

Nueces BBEST  
Biological Overlay  
Use of Instream Habitat Modeling

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BBEST Meeting

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# Use As a Biological Overlay

- **BIG PICTURE QUESTION:**
  - Are the base flow recommendations adequate to maintain instream habitats for fishes
- **FINER PICTURE QUESTIONS:**
  - Parameterization
  - Period of Record
  - Transfer to other gages?
  - Others?

# Analysis Questions

- **BIG PICTURE QUESTION:**
  - How/if to modify the analysis to give us the best answer to our overall goal?
- **FINER PICTURE QUESTIONS:**
  - Use “quality” threshold? What threshold? 0.8?
  - Total habitat or mesohabitat-specific totals?
  - If mesohabitats, all species on all types or just on subset (e.g., largemouth bass only in pools)?
  - Use total WUA or % of Max or something else (e.g., % of total habitat)?
  - Others?

# How Much is Enough?

- Flow regime supports adequate instream habitat if:
  - The range of medium (average) base flow numbers results in at least 90% of maximum WUA
  - Alternate: any of the 3 base flow ranges overlap  $\geq 90\%$
  - Details
    - How many of the 4 seasonal base flow numbers must give  $\geq 90\%$ ? Just one? Key season(s) based on life history?
    - What is best percent of maximum to call adequate – 90%?
    - Use specific mesohabitat and/or overall total WUA curves?

# If/How to Modify Flow Regime

- If the analysis indicates not enough habitat, what is the cause and does it suggest modifying HEFR, etc?
- If so.....considering uncertainty.....how to modify?
- One option would be to change the base flow numbers as follows:
  - Adjust at least one of the medium (average) base flow numbers to give at least 90% of maximum
  - Adjust HEFR (or IHA?) parameterization (e.g, lower or upper base flow thresholds)
  - Issues:
    - If adjust one species to have higher habitat, make sure that it does not reduce habitat too much (e.g., below 90% of max WUA) for other species

# Uncertainty

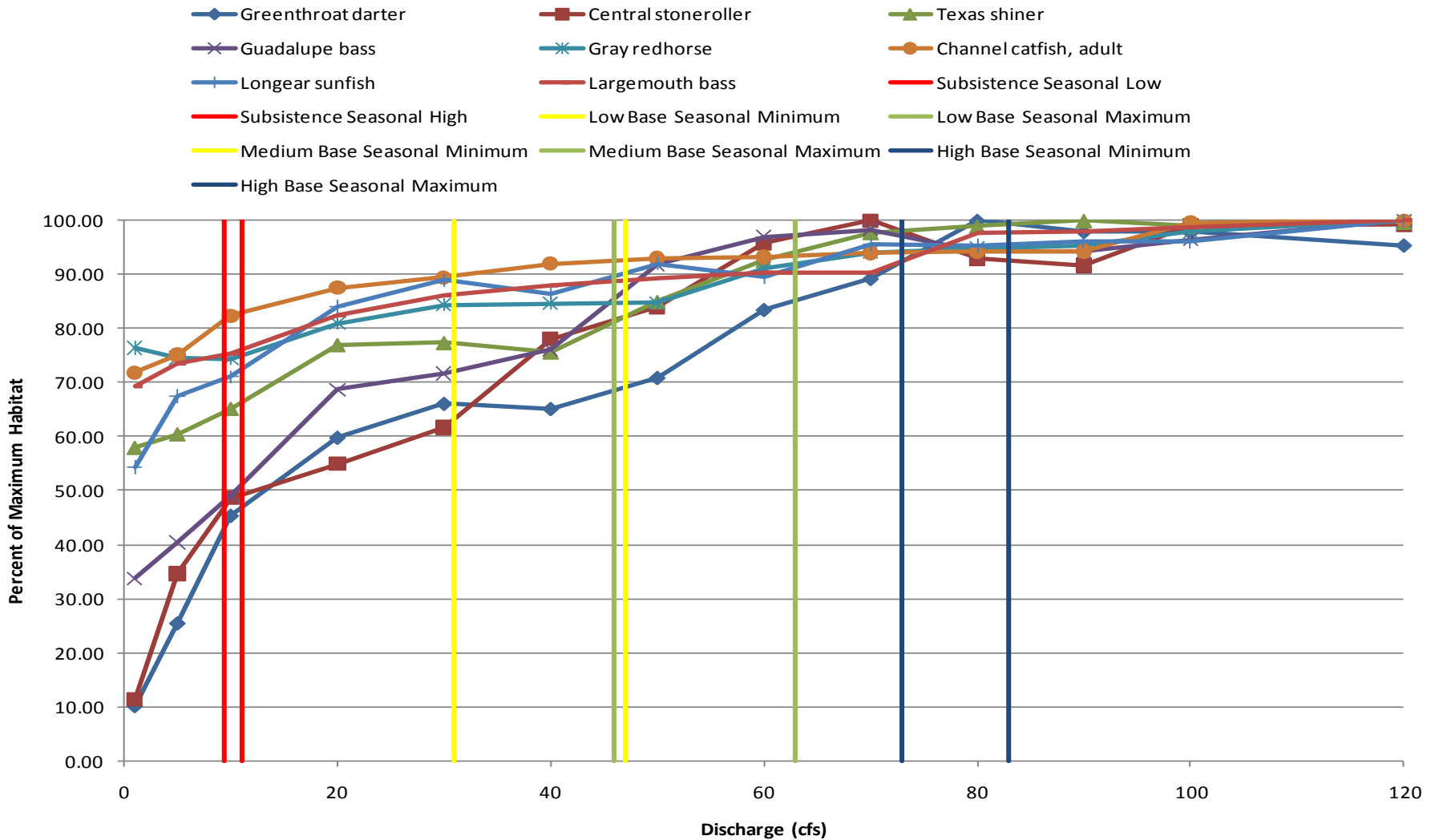
- Habitat suitability criteria
  - Our criteria (depth, velocity and substrate) are based on data from other basins
  - We have little data for some species, most are not life-history specific
- Hydraulics – we only have field data on depth and velocity from a very low flow. So, the model has more uncertainty as the flows go higher
  - Made decision to focus analysis on base flow range only
- Rating curve – this all relies on a stage-discharge rating w/ its own uncertainty (see report)
- Others

