

Nueces BBEST  
Biological Overlay  
Use of Instream Habitat Modeling

Ryan Smith Analysis, Thoughts

BBEST Meeting

7 October 2011

# Since Last Meeting

- Meeting with Ed Oborny, Brad Littrell
  - Deep water species curves increasing because data from bigger rivers
  - Have solid decision-making criteria
  - Emphasize total cross-sections
  - Base Low for riffle spp., Base High for pool spp.
  - What does river need not what was there
    - i.e., how low could flows go while still meeting thresholds
  - Other

# Since Last Meeting

- Conversations with Kevin Mayes
  - Look at habitat value of subsistence flow
    - 20-25% minimum criteria for % of Max
    - Optimal not needed as much
  - Other
- Literature perusal
  - Comparisons to use in SB2
    - Methods, analysis compare/contrast
  - Habitat quality and how to use
  - Habitat time series
- Writing!

# My Recommendations

1. Keep current hydrographic separation, HEFR parameterization (no “bright line”)
2. Keep all species currently modeled
3. Use Full Period of Record
  - But, any reason for Late at Three Rivers? (beyond habitat)
4. **Use (or emphasize) 0.5 quality threshold to**
  - **But, comment on patterns in all 3 quality ranges**
  - **Especially look for:**
    - **Species with little optimal (>0.8) in base flow recommendations**

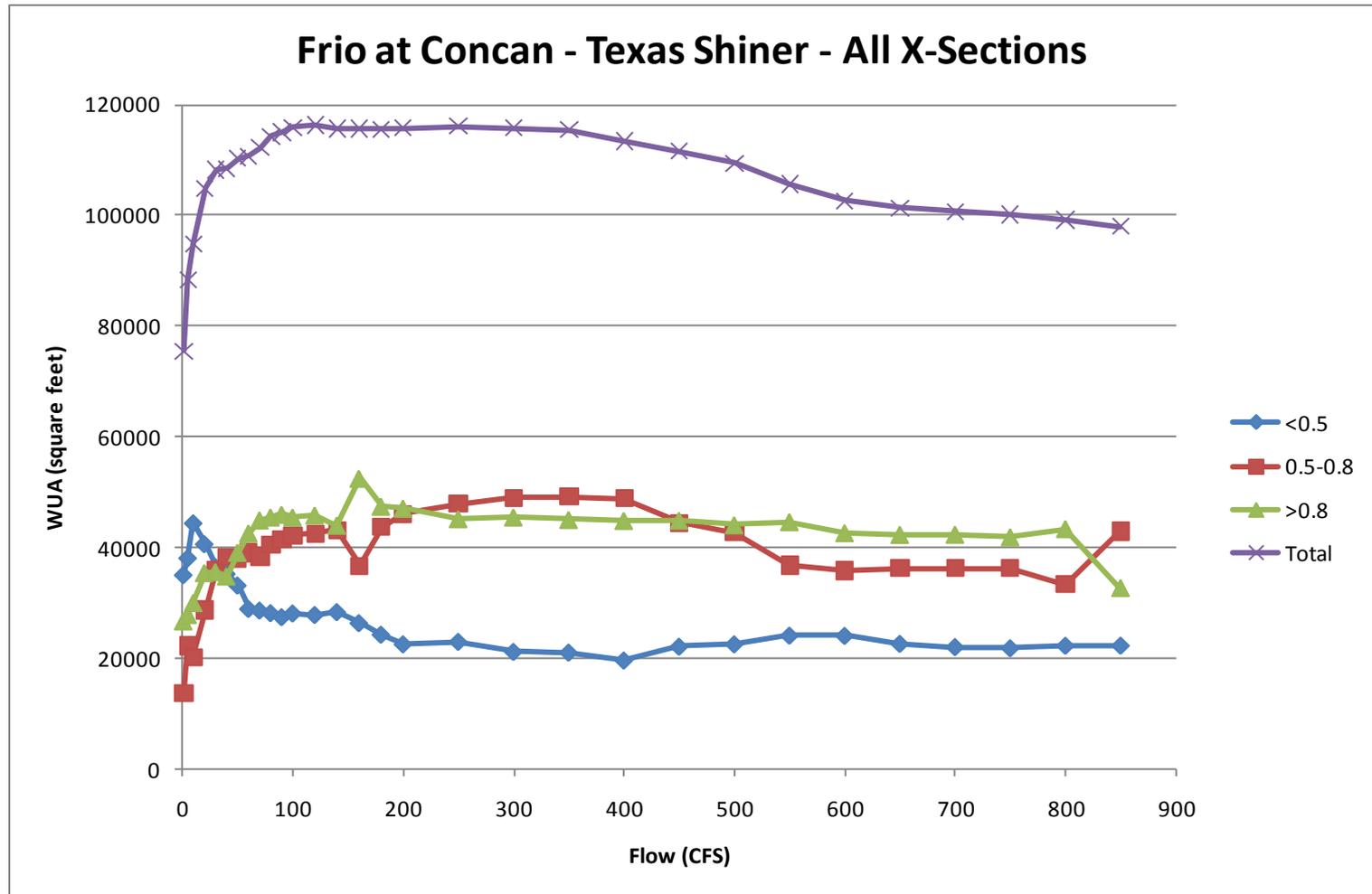
# My Recommendations

- 5. Emphasize total x-sections for decisions**
  - **Utilize subsets only where most appropriate**
    - **E.g., deep pool species in HC sites, shallow species at Three Rivers**
  - **Include mesohabitat x-section subset graphs, tables in Appendix**
- 6. Use 200% of highest base flow number as upper extent of maximum analysis**
- 7. Use 75% of max threshold to determine “enoughness” for Base flows**
  - **Maybe go even lower**
- 8. Use 20% of max threshold to evaluate subsistence**
- 9. Emphasize riffle species in Base Low and pool species in Base High**

# Uncertainty

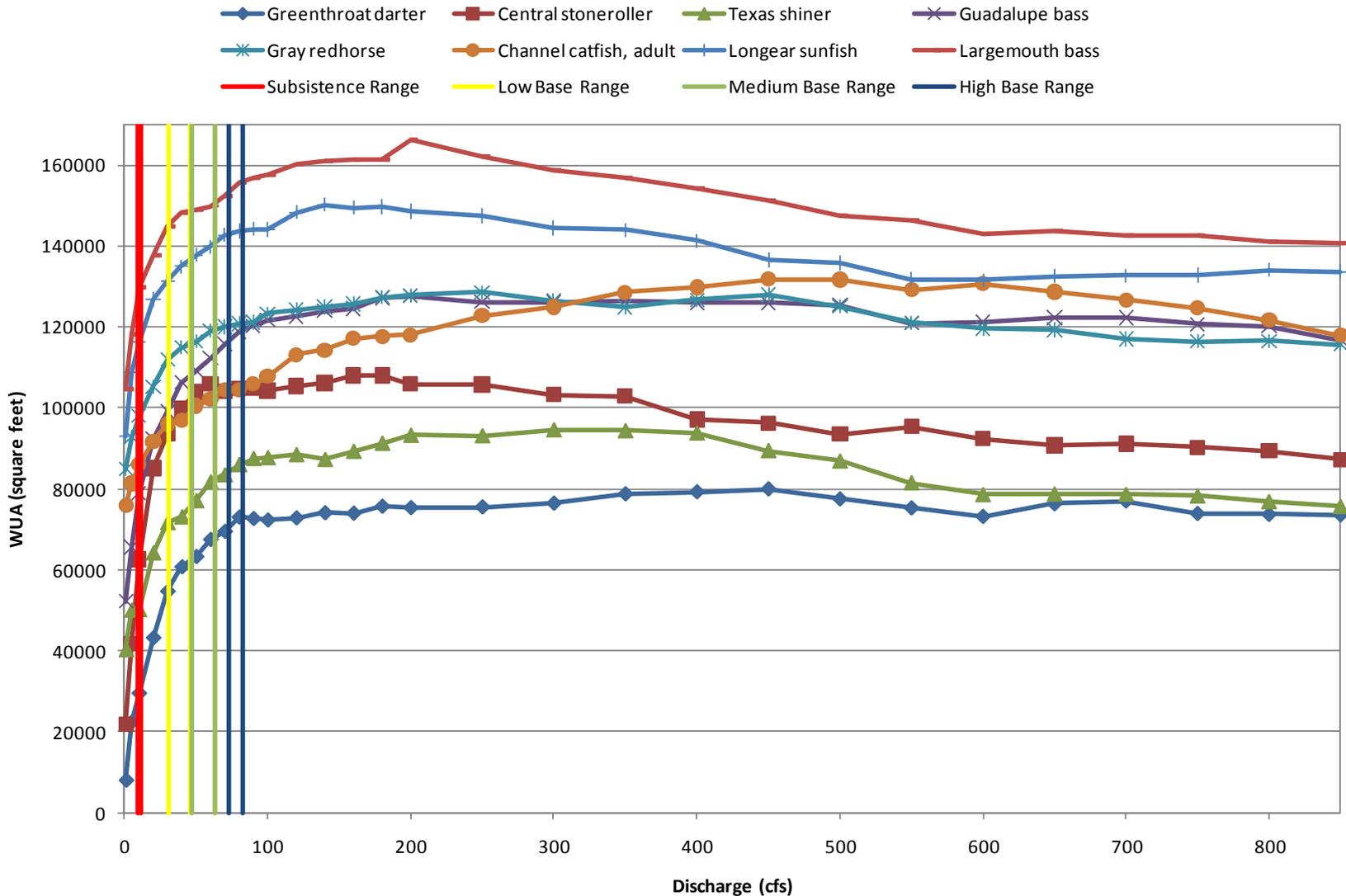
- Ed Oborny: if we aren't comfortable enough with the analysis to make revisions from habitat then we aren't comfortable enough with it to use it
- What are sources of uncertainty
  - Habitat suitability criteria
  - Hydraulics – we only have field data on depth and velocity from a very low flow. So, the model has more uncertainty as the flows go higher
  - Rating curve – this all relies on a stage-discharge rating w/ its own uncertainty (see report)
- How do we adjust how to use it?

# Concan – Species Example

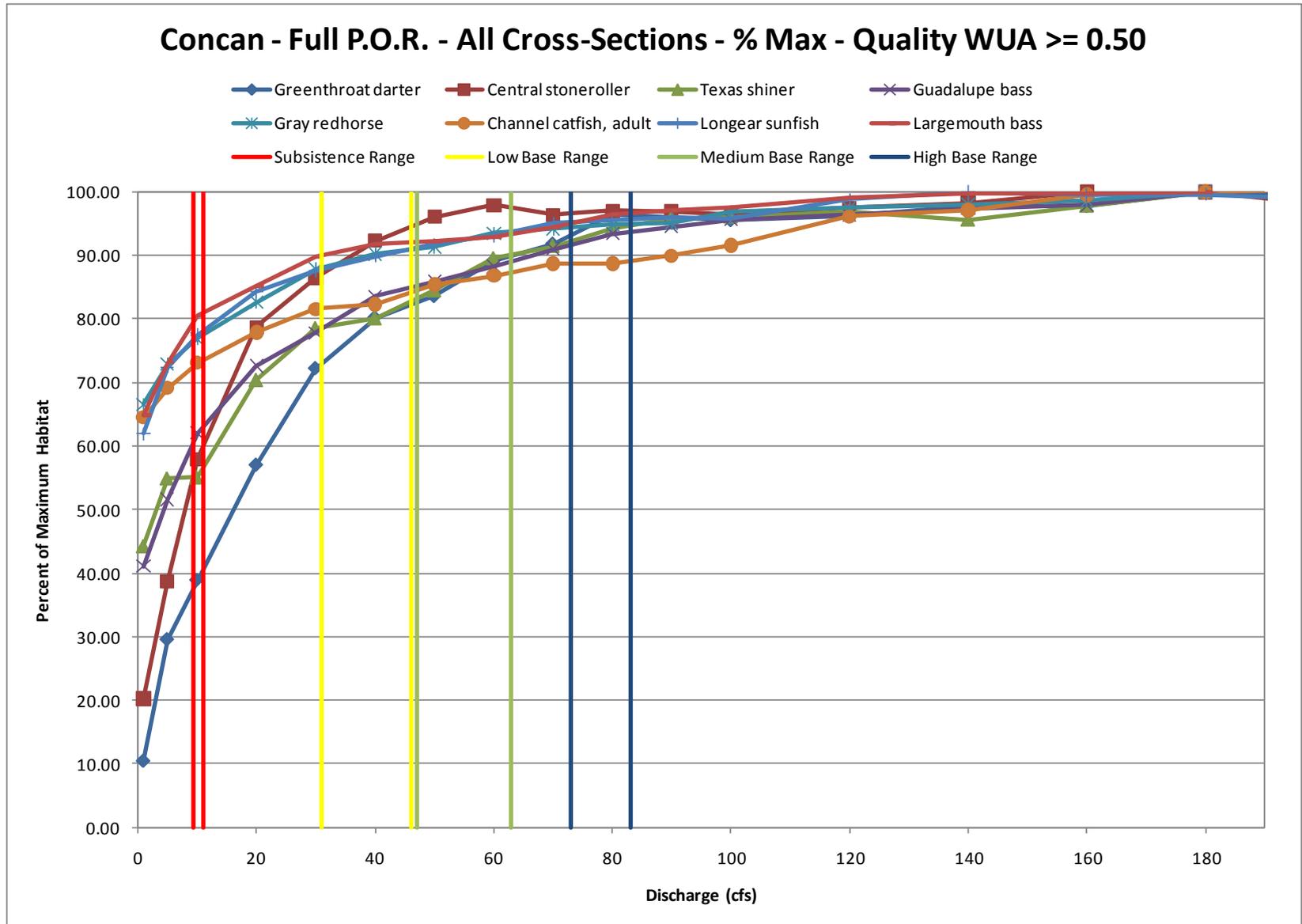


# Concan – WUA, All, 0.5 Threshold

Concan - Full P.O.R. - All Cross-Sections - Quality WUA  $\geq 0.50$



# Concan – % Max, 0.5 Threshold



# Concan – % of Max – 0.5, 200% Base, 75/50/25

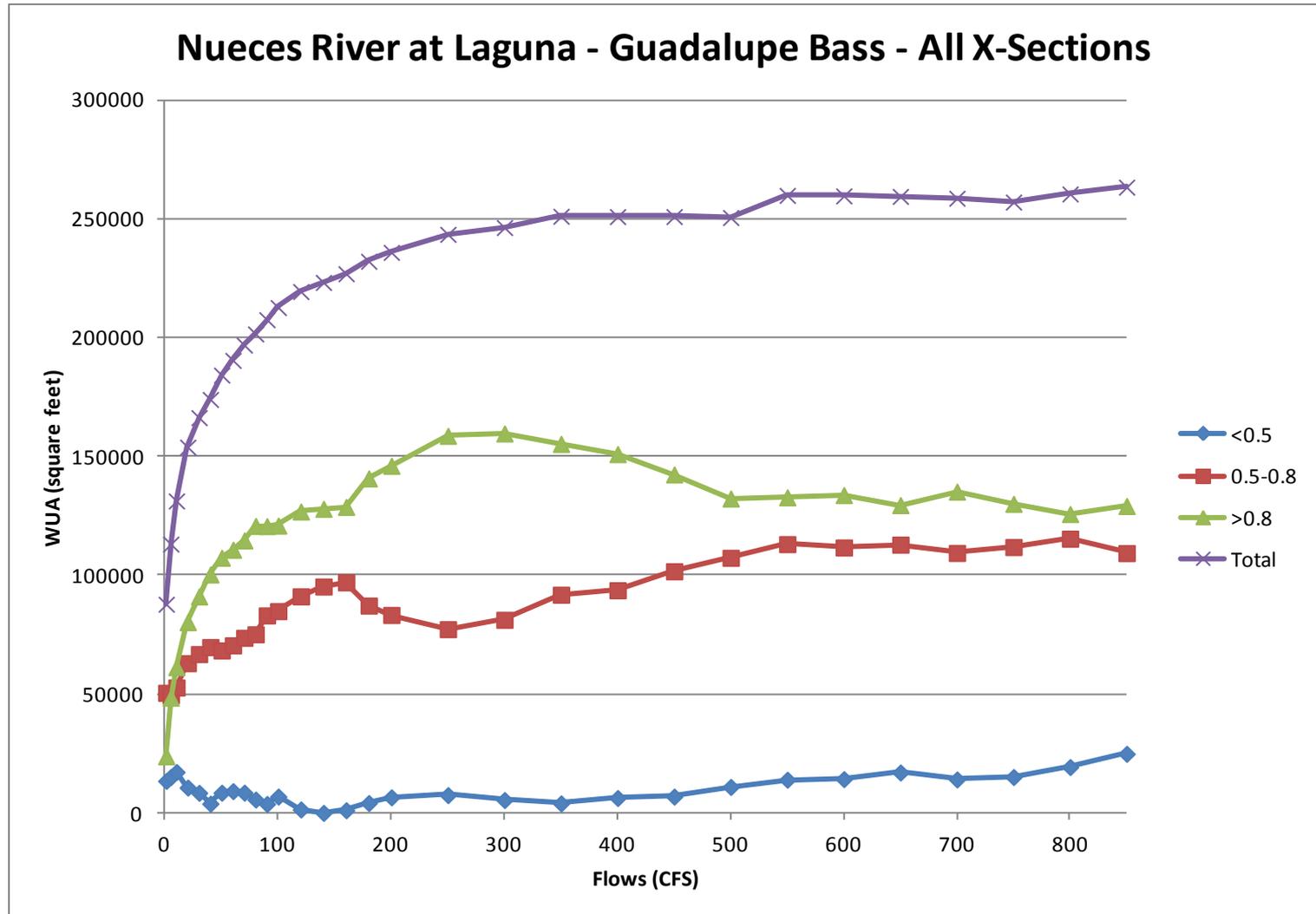
- **75/50/25** “enoughness” thresholds
- % of max habitat w/ 200% highest base flow (190 CFS) as upper end
- **0.5** quality threshold
- 3 Base flow levels
- Full POR, 8 modeled species, by total and each mesohabitat type

		Greenthroat darter			Central stoneroller			Texas shiner			Guadalupe bass			Gray redbhorse			Channel cat, adult			Longear sunfish			Largemouth bass		
		Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet
<b>TOTAL</b>	Winter	82%	90%	96%	95%	97%	97%	83%	90%	95%	85%	89%	94%	91%	94%	95%	84%	87%	89%	91%	94%	96%	92%	93%	97%
	Spring	80%	89%	96%	92%	98%	97%	80%	89%	94%	84%	88%	94%	90%	93%	95%	82%	87%	89%	90%	93%	96%	92%	93%	97%
	Summer	73%	83%	93%	87%	95%	97%	79%	83%	92%	78%	85%	92%	88%	91%	94%	82%	84%	89%	88%	91%	95%	90%	92%	95%
	Fall	75%	86%	96%	89%	97%	97%	79%	87%	94%	80%	87%	94%	89%	92%	95%	82%	86%	89%	88%	92%	96%	91%	93%	97%
<b>RIFFLE</b>	Winter	46%	52%	70%	59%	62%	69%	42%	47%	66%	34%	35%	58%	24%	32%	53%	5%	25%	26%	28%	36%	62%	19%	27%	52%
	Spring	45%	50%	70%	58%	62%	69%	38%	45%	66%	33%	33%	57%	24%	26%	53%	5%	23%	26%	25%	32%	61%	16%	26%	51%
	Summer	46%	47%	60%	58%	59%	65%	29%	42%	56%	34%	34%	45%	26%	24%	47%	5%	5%	26%	25%	28%	51%	15%	19%	35%
	Fall	46%	49%	70%	58%	61%	69%	32%	45%	66%	33%	33%	57%	26%	25%	53%	5%	15%	26%	25%	30%	61%	15%	24%	51%
<b>RUN</b>	Winter	89%	97%	100%	96%	100%	98%	86%	96%	98%	90%	96%	99%	92%	96%	96%	75%	79%	82%	95%	99%	98%	94%	94%	98%
	Spring	88%	96%	100%	93%	100%	98%	83%	94%	98%	87%	94%	99%	91%	95%	96%	75%	78%	82%	93%	98%	98%	94%	93%	98%
	Summer	77%	89%	99%	85%	97%	99%	85%	86%	97%	80%	90%	98%	90%	92%	96%	74%	75%	81%	90%	95%	100%	93%	94%	97%
	Fall	81%	93%	100%	88%	99%	98%	84%	91%	98%	82%	93%	99%	90%	94%	96%	74%	77%	82%	91%	97%	98%	93%	94%	98%
<b>POOL</b>	Winter	85%	96%	98%	98%	98%	93%	80%	83%	86%	92%	93%	94%	92%	93%	94%	91%	94%	94%	93%	92%	93%	94%	96%	97%
	Spring	76%	95%	99%	98%	100%	93%	76%	83%	86%	93%	92%	93%	91%	93%	94%	88%	94%	94%	92%	92%	93%	94%	96%	97%
	Summer	71%	87%	100%	97%	98%	93%	73%	80%	85%	88%	92%	93%	88%	92%	94%	88%	91%	94%	91%	93%	92%	91%	94%	96%
	Fall	72%	93%	99%	97%	99%	93%	74%	82%	86%	90%	92%	93%	89%	93%	94%	88%	93%	94%	91%	93%	93%	92%	95%	97%

# Concan Observations

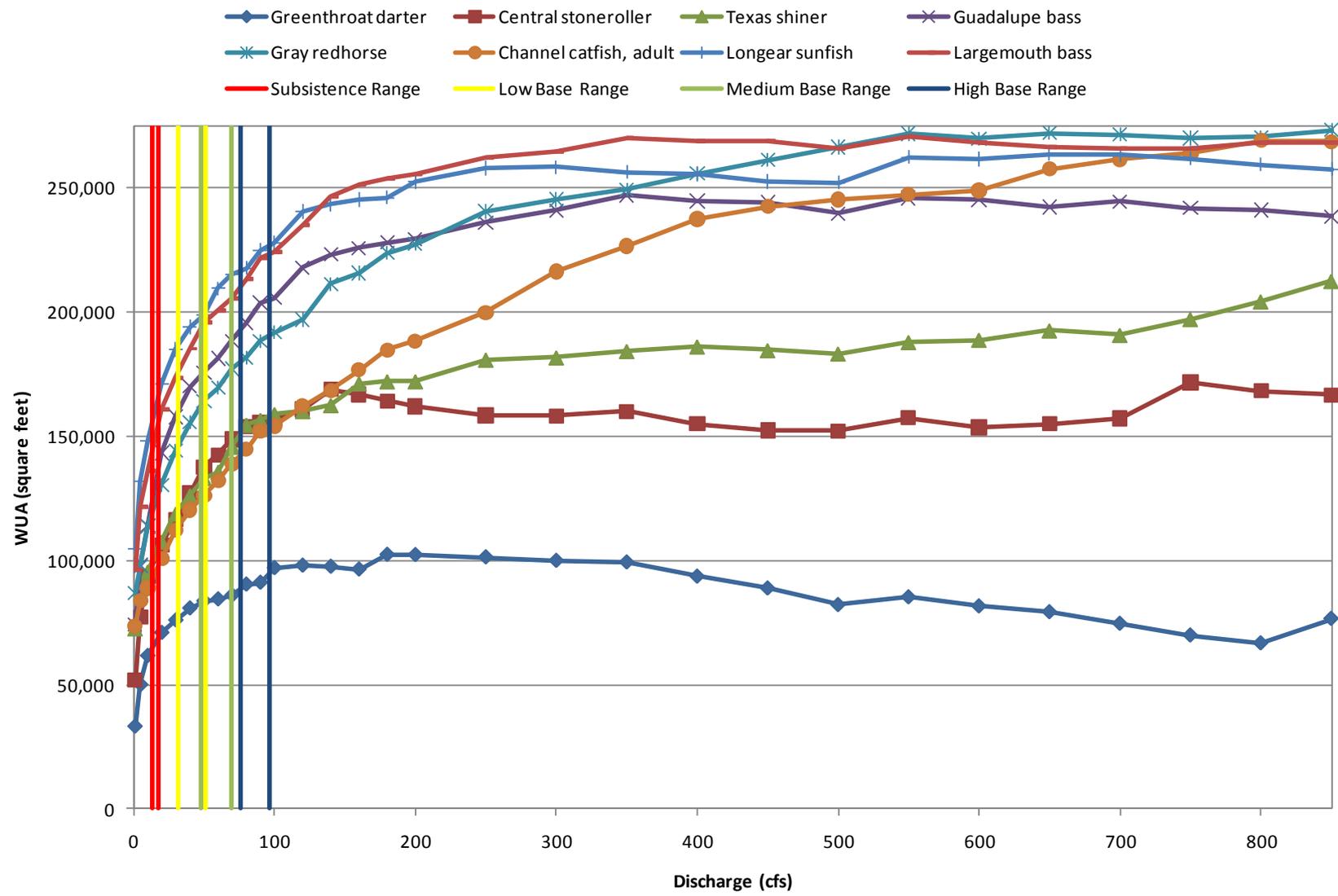
- Nearly all species WUA curves (Totals, many habitat subsets) peak at flows higher than our Base flows
  - But this is not as pronounced as at Laguna
- But, habitat looks good enough for all species using 0.5 quality and 75% enoughness thresholds
  - All species meet 75% threshold in all 3 Base levels
    - Most meet with a 90% too
  - All species meet 20% threshold in Subsistence range
  - All species look good in “preferred” mesohabitat type cross-sections

# Laguna – Species Example

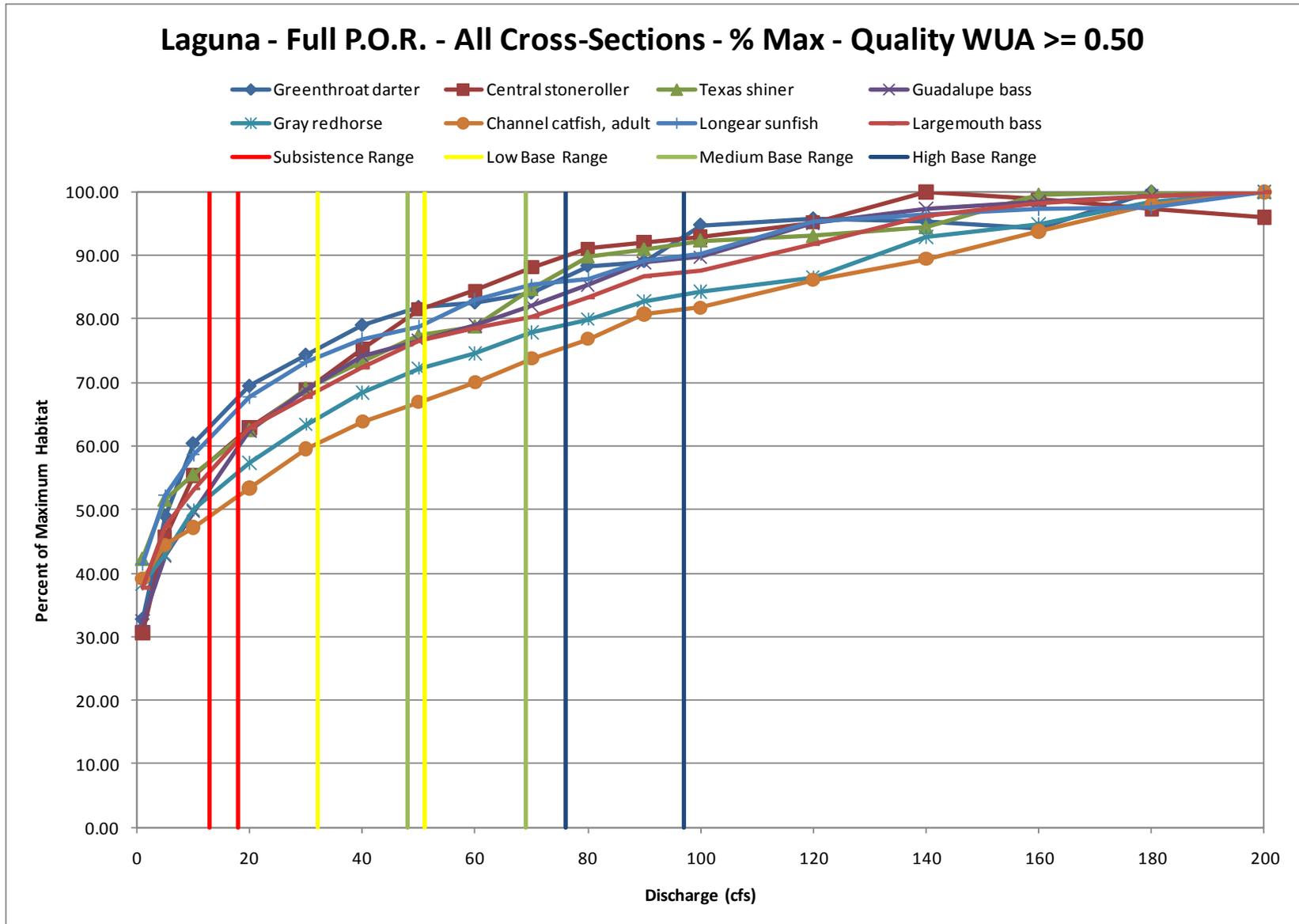


# Laguna – WUA, All, 0.5 Threshold

Laguna - Full P.O.R. - All Cross-Sections - Quality WUA  $\geq 0.50$



# Laguna – % Max, 0.5 Threshold



# Laguna – % of Max – 0.5, 200% Base, 75/50/25

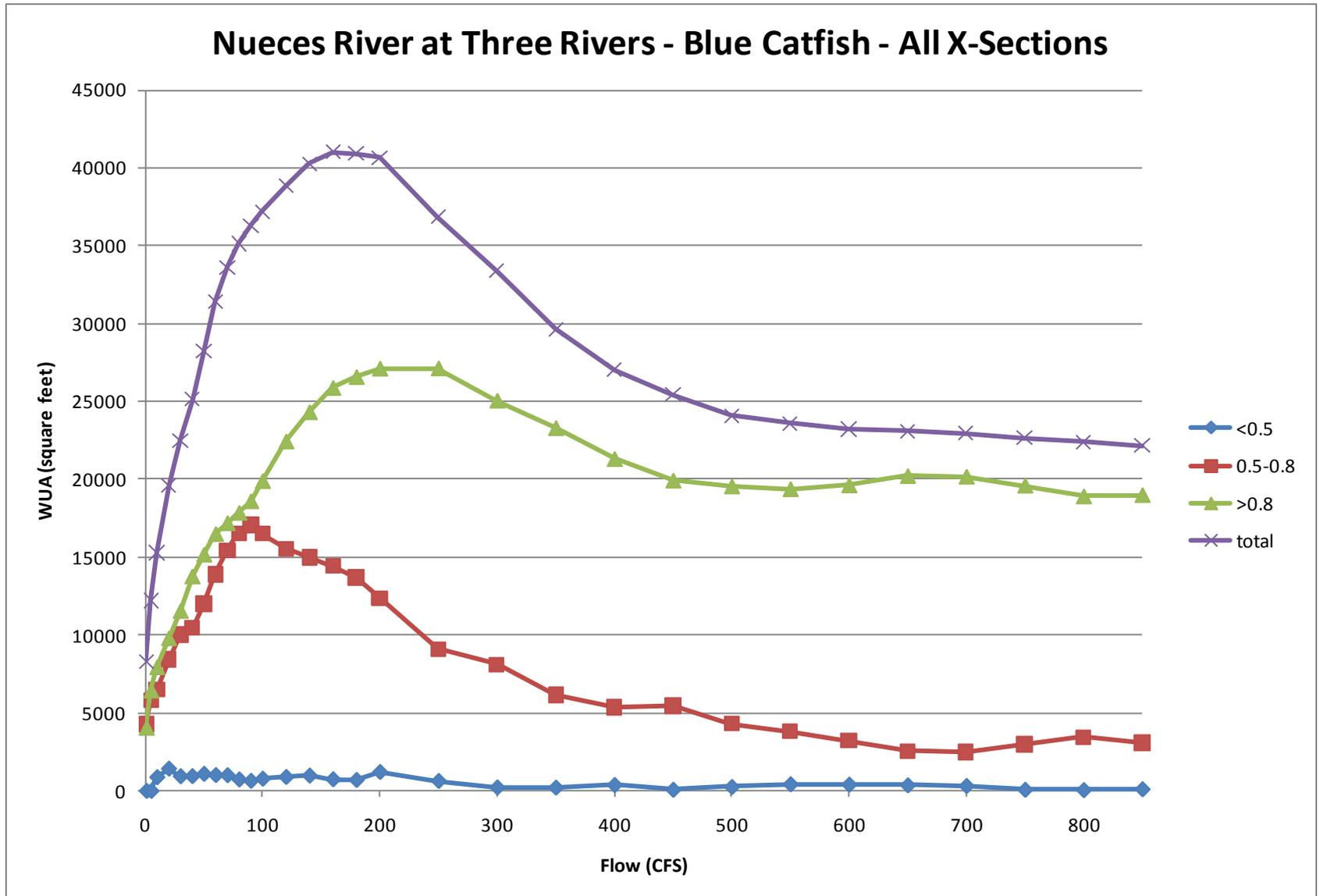
- **75/50/25** “enoughness” thresholds
- % of max habitat w/ 200% highest base flow (208 CFS) as upper end
- **0.5** quality threshold
- 3 Base flow levels
- Full POR, 8 modeled species, by total and each mesohabitat type

