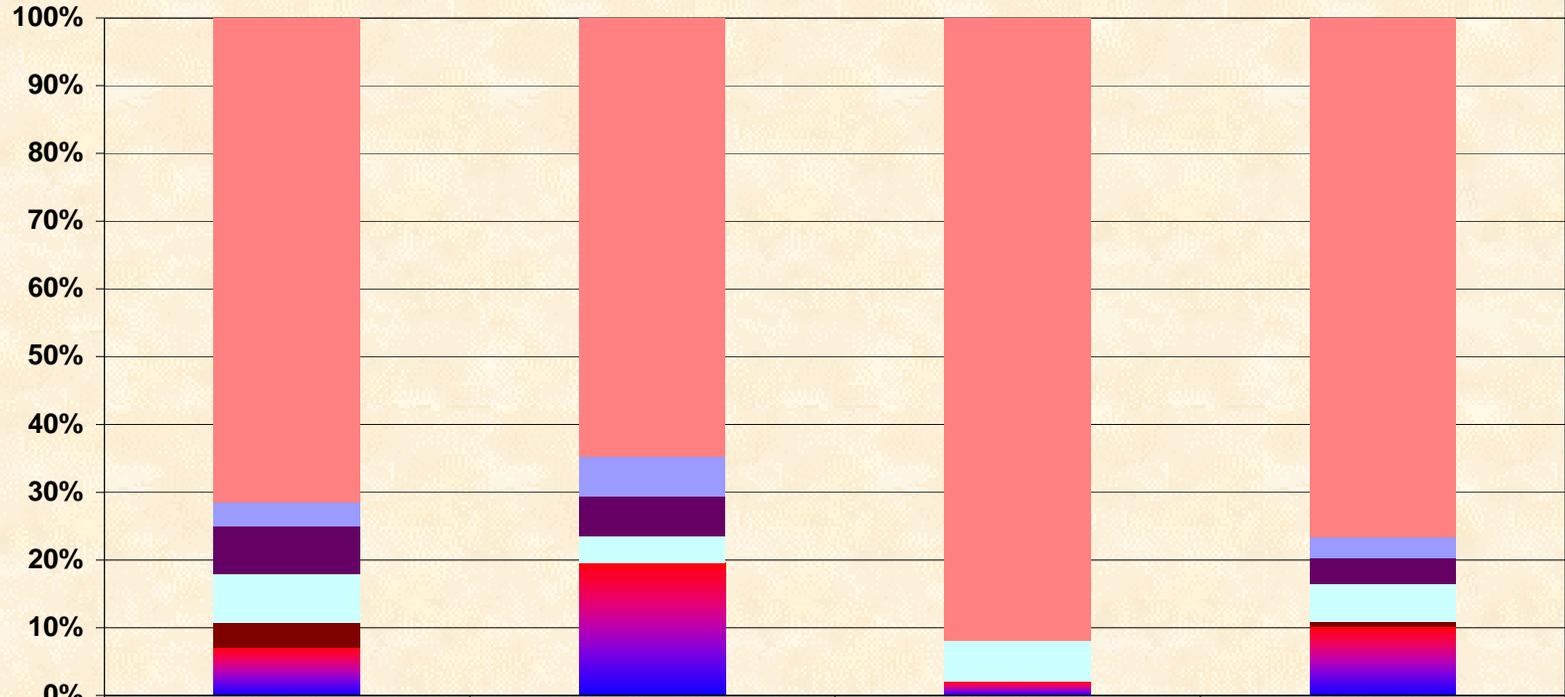
# Results – Abundance Estimates

Probability distribution for January Initial Rainbow Trout Abundance



# Results – Hoopnetting

Hoopnet Catch By Month within the Tanner Reach (RM 68.2-68.5)