# Concan – Background

- Frio River at Concan
- Dominantly bedrock channel with good habitat diversity
- Cross-sections
  - 4 riffles
  - 3 runs
  - 2 pools
- Measurements at X CFS (Subsistence)
- Report highlights:

# Concan – Total Habitat, 0.8, Full POR

## Concan - Total - % Max - Quality WUA - CBs >= 0.80

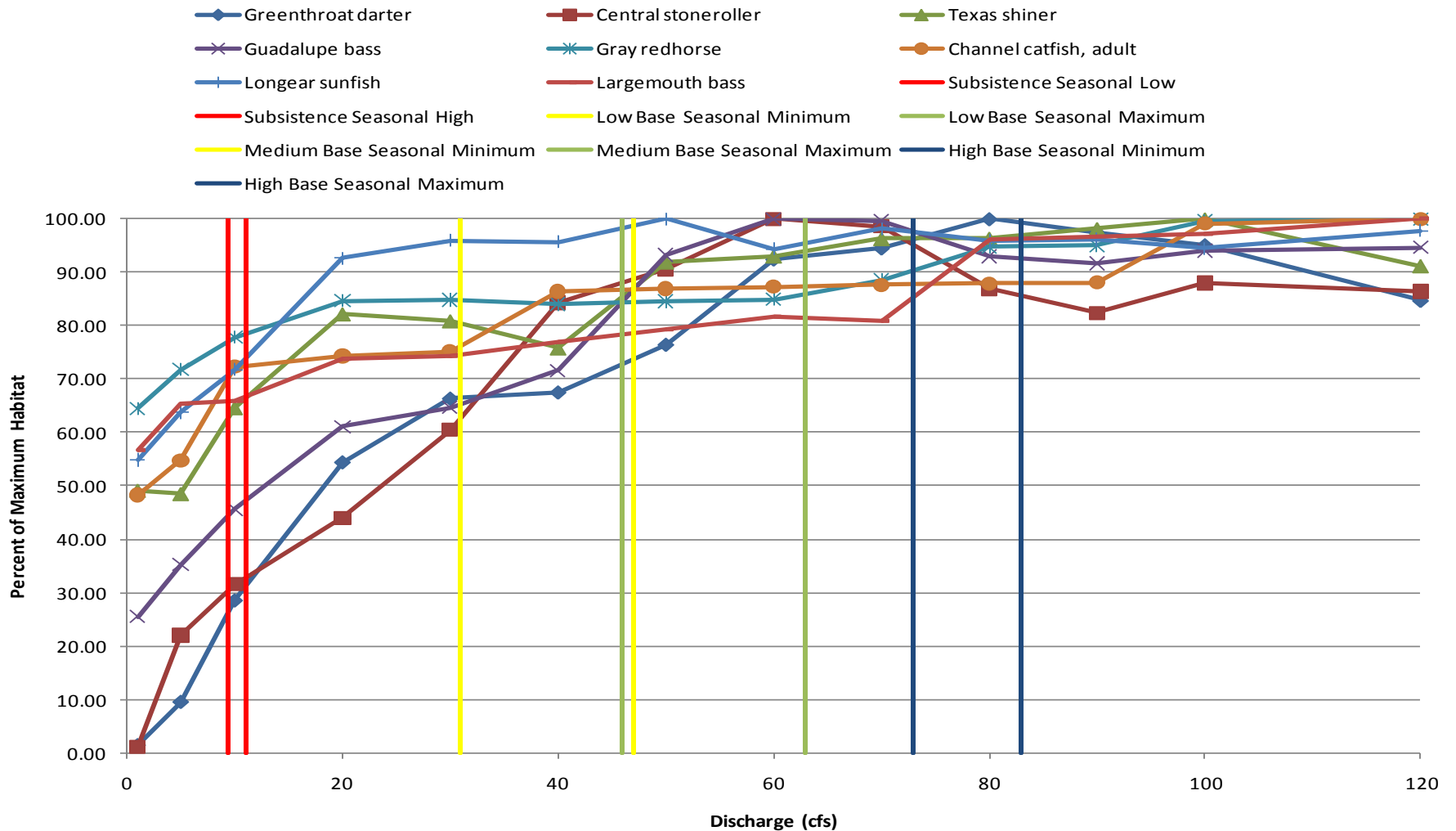






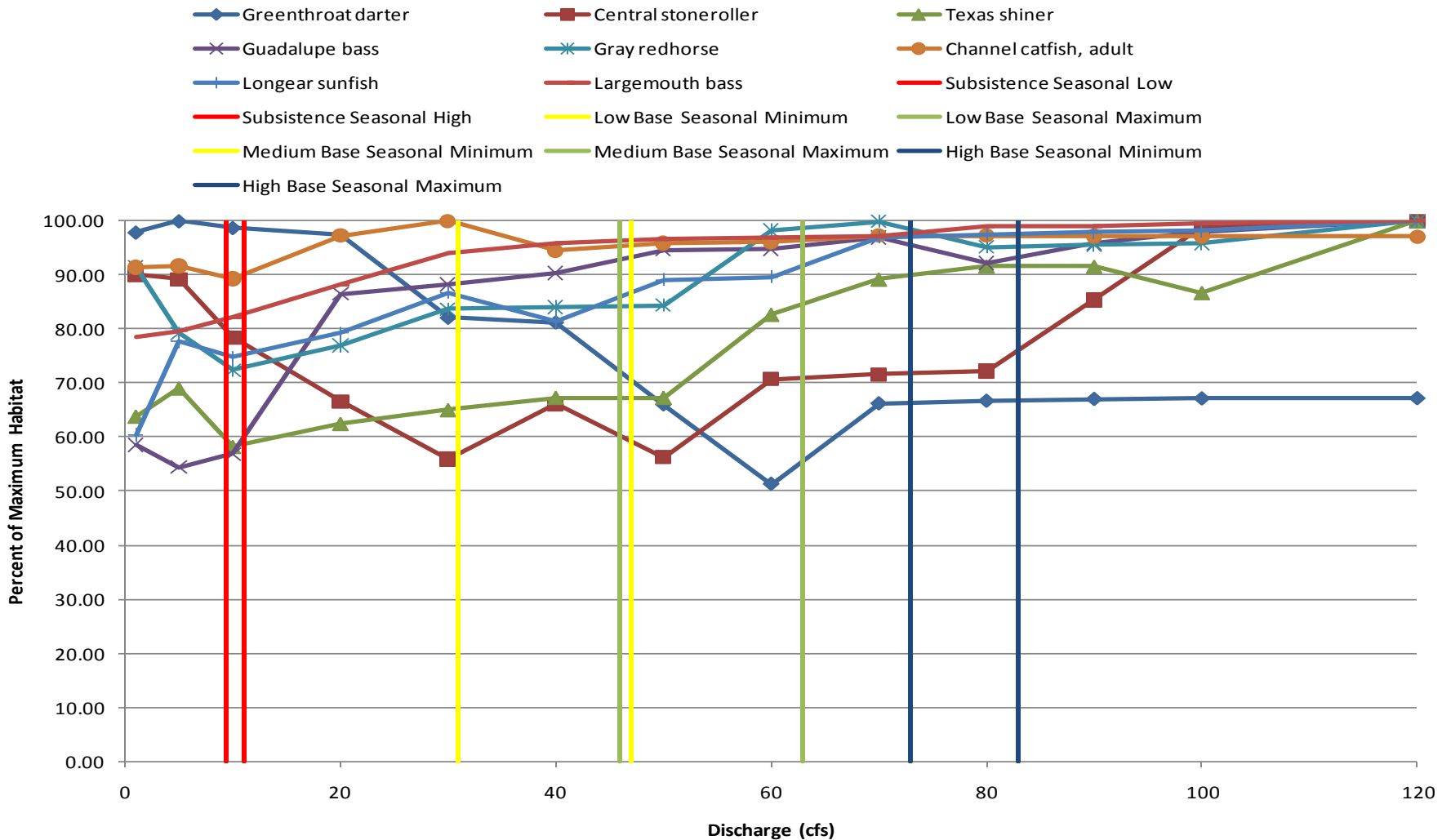
# Concan – Run, 0.8, Full POR

## Concan - Run - % Max - Quality WUA - CBs >= 0.80



# Concan – Pool, 0.8, Full POR

## Concan - Pool - % Max - Quality WUA - CBs >= 0.80



# Concan – Summary

- Table: FULL POR, Base-Medium, % of max habitat, for each species, by total and each mesohab type

		Greenthroat darter	Central stoneroller	Texas shiner	Guadalupe bass	Gray redhorse	Channel cat, adult	Longear sunfish	Largemouth bass
<b>TOTAL</b>	Winter	85%	97%	94%	99%	94%	94%	95%	92%
	Spring	82%	95%	92%	98%	92%	94%	93%	92%
	Summer	69%	82%	82%	89%	86%	93%	94%	90%
	Fall	77%	90%	89%	96%	90%	93%	94%	91%
<b>RIFFLE</b>	Winter	54%	66%	39%	49%	40%	0%	28%	54%
	Spring	49%	56%	17%	42%	19%	0%	21%	51%
	Summer	37%	42%	17%	33%	19%	0%	15%	50%
	Fall	44%	51%	17%	40%	19%	0%	19%	51%
<b>RUN</b>	Winter	93%	100%	94%	100%	86%	88%	96%	84%
	Spring	91%	99%	93%	99%	85%	88%	95%	84%
	Summer	74%	89%	87%	87%	85%	87%	99%	81%
	Fall	84%	95%	92%	97%	85%	88%	97%	83%
<b>POOL</b>	Winter	56%	72%	92%	97%	99%	96%	94%	97%
	Spring	53%	70%	89%	97%	97%	96%	91%	97%
	Summer	71%	60%	73%	95%	84%	95%	88%	97%