		Greenthroat darter			Central stoneroller			Texas shiner			Guadalupe bass			Gray redhorse			Channel cat, adult			Longear sunfish			Largemouth bass		
		Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet
<b>TOTAL</b>	Winter	82%	84%	91%	82%	88%	92%	78%	84%	92%	77%	82%	89%	72%	78%	83%	67%	73%	81%	79%	85%	90%	77%	80%	87%
	Spring	80%	83%	89%	78%	86%	92%	75%	81%	91%	75%	80%	87%	70%	76%	82%	65%	71%	79%	78%	84%	88%	74%	79%	85%
	Summer	75%	81%	87%	70%	80%	90%	70%	77%	88%	70%	76%	84%	64%	71%	79%	60%	66%	76%	74%	78%	86%	69%	76%	82%
	Fall	79%	83%	93%	76%	85%	93%	74%	80%	92%	74%	80%	89%	69%	75%	84%	64%	71%	81%	77%	83%	90%	73%	79%	87%
<b>RIFFLE</b>	Winter	78%	80%	88%	81%	85%	90%	58%	69%	82%	69%	75%	84%	54%	63%	74%	32%	44%	61%	68%	74%	82%	64%	70%	78%
	Spring	76%	79%	85%	77%	83%	89%	55%	64%	80%	67%	73%	81%	49%	60%	71%	28%	39%	57%	65%	72%	79%	60%	68%	76%
	Summer	72%	77%	83%	71%	80%	87%	48%	57%	75%	60%	68%	77%	39%	52%	66%	20%	30%	49%	60%	67%	75%	51%	62%	72%
	Fall	75%	79%	90%	75%	83%	90%	53%	63%	82%	66%	72%	84%	47%	59%	75%	26%	39%	61%	64%	72%	82%	58%	68%	79%
<b>RUN</b>	Winter	96%	100%	99%	89%	97%	99%	100%	98%	96%	90%	93%	97%	88%	89%	91%	88%	91%	93%	93%	98%	98%	88%	89%	95%
	Spring	96%	99%	100%	83%	96%	99%	98%	98%	96%	90%	92%	97%	87%	89%	91%	87%	90%	92%	92%	98%	98%	86%	88%	94%
	Summer	89%	96%	100%	72%	86%	99%	96%	99%	97%	87%	90%	96%	86%	88%	89%	84%	87%	92%	91%	92%	98%	84%	87%	91%
	Fall	96%	98%	99%	81%	96%	99%	98%	98%	96%	89%	91%	97%	87%	89%	91%	87%	90%	93%	92%	98%	98%	85%	88%	95%
<b>POOL</b>	Winter	0%	0%	27%	29%	38%	62%	72%	79%	84%	76%	83%	93%	96%	93%	92%	100%	99%	100%	92%	98%	99%	91%	92%	97%
	Spring	0%	0%	22%	28%	33%	56%	74%	75%	83%	74%	81%	91%	97%	94%	92%	100%	100%	99%	93%	96%	99%	91%	92%	95%
	Summer	0%	0%	8%	22%	28%	48%	73%	73%	83%	69%	75%	86%	98%	96%	93%	98%	100%	99%	94%	92%	98%	89%	91%	93%
	Fall	0%	0%	28%	27%	33%	66%	74%	75%	86%	73%	81%	93%	97%	94%	92%	100%	100%	99%	93%	96%	98%	90%	92%	97%

# Laguna Observations

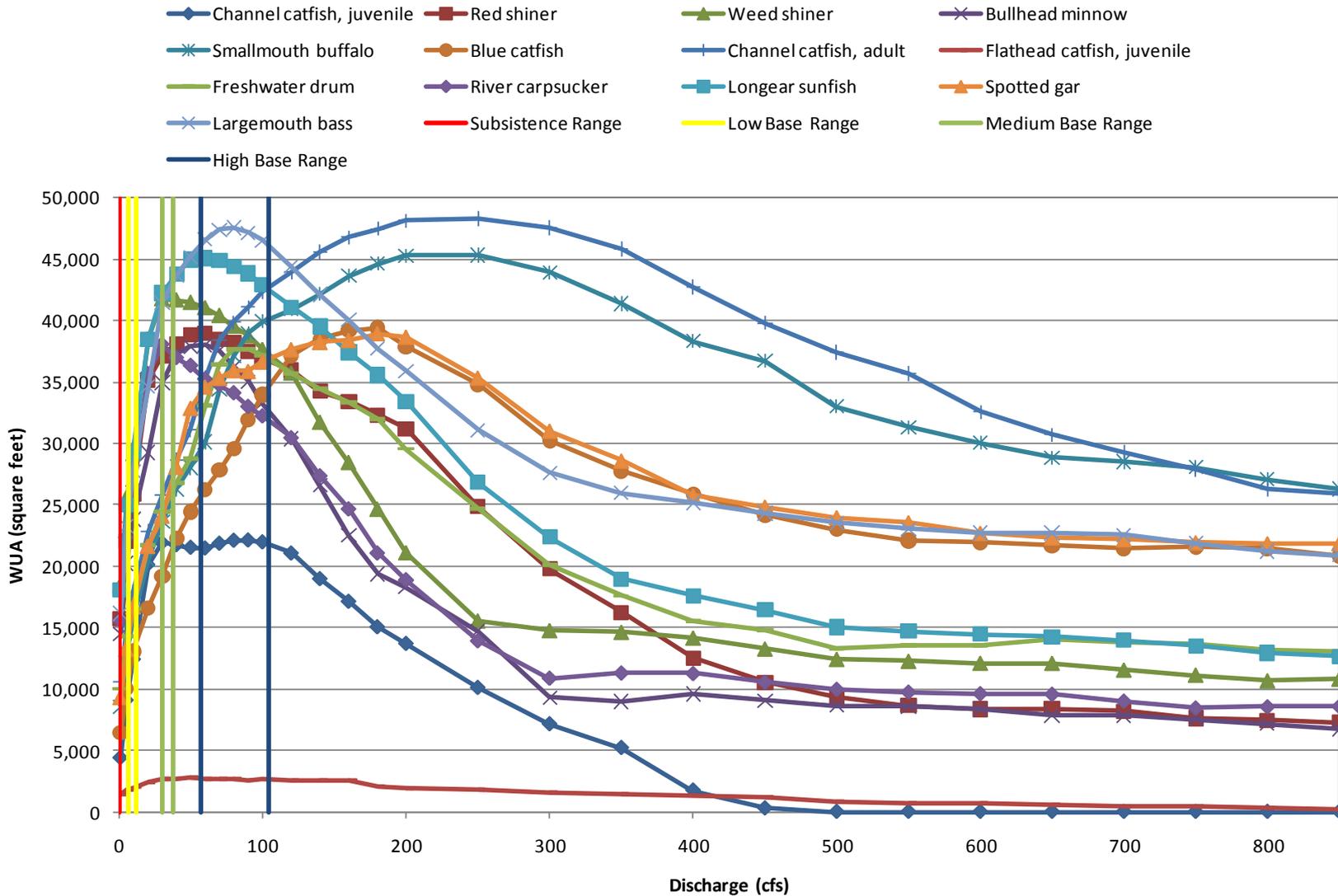
- Nearly all species WUA curves (Totals and many habitat subsets) peak at flows well higher than our Base flows
  - Many of them (Totals) max at highest modeled flow
    - Due to channel shape, criteria (for channel cats)
- Habitat looks good for all species using 0.5 quality and 90% enoughness thresholds
  - All species meet 75% threshold in at least 1 Base level
    - But, channel cat adults only in Base High, some gaps in other species
    - Fewer meet with a 90% too
  - All species meet 20% threshold in Subsistence range
  - All species look good in “preferred” mesohabitat type cross-sections

# Three Rivers – Species Example



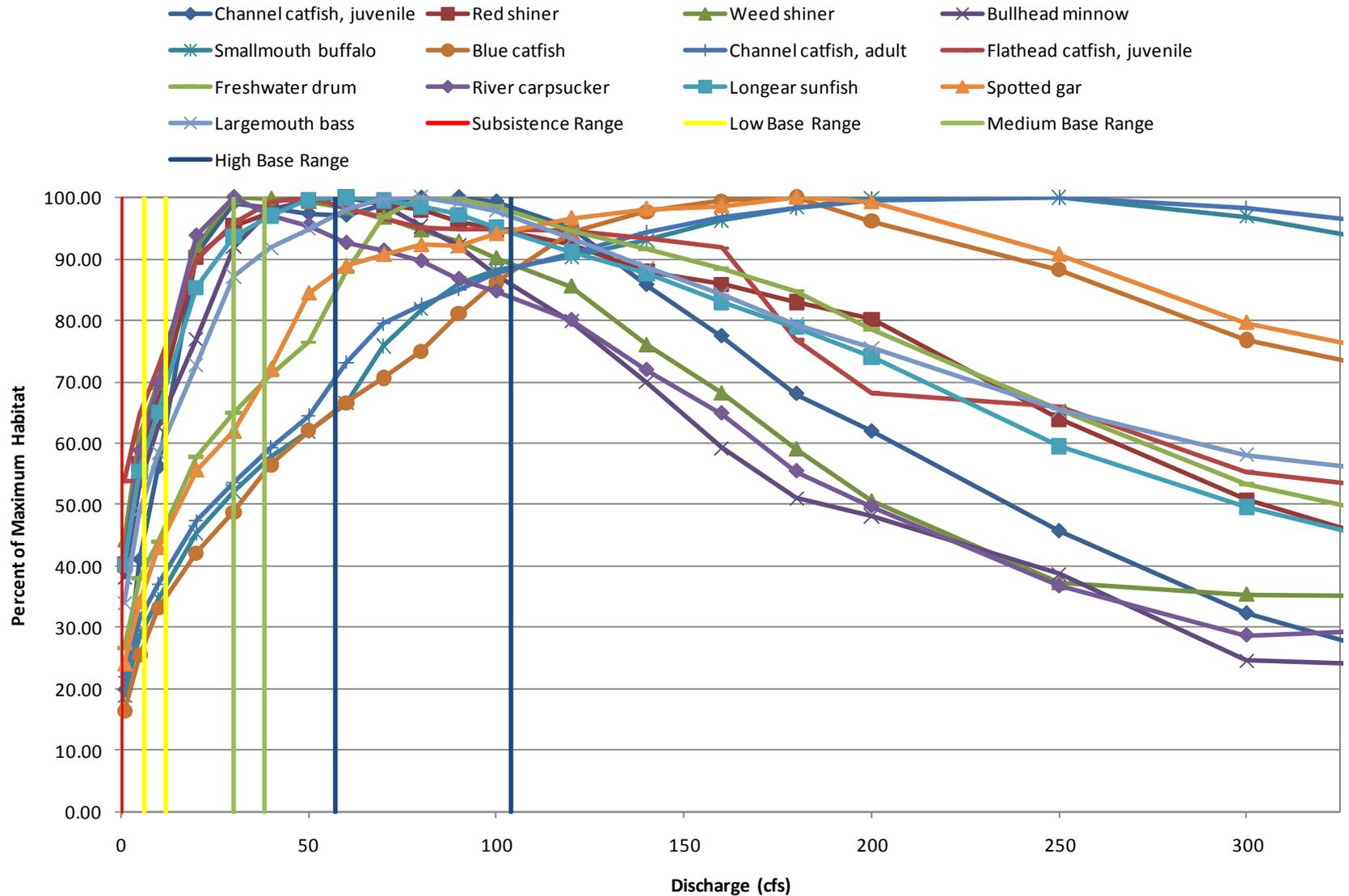
# Three Rivers – WUA, All, 0.5 Threshold

Three Rivers - Full P.O.R. - All Cross-Sections - Quality WUA  $\geq 0.50$



# Three Rivers – % Max, 0.5 Threshold

Three Rivers - Full P.O.R. - All X-Sections - % Max - Quality WUA >= 0.50



# Three Rivers – % of Max – 0.5, 200% Base, 75/50/25

- **75/50/25** “enoughness” thresholds
- % of max habitat w/ 200% highest base flow (324 CFS) as upper end
- **0.5** quality threshold
- 3 Base flow levels
- Full POR, 13 modeled species, by total and each mesohabitat type

		Channel catfish, juvenile			Red shiner			Weed shiner			Bullhead minnow			Smallmouth buffalo			Blue catfish			Channel catfish, adult			Flathead catfish, juvenile		
		Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet
<b>TOTAL</b>	Winter	63%	98%	98%	71%	97%	94%	74%	100%	89%	65%	97%	86%	37%	57%	89%	35%	55%	88%	39%	58%	88%	76%	99%	95%
	Spring	56%	99%	100%	67%	97%	97%	70%	100%	94%	63%	96%	94%	35%	56%	83%	33%	53%	77%	37%	57%	83%	72%	98%	95%
	Summer	45%	99%	97%	59%	95%	100%	63%	100%	99%	56%	92%	100%	30%	52%	65%	27%	49%	65%	33%	54%	71%	67%	96%	99%
	Fall	53%	98%	98%	65%	97%	99%	68%	100%	97%	61%	96%	99%	33%	56%	74%	32%	54%	70%	36%	58%	78%	71%	98%	97%
<b>RIFFLE</b>	Winter	43%	90%	96%	53%	87%	99%	57%	96%	81%	36%	96%	86%	1%	22%	81%	0%	14%	94%	1%	25%	79%	47%	91%	100%
	Spring	37%	89%	99%	49%	86%	99%	51%	95%	86%	28%	94%	90%	0%	19%	71%	0%	12%	89%	0%	21%	68%	40%	90%	100%
	Summer	20%	84%	100%	34%	83%	95%	33%	92%	98%	15%	91%	99%	0%	10%	44%	0%	5%	39%	0%	10%	45%	26%	86%	98%
	Fall	32%	89%	100%	45%	87%	97%	46%	95%	93%	25%	95%	96%	0%	21%	57%	0%	13%	62%	0%	23%	56%	36%	90%	99%
<b>RUN</b>	Winter	72%	100%	91%	77%	98%	94%	80%	100%	83%	74%	96%	68%	26%	57%	95%	18%	51%	87%	31%	61%	91%	0%	0%	0%
	Spring	68%	100%	97%	73%	98%	98%	78%	100%	90%	72%	95%	89%	21%	56%	85%	16%	49%	77%	27%	60%	86%	0%	0%	0%
	Summer	58%	100%	99%	64%	97%	100%	73%	100%	96%	63%	92%	100%	16%	52%	68%	11%	43%	65%	19%	56%	75%	0%	0%	0%
	Fall	65%	100%	99%	71%	98%	99%	76%	100%	94%	69%	96%	98%	20%	56%	76%	14%	50%	70%	25%	60%	82%	0%	0%	0%
<b>RUN</b>	Winter	58%	94%	100%	60%	96%	96%	62%	98%	94%	53%	95%	95%	26%	45%	81%	22%	39%	77%	28%	46%	83%	0%	0%	0%
	Spring	49%	95%	98%	53%	95%	98%	55%	98%	98%	49%	93%	98%	24%	44%	78%	21%	37%	60%	27%	45%	78%	0%	0%	0%
	Summer	38%	96%	91%	46%	93%	100%	49%	98%	100%	43%	88%	100%	20%	41%	53%	15%	32%	48%	23%	41%	61%	0%	0%	0%
	Fall	46%	94%	94%	51%	95%	99%	53%	98%	99%	47%	94%	100%	23%	44%	65%	19%	38%	53%	26%	45%	73%	0%	0%	0%
<b>POOL</b>	Winter	46%	22%	0%	93%	86%	66%	98%	96%	81%	93%	87%	76%	71%	81%	91%	68%	79%	88%	84%	91%	97%	94%	92%	76%
	Spring	47%	25%	0%	94%	87%	72%	98%	97%	86%	95%	87%	77%	70%	80%	88%	67%	78%	86%	83%	91%	96%	94%	92%	76%
	Summer	59%	36%	5%	96%	89%	81%	95%	100%	90%	94%	87%	82%	65%	78%	84%	61%	77%	83%	80%	91%	93%	98%	92%	85%
	Fall	50%	23%	0%	94%	87%	79%	97%	97%	90%	95%	87%	81%	68%	81%	86%	65%	79%	85%	82%	91%	93%	95%	92%	80%

# Three Rivers – % of Max – 0.5, 200% Base, 75/50/25

- **75/50/25** “enoughness” thresholds
- % of max habitat w/ 200% highest base flow (324 CFS) as upper end
- **0.5** quality threshold
- 3 Base flow levels
- Full POR, 13 modeled species, by total and each mesohabitat type

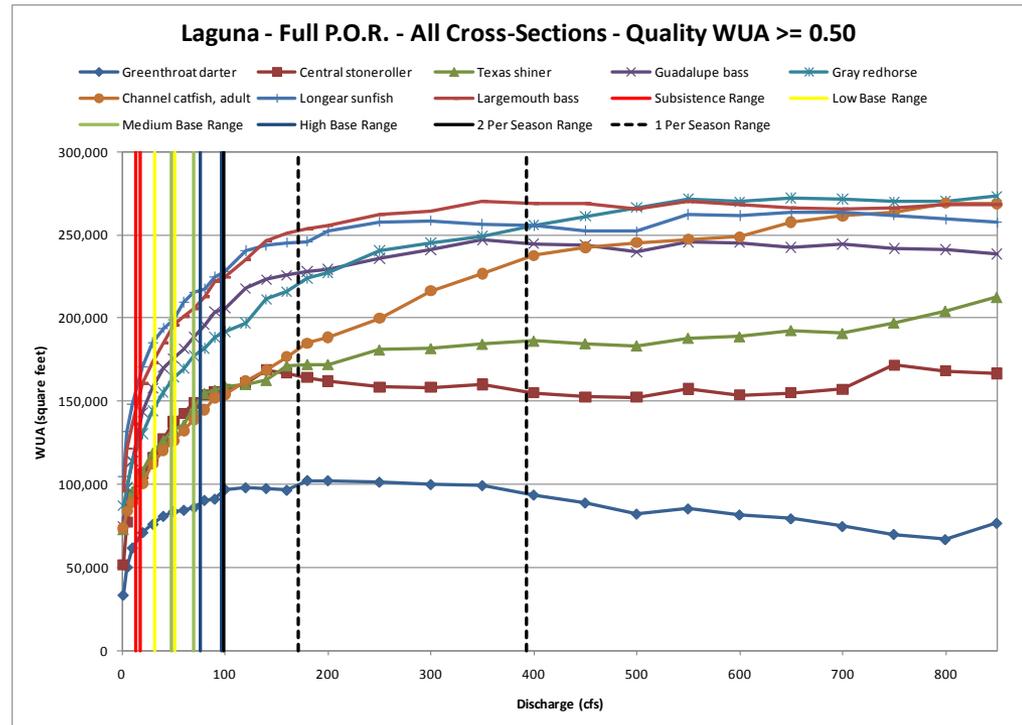
		Freshwater drum			River carpsucker			Longear sunfish			Spotted gar			Largemouth bass		
		Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet
<b>TOTAL</b>	Winter	47%	70%	98%	75%	98%	84%	69%	96%	94%	46%	70%	95%	61%	91%	97%
	Spring	44%	69%	100%	70%	98%	89%	65%	96%	98%	43%	68%	92%	58%	90%	100%
	Summer	40%	65%	84%	62%	100%	93%	58%	94%	100%	36%	62%	88%	51%	87%	97%
	Fall	43%	69%	95%	68%	98%	92%	63%	96%	100%	41%	69%	90%	56%	90%	99%
<b>RIFFLE</b>	Winter	3%	49%	81%	61%	95%	86%	45%	92%	94%	14%	69%	80%	34%	92%	85%
	Spring	0%	43%	96%	55%	94%	90%	38%	91%	95%	9%	64%	94%	27%	91%	91%
	Summer	0%	22%	78%	36%	93%	98%	20%	88%	99%	2%	49%	97%	14%	87%	100%
	Fall	0%	46%	93%	50%	94%	94%	33%	92%	98%	7%	66%	100%	24%	91%	99%
<b>RUN</b>	Winter	41%	76%	97%	83%	98%	79%	75%	97%	91%	48%	72%	99%	67%	93%	88%
	Spring	35%	75%	99%	80%	98%	88%	73%	96%	97%	46%	70%	95%	63%	92%	97%
	Summer	25%	73%	90%	72%	100%	95%	65%	95%	100%	33%	65%	88%	55%	89%	99%
	Fall	32%	76%	97%	78%	98%	93%	71%	97%	99%	42%	71%	93%	61%	93%	100%
<b>RUN</b>	Winter	35%	56%	99%	62%	97%	84%	58%	95%	98%	31%	57%	89%	46%	84%	99%
	Spring	33%	55%	99%	55%	98%	87%	52%	94%	99%	28%	55%	85%	43%	83%	99%
	Summer	30%	51%	75%	47%	100%	90%	45%	91%	100%	24%	47%	81%	37%	80%	92%
	Fall	32%	55%	91%	53%	97%	88%	50%	94%	100%	27%	56%	83%	42%	84%	96%
<b>POOL</b>	Winter	89%	94%	96%	99%	96%	84%	96%	100%	89%	68%	81%	92%	85%	94%	99%
	Spring	89%	94%	100%	99%	96%	87%	96%	100%	97%	66%	80%	89%	85%	93%	98%
	Summer	87%	95%	95%	97%	96%	91%	93%	99%	99%	64%	77%	85%	80%	93%	96%
	Fall	88%	94%	96%	98%	96%	91%	95%	100%	99%	66%	80%	87%	83%	93%	97%

# Three Rivers Observations

- About half of the species WUA curves (Totals) peak at flows higher than our Base flows
  - Deeper water species peak above our base flows
  - Due in part to habitat criteria?
- Habitat looks good enough for most species using 0.5 quality and 75% enoughness thresholds
  - Smallmouth buffalo, blue catfish, channel catfish adults, freshwater drum and spotted gar only meet 75% in Base High
  - Many more species not meeting 90% threshold
  - Subsistence range meets 20% threshold for all but smallmouth buffalo (19%) and blue catfish (16%)

# Still Working

- Report section(s)
- Habitat time series
  - Have time series, tool
  - What will we use it for?
    - Evaluation of project at Laguna?
- Habitat value of high flow pulses
  - Calculate % of max for lower tiers of pulses?



# APPENDIX

# Concan – Greenthroat Darter

## Frio at Concan - Greenthroat Darter - All X-Sections

100000

90000

80000

70000

60000

50000

40000

30000

20000

10000

0

WUA (square feet)

## Frio at Concan - Texas Shiner - All X-Sections

120000

100000

80000

60000

40000

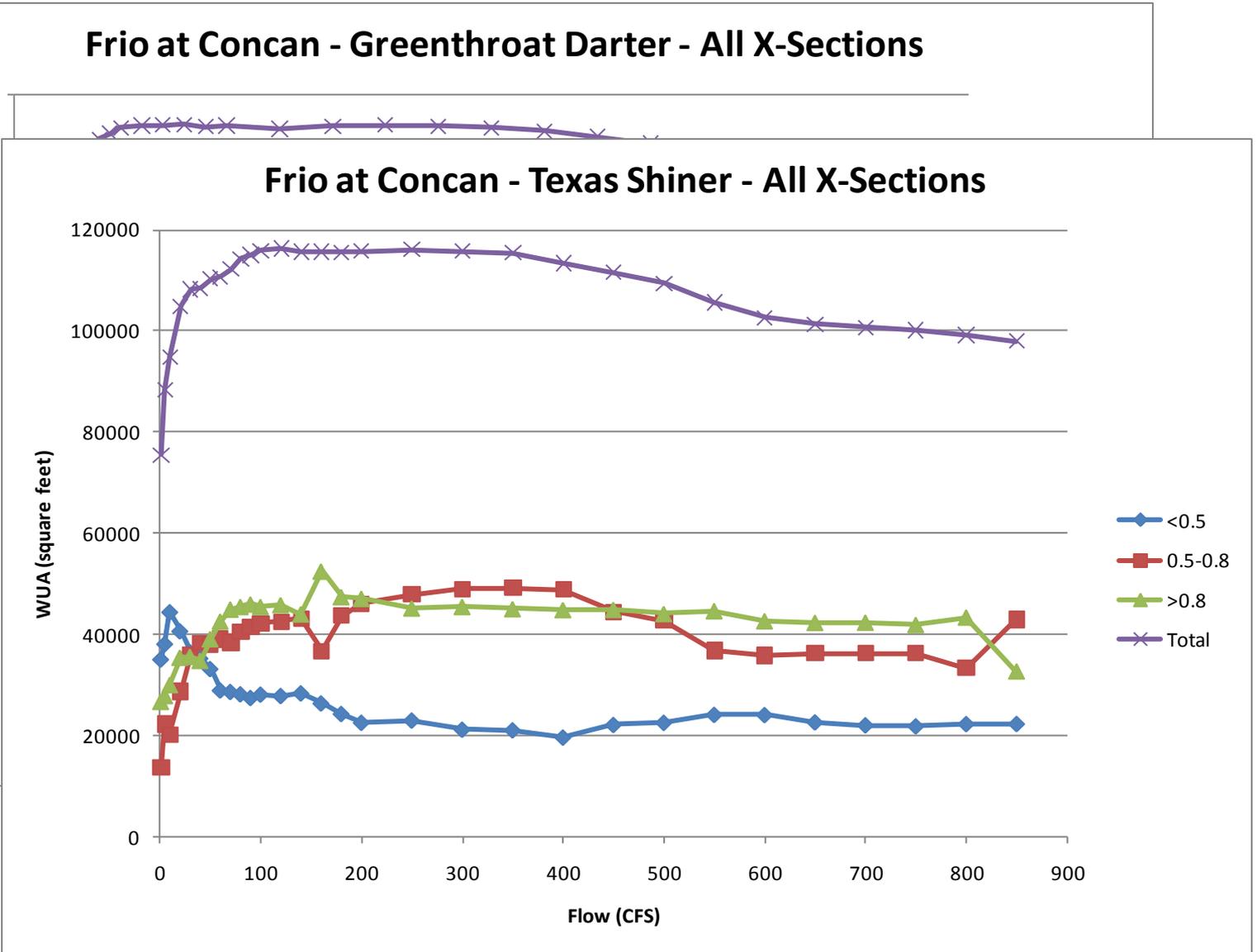
20000

0

WUA (square feet)

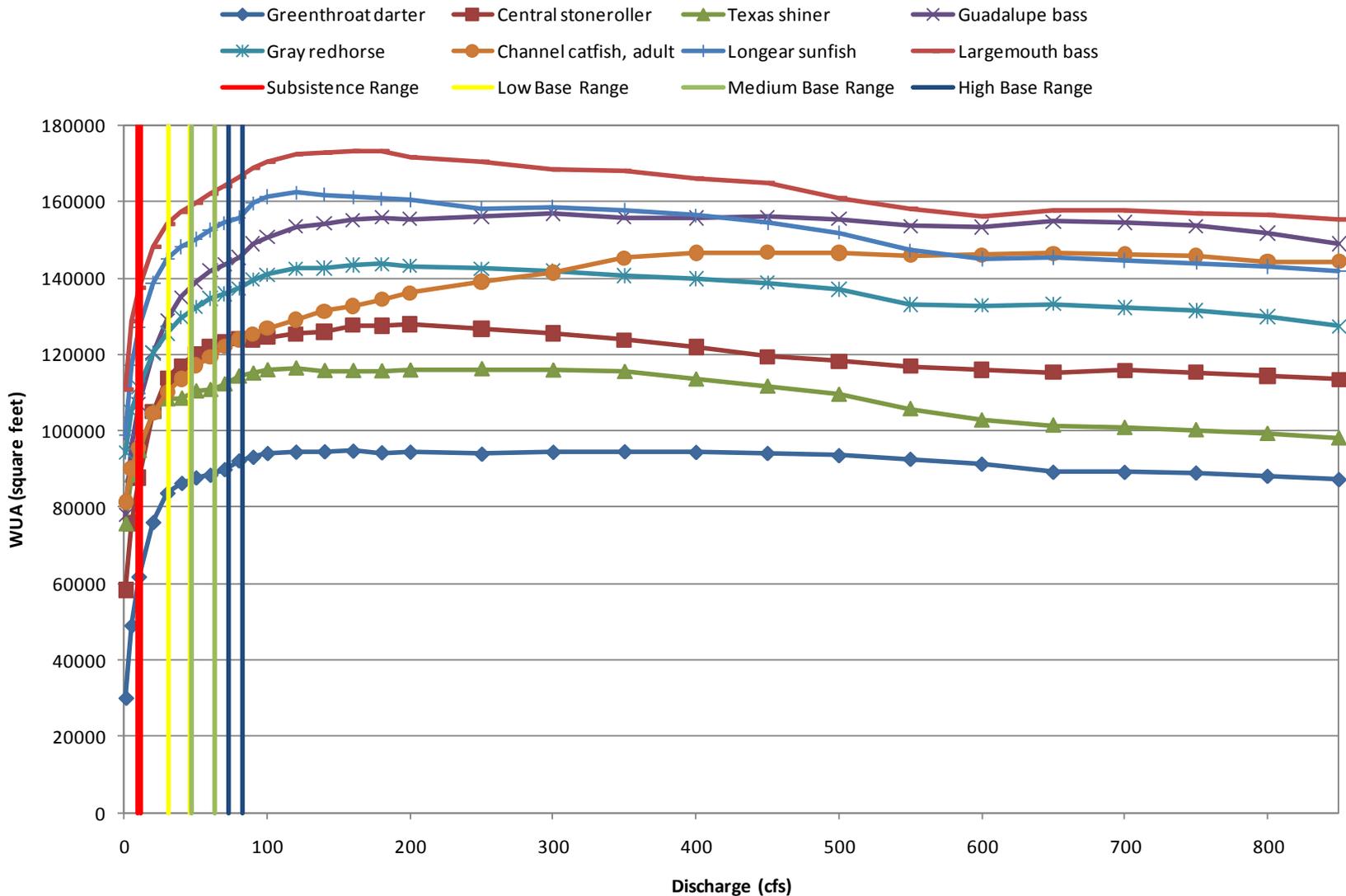
Flow (CFS)