Jul-2148 hrs

Aug-2209 hrs

Sep-1795 hrs

Total-6152 hrs

Speckled Dace

0

Humpback Chub

20

33

45

98

Bluehead Sucker

1

3

4

Flannelmouth Sucker

2

3

5

Other

0

Fathead Minnow

2

2

3

7

Common Carp

0

Brown Trout

1

1

Rainbow Trout

2

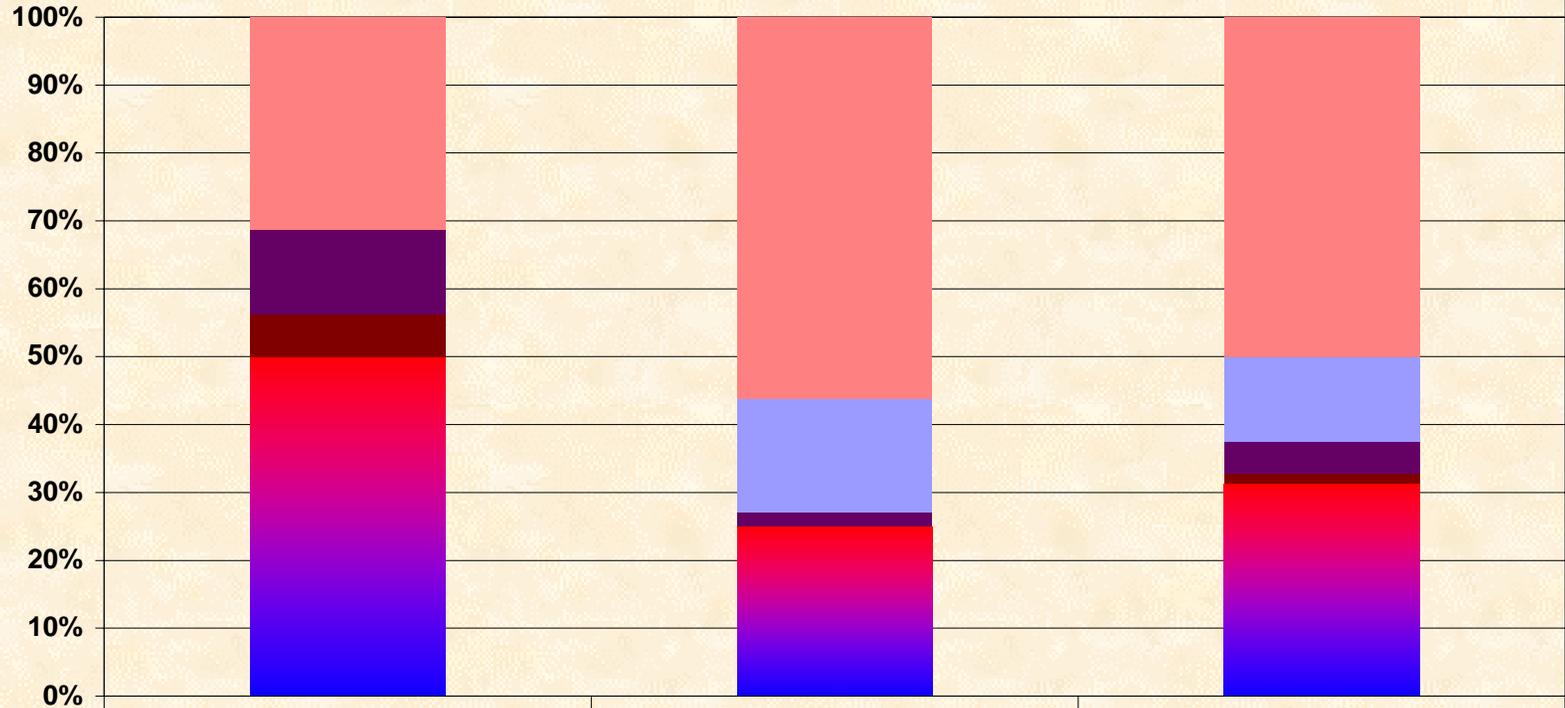
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13

# Results – Hoopnetting

Hoopnet Catch By Month within the Unkar Reach (RM 71.8-72.7)



	Aug-2109 hrs	Sep-2041 hrs	Total-4150 hrs
Speckled Dace			0
Humpback Chub	5	27	32
Bluehead Sucker		8	8
Flannelmouth Sucker	2	1	3
Other			0
Fathead Minnow			0
Common Carp			0
Brown Trout	1		1
Rainbow Trout	8	12	20