	Fall	59%	64%	82%	97%	91%	96%	91%	97%

# Concan – Concerns

- Concern
  - NONE
- Maybe
  - Greenthroat darter: >90% of max only in Total habitat in Base-High range, Base-Medium is at 85% of max; riffle cross sections are only 79% of max in Base-High range
  - Gray redhorse: marginal habitat in Runs, but good in Total
  - Channel catfish (adults): poor habitat in Runs, but good in Total

# Concan – Solutions

- Potential: Adjust Period of Record to LATE?

		Greenthroat darter	Central stoneroller	Texas shiner	Guadalupe bass	Gray redhorse	Channel cat, adult	Longear sunfish	Largemouth bass
<b>FULL</b>	Winter	85%	97%	94%	99%	94%	94%	95%	92%
	Spring	82%	95%	92%	98%	92%	94%	93%	92%
	Summer	69%	82%	82%	89%	86%	93%	94%	90%
	Fall	77%	90%	89%	96%	90%	93%	94%	91%
<b>LATE</b>	Winter	90%	99%	98%	100%	96%	94%	99%	92%
	Spring	86%	98%	95%	99%	95%	94%	96%	92%
	Summer	84%	96%	93%	99%	93%	94%	94%	92%
	Fall	88%	99%	96%	100%	95%	94%	98%	92%
<b>EARLY</b>	Winter	73%	86%	87%	95%	88%	93%	95%	91%
	Spring	77%	90%	89%	96%	90%	93%	94%	91%
	Summer	66%	71%	76%	76%	86%	91%	91%	88%
	Fall	66%	79%	77%	79%	86%	92%	91%	89%

# Laguna – Background

- Nueces River at Laguna
- Wide, dominantly gravel channel
- Cross-sections
  - 3 riffles
  - 4 runs
  - 2 pools
- Measurements at X CFS (Subsistence)
- Report highlights:











# Laguna – Summary

- Table: FULL POR, Base-Medium, % of max habitat, for each species, by total and each mesohab type