- <0.5
- 0.5-0.8
- >0.8
- Total



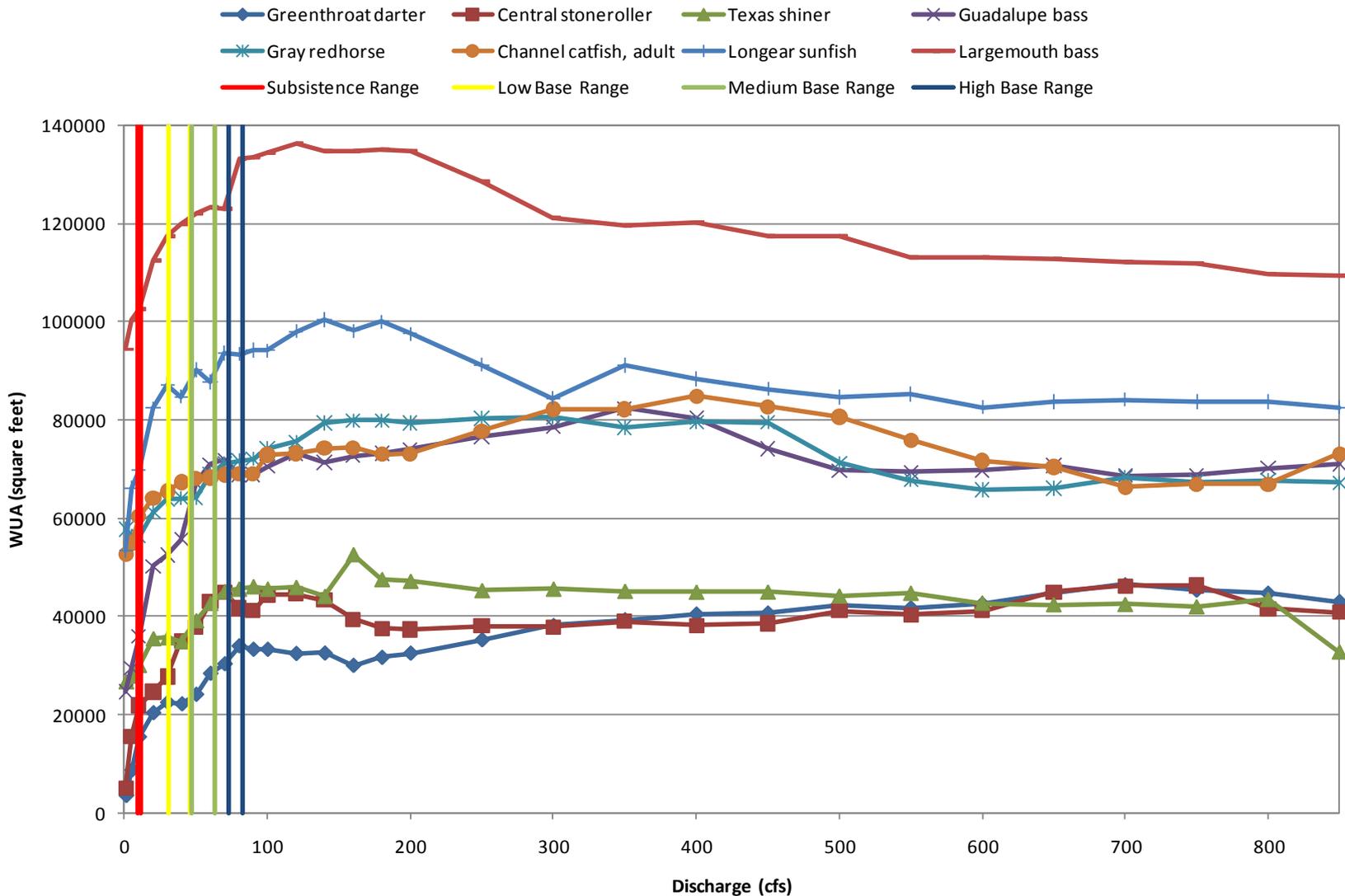
# Concan – WUA, All, No Threshold

Concan - Full P.O.R. - All Cross-Sections - Total WUA

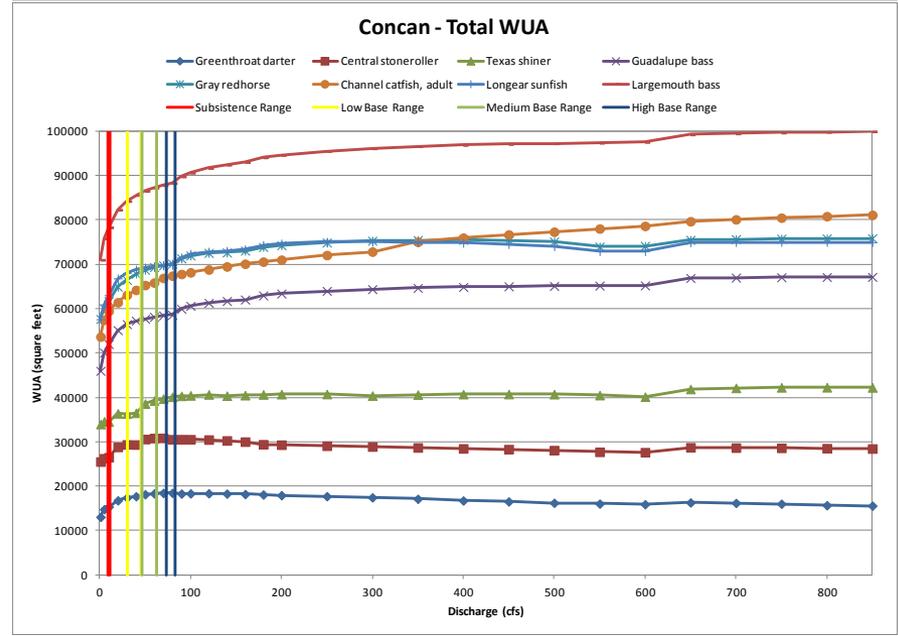
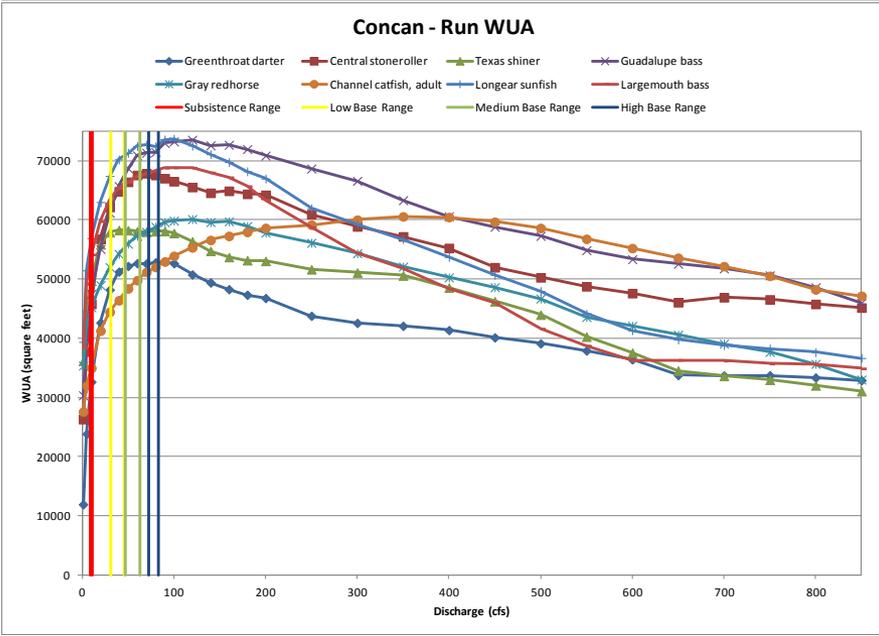
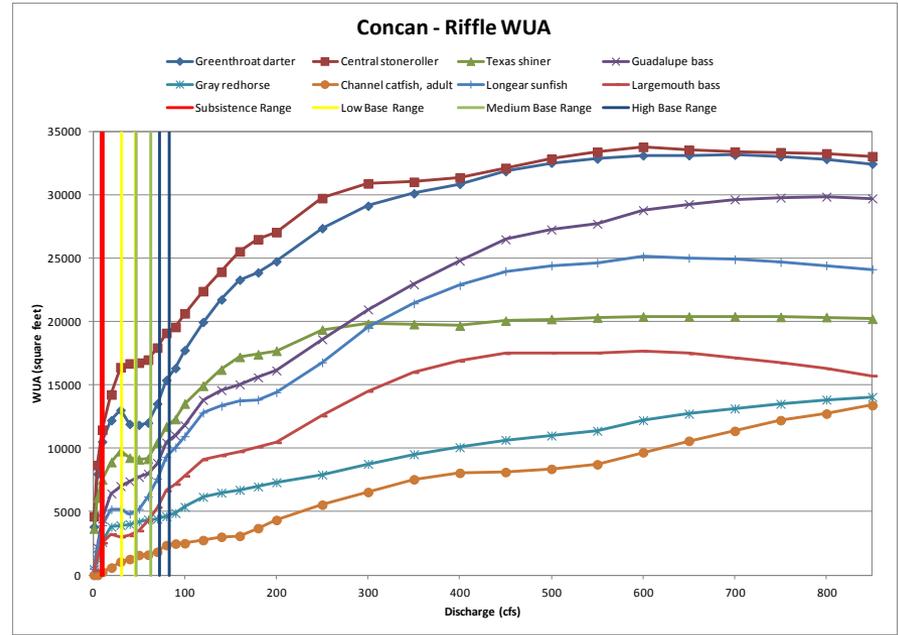
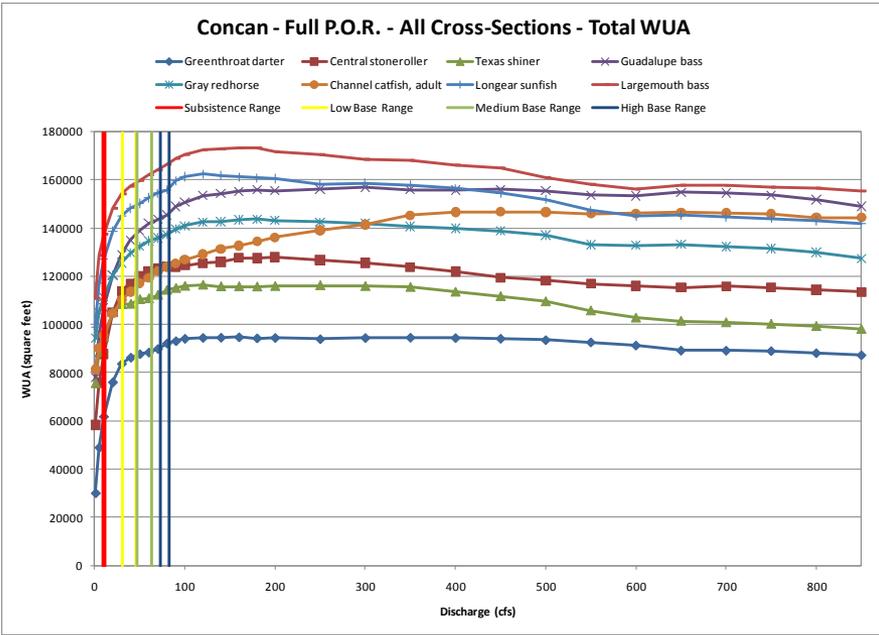


# Concan – WUA, All, 0.8 Threshold

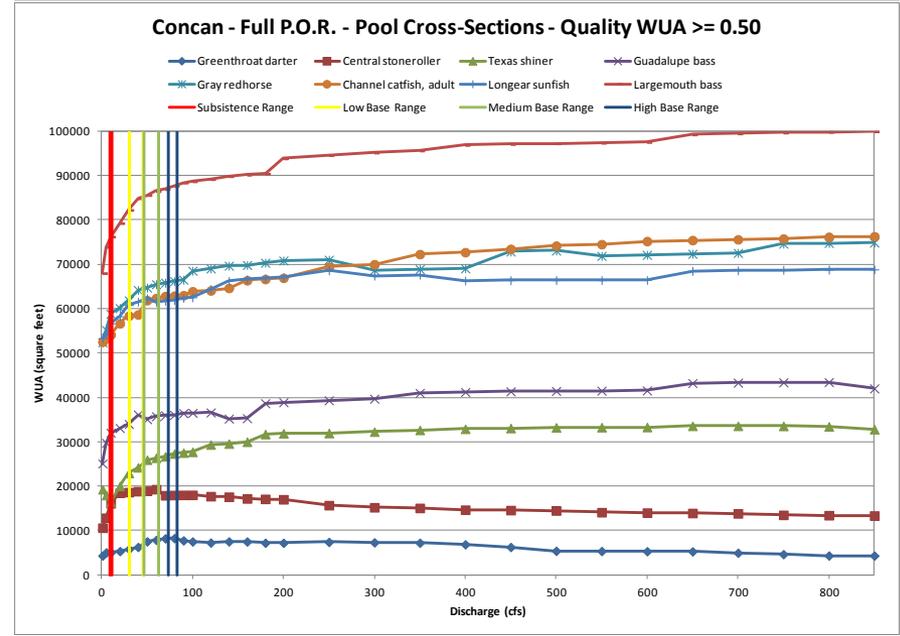
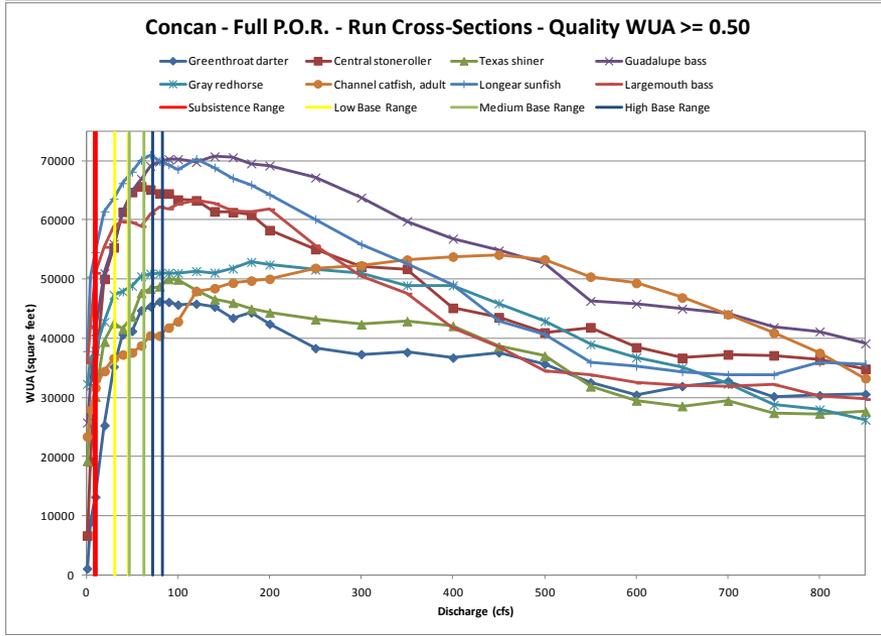
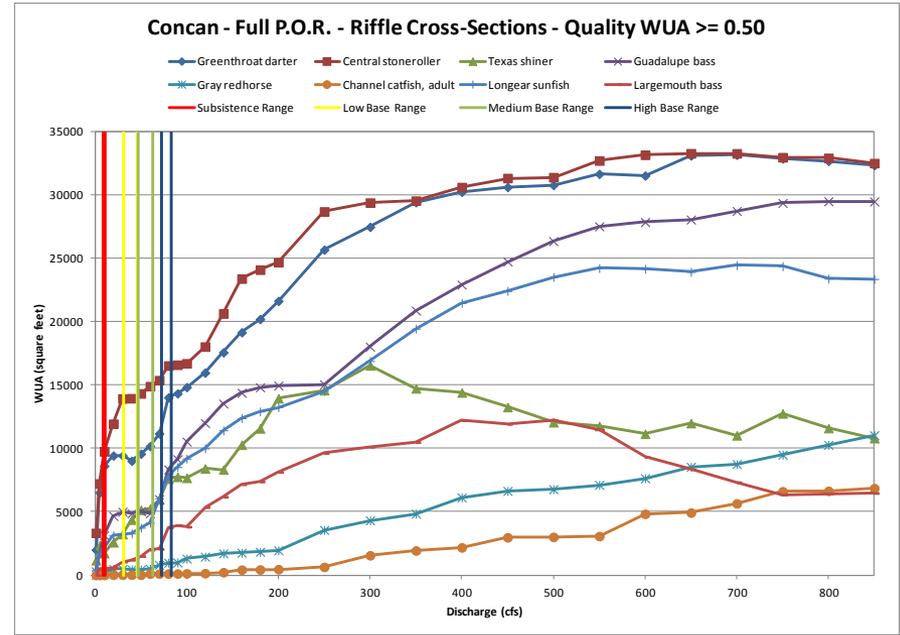
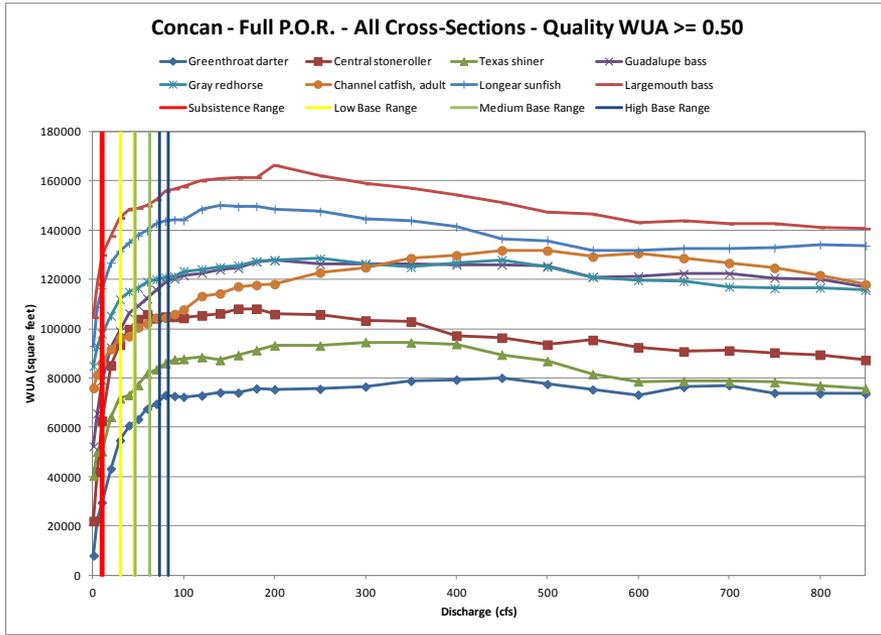
Concan - Full P.O.R. - All Cross-Sections - Quality WUA  $\geq 0.80$



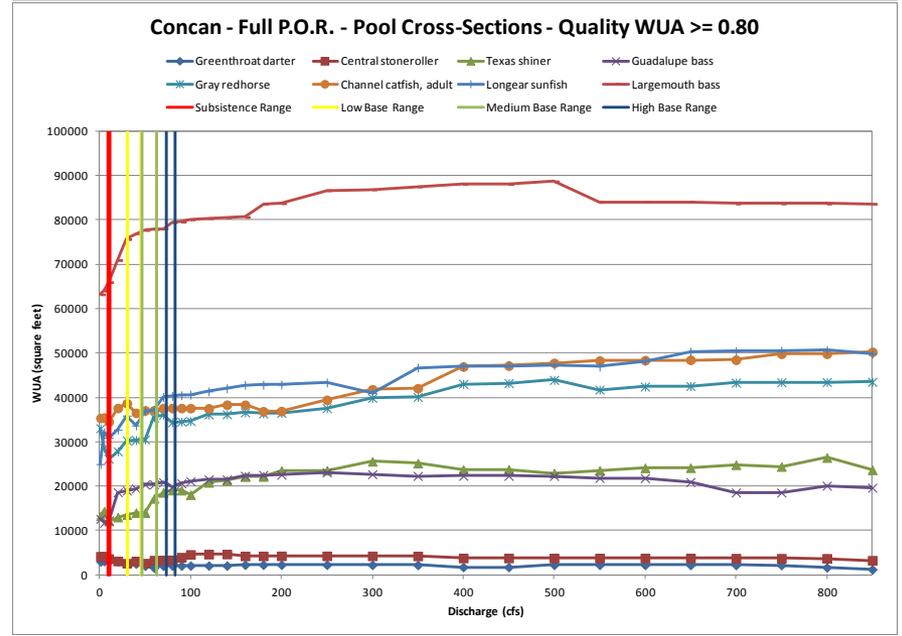
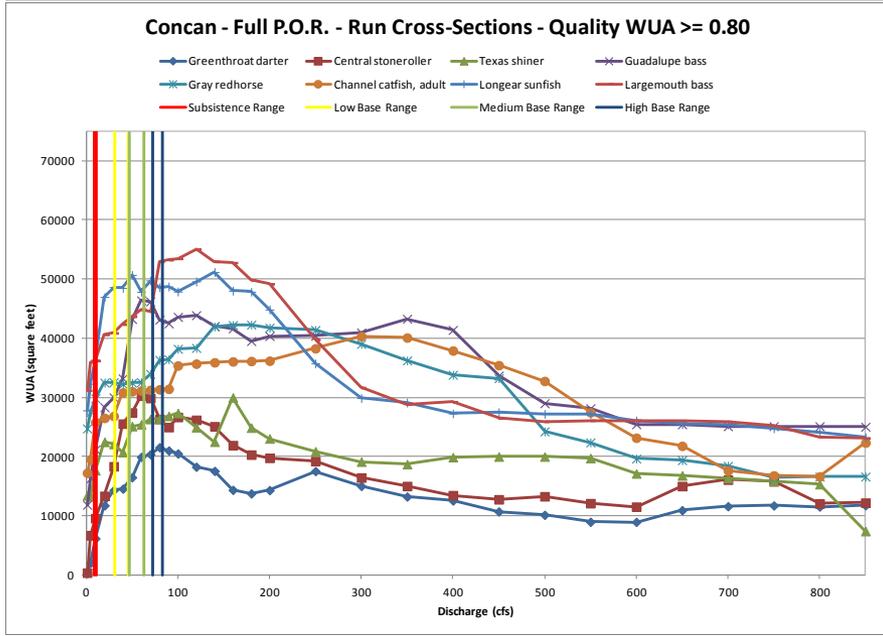
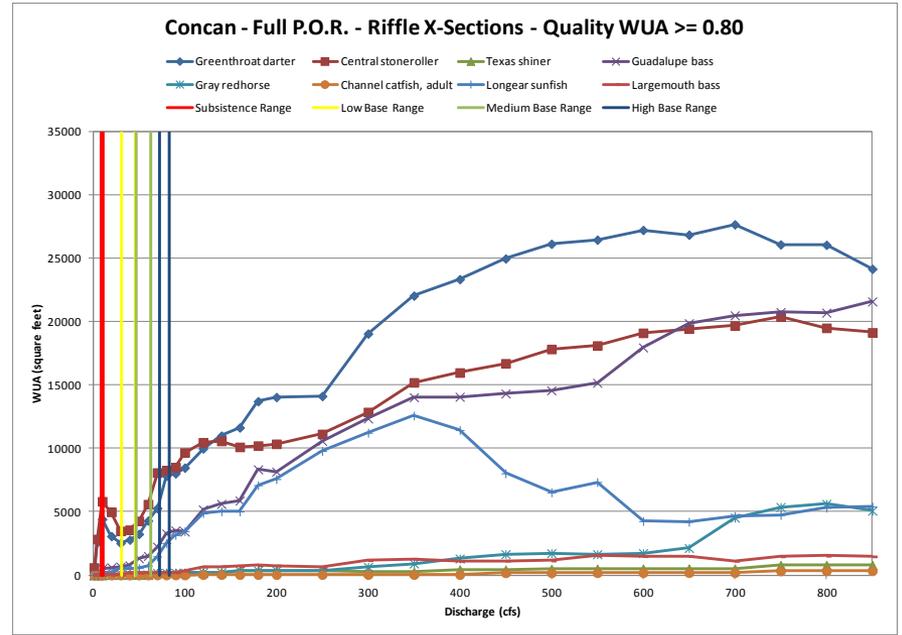
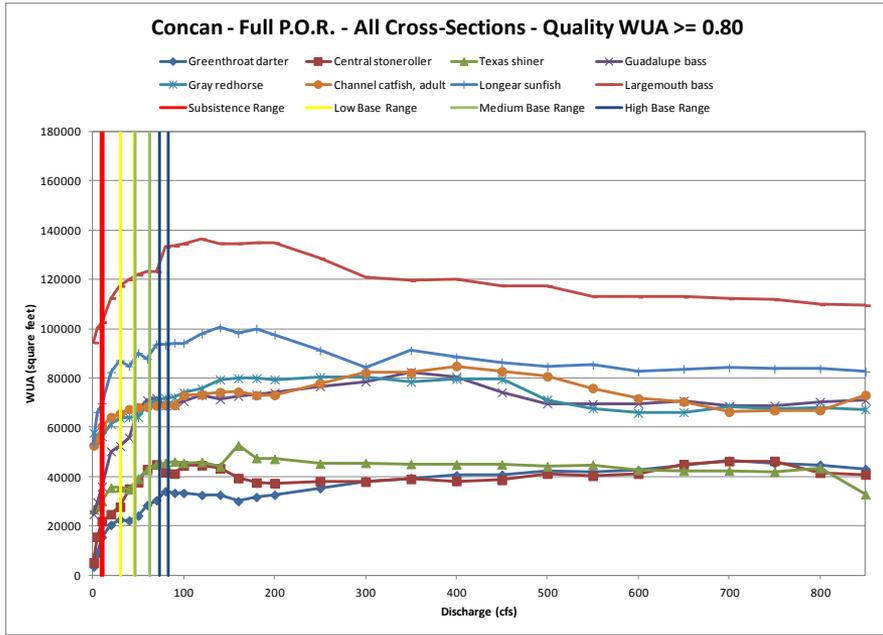
# Concan – WUA, No Threshold



