Development of Fish monitoring (Electrofishing) and Recent Trends in the Grand Canyon Fish Community 2000-2006

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Arizona Game & Fish

History and development of long-term monitoring

- In 1999 GCMRC recognized the need for a more robust monitoring Program within the Grand Canyon. Experimental flows were being carried out with little power to detect long-term temporal or spatial changes in the overall fish community.
- In 2000, Carl Walters was hired to help develop a long term monitoring program that would better describe the fish community within the Grand Canyon and with power to detect trends within this community.
- Initial analyses of GCMRC fish data suggested that electrofishing (EL) may be most effective in monitoring rainbow trout, brown trout and common carp and that netting (hoop and trammel) may most effectively capture trends in native fish.
- Arizona Game and Fish Department took over the task of developing EL monitoring and SWCA was hired to conduct netting surveys.

Data driven approach to Long-term monitoring design (how many samples and where??)

- Carl W. Designed a visual basic program (SAMPLE.exe) to best focus our sampling efforts both in terms of sample size and spatial allocation for each of the species of concern. This program was run using data from 1991-1999.
- In 2004 we recreated sample.exe in excel and reanalyzed data from 2000-2004 to refine long-term monitoring.

Actual sample design 2005-2006

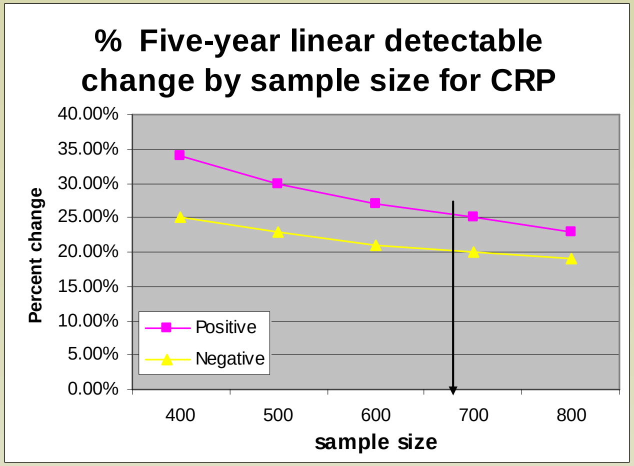
Total effort and allocation of effort by reach are based an data analysis

Reach	River miles
1	0- 29.1
2	29.2- 56
3	56.1 – 68.6
4	68.7 - 76.7
5	78.8 -108.5
6	108.6 -129
7	130.5 - 166.6
8	166.7- 179.5
9	179.8 - 200
10	200.1 - 220
11	220.1 - 225

reach	samples	Samples per night	Samples per boat	days
1	48	24	12	2
2	48	24	12	2
3	120	24	12	5
4	48	24	12	2
5	168	24	12	7
6	96	24	12	4
7	96	24	12	4
8	48	24	12	2
9	90	30	15	3
10	60	30	15	2
11	40	20	10	2
sum	862			35

How did we develop the current sampling strategy? (Sample.exe)

Bootstrap data 1000 times over varying Ns



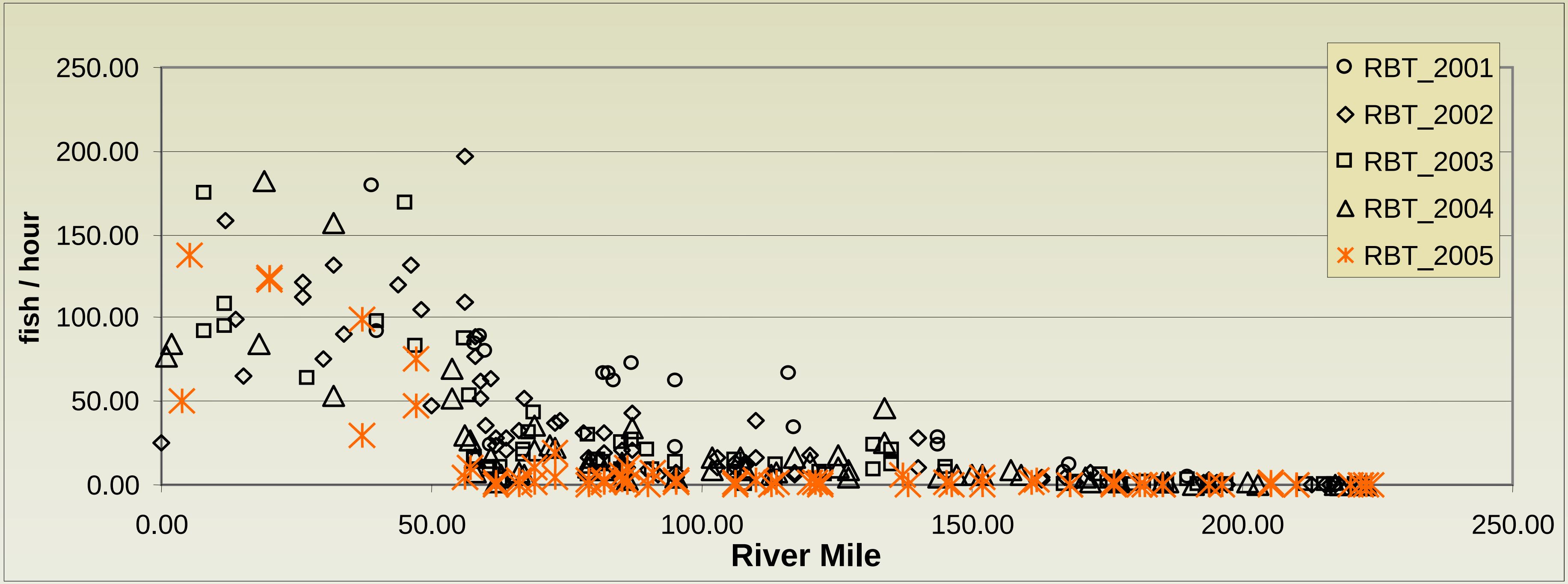
N for each species CV = 0.1	
BNT	800
RBT	225
CRP	675

Find CV by species and fish reach and adjust optimum samples per reach by CV and shoreline miles