		Greenthroat darter	Central stoneroller	Texas shiner	Guadalupe bass	Gray redhorse	Channel cat, adult	Longear sunfish	Largemouth bass
<b>TOTAL</b>	Winter	98%	98%	88%	95%	89%	94%	98%	89%
	Spring	99%	99%	87%	93%	88%	94%	95%	88%
	Summer	97%	95%	78%	88%	80%	93%	88%	82%
	Fall	99%	99%	87%	92%	87%	94%	94%	88%
<b>RIFFLE</b>	Winter	99%	99%	69%	90%	70%	0%	94%	76%
	Spring	100%	100%	66%	87%	65%	0%	90%	74%
	Summer	97%	95%	51%	77%	50%	0%	79%	60%
	Fall	100%	100%	65%	86%	65%	0%	89%	74%
<b>RUN</b>	Winter	48%	68%	99%	78%	99%	98%	90%	97%
	Spring	53%	71%	100%	79%	99%	97%	89%	97%
	Summer	58%	67%	99%	86%	97%	96%	89%	94%
	Fall	54%	71%	100%	79%	99%	97%	89%	97%
<b>POOL</b>	Winter	0%	0%	98%	80%	53%	95%	68%	98%
	Spring	0%	0%	95%	79%	53%	96%	70%	98%
	Summer	0%	0%	63%	81%	55%	98%	68%	97%
	Fall	0%	0%	95%	79%	53%	96%	71%	98%

# Laguna – Concerns

- Concerns
  - NONE
- Maybe
  - Texas shiner: Run cross-sections are good, but Total habitat is >90% of max only in the Base-High range, Base-Medium is at 78-88% of max
  - Gray redhorse: Run cross-sections are good, but Total habitat is >90% of max only in the Base-High range, Base-Medium is at 80-89% of max
  - Largemouth bass: Pool cross-sections are good, but Total habitat is >90% of max only in the Base-High range, Base-Medium is at 82-89% of max

# Laguna – Solutions

- Potential: Adjust Period of Record to LATE?