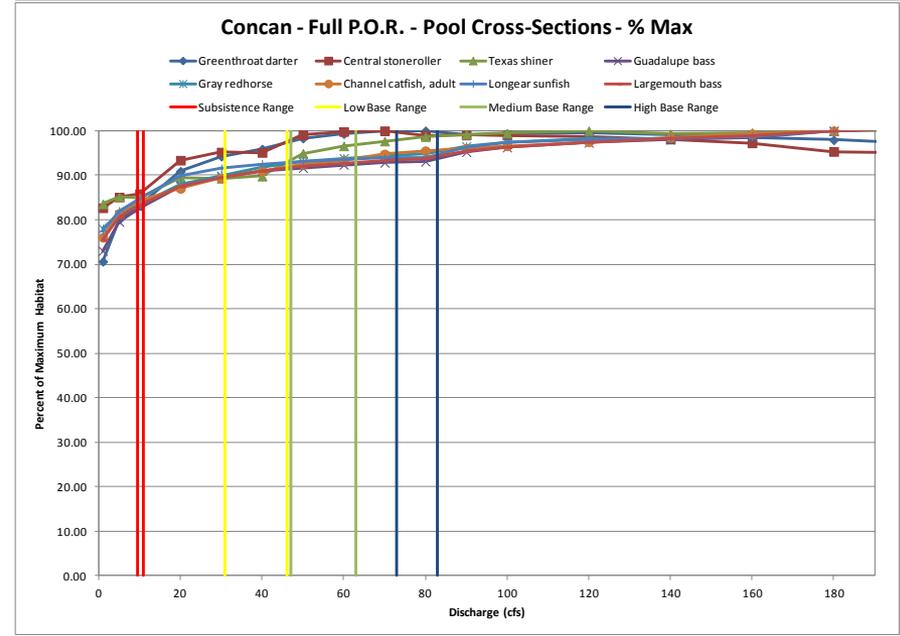
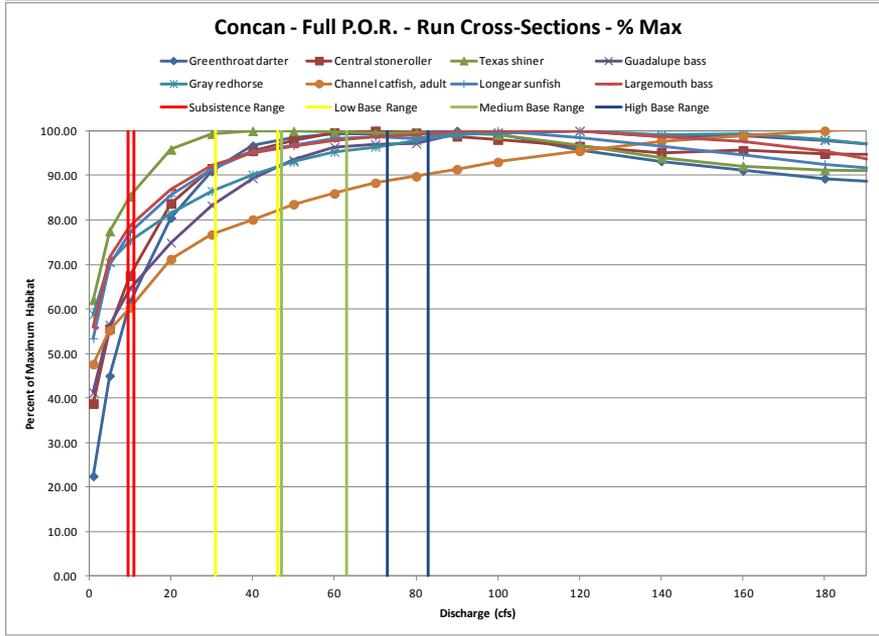
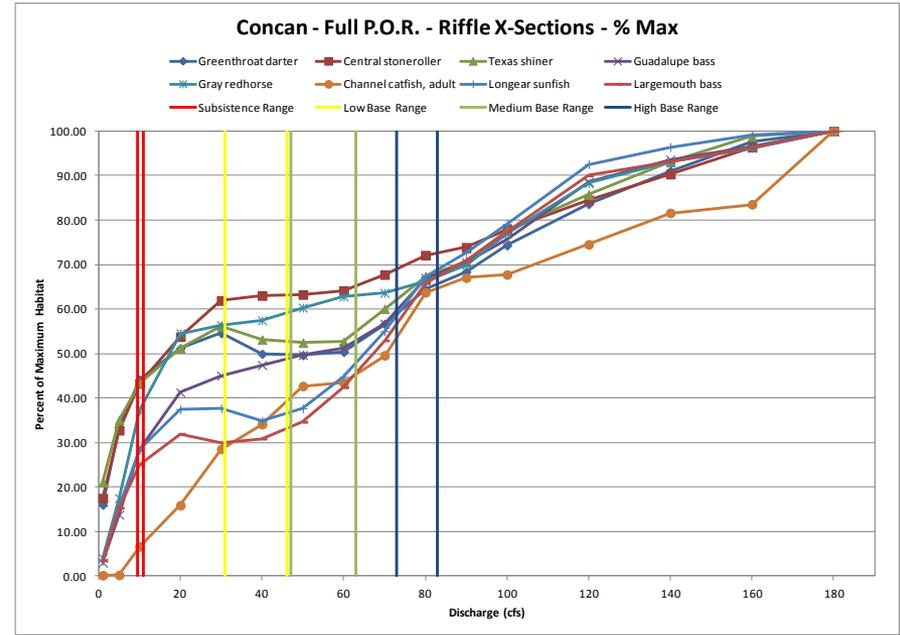
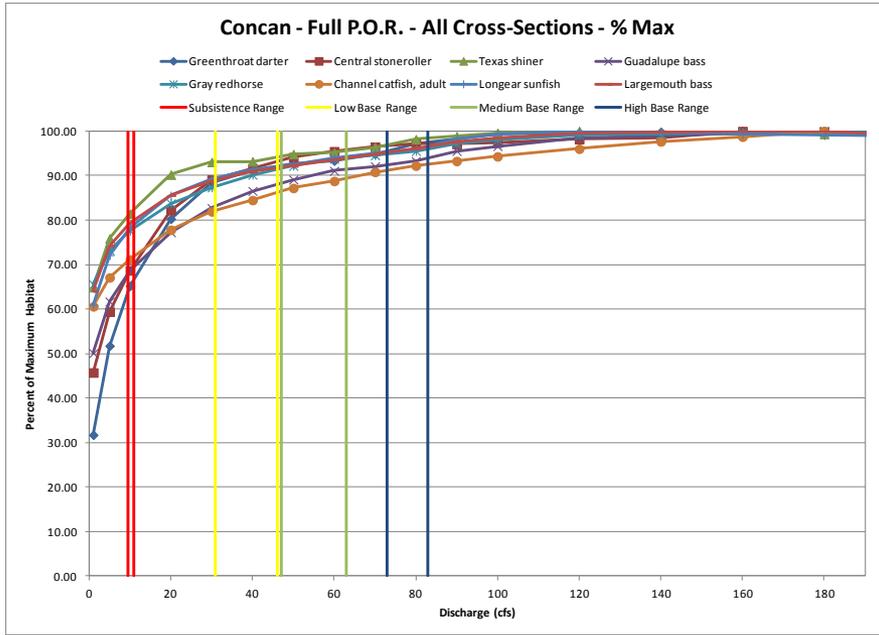
# Concan – WUA, 0.5 Threshold



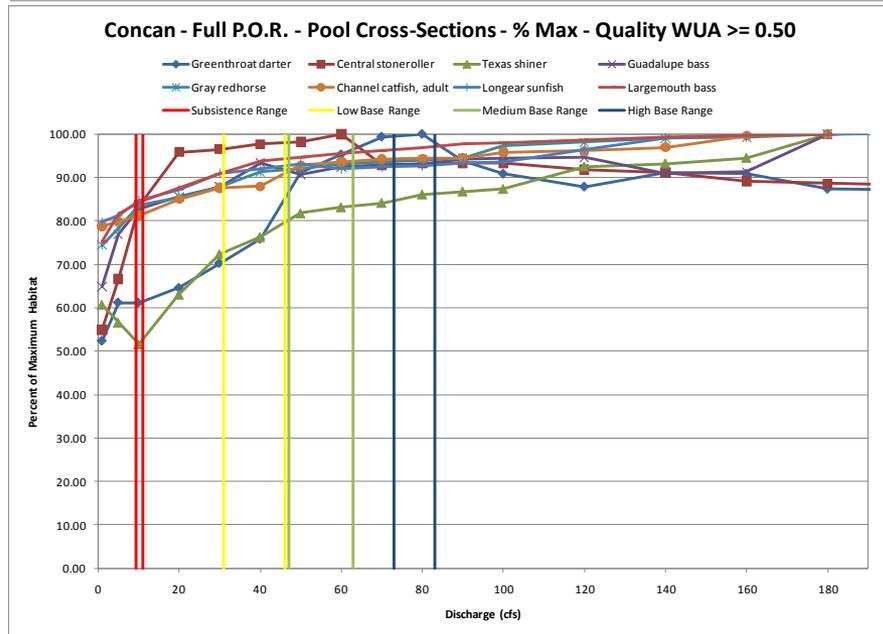
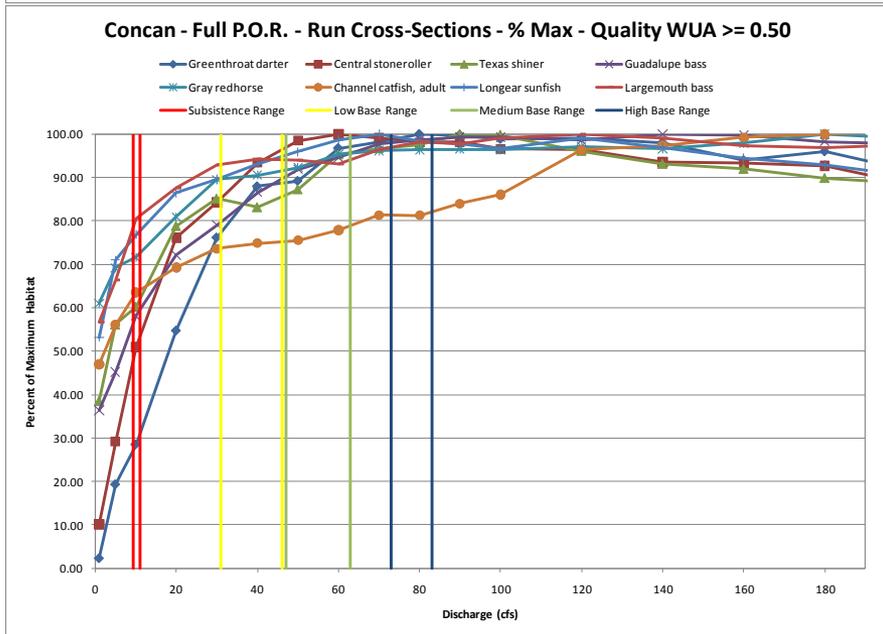
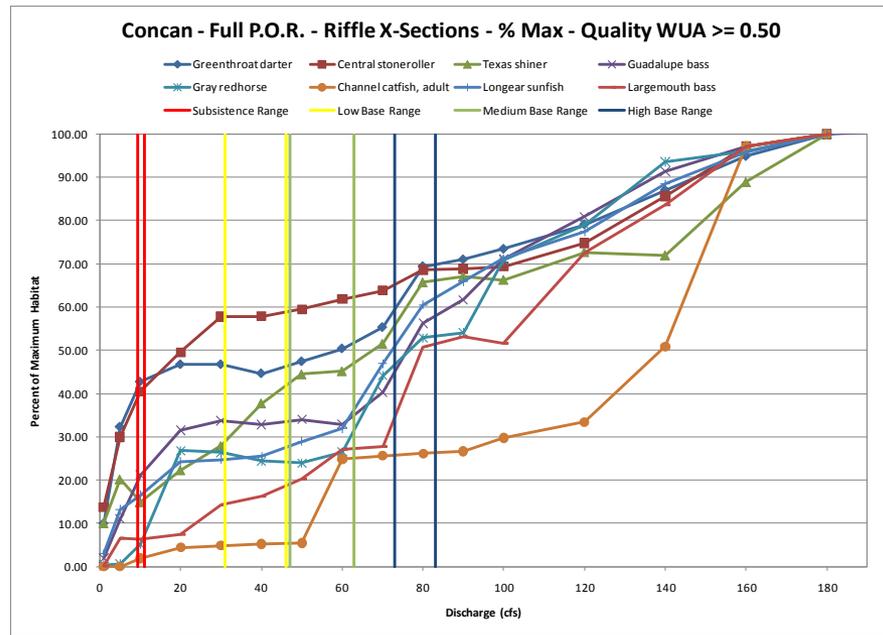
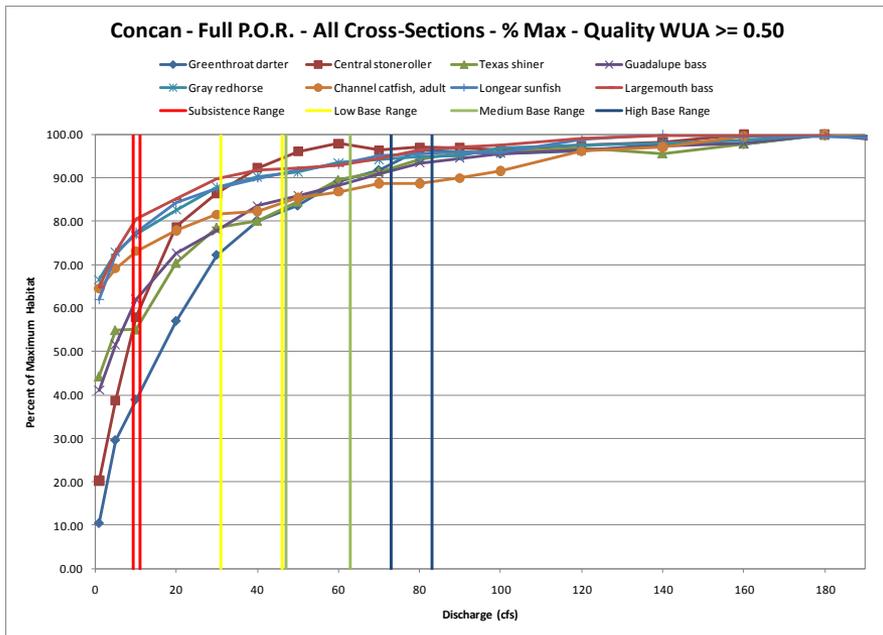
# Concan – WUA, 0.8 Threshold



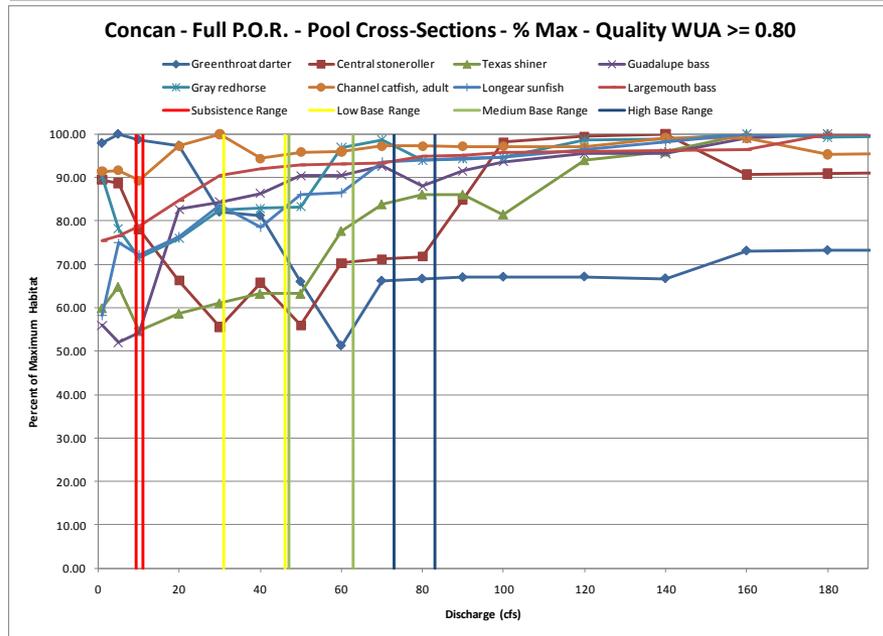
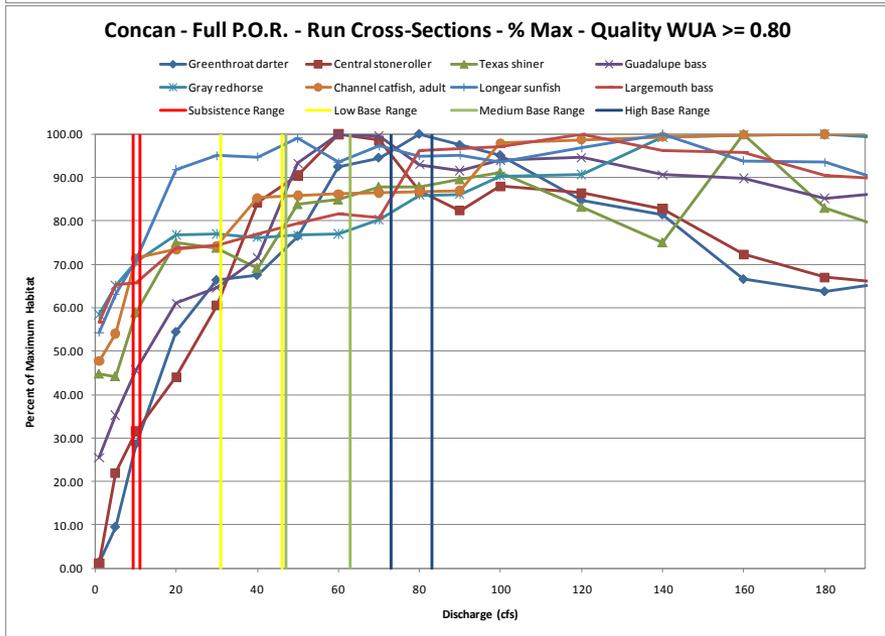
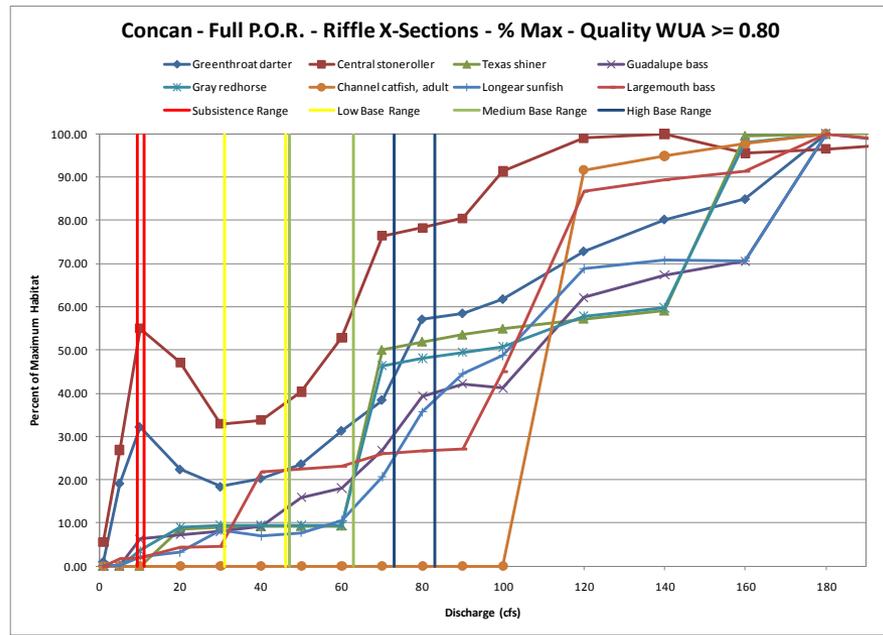
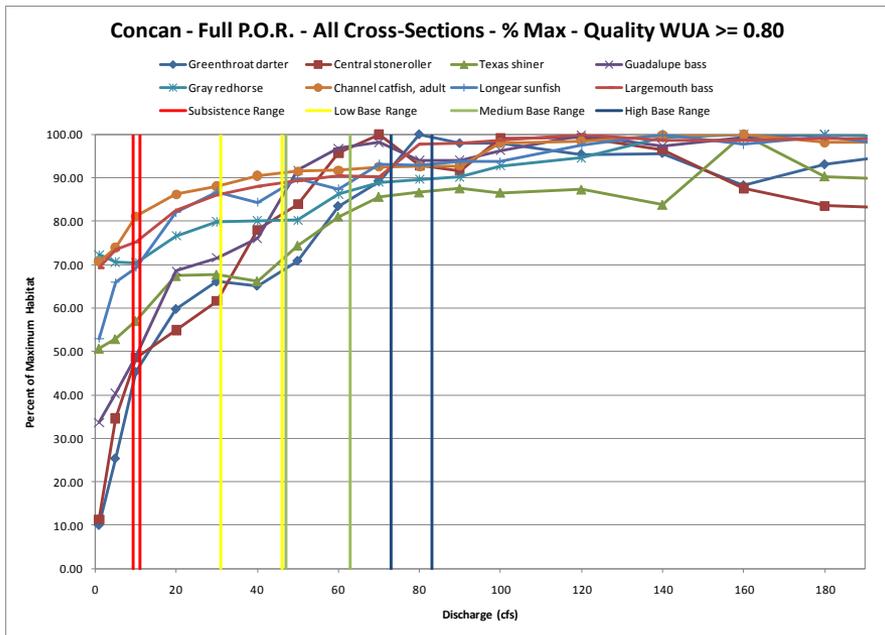
# Concan – % Max, No Threshold



# Concan – % Max, 0.5 Threshold



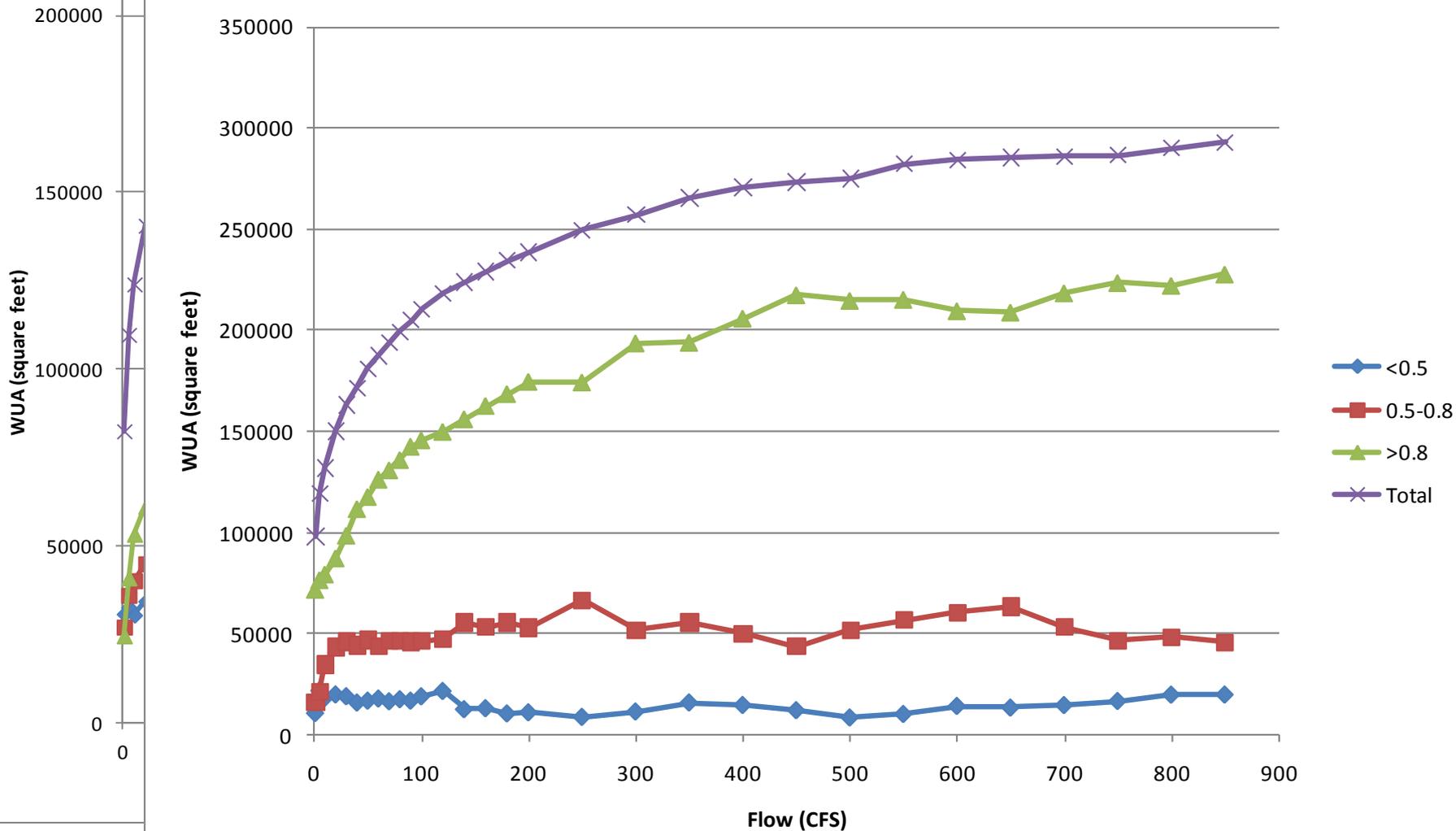
# Concan – % Max, 0.8 Threshold



# Laguna – All Species

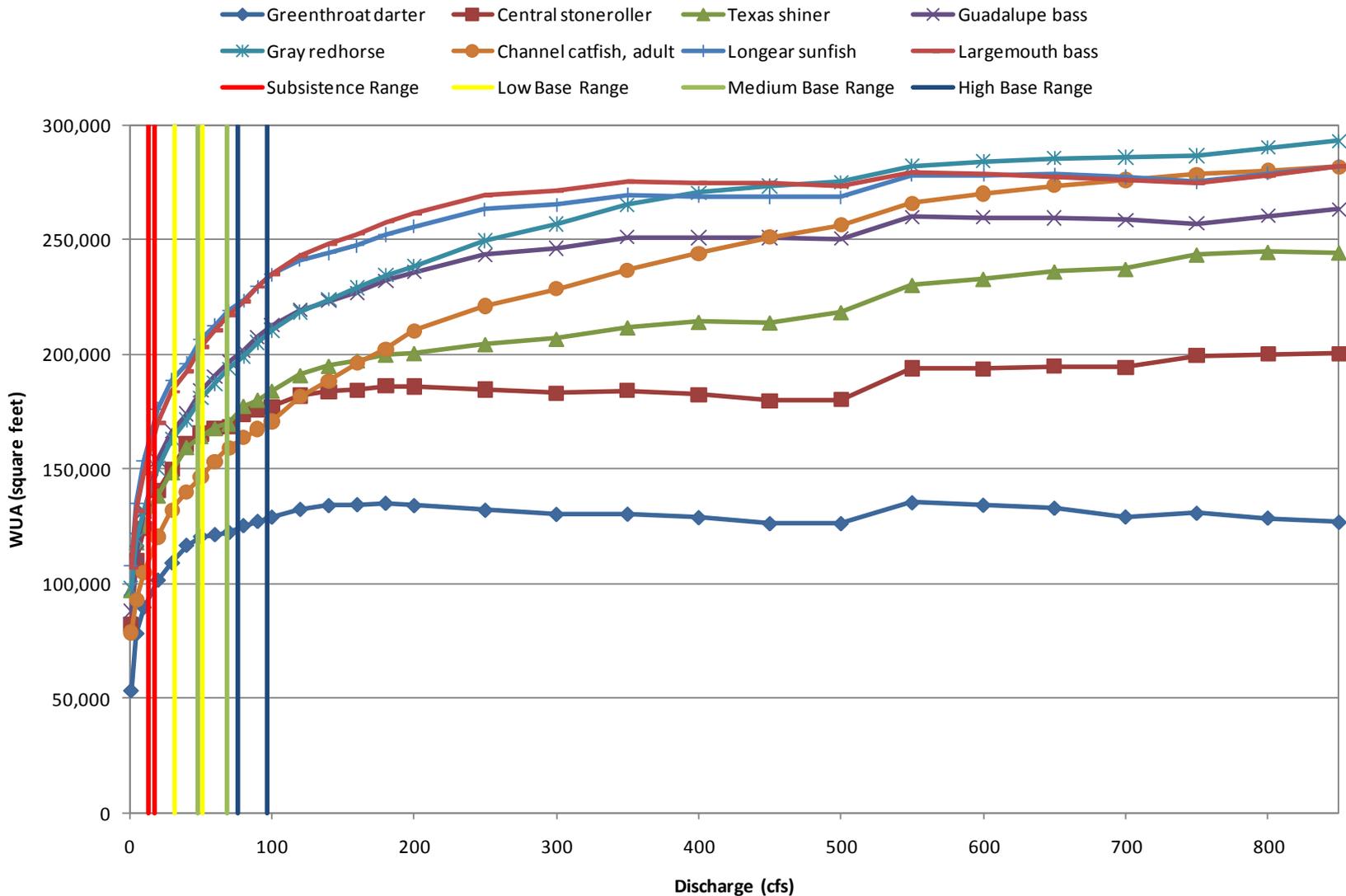
Nueces River at Laguna - Central Stationereller - All X-Sections