Reality check
Adjust for logistic feasibility

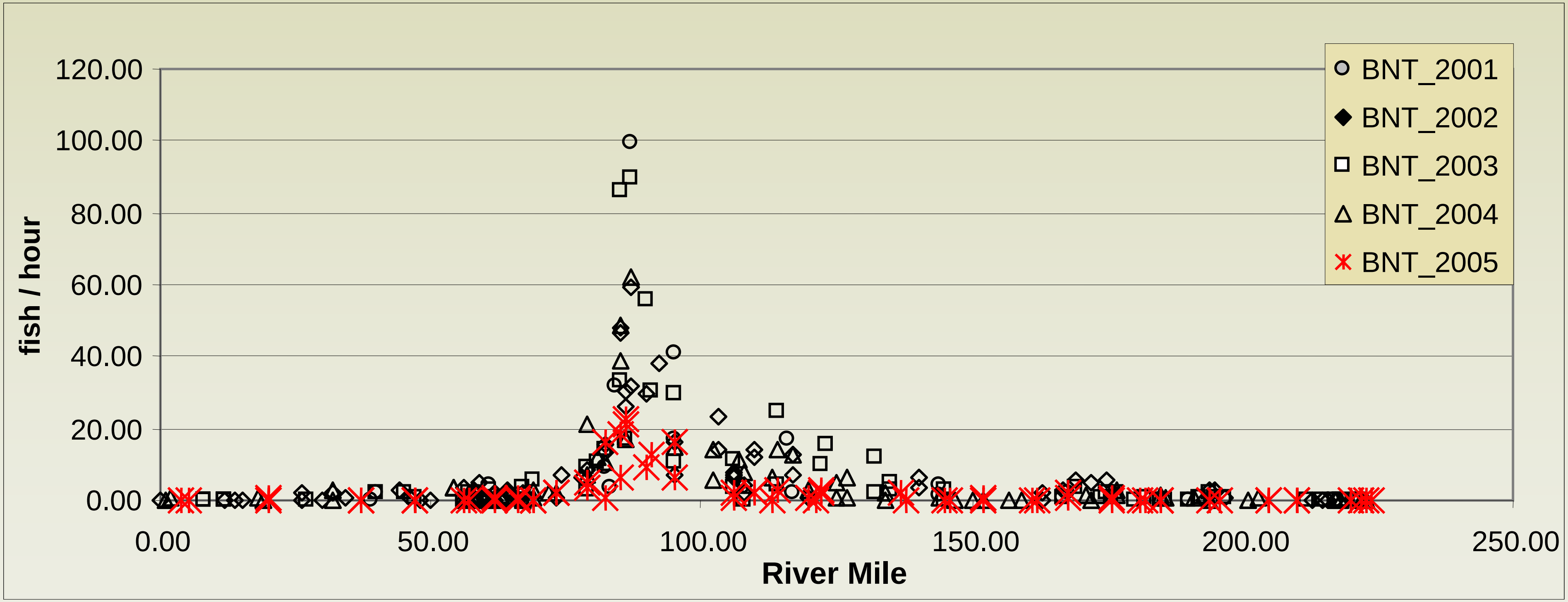
Rainbow trout

Mean CPUE (fish/hour) for rainbow trout at individual sample sites in the Colorado River from Lees Ferry to Diamond Creek (long-term monitoring trips [2001-2005]). Each point represents an N of 8-15)



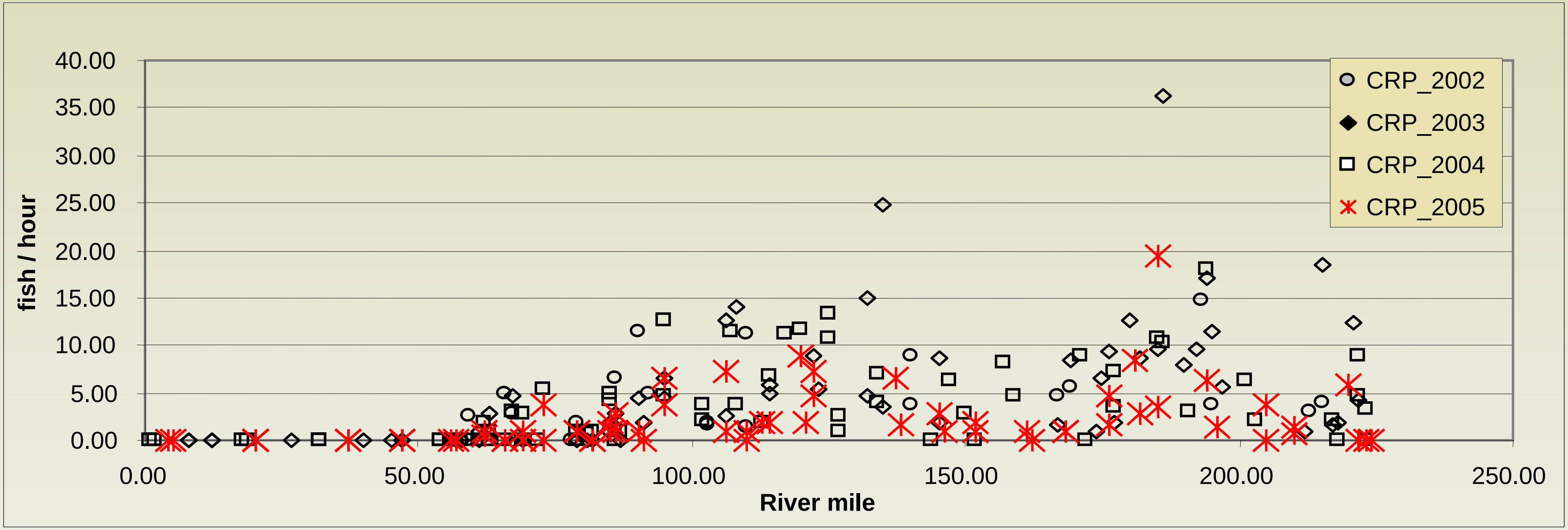
Brown trout

Mean CPUE (fish/hour) for brown trout at individual sample sites in the Colorado River from Lees Ferry to Diamond Creek (long-term monitoring trips [2001-2004]). Each point represents an N of 8-15)