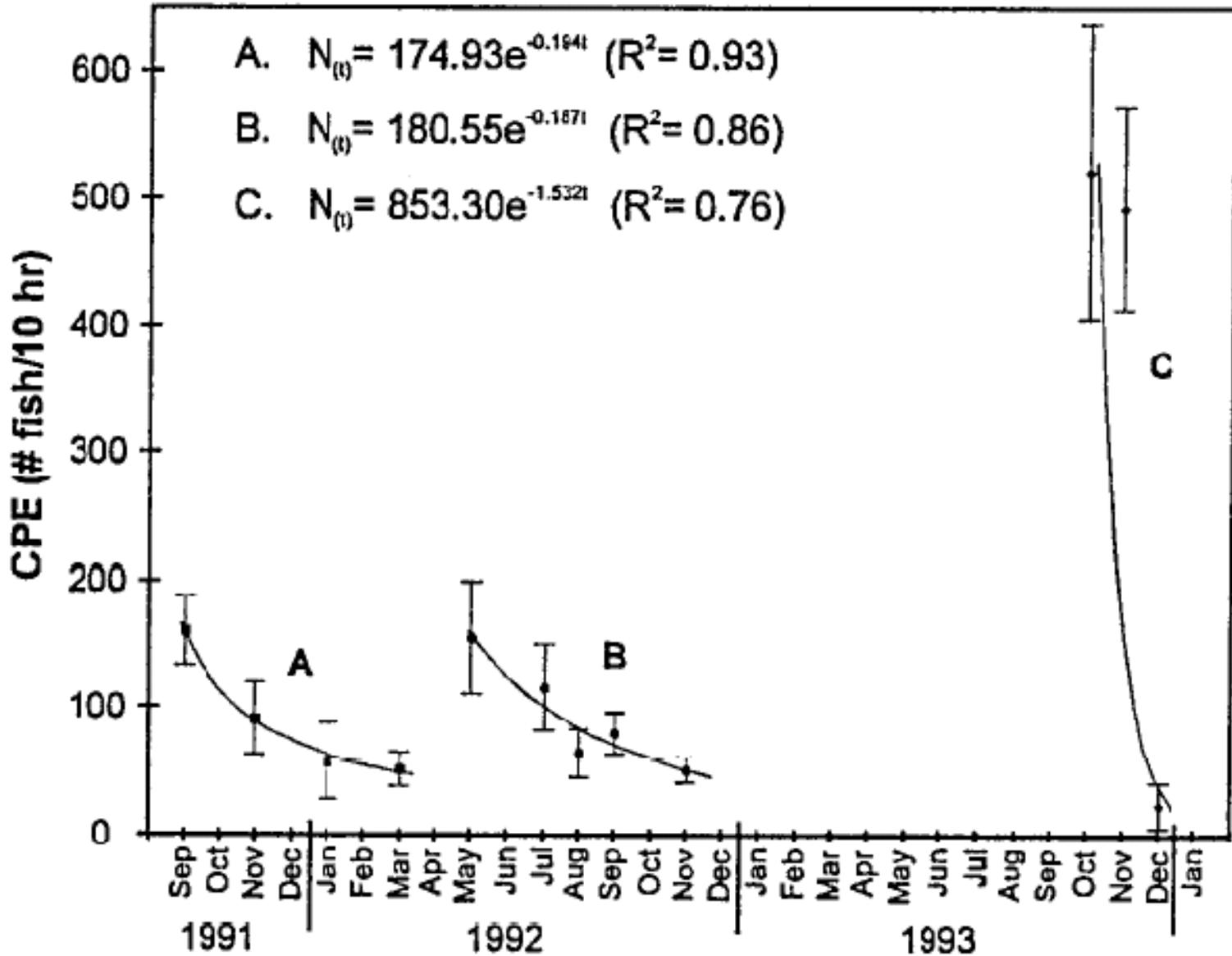


Fig. 6-12. Exponential decreases in densities of subadult humpback chub in the mainstem Colorado River from the LCR (RM 61.3) to Lava Canyon (RM 65.4) for September 1991 through March 1992 (A), May through November 1992 (B), and September through November 1993 (C).

# Results – Control Reach

N = approx. 2,700

Tag Location	Recap Location	Tag Date	Recap Date	Distance Moved	Elapsed Time
46 mile	61.5 mile	1/15/2003	1/25/2003	15.5 miles	10 days
50 mile	57.5 mile	2/13/2003	2/16/2003	7.5 miles	3 days
48.5 mile	65.7 mile	2/13/2003	2/23/2003	17.2 miles	10 days
49 mile	56.2 mile	2/13/2003	2/16/2003	7.2 miles	3 days
50 mile	56.2 mile	2/13/2003	3/5/2003	6.2 miles	20 days
46.5 mile	58.5 mile	1/16/2003	3/12/2003	12 miles	55 days
51.1 mile	59.5 mile	3/10/2003	3/18/2003	8.4 miles	8 days
41 mile	59.5 mile	3/10/2003	3/18/2003	18.5 miles	8 days
48 mile	-14.5 mile	1/15/2003	4/29/2003	62.5 miles	104 days
48.2 mile	Lees Ferry Reach	2/13/2003	May	>48.2 miles	>71 days
45 mile	0 mile	2/12/2003	6/14/2003	45 miles	122 days