## Nueces River at Laguna - Gray Redhorse - All X-sections



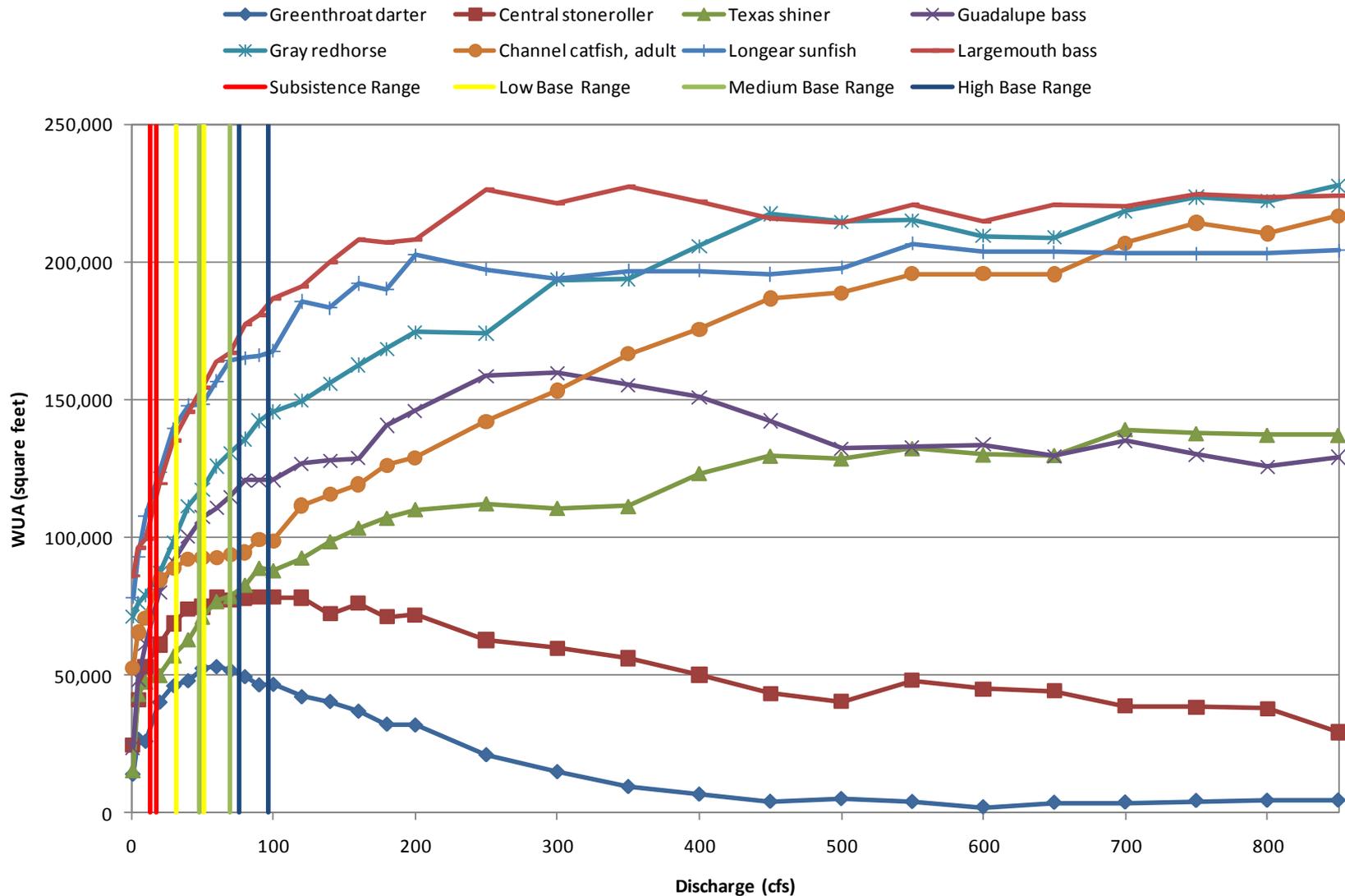
# Laguna – WUA, All, No Threshold

## Laguna - Full P.O.R. - All Cross-Sections - Total WUA

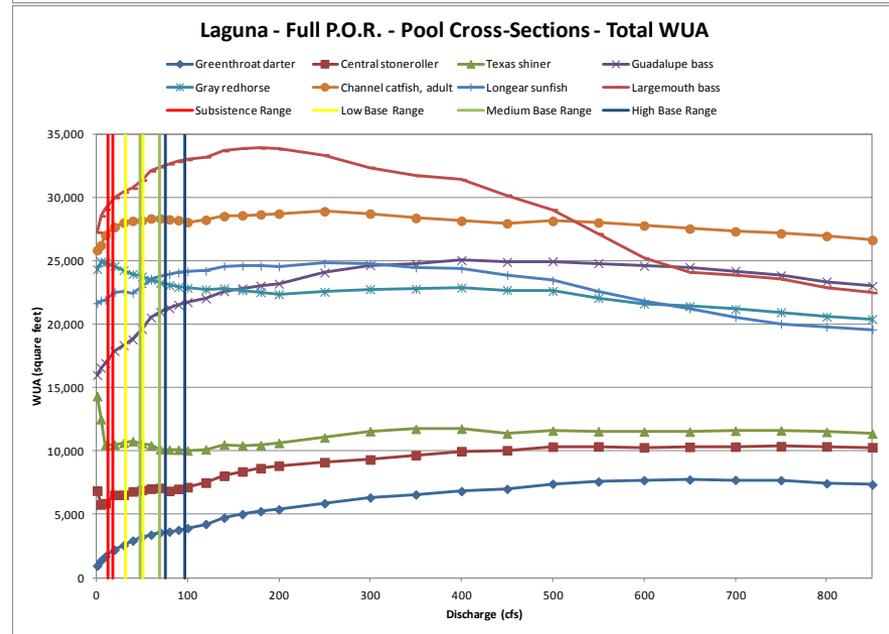
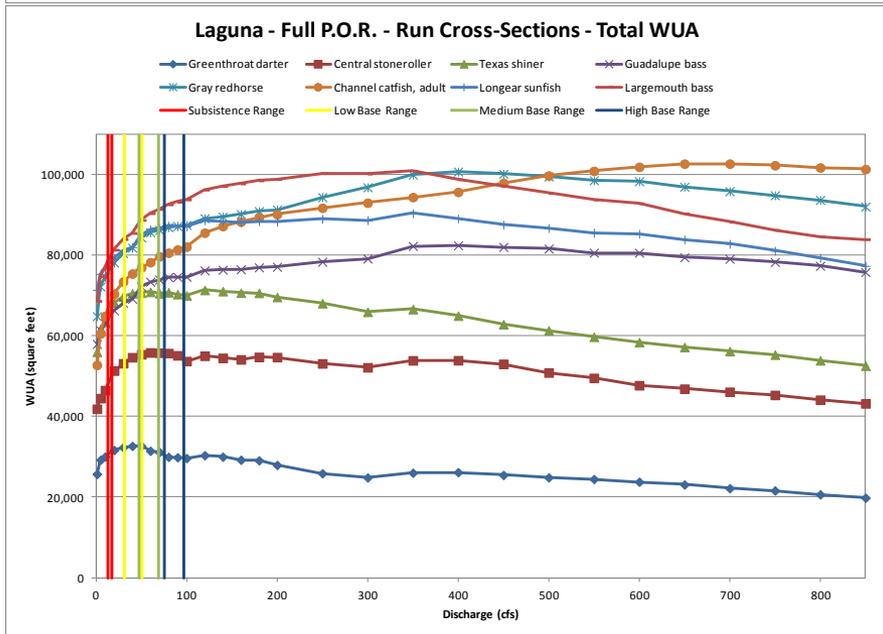
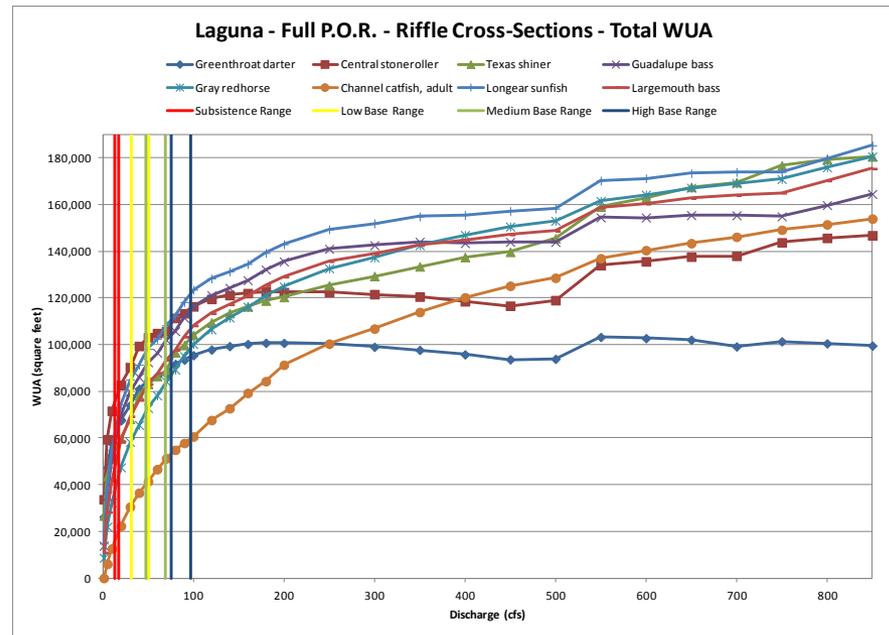
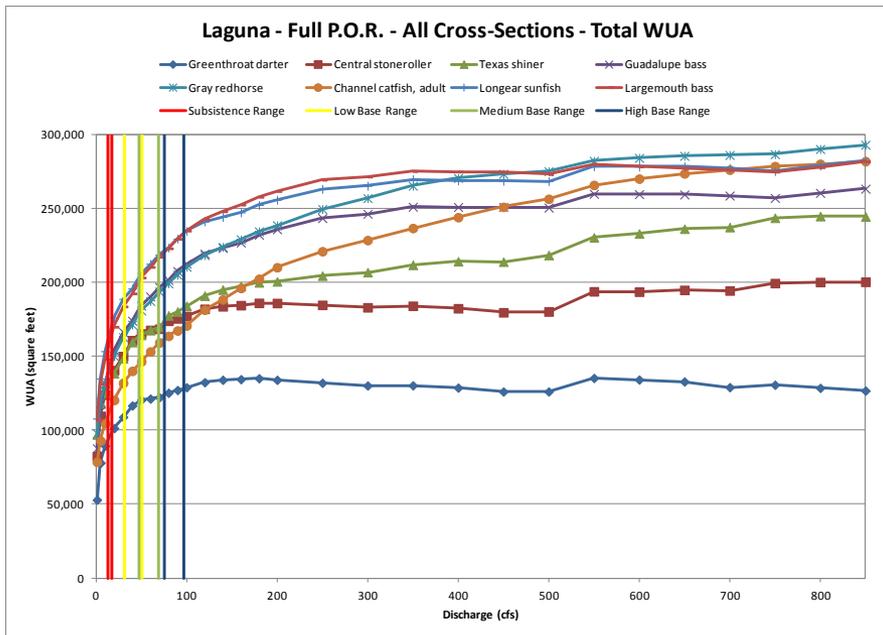


# Laguna – WUA, All, 0.8 Threshold

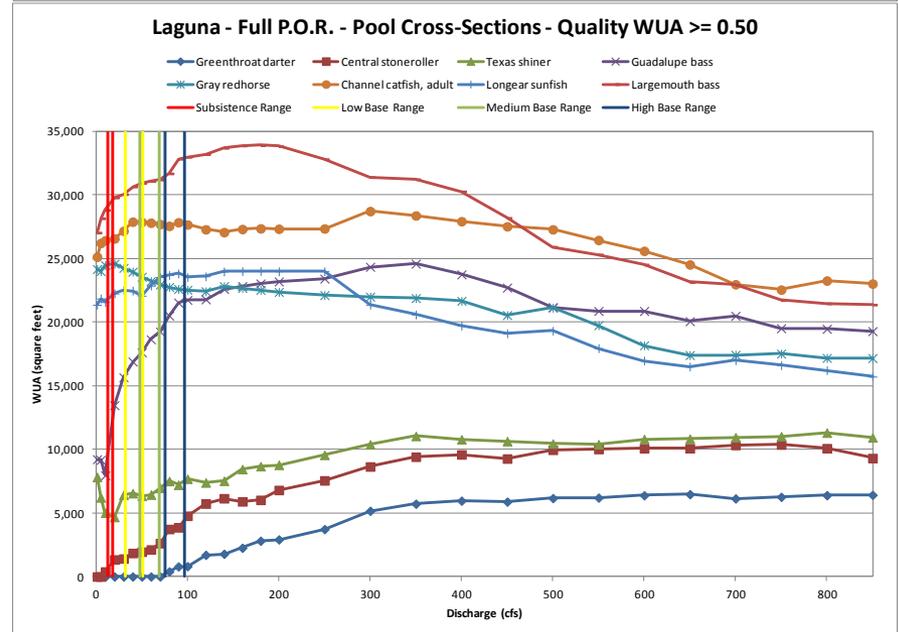
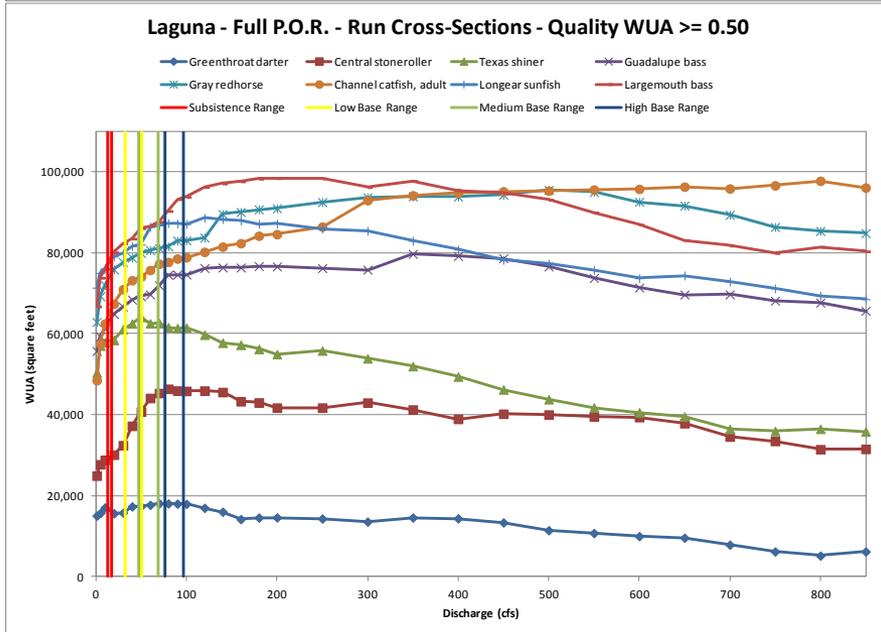
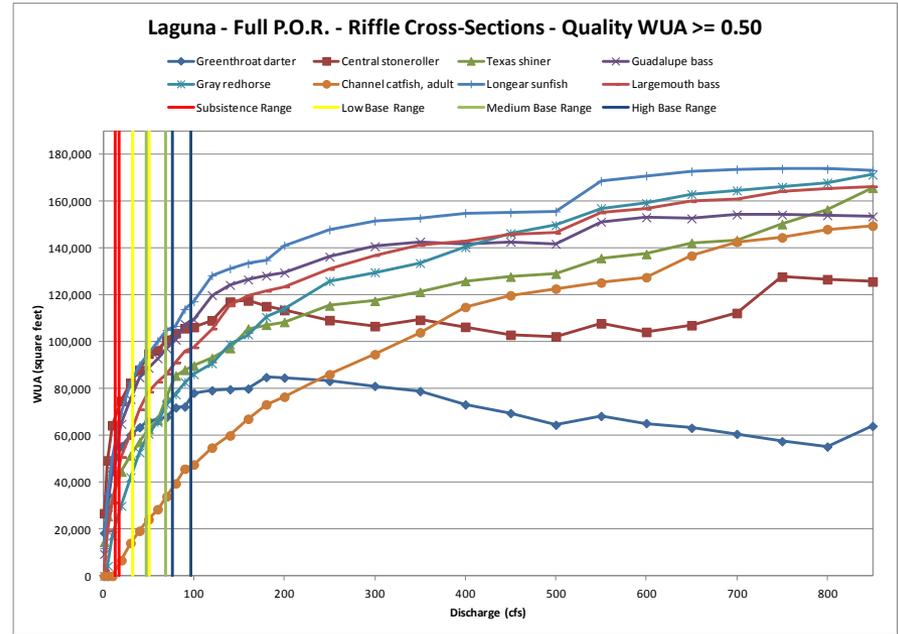
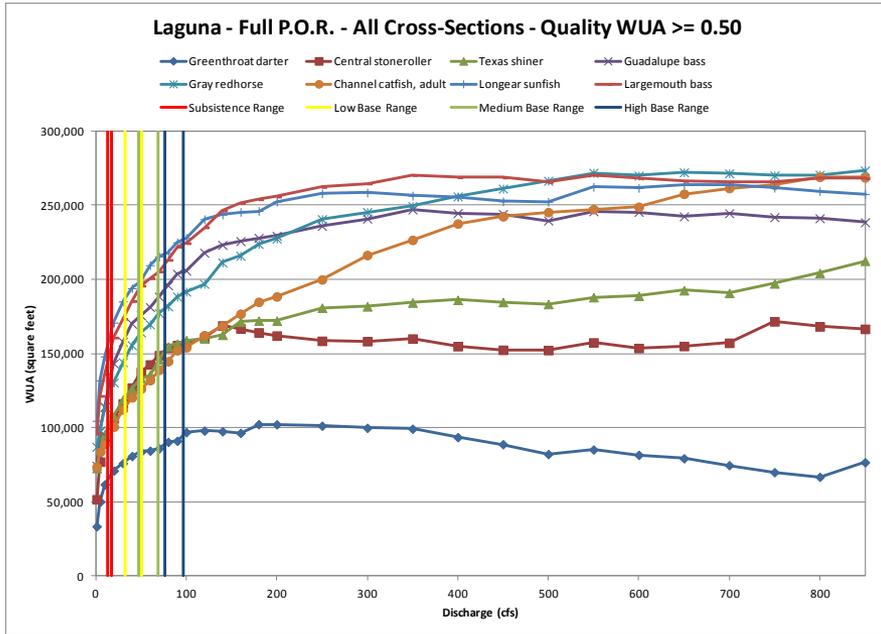
Laguna - Full P.O.R. - All Cross-Sections - Quality WUA  $\geq 0.80$



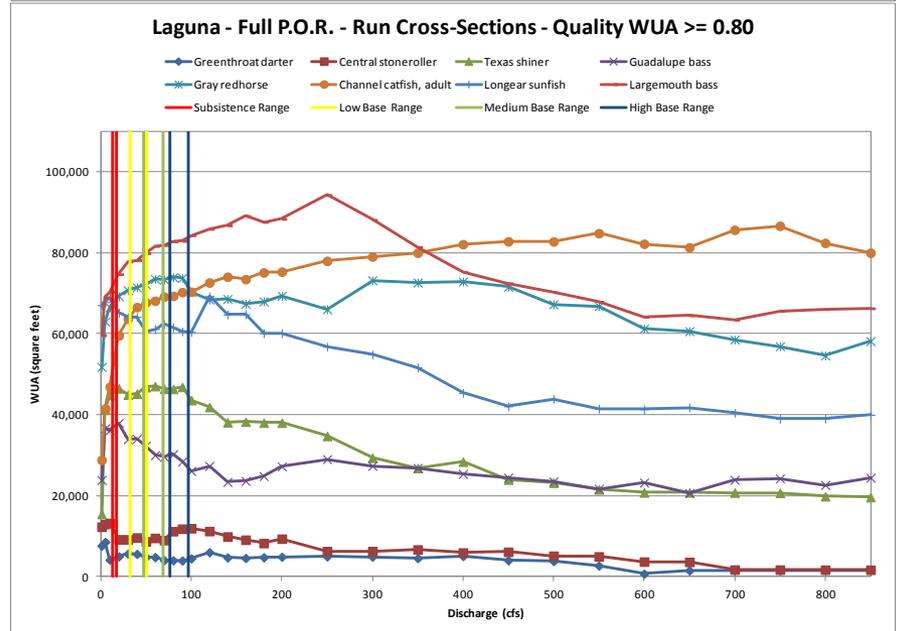
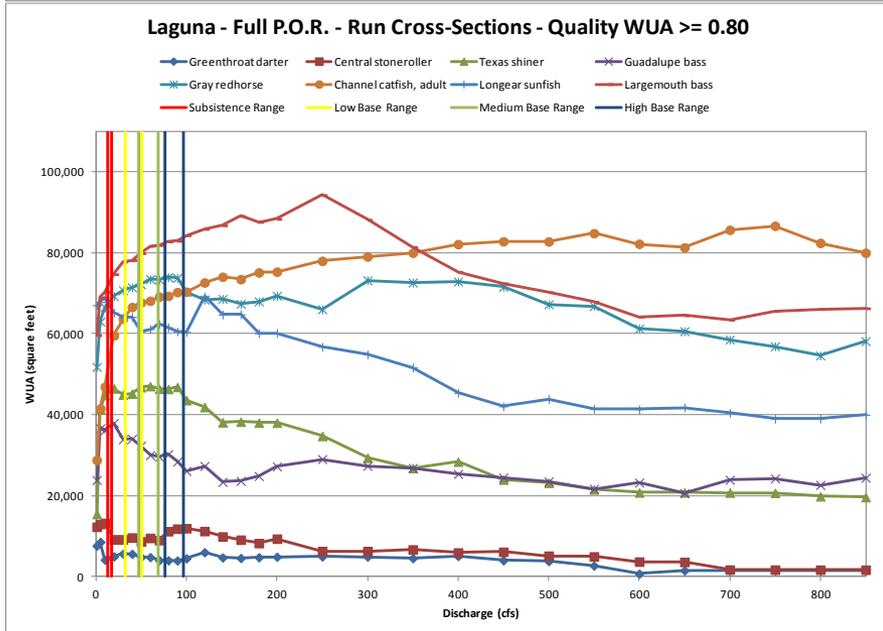
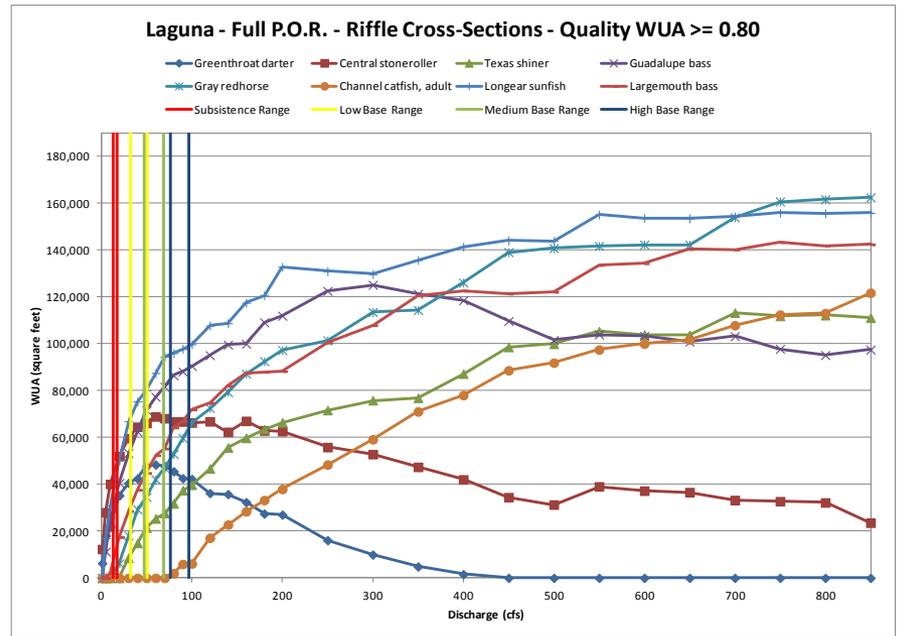
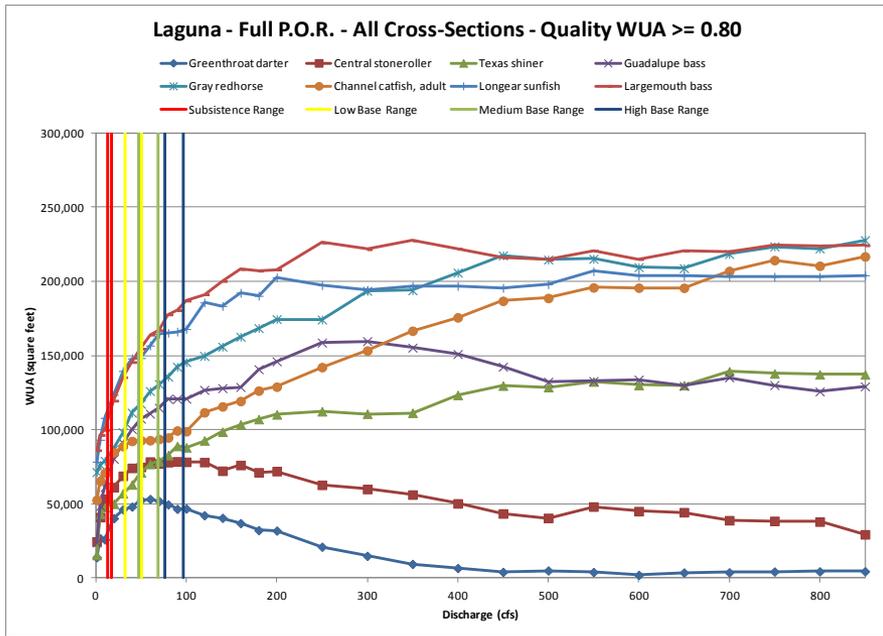
# Laguna – WUA, No Threshold



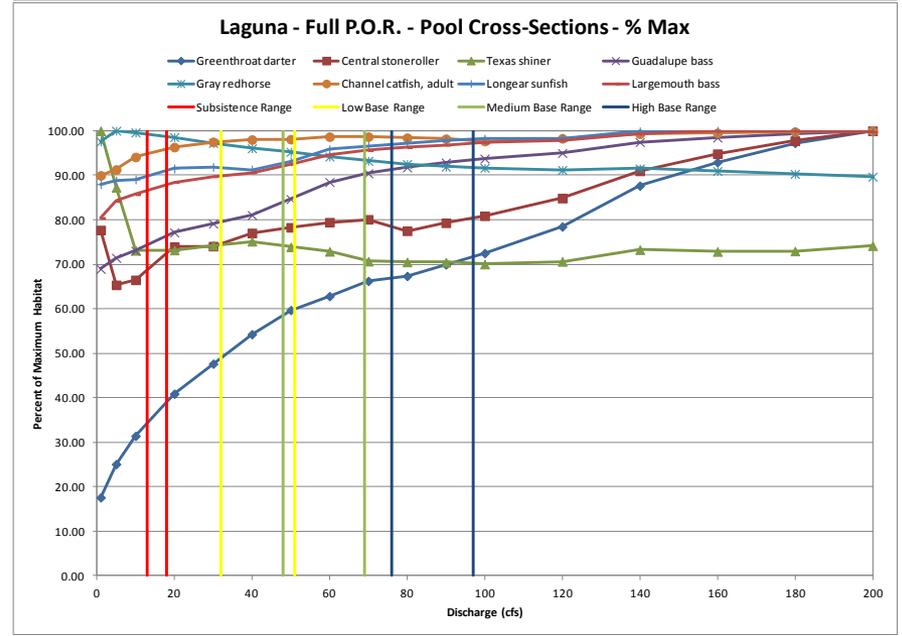
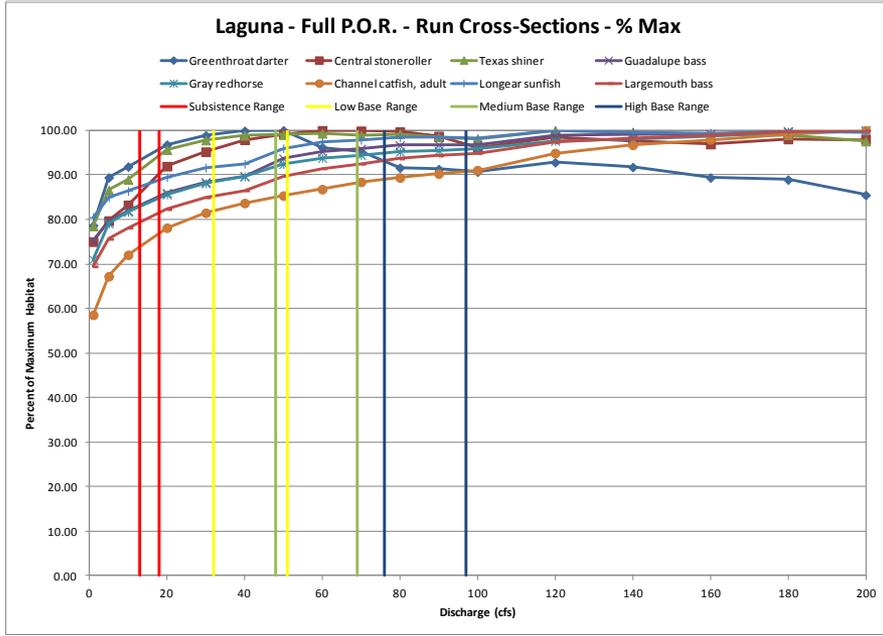
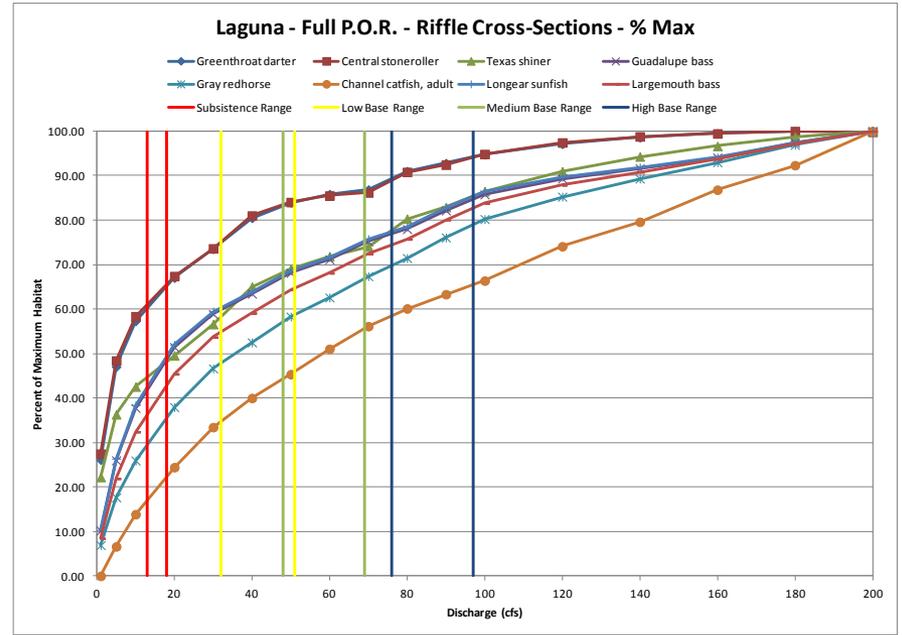
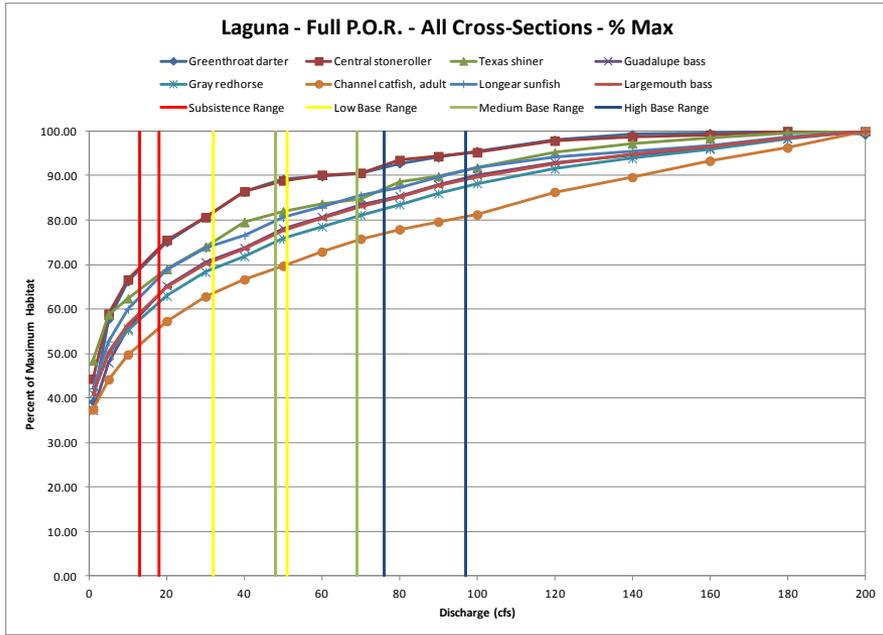
# Laguna – WUA, 0.5 Threshold