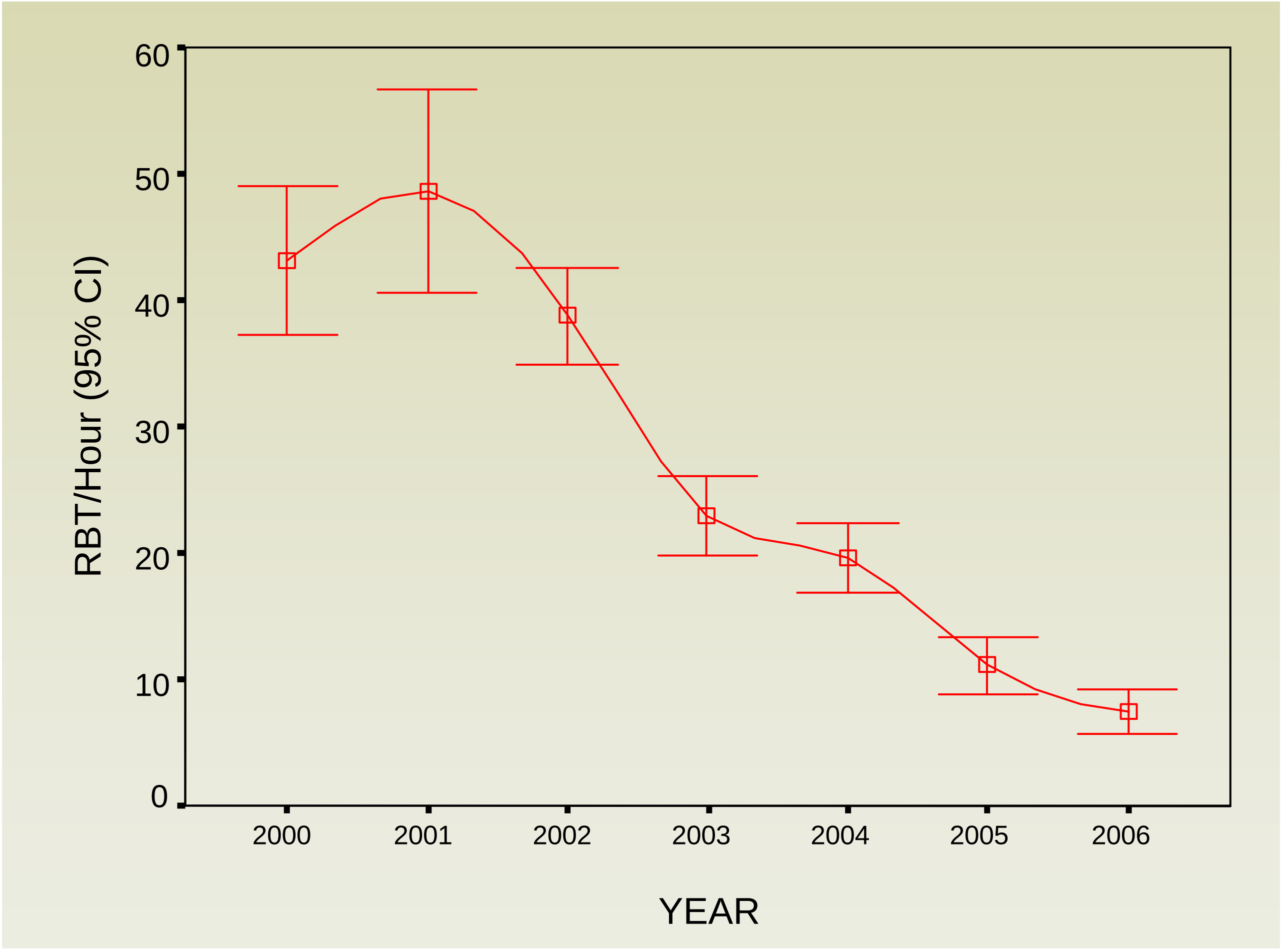
Common carp

Mean CPUE (fish/hour) for common carp at individual sample sites in the Colorado River from Lees Ferry to Diamond Creek (long-term monitoring trips [2001-2004]). Each point represents an N of 8-15)



Rainbow trout

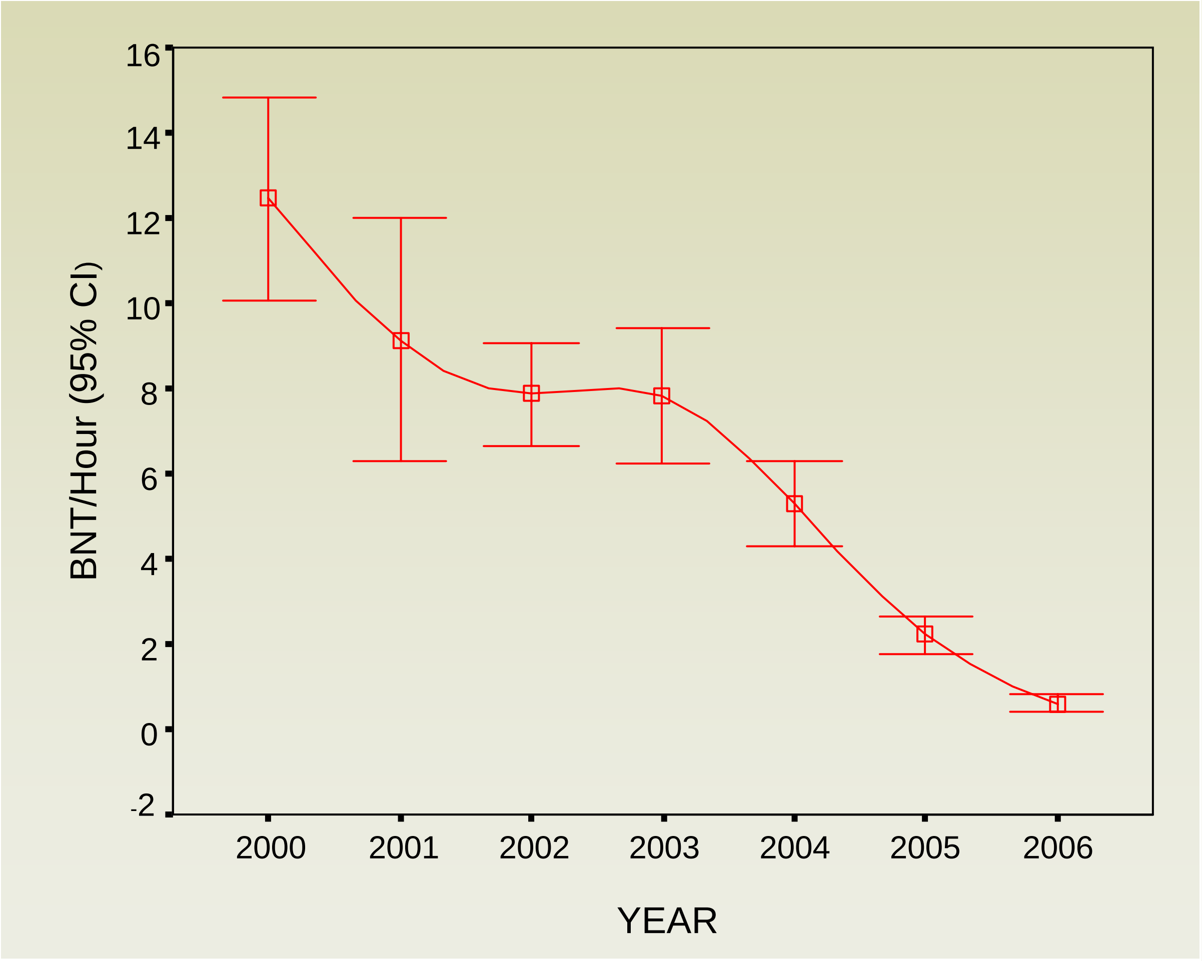
Mean CPUE (fish/hour) in Grand Canyon
(RM 0 – 226, 2000-2006)