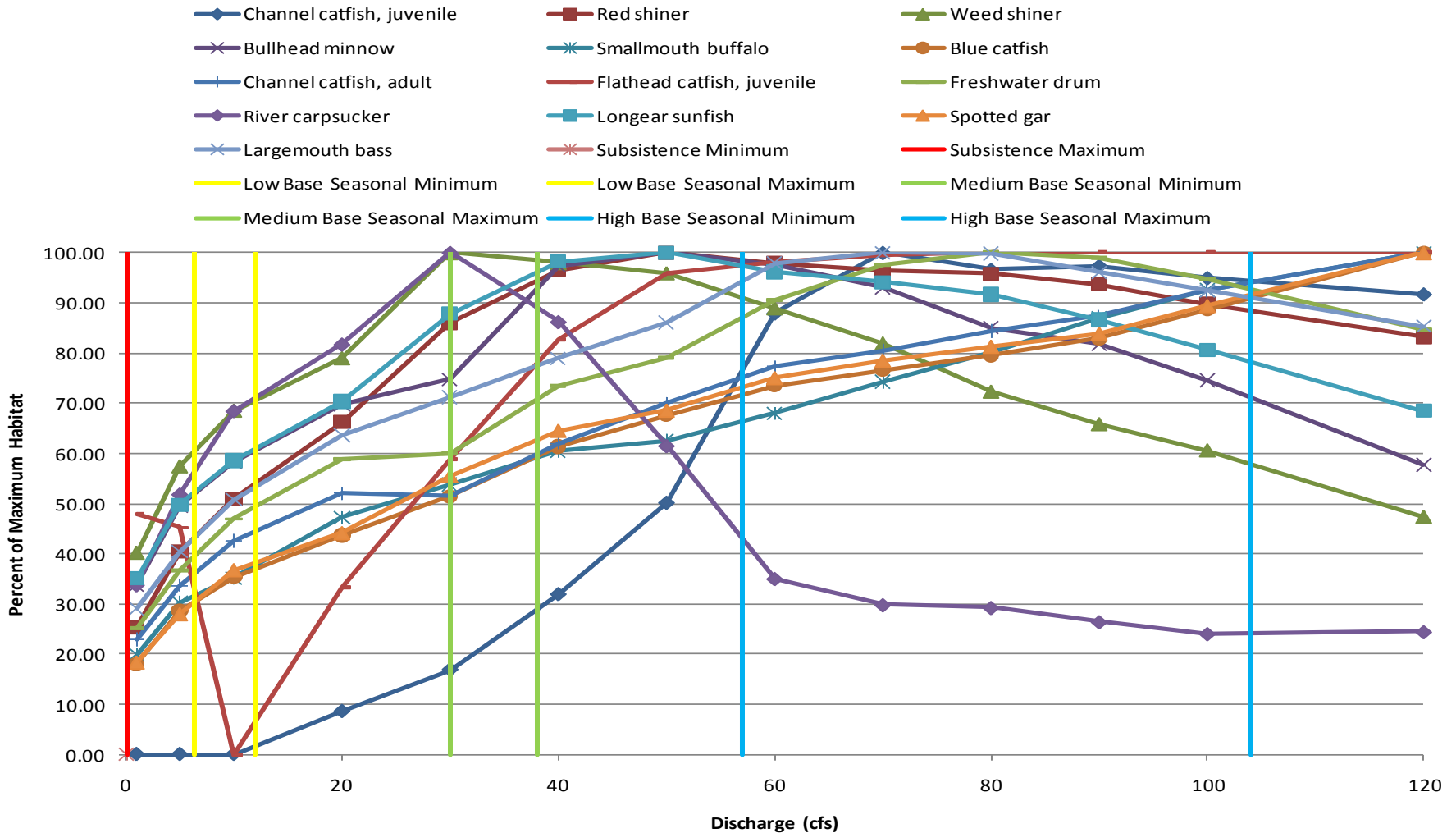
		Greenthroat darter	Central stoneroller	Texas shiner	Guadalupe bass	Gray redhorse	Channel cat, adult	Longear sunfish	Largemouth bass
<b>FULL</b>	Winter	98%	98%	88%	95%	89%	94%	98%	89%
	Spring	99%	99%	87%	93%	88%	94%	95%	88%
	Summer	97%	95%	78%	88%	80%	93%	88%	82%
	Fall	99%	99%	87%	92%	87%	94%	94%	88%
<b>LATE</b>	Winter	94%	99%	92%	98%	92%	95%	98%	93%
	Spring	98%	98%	88%	95%	89%	94%	98%	89%
	Summer	99%	99%	87%	93%	88%	94%	95%	88%
	Fall	95%	99%	91%	97%	91%	95%	98%	92%
<b>EARLY</b>	Winter	100%	100%	87%	92%	87%	93%	94%	88%
	Spring	100%	99%	86%	91%	86%	93%	93%	87%
	Summer	90%	94%	71%	83%	77%	93%	88%	78%
	Fall	95%	95%	76%	86%	79%	93%	88%	81%

# Three Rivers – Background

- Nueces River at Three Rivers
- Predominantly sandy/muddy run habitats
- Cross-sections
  - 1 riffles
  - 2 runs, 2 shallow runs
  - 2 pools
- Measurements at X CFS (Subsistence)
- Report highlights:

# Three Rivers – Total Habitat, 0.8, Full POR

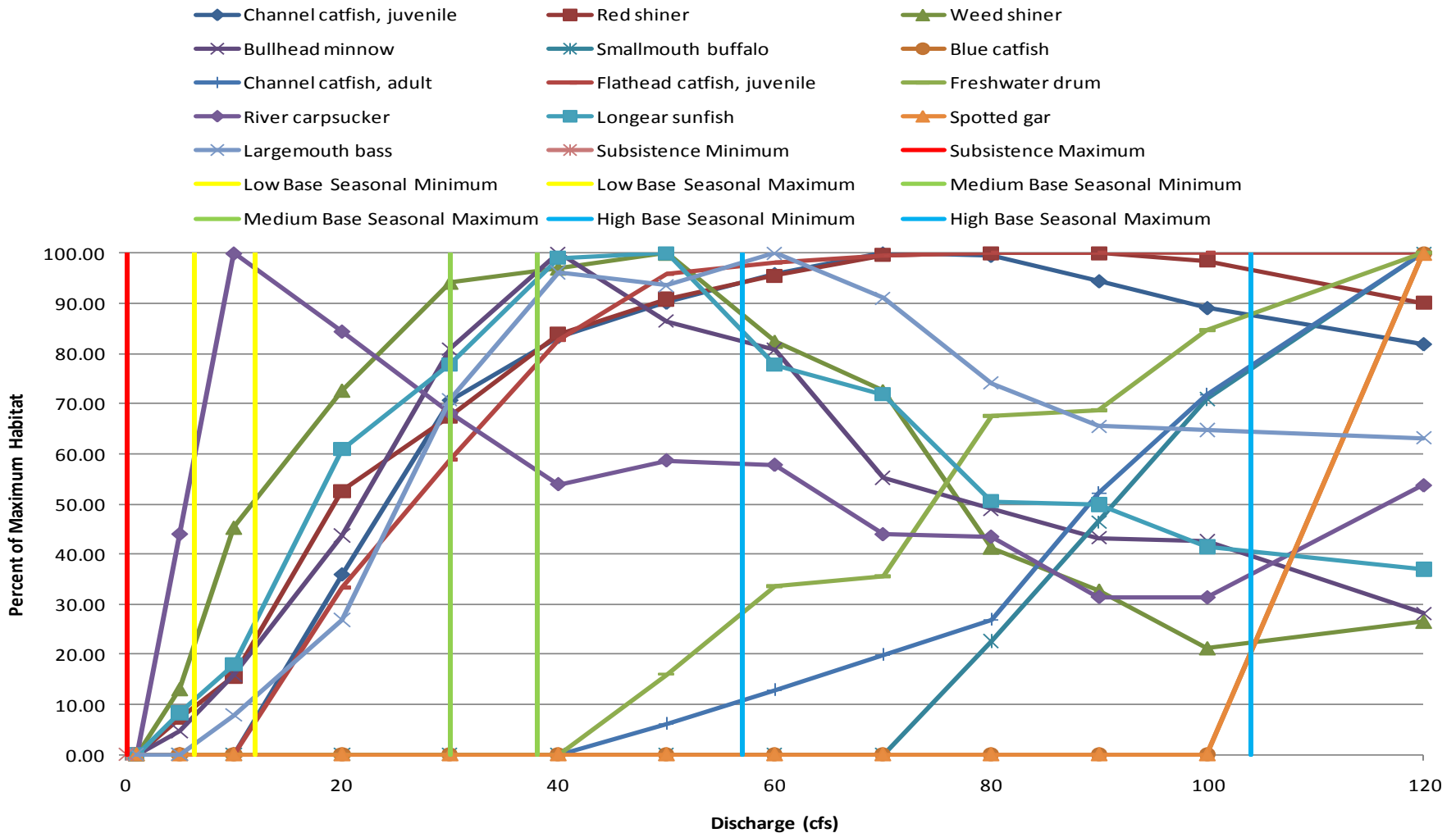
## Three Rivers - Total - % Max - Quality WUA - CBs >= 0.80