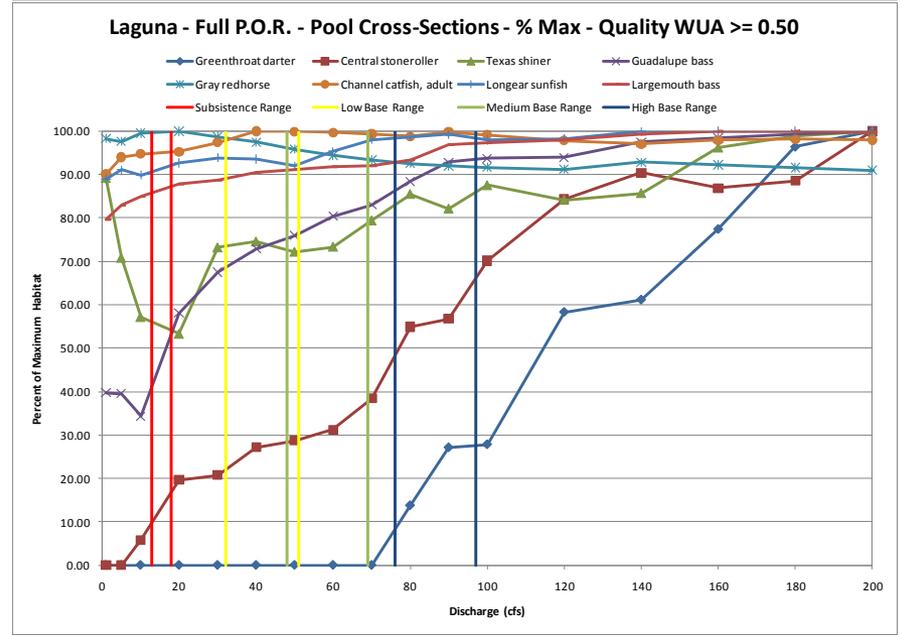
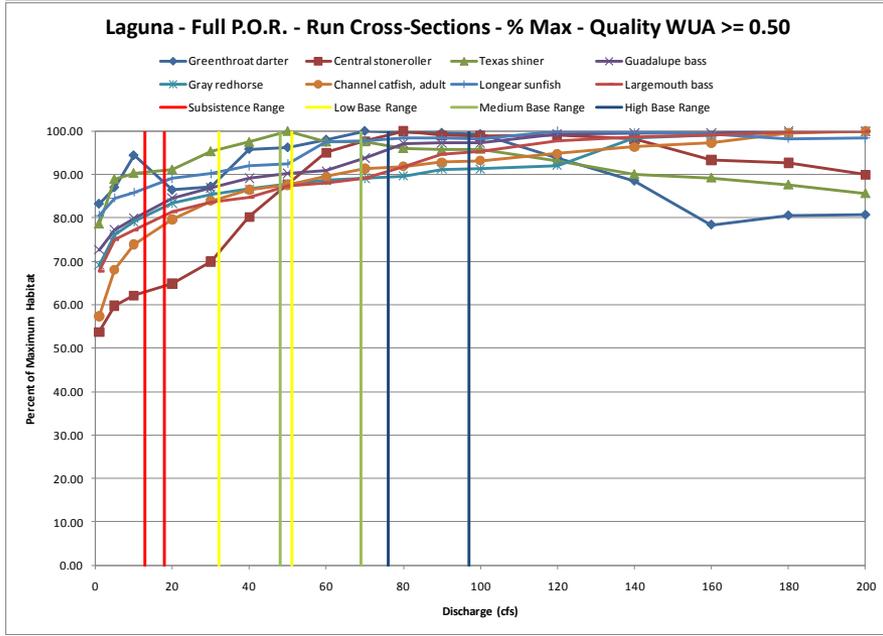
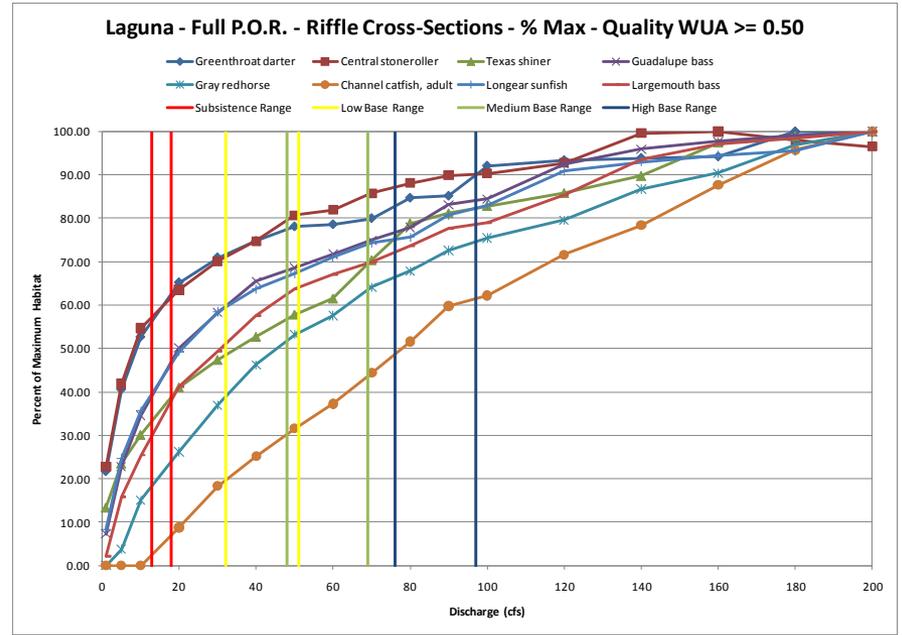
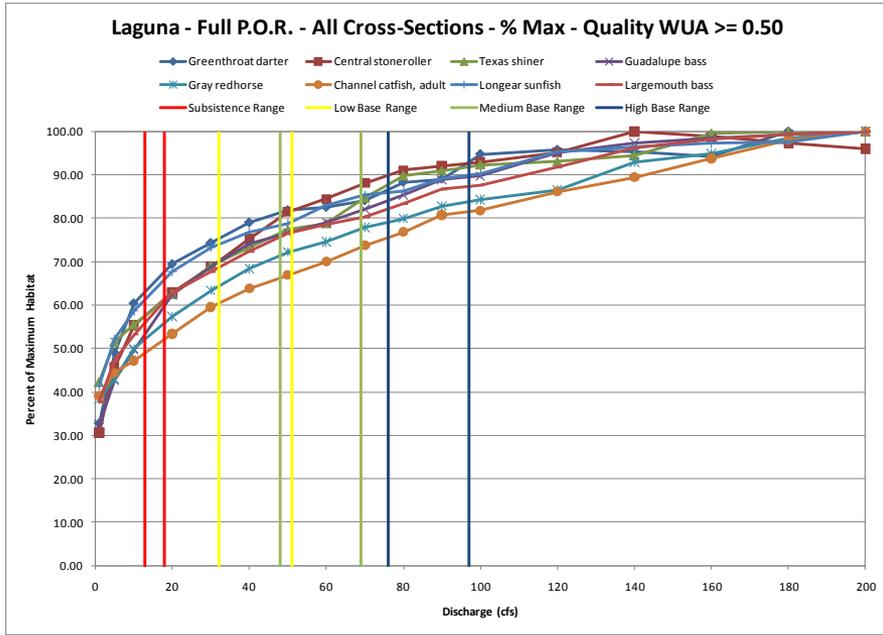
# Laguna – WUA, 0.8 Threshold



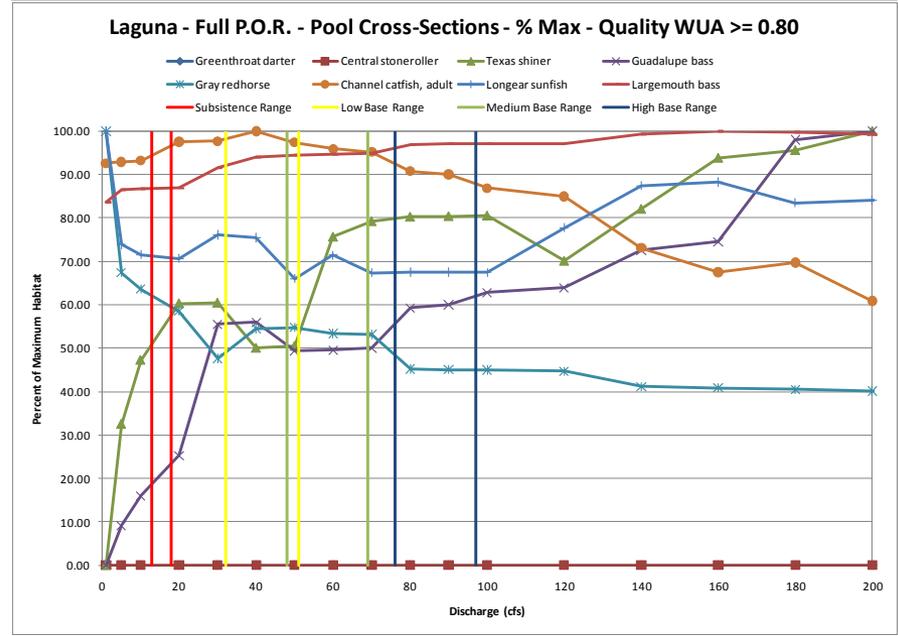
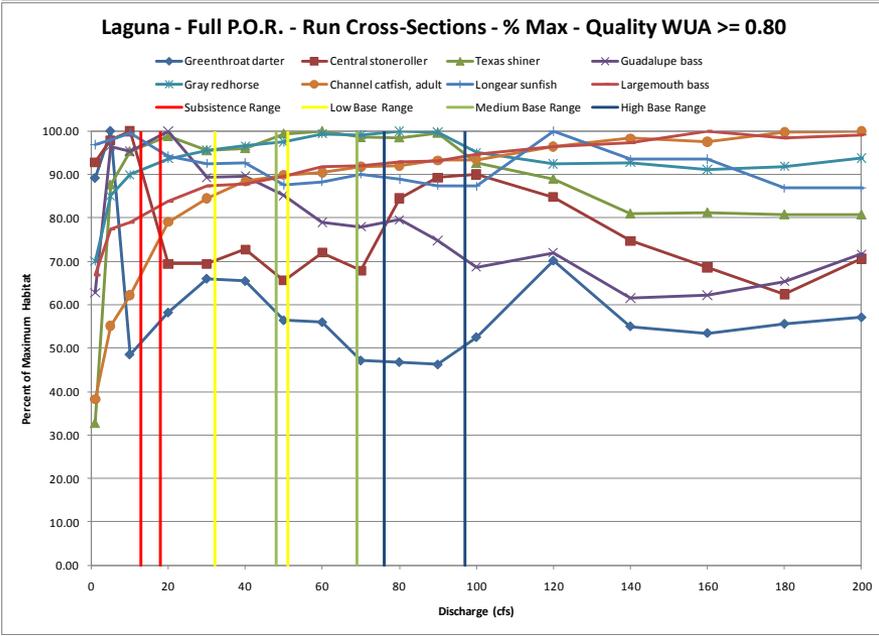
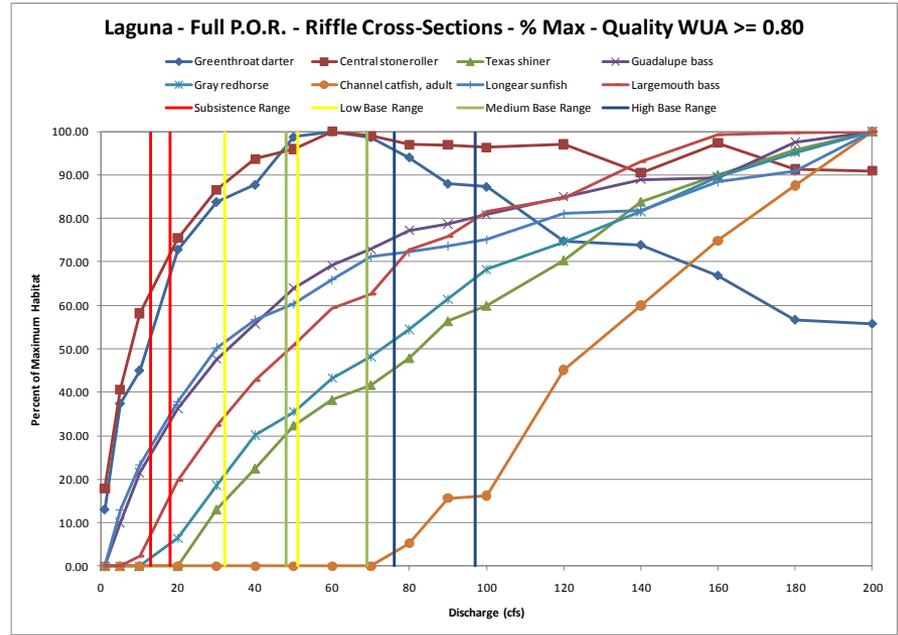
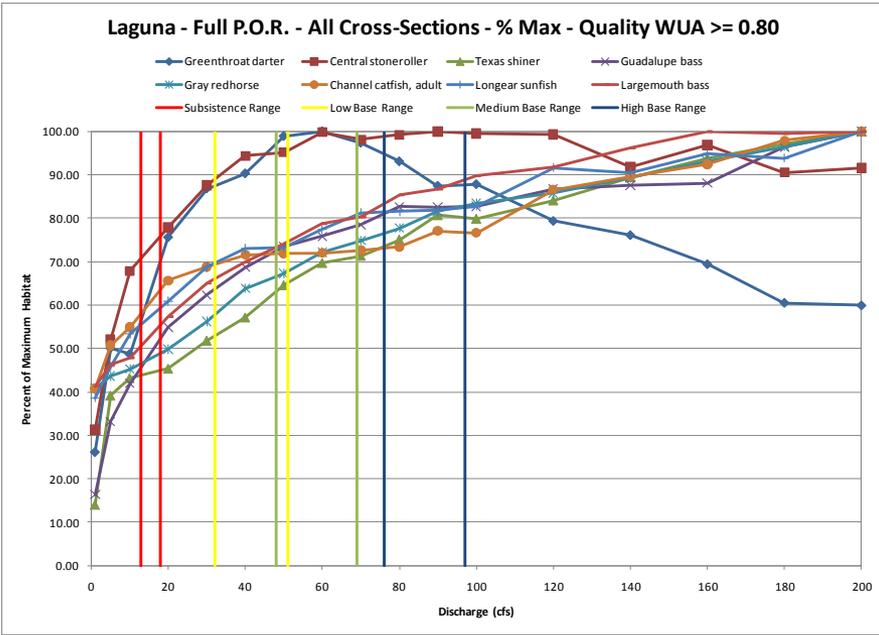
# Laguna – % Max, No Threshold



# Laguna – % Max, 0.5 Threshold

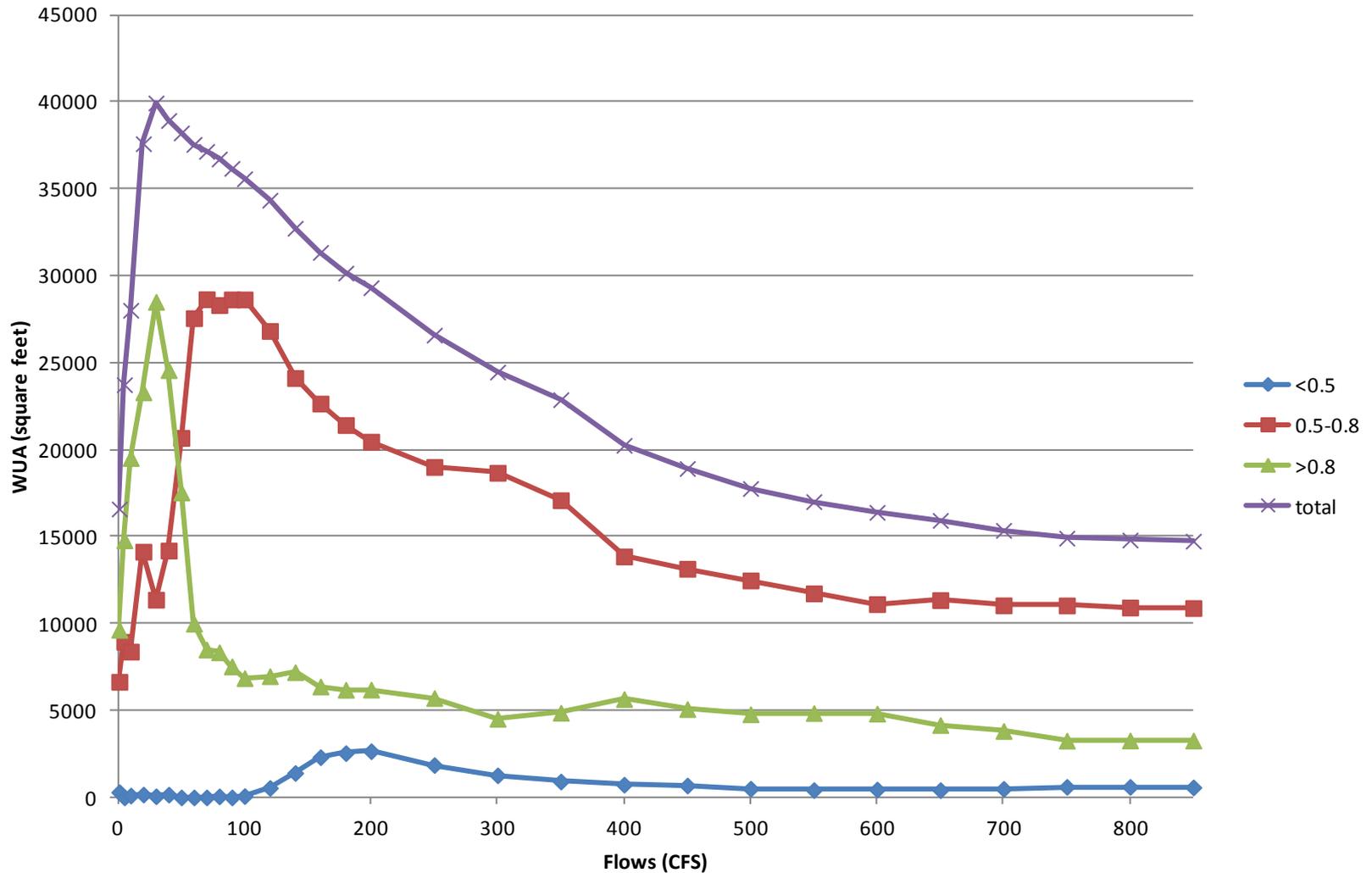


# Laguna – % Max, 0.8 Threshold



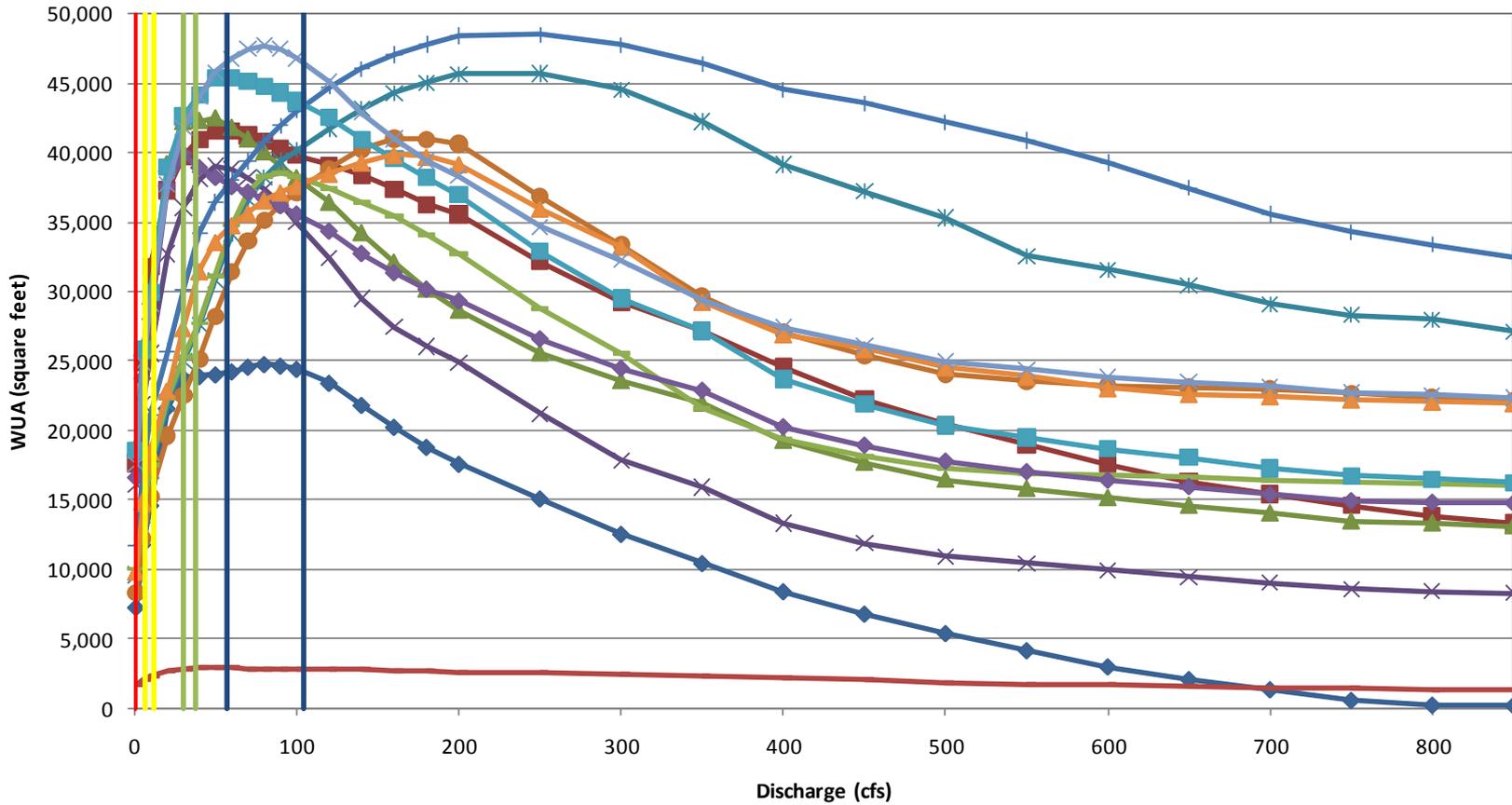
# Three Rivers – All Species

## Nueces River at Three Rivers - River Carpsucker - All X-Sections



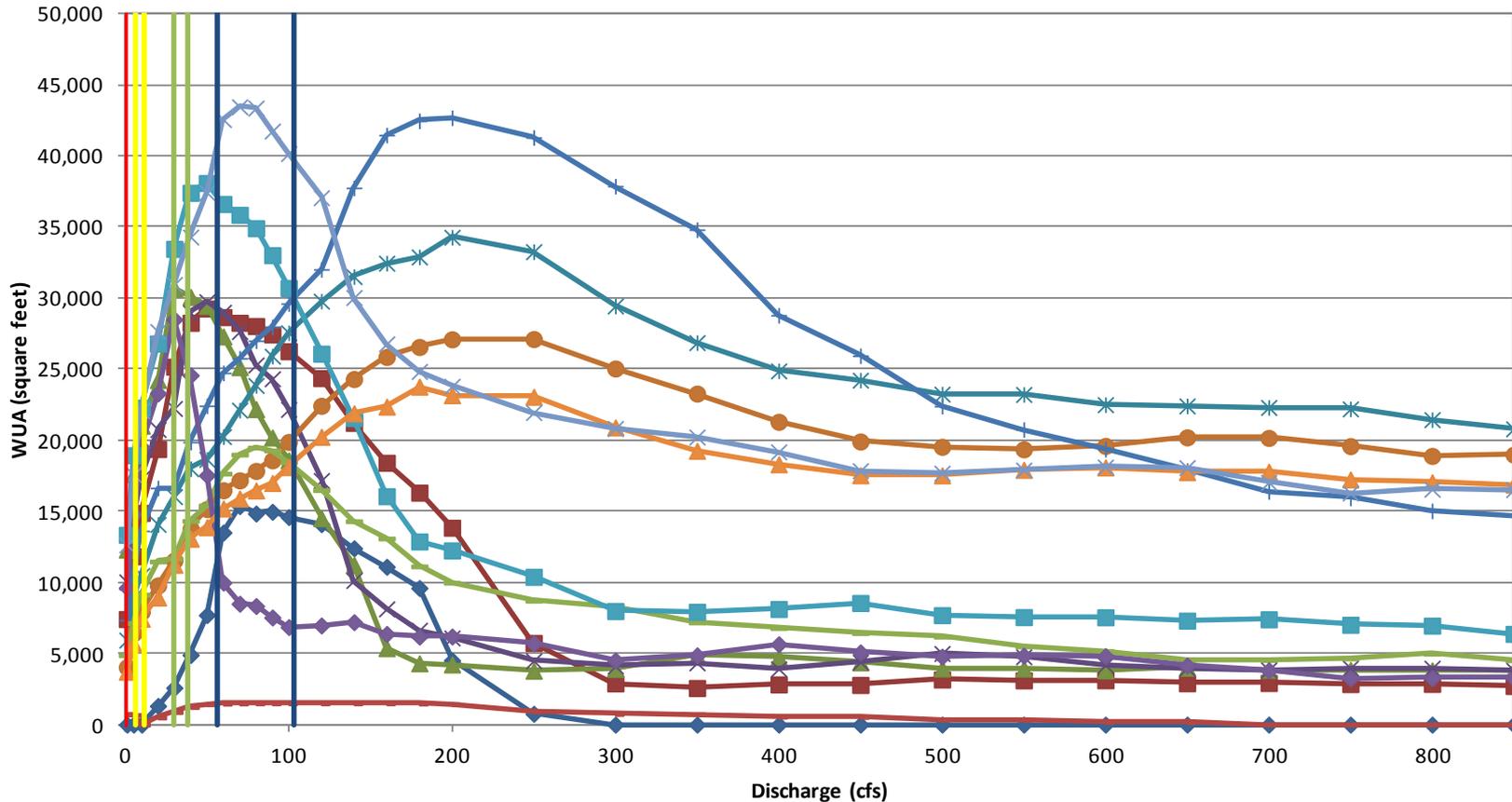
# Three Rivers – WUA, All, No Threshold

## Three Rivers - Full P.O.R. - All Cross-Sections - Total WUA



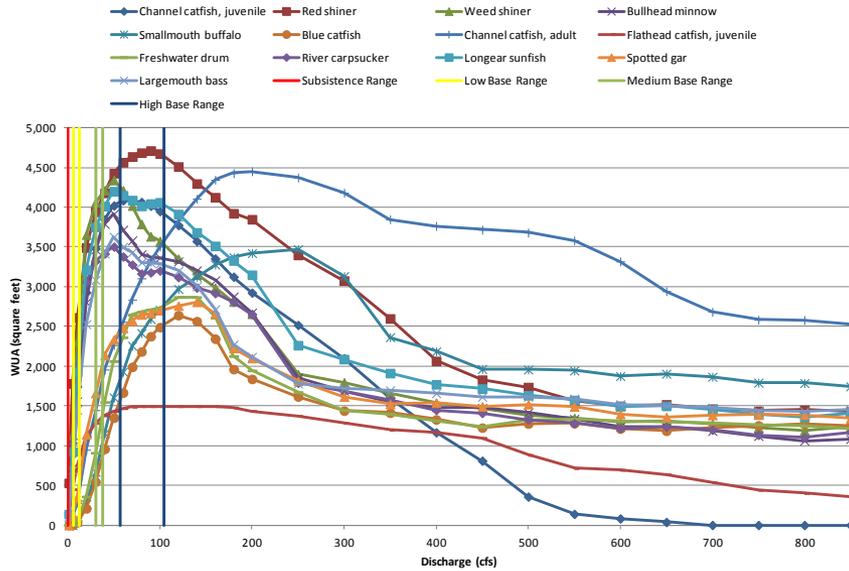
# Three Rivers – WUA, All, 0.8 Threshold

## Three Rivers - Full P.O.R. - All Cross-Sections - Quality WUA $\geq 0.80$

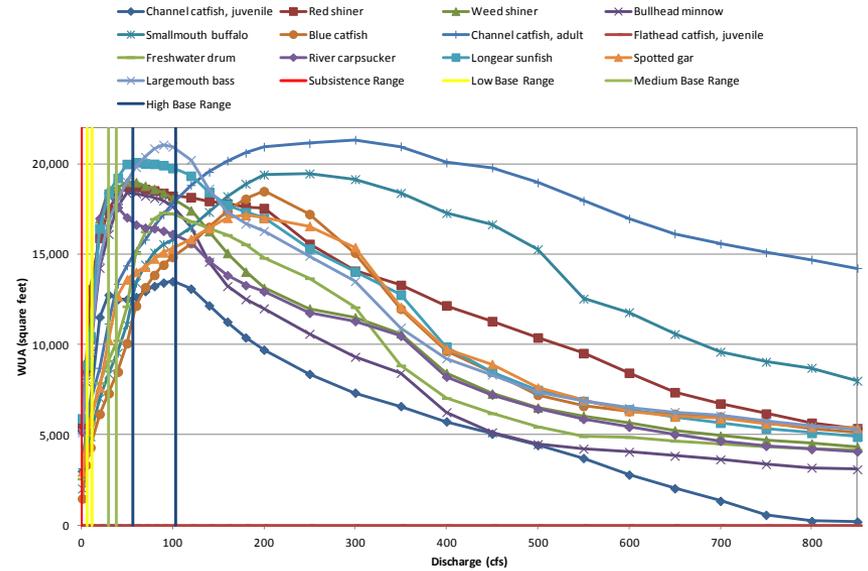


# Three Rivers – WUA, No Threshold

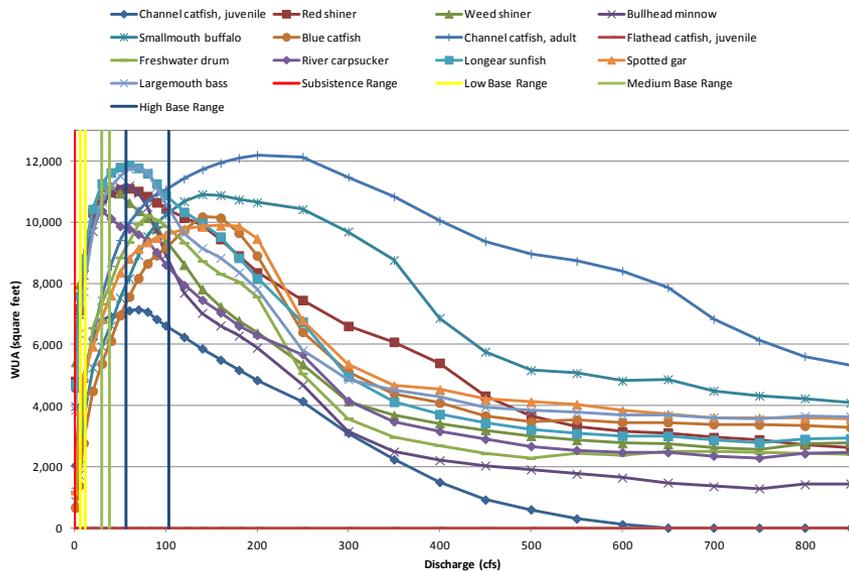
Three Rivers - Full P.O.R. - Riffle Cross-Sections - Total WUA



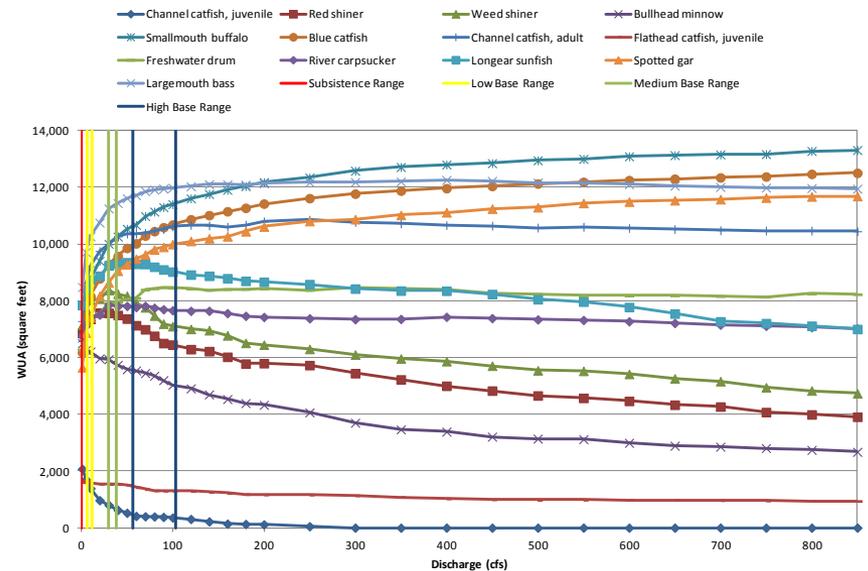
Three Rivers - Full P.O.R. - Run Cross-Sections - Total WUA