Brown trout

Mean CPUE (fish/hour) in Grand Canyon

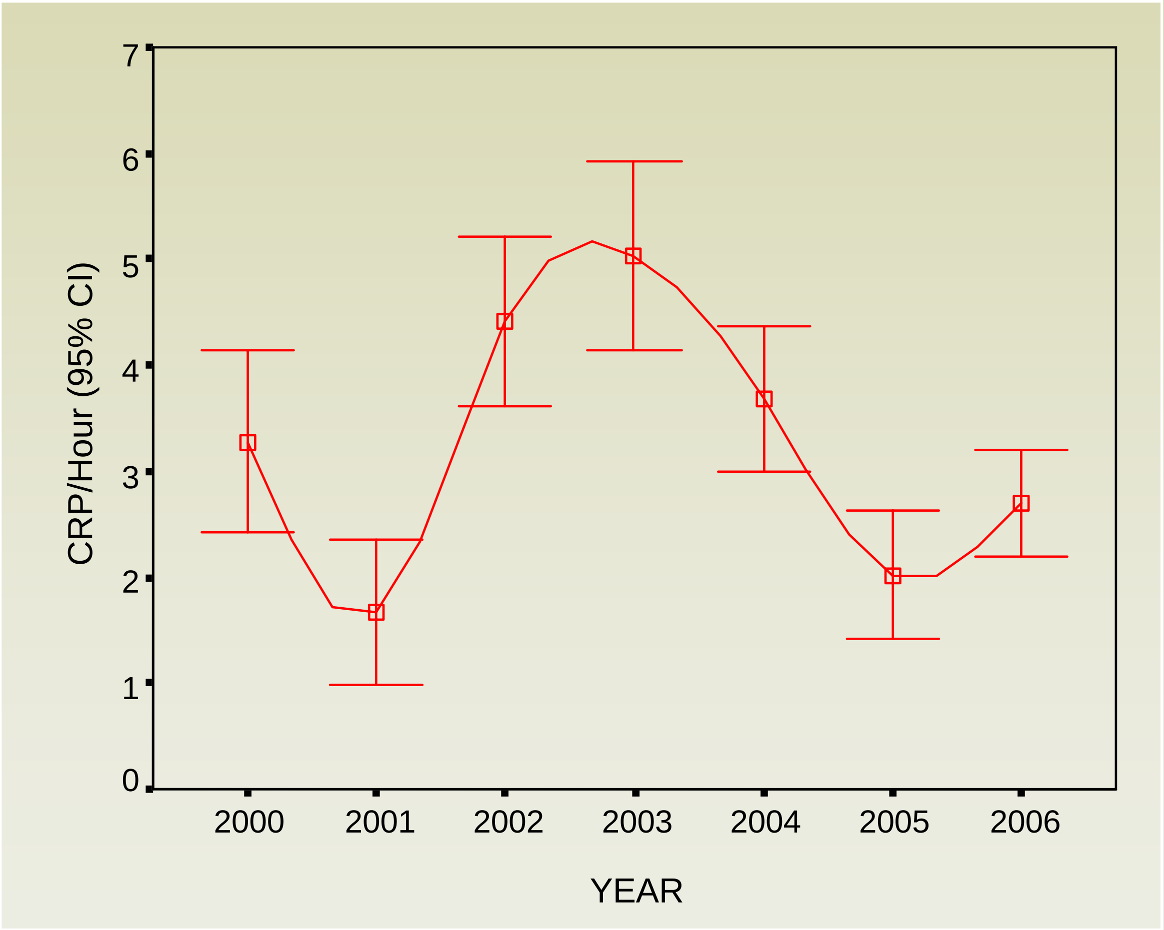
(RM 0 – 226, 2000-2006)



Carp

Mean CPUE (fish/hour) in Grand Canyon

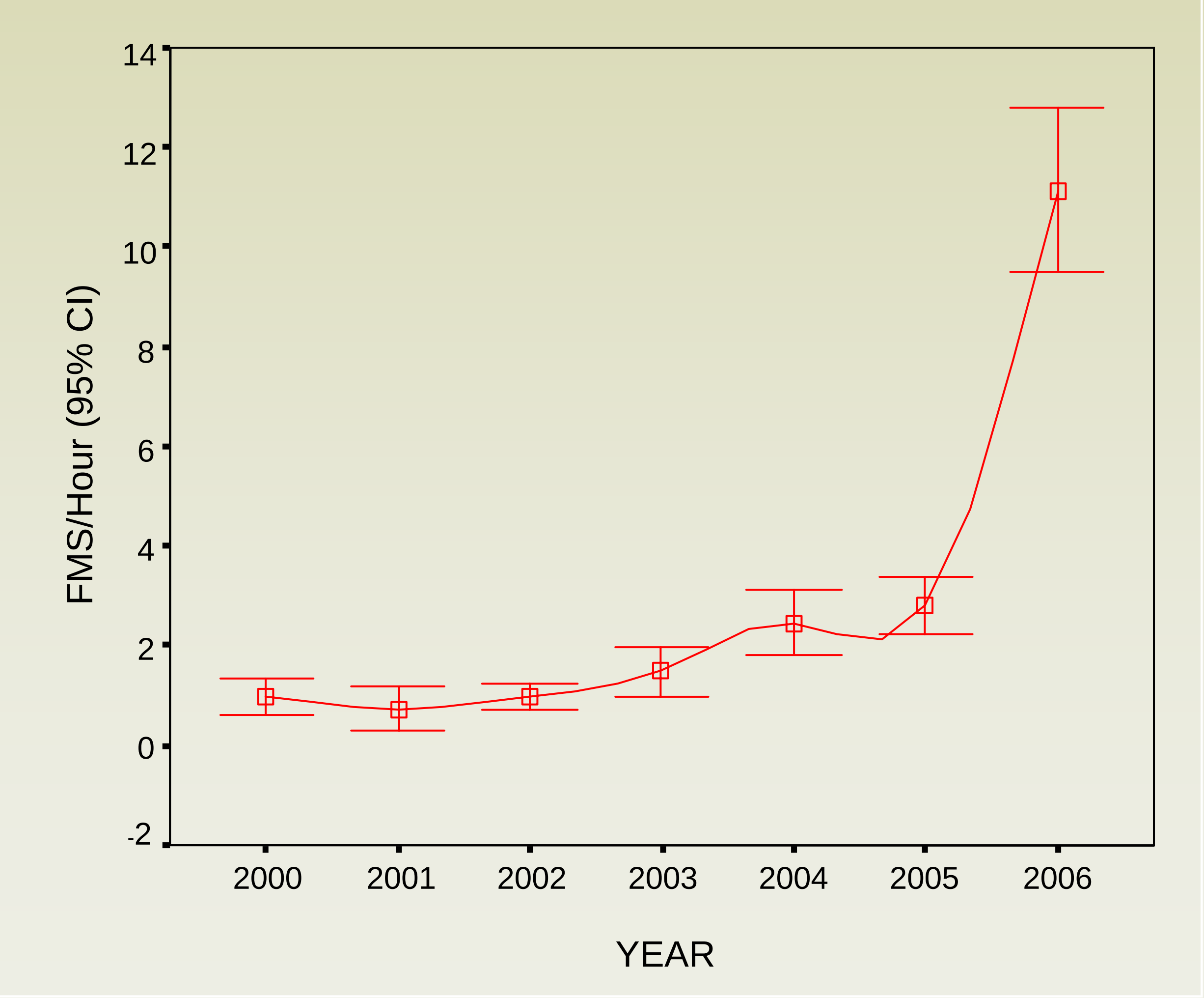
(RM 0 – 226, 2000-2006)