# Three Rivers – Riffle, 0.8, Full POR

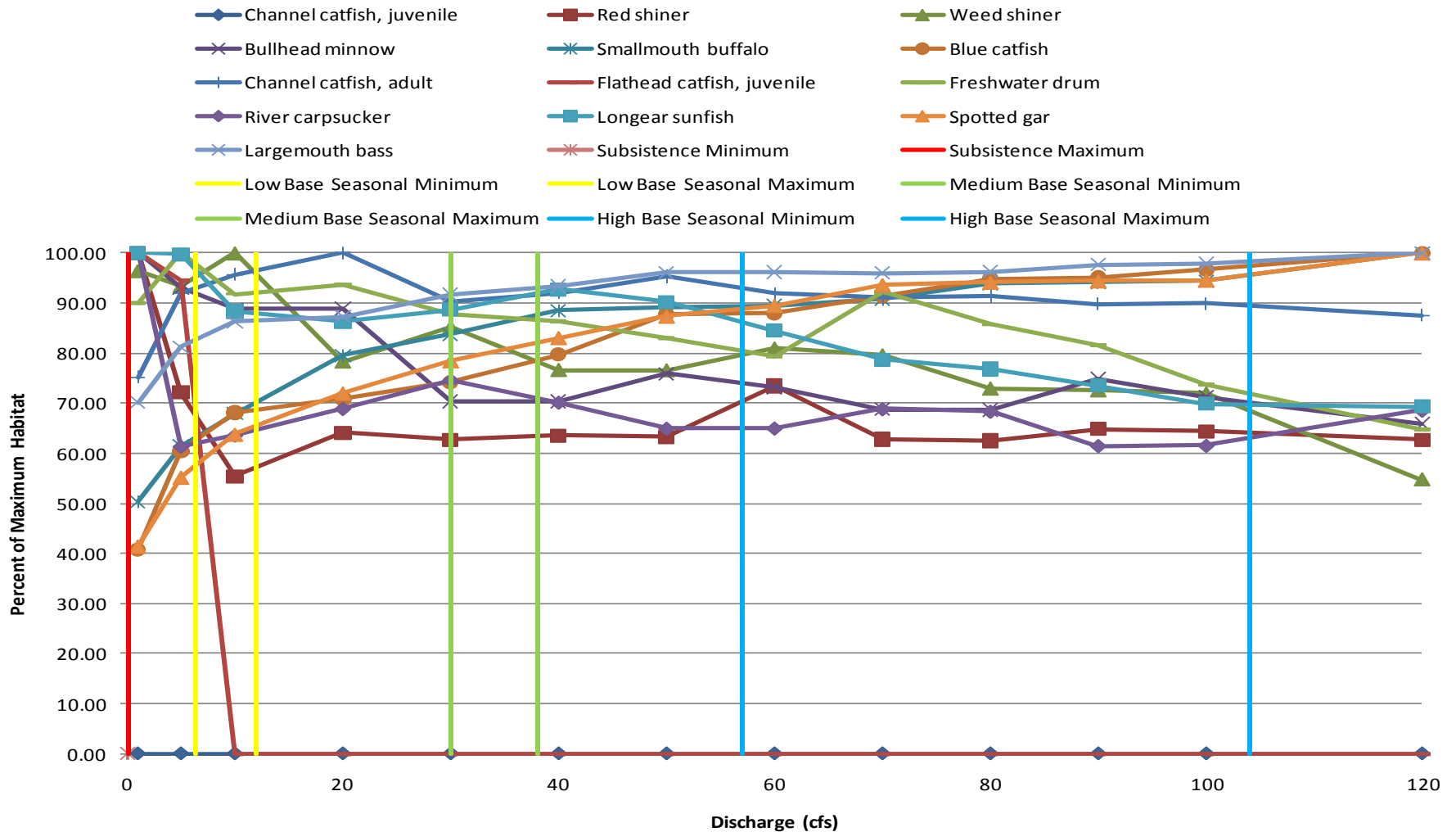
Three Rivers - Riffle - % Max - Quality WUA - CBs >= 0.80