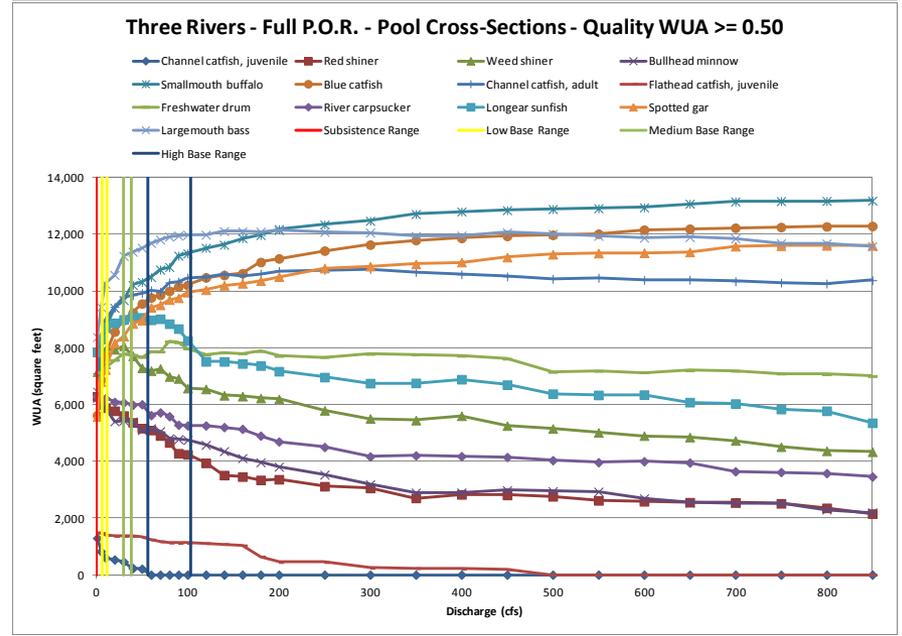
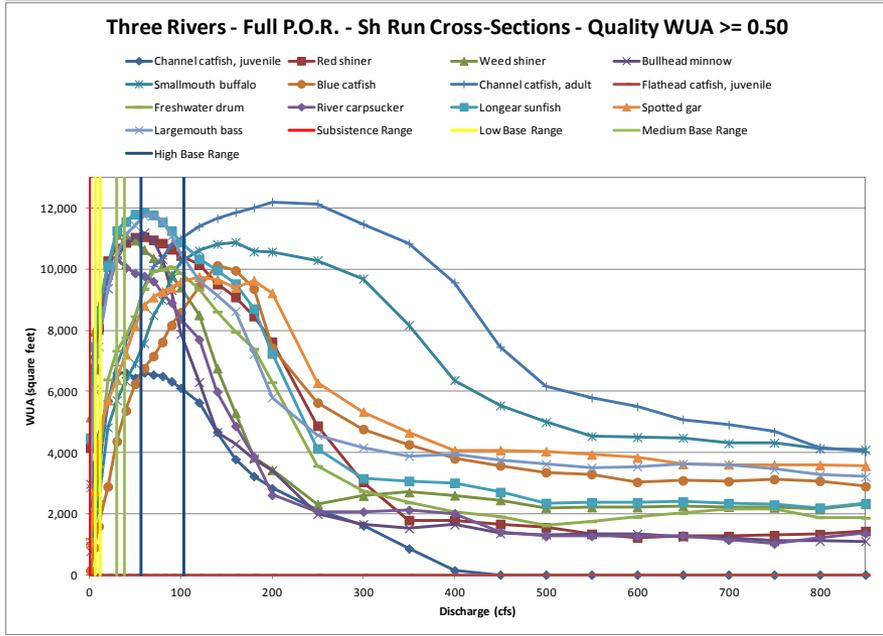
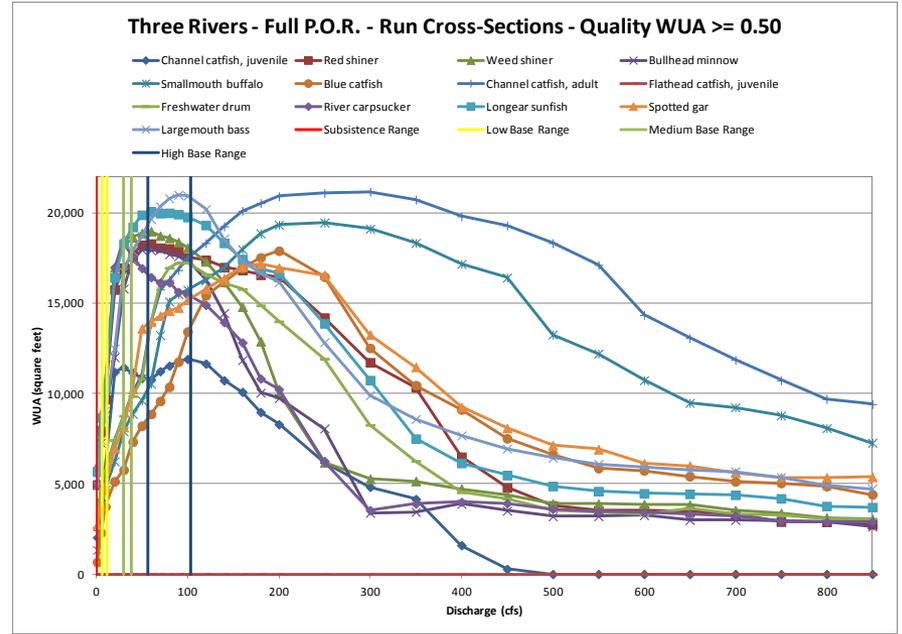
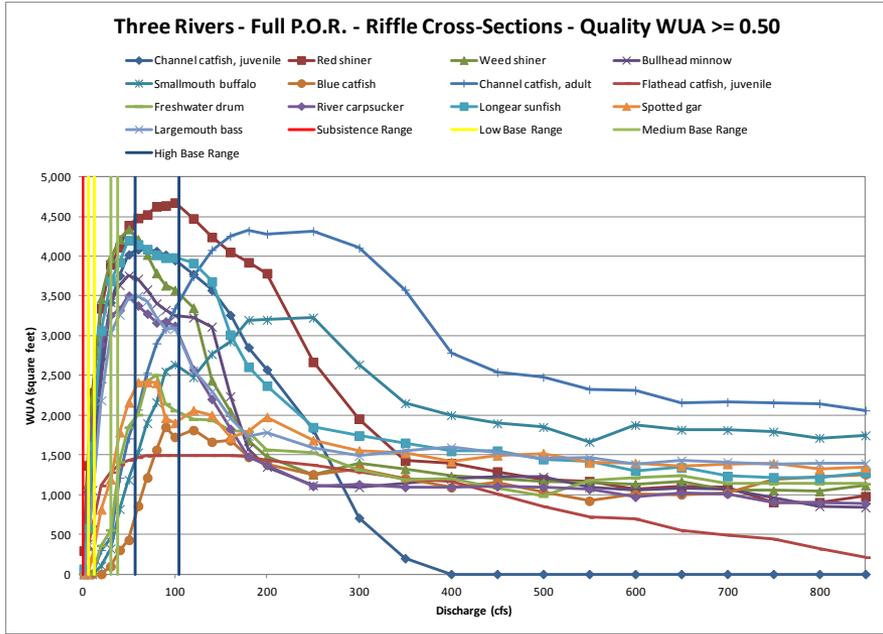
Three Rivers - Full P.O.R. - Shallow Run Cross-Sections - Total WUA



Three Rivers - Full P.O.R. - Pool Cross-Sections - Total WUA

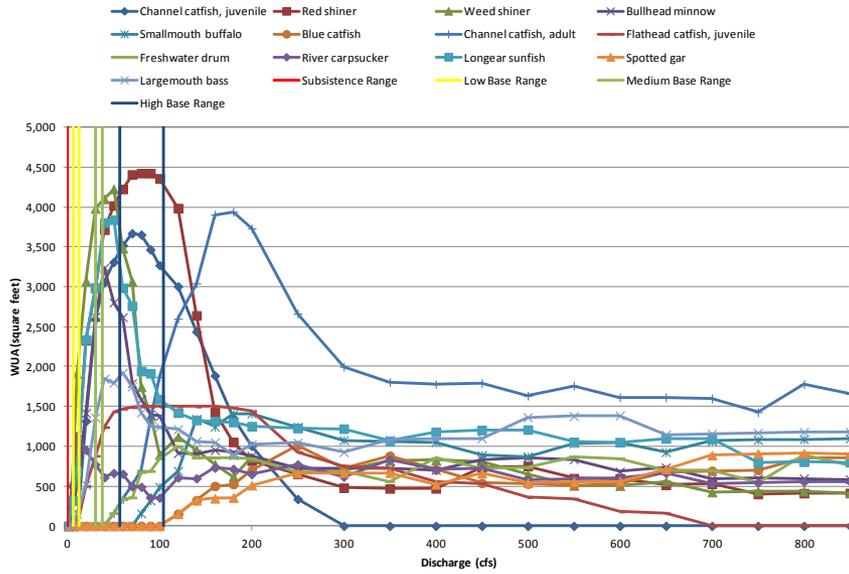


# Three Rivers – WUA, 0.5 Threshold

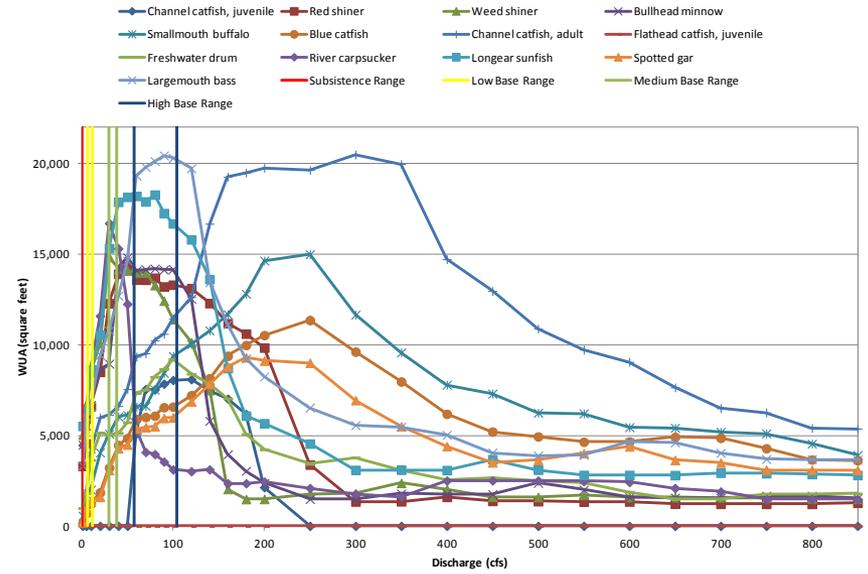


# Three Rivers – WUA, 0.8 Threshold

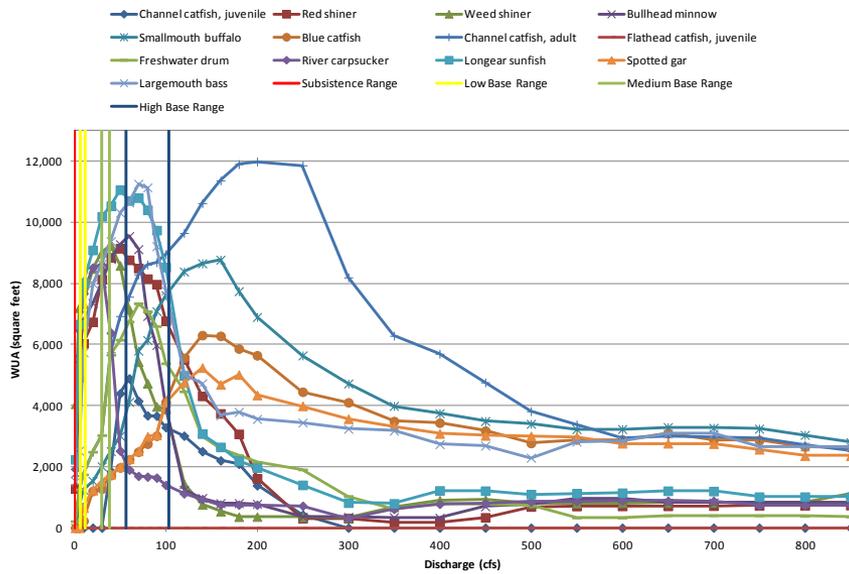
Three Rivers - Full P.O.R. - Riffle Cross-Sections - Quality WUA >= 0.80



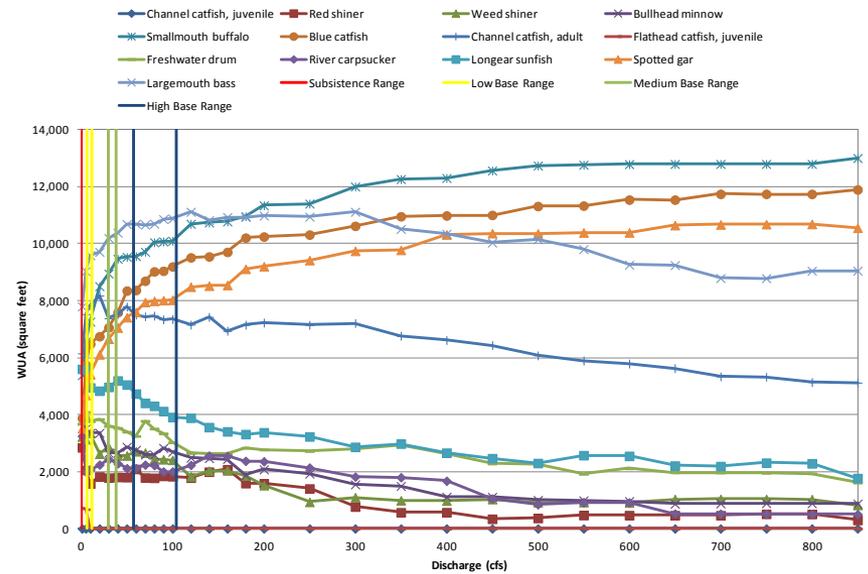
Three Rivers - Full P.O.R. - Run Cross-Sections - Quality WUA >= 0.80



Three Rivers - Full P.O.R. - Sh Run Cross-Sections - Quality WUA >= 0.80



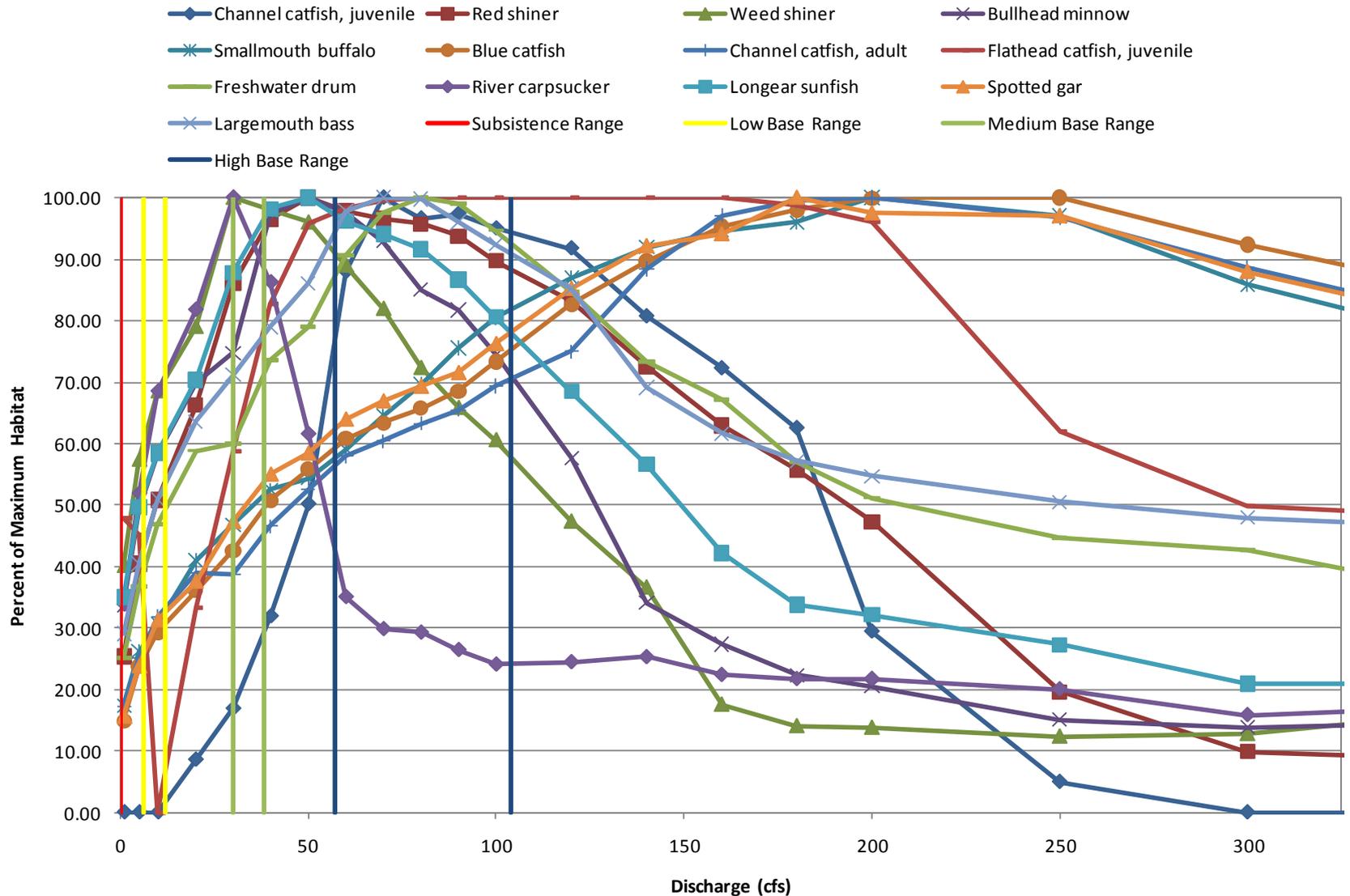
Three Rivers - Full P.O.R. - Pool Cross-Sections - Quality WUA >= 0.80





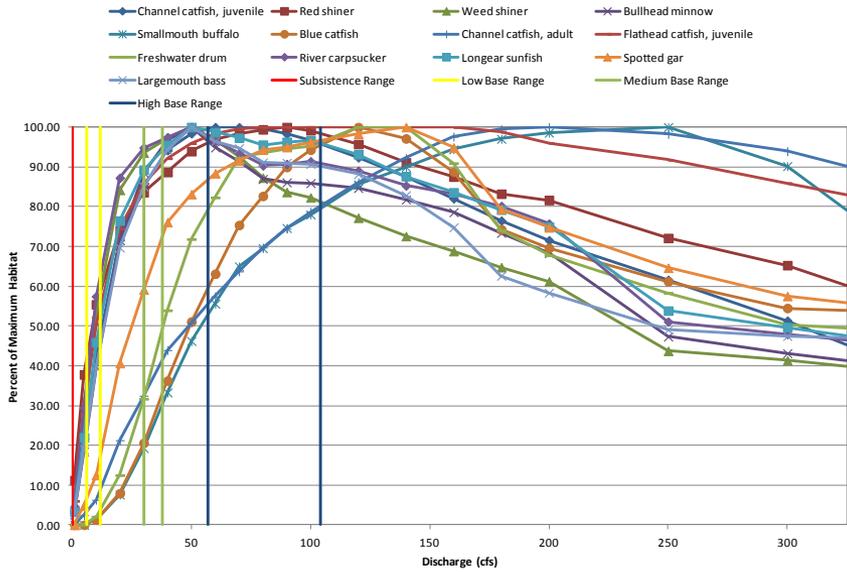
# Three Rivers – % Max, 0.8 Threshold

Three Rivers - Full P.O.R. - All X-Sections - % Max - Quality WUA >= 0.80

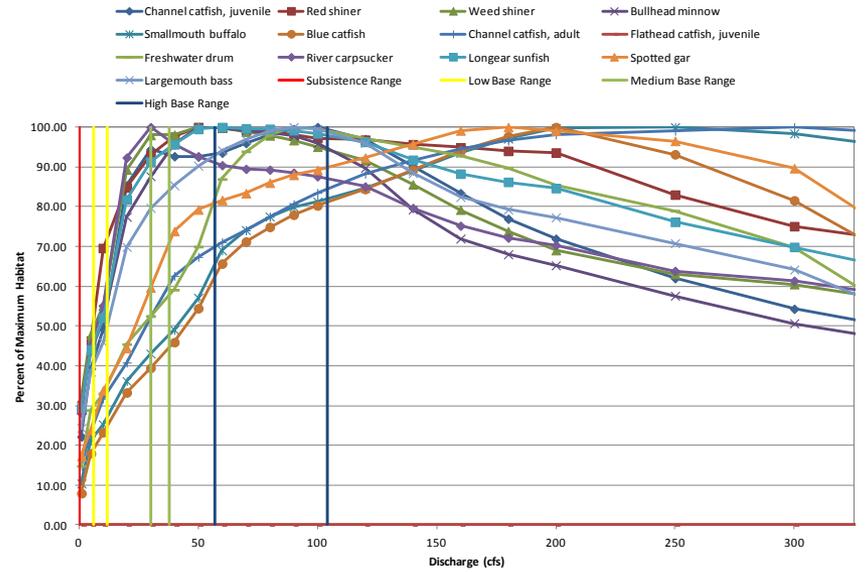


# Three Rivers – % Max, No Threshold

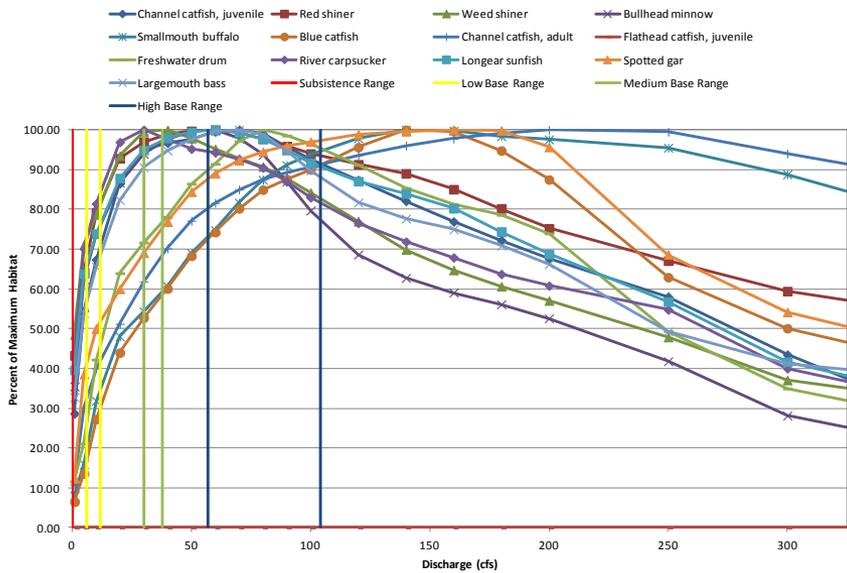
Three Rivers - Full P.O.R. - Riffle Cross-Sections - % Max



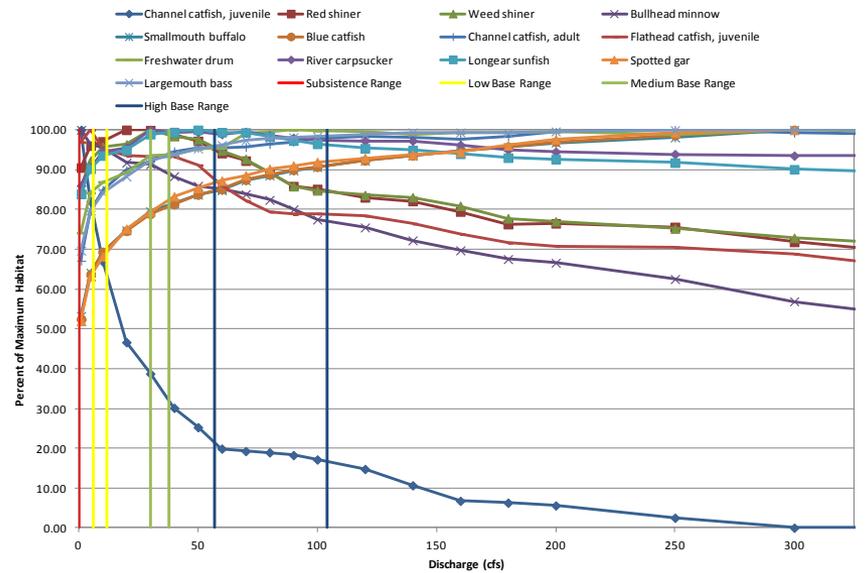
Three Rivers - Full P.O.R. - Run Cross-Sections - % Max



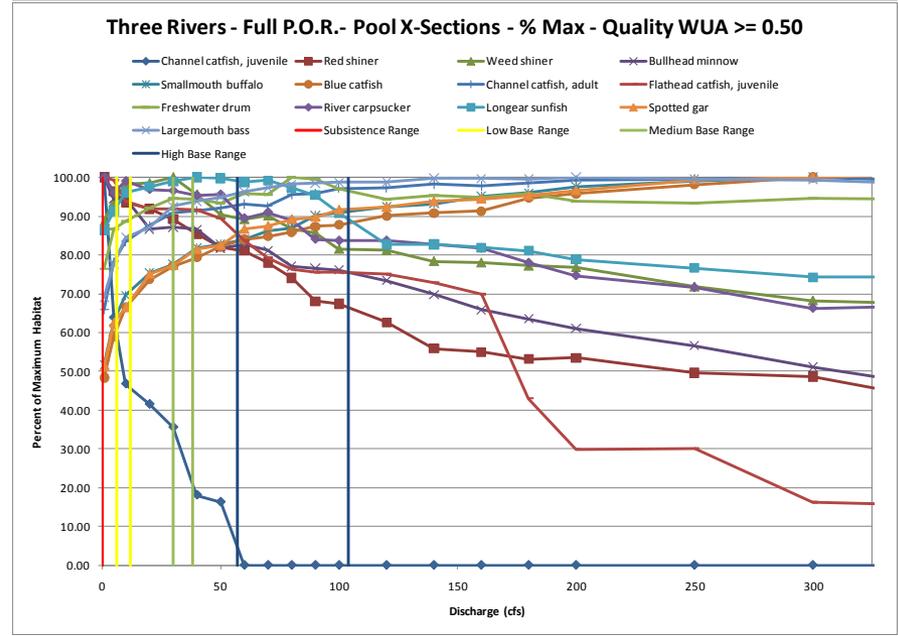
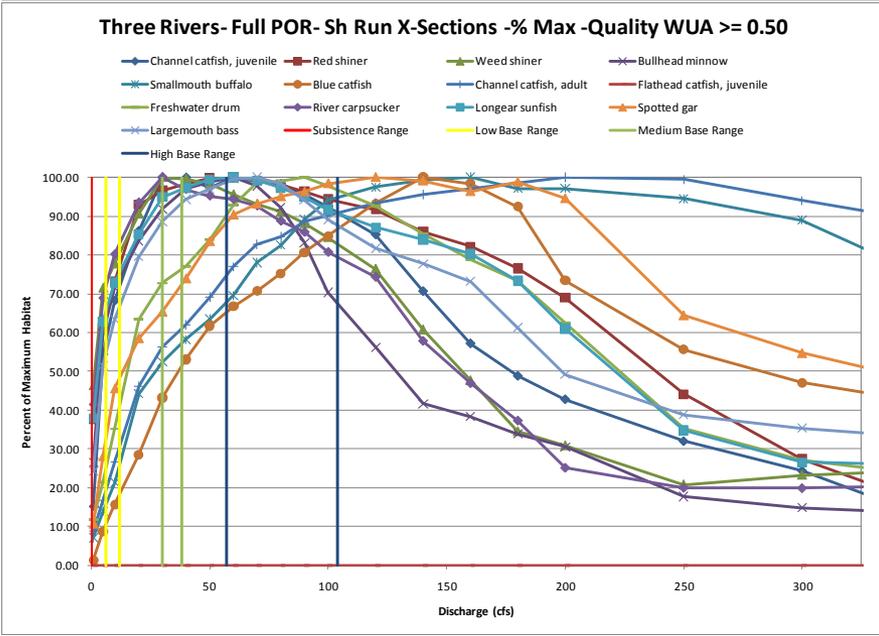
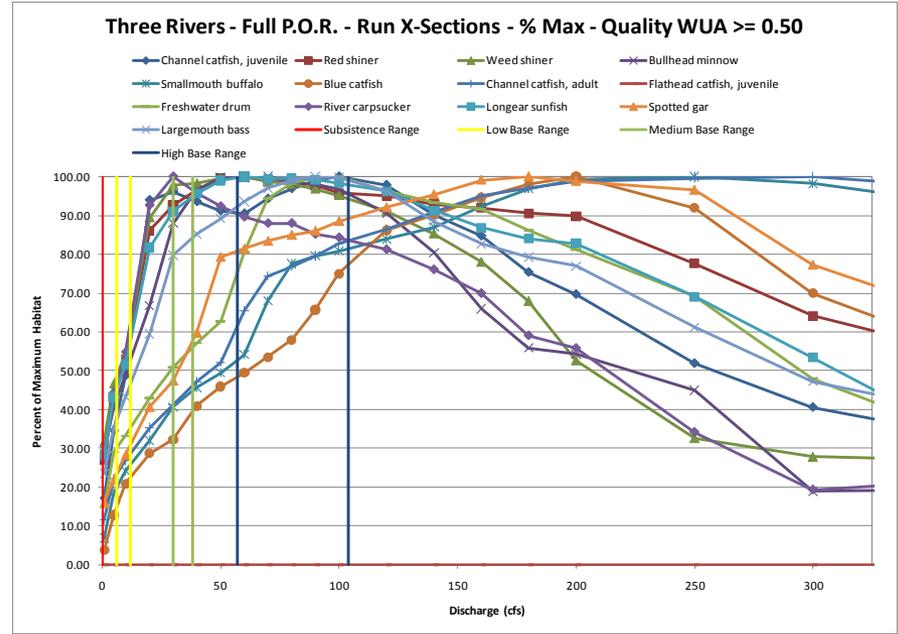
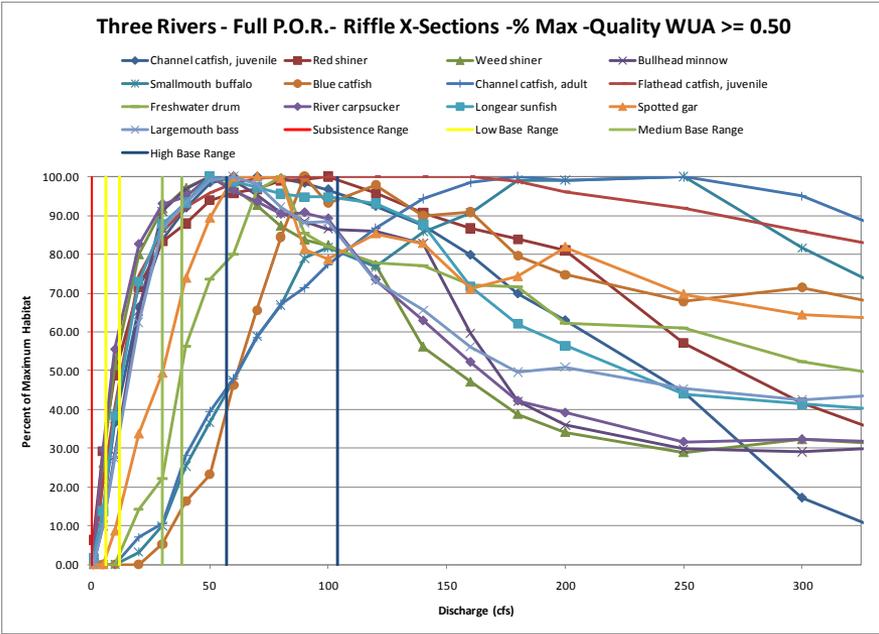
Three Rivers - Full P.O.R. - Shallow Run Cross-Sections - % Max