Flannelmouth sucker

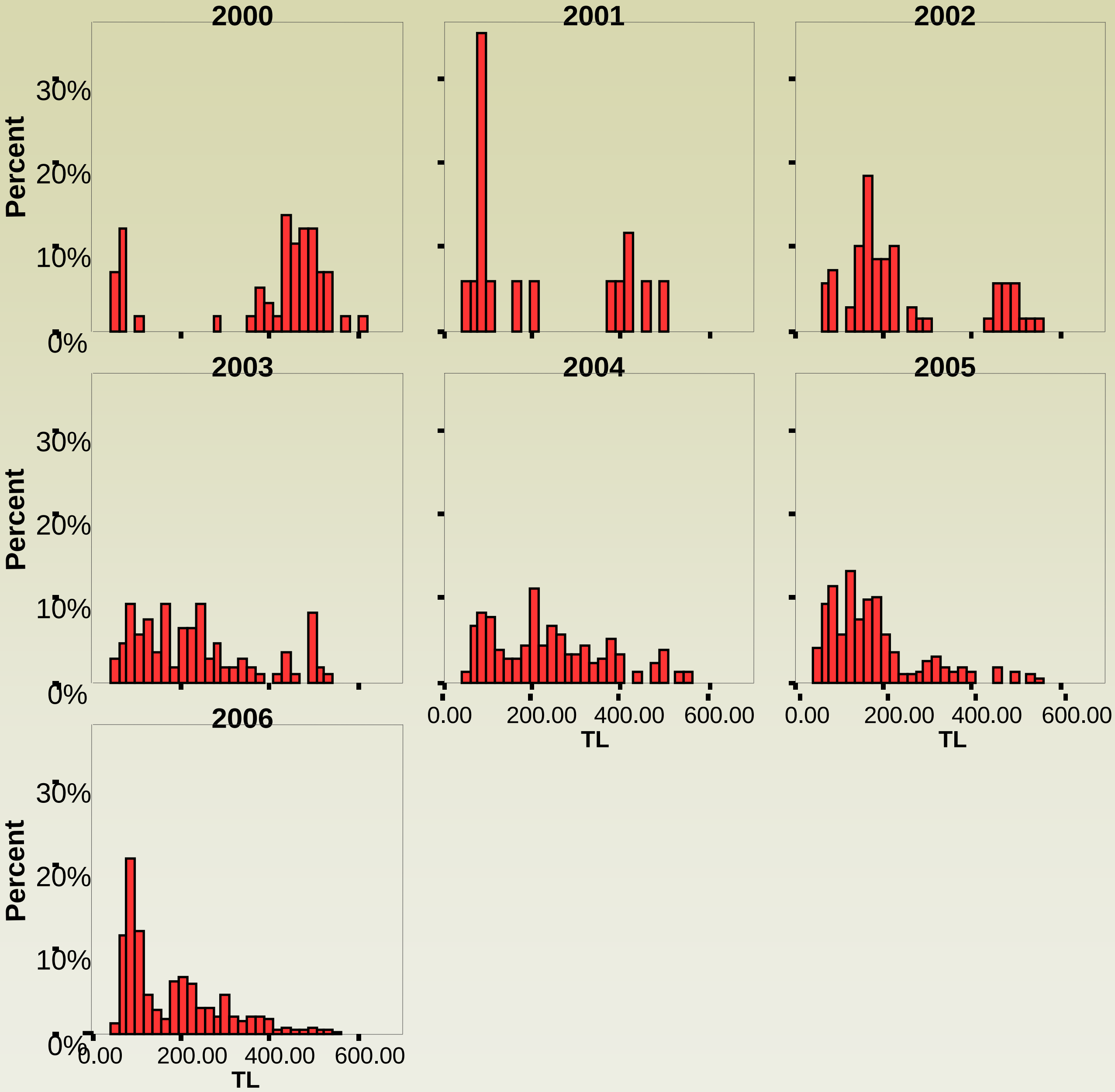
Mean CPUE (fish/hour) in Grand Canyon

(RM 0 – 226, 2000-2006)