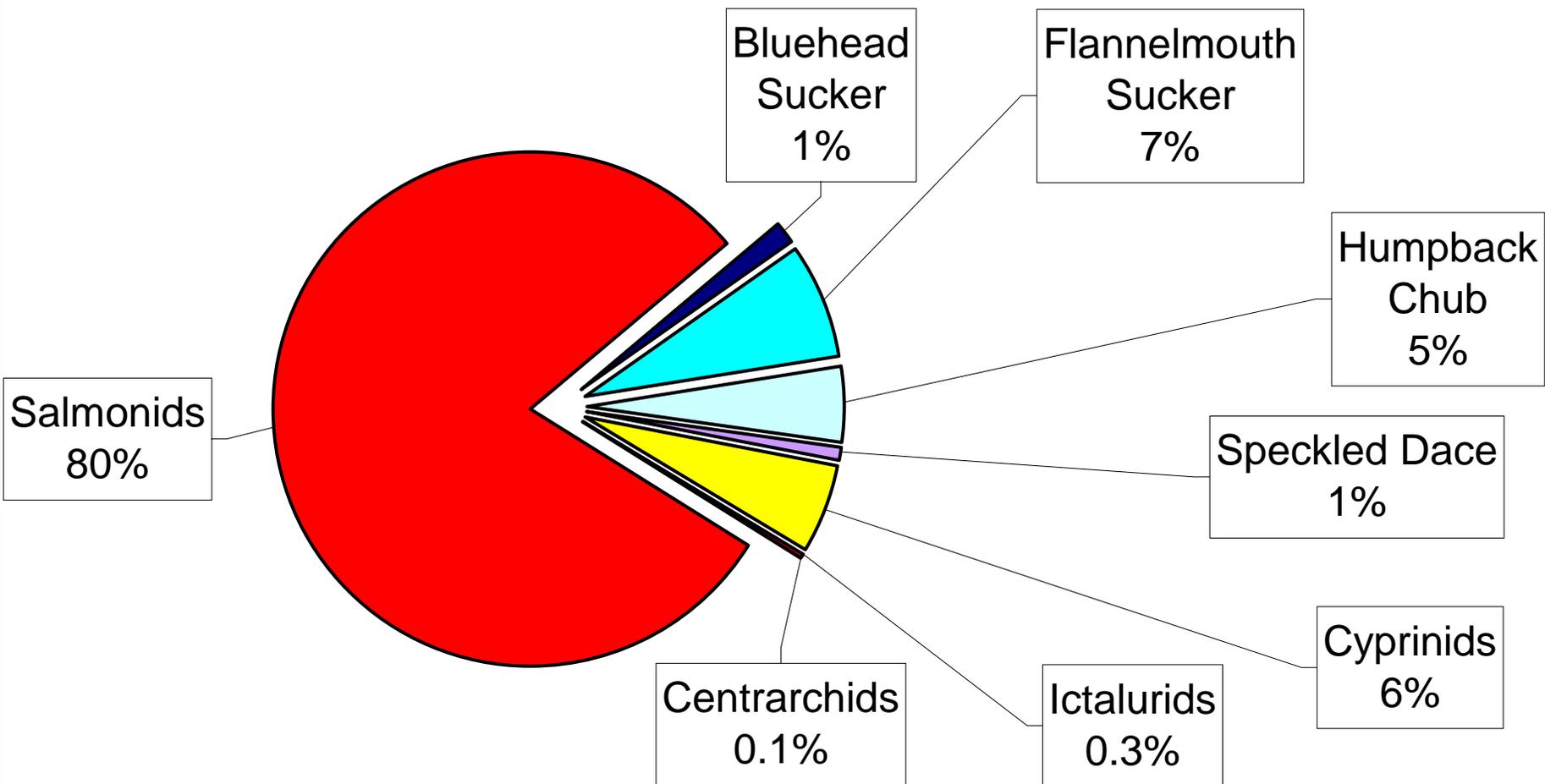
July & August - 33 Floy-tags recaptured in Removal Reaches:

16 from Control Reach,

17 from AGFD sampling between Lava Chuar and Unkar.

# Present Fish Community - Grand Canyon

2000-2001 Observed Species Composition in the Colorado River Using Electrofishing and Netting Methods



# Decision Process

## Null Hypothesis

		True	False
Reject Null	Type I Error Incorrect	Correct Decision	
Fail to Reject Null	Correct Decision	Type II Error Incorrect	