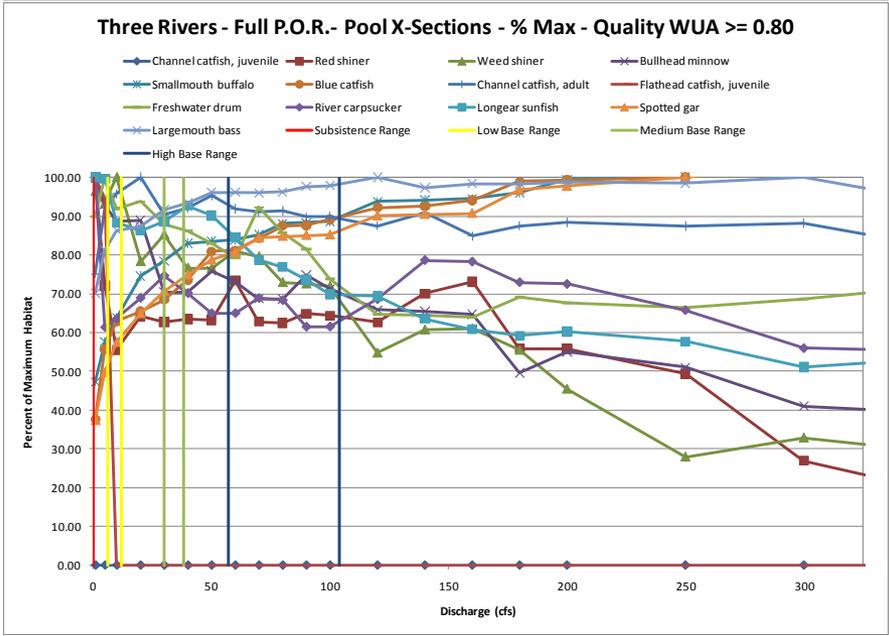
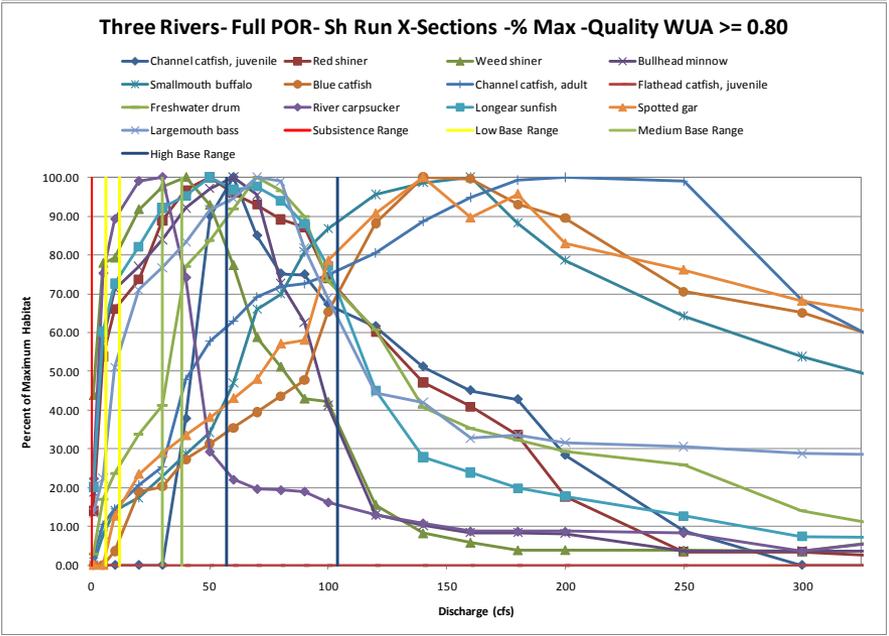
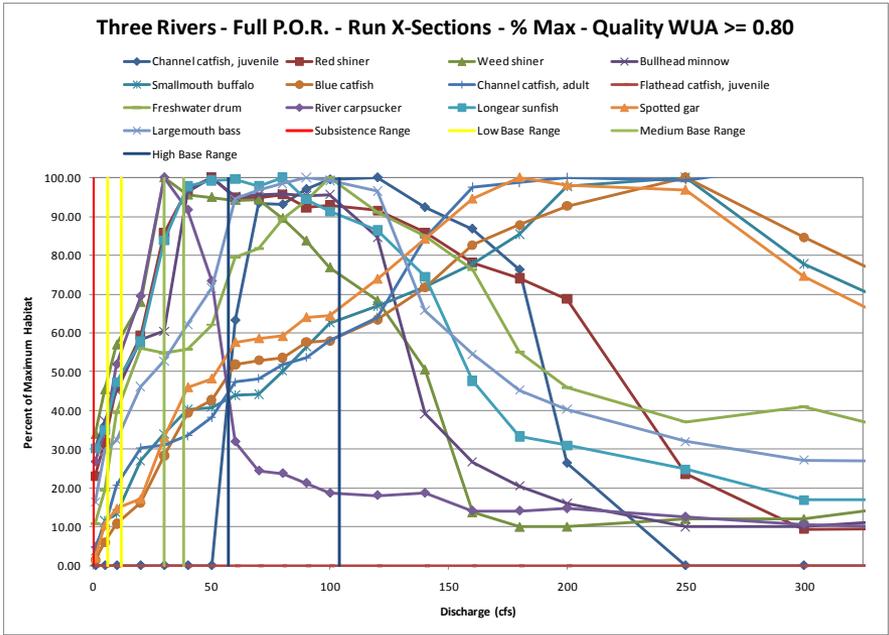
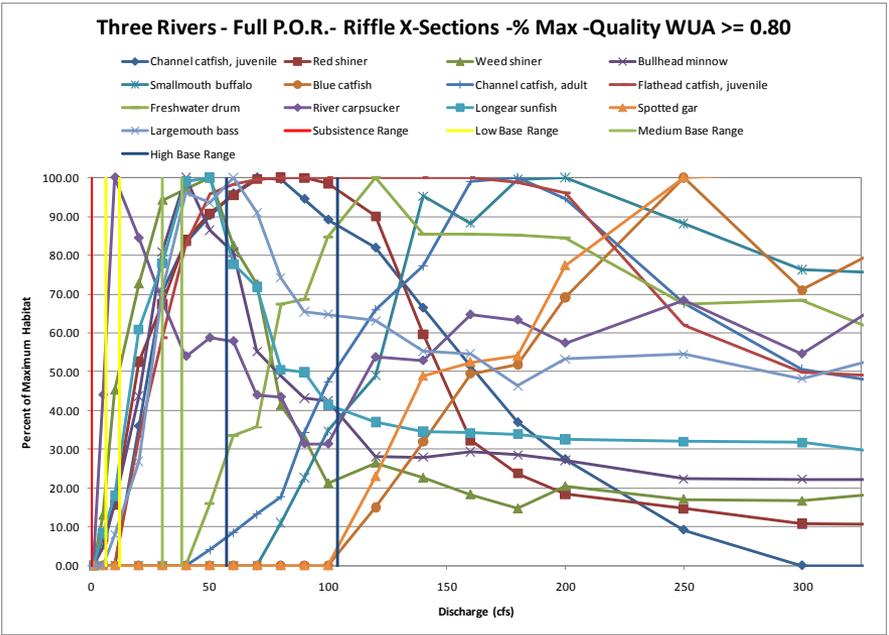
Three Rivers - Full P.O.R. - Pool Cross-Sections - % Max



# Three Rivers – % Max, 0.5 Threshold



# Three Rivers – % Max, 0.8 Threshold



**EXTRA**

# Concan – % of Max – 0.5, 200% Base, 90/75/50

- **90/75/50** “enoughness” thresholds
- % of max habitat w/ 200% highest base flow (190 CFS) as upper end
- **0.5** quality threshold
- 3 Base flow levels
- Full POR, 8 modeled species, by total and each mesohabitat type

		Greenthroat darter			Central stoneroller			Texas shiner			Guadalupe bass			Gray redbhorse			Channel cat, adult			Longear sunfish			Largemouth bass		
		Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet
<b>TOTAL</b>	Winter	82%	90%	96%	95%	97%	97%	83%	90%	95%	85%	89%	94%	91%	94%	95%	84%	87%	89%	91%	94%	96%	92%	93%	97%
	Spring	80%	89%	96%	92%	98%	97%	80%	89%	94%	84%	88%	94%	90%	93%	95%	82%	87%	89%	90%	93%	96%	92%	93%	97%
	Summer	73%	83%	93%	87%	95%	97%	79%	83%	92%	78%	85%	92%	88%	91%	94%	82%	84%	89%	88%	91%	95%	90%	92%	95%
	Fall	75%	86%	96%	89%	97%	97%	79%	87%	94%	80%	87%	94%	89%	92%	95%	82%	86%	89%	88%	92%	96%	91%	93%	97%
<b>RIFFLE</b>	Winter	46%	52%	70%	59%	62%	69%	42%	47%	66%	34%	35%	58%	24%	32%	53%	5%	25%	26%	28%	36%	62%	19%	27%	52%
	Spring	45%	50%	70%	58%	62%	69%	38%	45%	66%	33%	33%	57%	24%	26%	53%	5%	23%	26%	25%	32%	61%	16%	26%	51%
	Summer	46%	47%	60%	58%	59%	65%	29%	42%	56%	34%	34%	45%	26%	24%	47%	5%	5%	26%	25%	28%	51%	15%	19%	35%
	Fall	46%	49%	70%	58%	61%	69%	32%	45%	66%	33%	33%	57%	26%	25%	53%	5%	15%	26%	25%	30%	61%	15%	24%	51%
<b>RUN</b>	Winter	89%	97%	100%	96%	100%	98%	86%	96%	98%	90%	96%	99%	92%	96%	96%	75%	79%	82%	95%	99%	98%	94%	94%	98%
	Spring	88%	96%	100%	93%	100%	98%	83%	94%	98%	87%	94%	99%	91%	95%	96%	75%	78%	82%	93%	98%	98%	94%	93%	98%
	Summer	77%	89%	99%	85%	97%	99%	85%	86%	97%	80%	90%	98%	90%	92%	96%	74%	75%	81%	90%	95%	100%	93%	94%	97%
	Fall	81%	93%	100%	88%	99%	98%	84%	91%	98%	82%	93%	99%	90%	94%	96%	74%	77%	82%	91%	97%	98%	93%	94%	98%
<b>POOL</b>	Winter	85%	96%	98%	98%	98%	93%	80%	83%	86%	92%	93%	94%	92%	93%	94%	91%	94%	94%	93%	92%	93%	94%	96%	97%
	Spring	76%	95%	99%	98%	100%	93%	76%	83%	86%	93%	92%	93%	91%	93%	94%	88%	94%	94%	92%	92%	93%	94%	96%	97%
	Summer	71%	87%	100%	97%	98%	93%	73%	80%	85%	88%	92%	93%	88%	92%	94%	88%	91%	94%	91%	93%	92%	91%	94%	96%
	Fall	72%	93%	99%	97%	99%	93%	74%	82%	86%	90%	92%	93%	89%	93%	94%	88%	93%	94%	91%	93%	93%	92%	95%	97%

# Laguna – % of Max – 0.5, 200% Base, 90/75/50

- **90/75/50** “enoughness” thresholds
- % of max habitat w/ 200% highest base flow (208 CFS) as upper end
- **0.5** quality threshold
- 3 Base flow levels
- Full POR, 8 modeled species, by total and each mesohabitat type

		Greenthroat darter			Central stoneroller			Texas shiner			Guadalupe bass			Gray redhorse			Channel cat, adult			Longear sunfish			Largemouth bass		
		Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet
<b>TOTAL</b>	Winter	82%	84%	91%	82%	88%	92%	78%	84%	92%	77%	82%	89%	72%	78%	83%	67%	73%	81%	79%	85%	90%	77%	80%	87%
	Spring	80%	83%	89%	78%	86%	92%	75%	81%	91%	75%	80%	87%	70%	76%	82%	65%	71%	79%	78%	84%	88%	74%	79%	85%
	Summer	75%	81%	87%	70%	80%	90%	70%	77%	88%	70%	76%	84%	64%	71%	79%	60%	66%	76%	74%	78%	86%	69%	76%	82%
	Fall	79%	83%	93%	76%	85%	93%	74%	80%	92%	74%	80%	89%	69%	75%	84%	64%	71%	81%	77%	83%	90%	73%	79%	87%
<b>RIFFL</b>	Winter	78%	80%	88%	81%	85%	90%	58%	69%	82%	69%	75%	84%	54%	63%	74%	32%	44%	61%	68%	74%	82%	64%	70%	78%
	Spring	76%	79%	85%	77%	83%	89%	55%	64%	80%	67%	73%	81%	49%	60%	71%	28%	39%	57%	65%	72%	79%	60%	68%	76%
	Summer	72%	77%	83%	71%	80%	87%	48%	57%	75%	60%	68%	77%	39%	52%	66%	20%	30%	49%	60%	67%	75%	51%	62%	72%
	Fall	75%	79%	90%	75%	83%	90%	53%	63%	82%	66%	72%	84%	47%	59%	75%	26%	39%	61%	64%	72%	82%	58%	68%	79%
<b>RUN</b>	Winter	96%	100%	99%	89%	97%	99%	100%	98%	96%	90%	93%	97%	88%	89%	91%	88%	91%	93%	93%	98%	98%	88%	89%	95%
	Spring	96%	99%	100%	83%	96%	99%	98%	98%	96%	90%	92%	97%	87%	89%	91%	87%	90%	92%	92%	98%	98%	86%	88%	94%
	Summer	89%	96%	100%	72%	86%	99%	96%	99%	97%	87%	90%	96%	86%	88%	89%	84%	87%	92%	91%	92%	98%	84%	87%	91%
	Fall	96%	98%	99%	81%	96%	99%	98%	98%	96%	89%	91%	97%	87%	89%	91%	87%	90%	93%	92%	98%	98%	85%	88%	95%
<b>POOL</b>	Winter	0%	0%	27%	29%	38%	62%	72%	79%	84%	76%	83%	93%	96%	93%	92%	100%	99%	100%	92%	98%	99%	91%	92%	97%
	Spring	0%	0%	22%	28%	33%	56%	74%	75%	83%	74%	81%	91%	97%	94%	92%	100%	100%	99%	93%	96%	99%	91%	92%	95%
	Summer	0%	0%	8%	22%	28%	48%	73%	73%	83%	69%	75%	86%	98%	96%	93%	98%	100%	99%	94%	92%	98%	89%	91%	93%
	Fall	0%	0%	28%	27%	33%	66%	74%	75%	86%	73%	81%	93%	97%	94%	92%	100%	100%	99%	93%	96%	98%	90%	92%	97%

# Three Rivers – % of Max – 0.5, 200% Base, 90/75/50

- **90/75/50** “enoughness” thresholds
- % of max habitat w/ 200% highest base flow (324 CFS) as upper end
- **0.5** quality threshold
- 3 Base flow levels
- Full POR, 13 modeled species, by total and each mesohabitat type

		Channel catfish, juvenile			Red shiner			Weed shiner			Bullhead minnow			Smallmouth buffalo			Blue catfish			Channel catfish, adult			Flathead catfish, juvenile		
		Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet
<b>TOTAL</b>	Winter	63%	98%	98%	71%	97%	94%	74%	100%	89%	65%	97%	86%	37%	57%	89%	35%	55%	88%	39%	58%	88%	76%	99%	95%
	Spring	56%	99%	100%	67%	97%	97%	70%	100%	94%	63%	96%	94%	35%	56%	83%	33%	53%	77%	37%	57%	83%	72%	98%	95%
	Summer	45%	99%	97%	59%	95%	100%	63%	100%	99%	56%	92%	100%	30%	52%	65%	27%	49%	65%	33%	54%	71%	67%	96%	99%
	Fall	53%	98%	98%	65%	97%	99%	68%	100%	97%	61%	96%	99%	33%	56%	74%	32%	54%	70%	36%	58%	78%	71%	98%	97%
<b>RIFFLE</b>	Winter	43%	90%	96%	53%	87%	99%	57%	96%	81%	36%	96%	86%	1%	22%	81%	0%	14%	94%	1%	25%	79%	47%	91%	100%
	Spring	37%	89%	99%	49%	86%	99%	51%	95%	86%	28%	94%	90%	0%	19%	71%	0%	12%	89%	0%	21%	68%	40%	90%	100%
	Summer	20%	84%	100%	34%	83%	95%	33%	92%	98%	15%	91%	99%	0%	10%	44%	0%	5%	39%	0%	10%	45%	26%	86%	98%
	Fall	32%	89%	100%	45%	87%	97%	46%	95%	93%	25%	95%	96%	0%	21%	57%	0%	13%	62%	0%	23%	56%	36%	90%	99%
<b>RUN</b>	Winter	72%	100%	91%	77%	98%	94%	80%	100%	83%	74%	96%	68%	26%	57%	95%	18%	51%	87%	31%	61%	91%	0%	0%	0%
	Spring	68%	100%	97%	73%	98%	98%	78%	100%	90%	72%	95%	89%	21%	56%	85%	16%	49%	77%	27%	60%	86%	0%	0%	0%
	Summer	58%	100%	99%	64%	97%	100%	73%	100%	96%	63%	92%	100%	16%	52%	68%	11%	43%	65%	19%	56%	75%	0%	0%	0%
	Fall	65%	100%	99%	71%	98%	99%	76%	100%	94%	69%	96%	98%	20%	56%	76%	14%	50%	70%	25%	60%	82%	0%	0%	0%
<b>RUN</b>	Winter	58%	94%	100%	60%	96%	96%	62%	98%	94%	53%	95%	95%	26%	45%	81%	22%	39%	77%	28%	46%	83%	0%	0%	0%
	Spring	49%	95%	98%	53%	95%	98%	55%	98%	98%	49%	93%	98%	24%	44%	78%	21%	37%	60%	27%	45%	78%	0%	0%	0%
	Summer	38%	96%	91%	46%	93%	100%	49%	98%	100%	43%	88%	100%	20%	41%	53%	15%	32%	48%	23%	41%	61%	0%	0%	0%
	Fall	46%	94%	94%	51%	95%	99%	53%	98%	99%	47%	94%	100%	23%	44%	65%	19%	38%	53%	26%	45%	73%	0%	0%	0%
<b>POOL</b>	Winter	46%	22%	0%	93%	86%	66%	98%	96%	81%	93%	87%	76%	71%	81%	91%	68%	79%	88%	84%	91%	97%	94%	92%	76%
	Spring	47%	25%	0%	94%	87%	72%	98%	97%	86%	95%	87%	77%	70%	80%	88%	67%	78%	86%	83%	91%	96%	94%	92%	76%
	Summer	59%	36%	5%	96%	89%	81%	95%	100%	90%	94%	87%	82%	65%	78%	84%	61%	77%	83%	80%	91%	93%	98%	92%	85%
	Fall	50%	23%	0%	94%	87%	79%	97%	97%	90%	95%	87%	81%	68%	81%	86%	65%	79%	85%	82%	91%	93%	95%	92%	80%

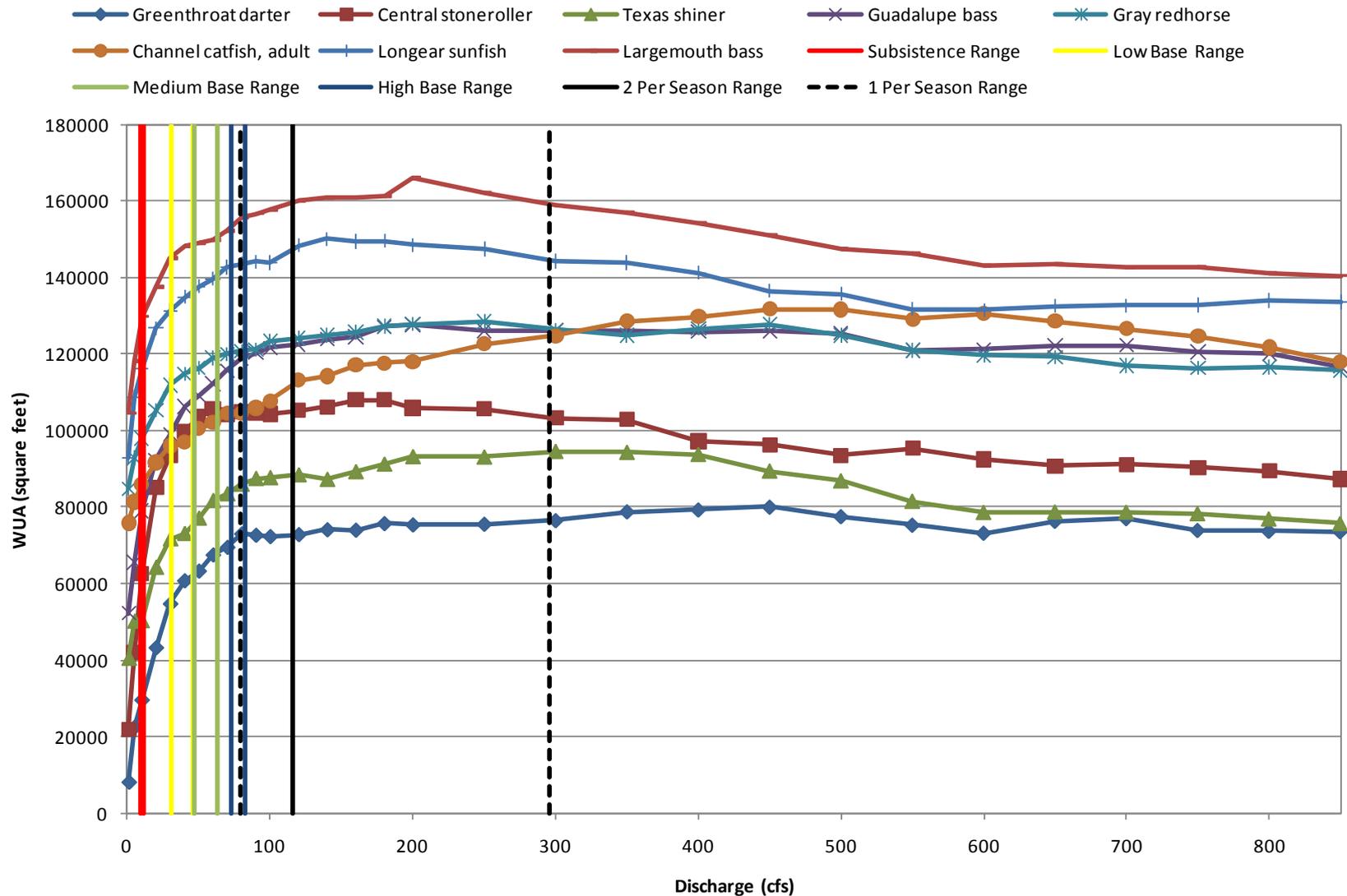
# Three Rivers – % of Max – 0.5, 200% Base, 90/75/50

- **90/75/50** “enoughness” thresholds
- % of max habitat w/ 200% highest base flow (324 CFS) as upper end
- **0.5** quality threshold
- 3 Base flow levels
- Full POR, 13 modeled species, by total and each mesohabitat type

		Freshwater drum			River carpsucker			Longear sunfish			Spotted gar			Largemouth bass		
		Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet	Dry	Avg	Wet
<b>TOTAL</b>	Winter	47%	70%	98%	75%	98%	84%	69%	96%	94%	46%	70%	95%	61%	91%	97%
	Spring	44%	69%	100%	70%	98%	89%	65%	96%	98%	43%	68%	92%	58%	90%	100%
	Summer	40%	65%	84%	62%	100%	93%	58%	94%	100%	36%	62%	88%	51%	87%	97%
	Fall	43%	69%	95%	68%	98%	92%	63%	96%	100%	41%	69%	90%	56%	90%	99%
<b>RIFFLE</b>	Winter	3%	49%	81%	61%	95%	86%	45%	92%	94%	14%	69%	80%	34%	92%	85%
	Spring	0%	43%	96%	55%	94%	90%	38%	91%	95%	9%	64%	94%	27%	91%	91%
	Summer	0%	22%	78%	36%	93%	98%	20%	88%	99%	2%	49%	97%	14%	87%	100%
	Fall	0%	46%	93%	50%	94%	94%	33%	92%	98%	7%	66%	100%	24%	91%	99%
<b>RUN</b>	Winter	41%	76%	97%	83%	98%	79%	75%	97%	91%	48%	72%	99%	67%	93%	88%
	Spring	35%	75%	99%	80%	98%	88%	73%	96%	97%	46%	70%	95%	63%	92%	97%
	Summer	25%	73%	90%	72%	100%	95%	65%	95%	100%	33%	65%	88%	55%	89%	99%
	Fall	32%	76%	97%	78%	98%	93%	71%	97%	99%	42%	71%	93%	61%	93%	100%
<b>RUN</b>	Winter	35%	56%	99%	62%	97%	84%	58%	95%	98%	31%	57%	89%	46%	84%	99%
	Spring	33%	55%	99%	55%	98%	87%	52%	94%	99%	28%	55%	85%	43%	83%	99%
	Summer	30%	51%	75%	47%	100%	90%	45%	91%	100%	24%	47%	81%	37%	80%	92%
	Fall	32%	55%	91%	53%	97%	88%	50%	94%	100%	27%	56%	83%	42%	84%	96%
<b>POOL</b>	Winter	89%	94%	96%	99%	96%	84%	96%	100%	89%	68%	81%	92%	85%	94%	99%
	Spring	89%	94%	100%	99%	96%	87%	96%	100%	97%	66%	80%	89%	85%	93%	98%
	Summer	87%	95%	95%	97%	96%	91%	93%	99%	99%	64%	77%	85%	80%	93%	96%
	Fall	88%	94%	96%	98%	96%	91%	95%	100%	99%	66%	80%	87%	83%	93%	97%

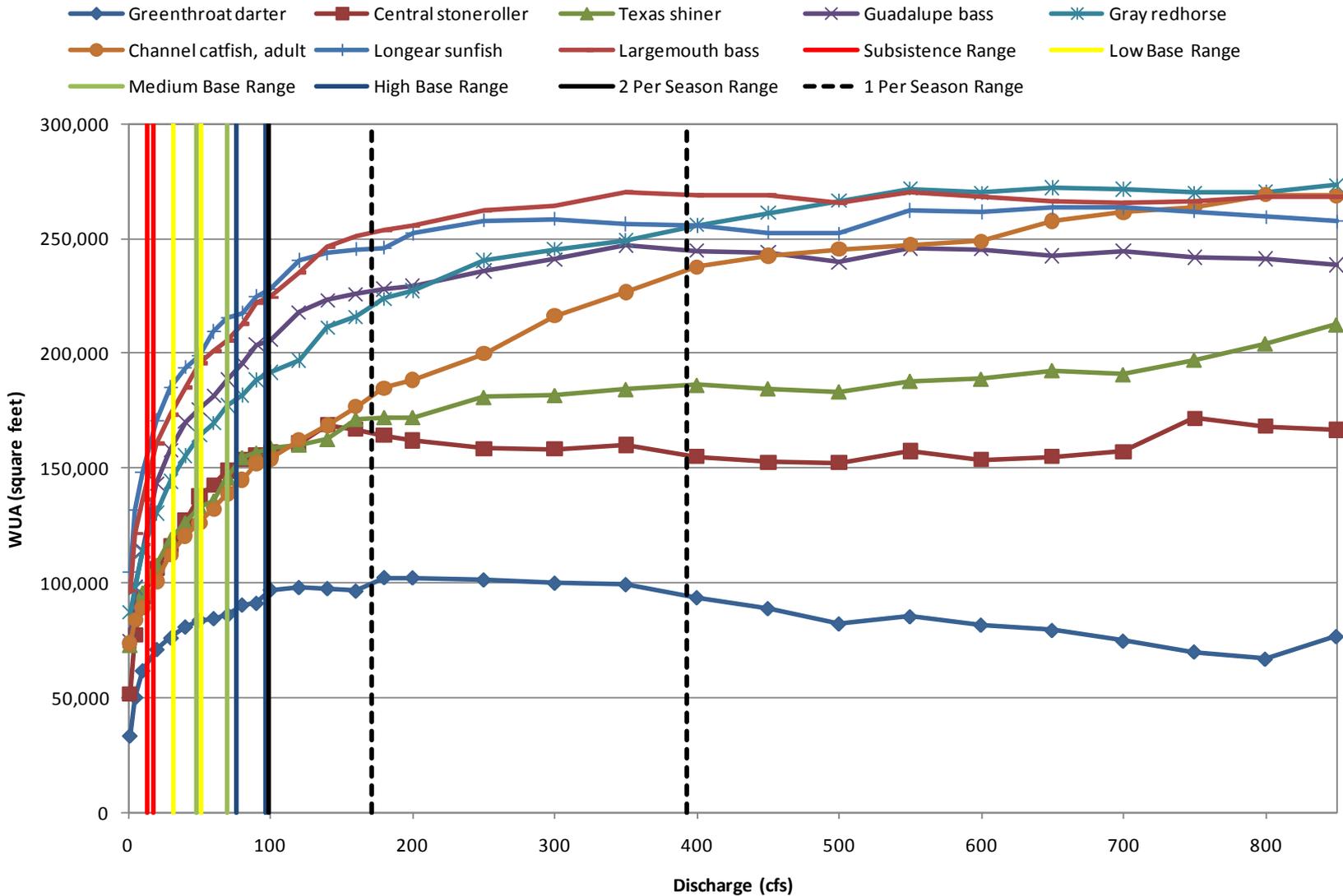
# Concan – WUA, All, 0.5 Threshold

Concan - Full P.O.R. - All Cross-Sections - Quality WUA  $\geq 0.50$



# Laguna – WUA, All, 0.5 Threshold

Laguna - Full P.O.R. - All Cross-Sections - Quality WUA  $\geq 0.50$



# Three – WUA, All, 0.5 Threshold

Three Rivers - Full P.O.R. - All Cross-Sections - Quality WUA  $\geq 0.50$

- ◆ Channel catfish, juvenile
- ◆ Smallmouth buffalo
- ◆ Freshwater drum
- ◆ Largemouth bass
- ◆ High Base Range
- Red shiner
- Blue catfish
- ◆ River carpsucker
- Subsistence Range
- ◆ 4 Per Season Range
- ▲ Weed shiner
- ◆ Channel catfish, adult
- Longear sunfish
- ◆ 3 Per Season Range
- ◆ Bullhead minnow
- ◆ Flathead catfish, juvenile
- ▲ Spotted gar
- ◆ Medium Base Range
- ◆ 2 Per Season Range