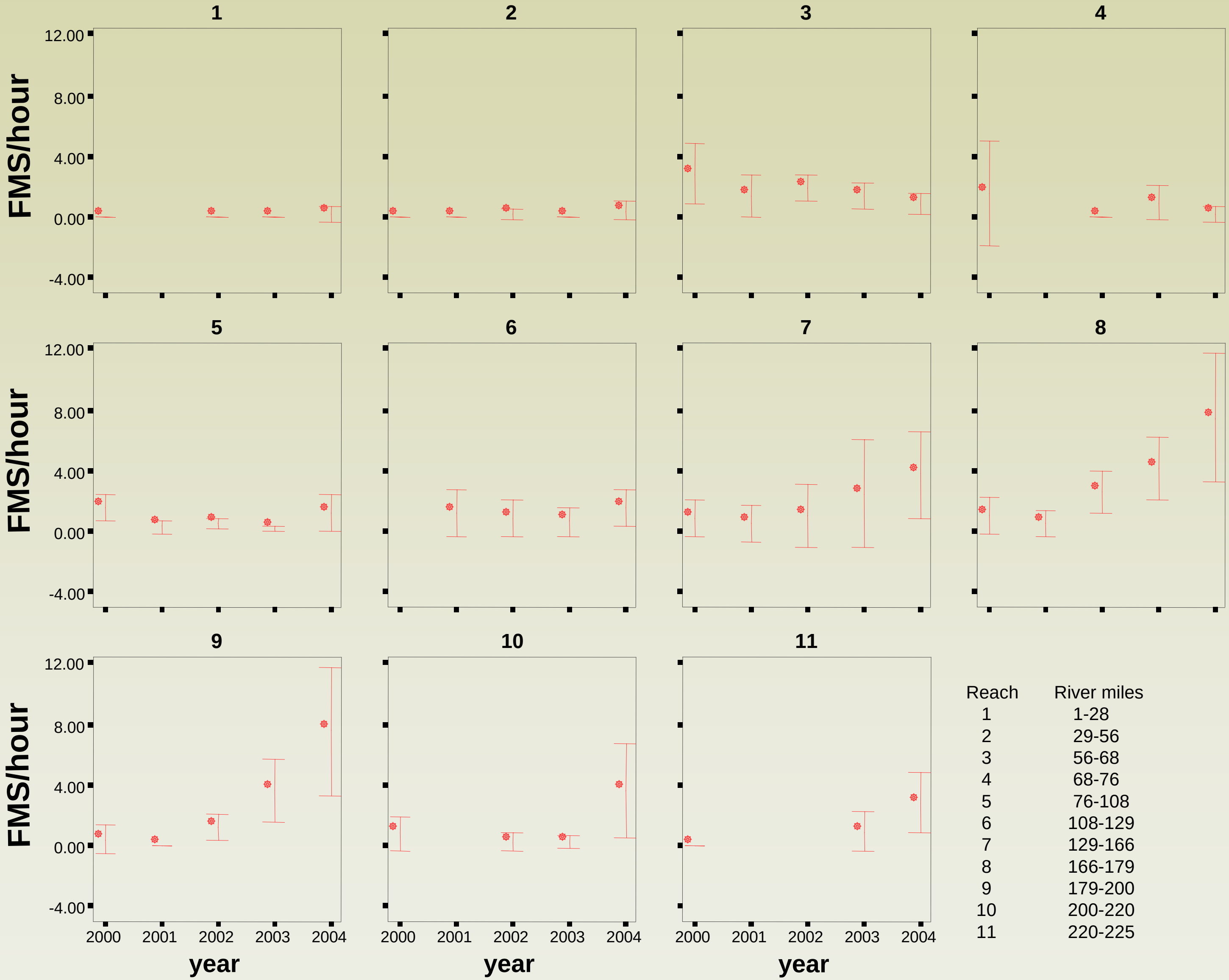
Flannelmouth sucker

Length histograms
By year and percent
of total catch

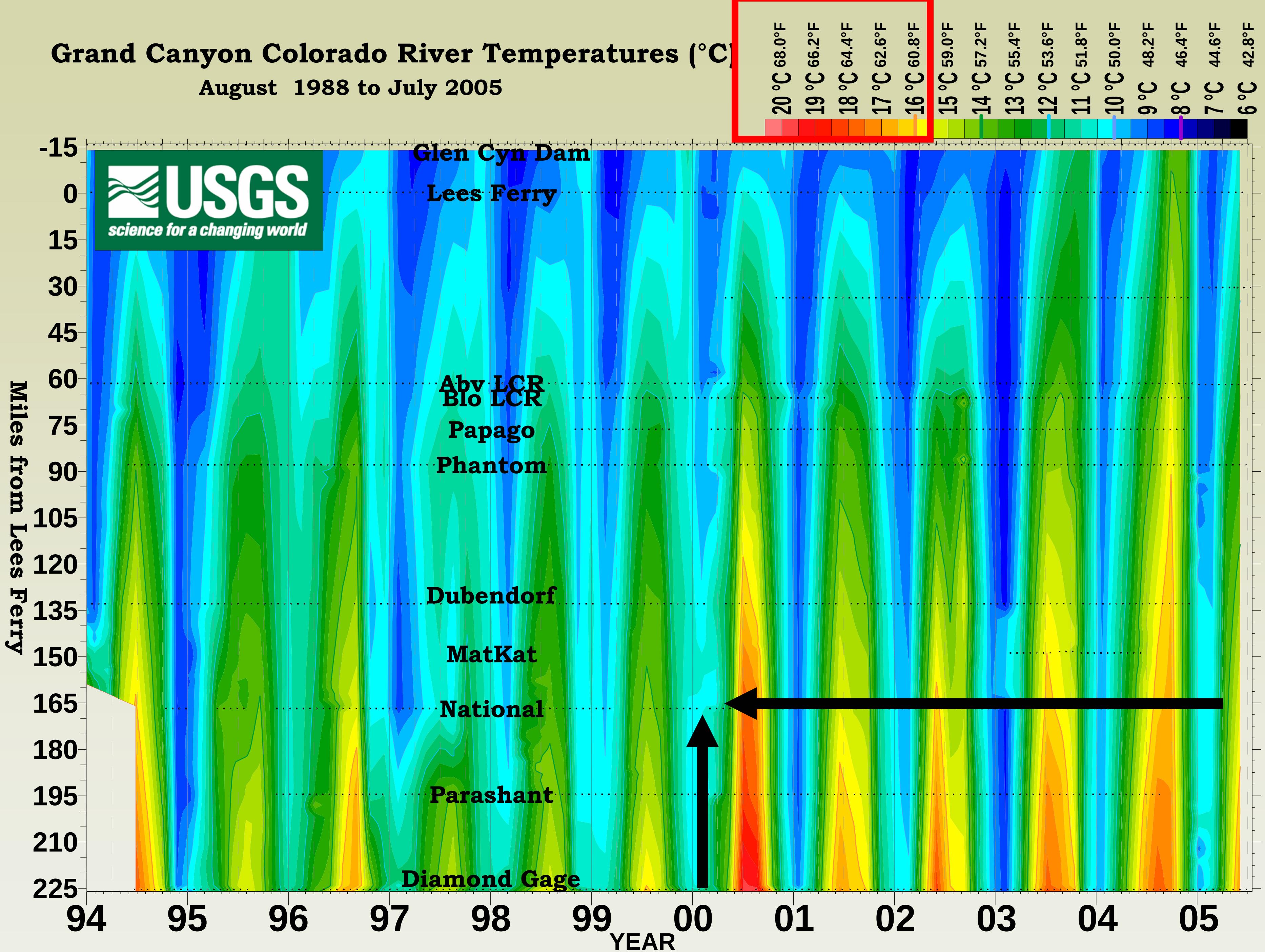


Flannelmouth sucker

Mean CPUE (fish/hour) for flannelmouth sucker (by year) in Logistic reaches. (2000-2004)



Reach	River miles
1	1-28
2	29-56
3	56-68
4	68-76
5	76-108
6	108-129
7	129-166
8	166-179
9	179-200
10	200-220
11	220-225



Grand Canyon Colorado River Temperatures (°C)
August 1988 to July 2005
20 °C 68.0°F
19 °C 66.2°F
18 °C 64.4°F
17 °C 62.6°F
16 °C 60.8°F
15 °C 59.0°F
14 °C 57.2°F
13 °C 55.4°F
12 °C 53.6°F
11 °C 51.8°F
10 °C 50.0°F
9 °C 48.2°F
8 °C 46.4°F
7 °C 44.6°F
6 °C 42.8°F
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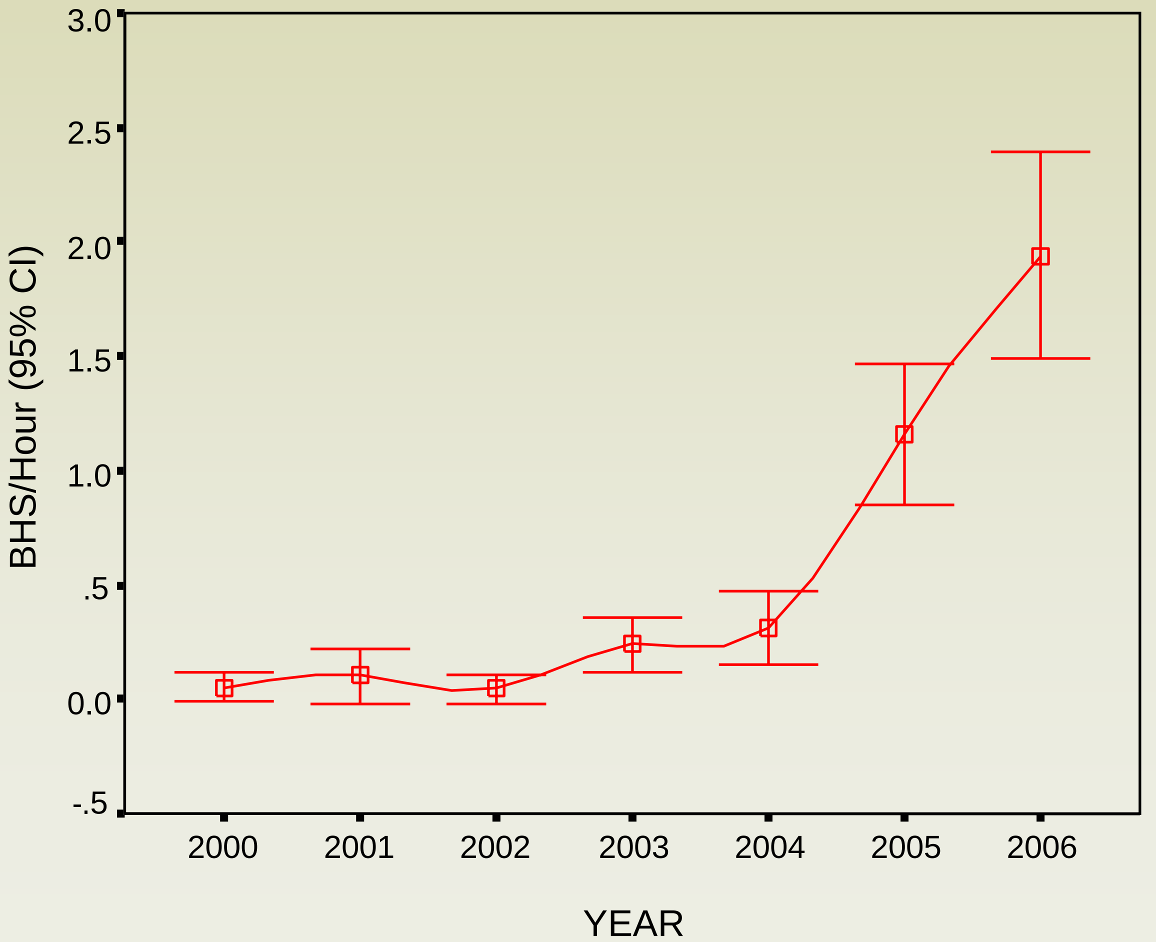
Glen Cyn Dam
Lees Ferry
Abv LCR
Blo LCR
Papago
Phantom
Dubendorf
MatKat
National
Parashant
Diamond Gage
Miles from Lees Ferry
-15
0
15
30
45
60
75
90
105
120
135
150
165
180
195
210
225
94
95
96
97
98
99
00
01
02
03
04
05
YEAR

Bluehead sucker

Mean CPUE (fish/hour) in Grand Canyon

(RM 0 – 226, 2000-2006)

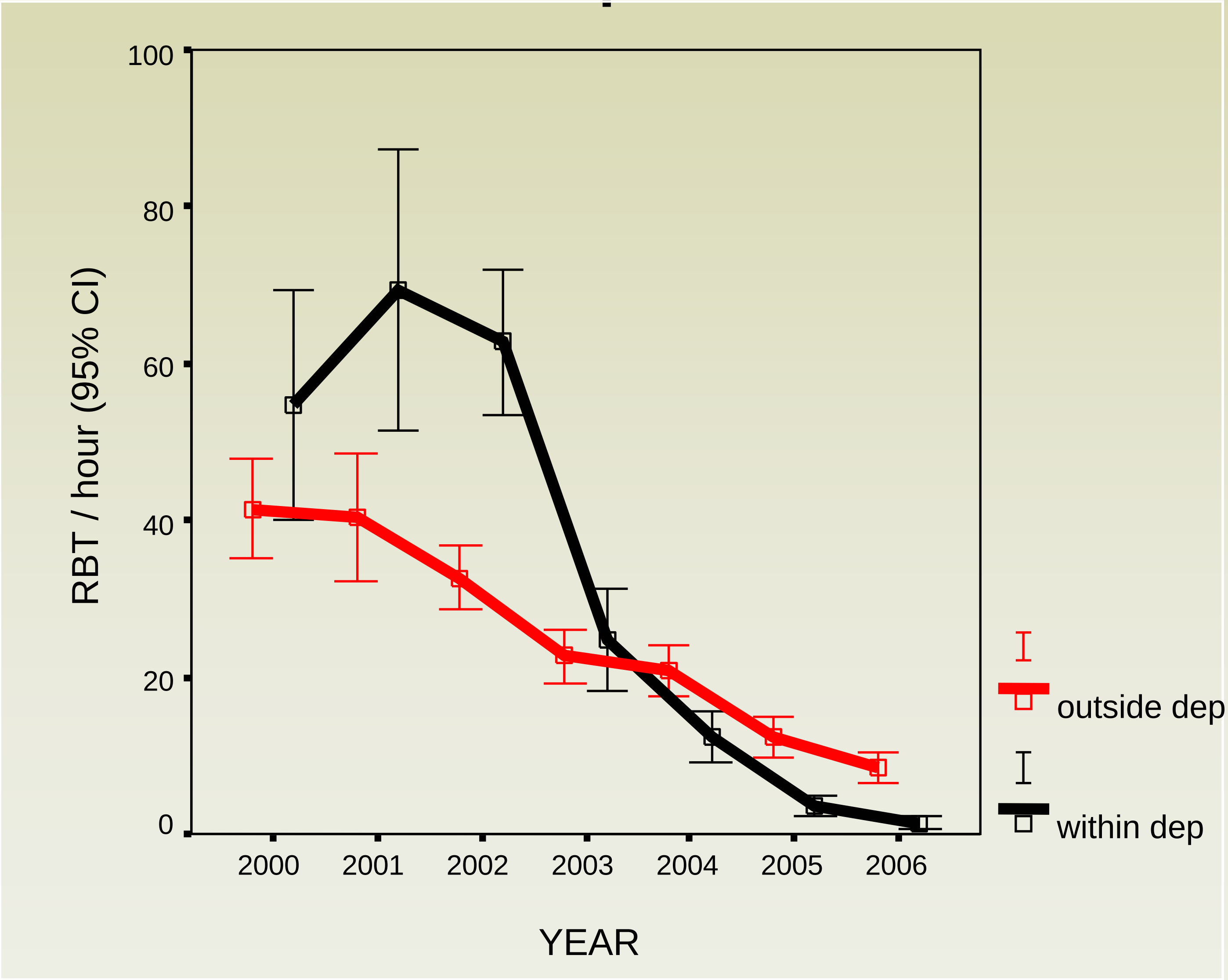


Diamond down (RM 228-260) June-July 2005

	FMS	HBC	SPD	BHS	CCF	CRP	FHM	MOS	RBT	RSH	SMB	STB	TFS
Electrofishing	56	0	32	0	8	30	6	0	0	81	3	42	0
Angling	0	0	0	0	80	5	0	0	0	0	0	3	0
Trammel netting	4	0	0	0	24	30	0	0	0	0	0	6	1
Hoop netting	9	1	10	0	1	4	1	0	0	3	1	3	0
Longlines	0	0	0	0	9	0	0	0	0	0	0	3	0
Seining	29	3	5	0	0	0	2	0	0	87	0	3	0
Backpack electrofishing	8	0	49	0	4	13	0	8	0	20	0	0	0
TOTAL	*106*	*4*	*96*	*0*	*126*	*82*	*9*	*8*	*0*	*191*	*4*	*60*	*1*

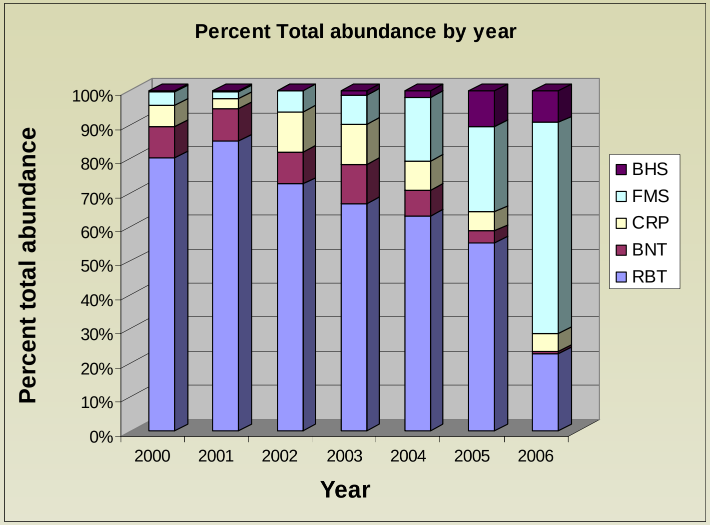
BHS = bluehead sucker, CCF = channel catfish, CRP = common carp, FHM = fathead minnow, FMS = flannelmouth sucker, HBC = humpback chub, MOS = mosquitofish, RBT = rainbow trout, RSH = red shiner, SMB = smallmouth bass, SPD = speckled dace, STB = striped bass, and TFS = threadfin shad

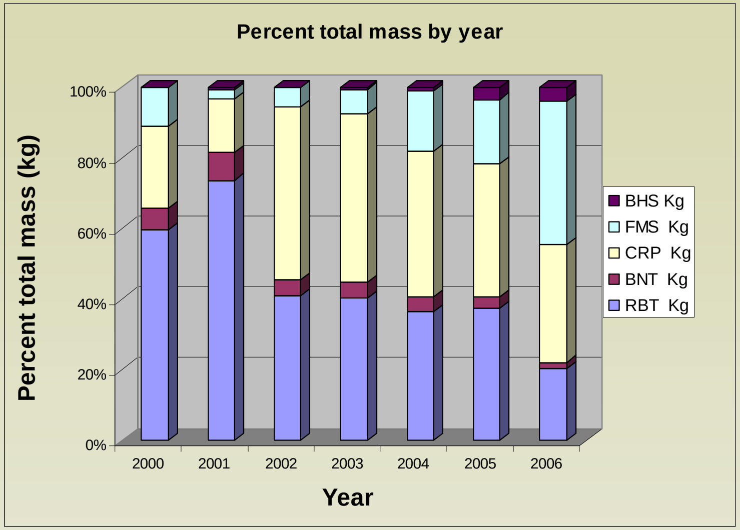
RBT (fish / hour) within and outside the LCR depletion area

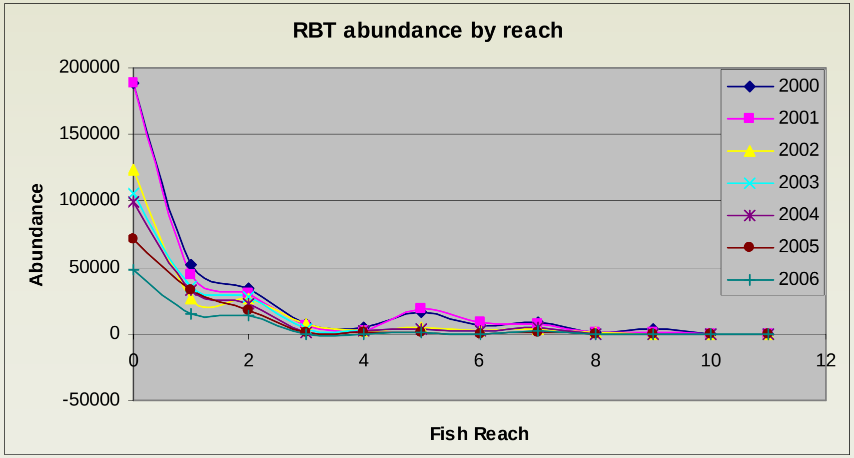


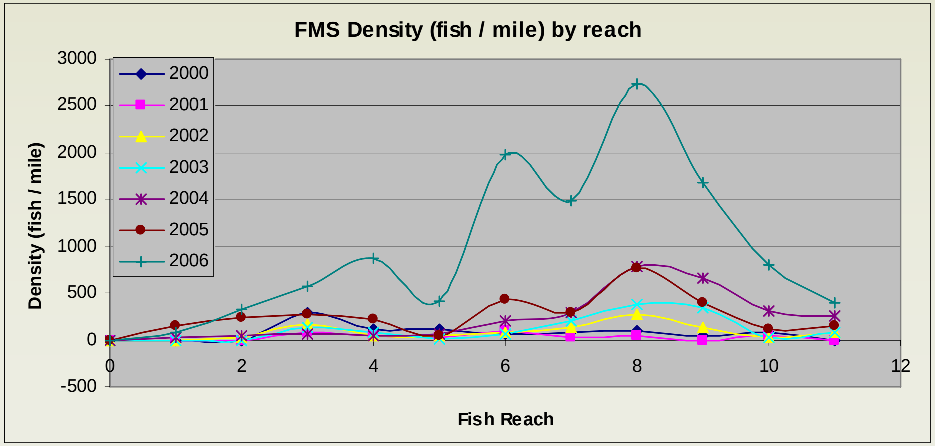
Examples of output from early attempts at abundance and biomass modeling

This is only an example of the potential. Trends are real, numbers are estimated (some are best guesses and place holders) and are pending further analysis and external review.









Conclusions I

- The current electroshocking monitoring design appears to be appropriate for RBT, BNT, FMS and BHS.
- We need to reevaluate results from CRP monitoring.
- Salmonid densities have experienced dramatic decline over the most recent years while FMS and BHS have increased significantly.
- Recent higher water temperatures are likely partially responsible for both the decline in salmonids and increase in suckers.

Conclusions II

- Gear comparisons show that electroshocking may be appropriate for detection of most non-native warm-water species likely to occur in Grand Canyon.
- Long-term monitoring offers a larger data set to act as a control for more temporally or spatially discrete experiments.
- Catch per unit effort data may be converted to abundance and biomass in future modeling exercises. This will allow us the ability to incorporate the monitoring data into larger models such as carbon budget and ecopath models.

Thank You

Robust long-term monitoring of aquatic populations is important to adaptive management programs because it characterizes a "baseline" or antecedent context in which response of biota to changing management policies or experiments can be interpreted.

(Walters and Holling 1990; Thomas 1996; Walters 1997).