# Three Rivers – Pool, 0.8, Full POR

## Three Rivers - Pool - % Max - Quality WUA - CBs >= 0.80



# Three Rivers – Summary

- Table: FULL POR, Base-Medium, % of max habitat, for each species, by total and each mesohab type

		Channel catfish, juvenile	Red shiner	Weed shiner	Bullhead minnow	Smallmouth buffalo	Blue catfish	Channel catfish, adult	Flathead catfish, juvenile	Freshwater drum	River carpsucker	Longear sunfish	Spotted gar	Largemouth bass
<b>TOTAL</b>	Winter	29%	94%	98%	93%	54%	52%	46%	78%	71%	89%	96%	57%	77%
	Spring	26%	92%	99%	88%	53%	50%	45%	73%	68%	92%	94%	55%	76%
	Summer	17%	86%	100%	75%	49%	45%	40%	59%	60%	100%	88%	50%	71%
	Fall	27%	93%	99%	91%	54%	51%	46%	76%	69%	90%	95%	56%	77%
<b>RIFFLE</b>	Winter	81%	81%	96%	96%	0%	0%	0%	78%	0%	57%	95%	0%	91%
	Spring	78%	77%	96%	92%	0%	0%	0%	73%	0%	60%	91%	0%	86%
	Summer	71%	67%	94%	81%	0%	0%	0%	59%	0%	68%	78%	0%	71%
	Fall	80%	79%	96%	94%	0%	0%	0%	76%	0%	58%	93%	0%	89%
<b>SH RUN</b>	Winter	30%	95%	100%	91%	27%	26%	46%	0%	70%	79%	95%	33%	82%
	Spring	23%	94%	99%	89%	26%	24%	41%	0%	63%	84%	94%	32%	81%
	Summer	0%	89%	98%	84%	23%	20%	27%	0%	41%	100%	92%	29%	77%
	Fall	26%	94%	99%	90%	27%	25%	43%	0%	66%	82%	94%	32%	81%
<b>RUN</b>	Winter	0%	95%	96%	89%	50%	45%	34%	0%	56%	93%	95%	46%	60%
	Spring	0%	93%	97%	82%	48%	42%	33%	0%	55%	95%	92%	43%	58%
	Summer	0%	86%	100%	60%	44%	34%	32%	0%	55%	100%	84%	35%	53%
	Fall	0%	94%	97%	86%	49%	44%	34%	0%	56%	94%	94%	45%	59%
<b>POOL</b>	Winter	0%	63%	78%	70%	87%	77%	92%	0%	87%	71%	92%	82%	93%
	Spring	0%	63%	80%	70%	86%	76%	91%	0%	87%	72%	91%	81%	93%
	Summer	0%	63%	85%	70%	83%	73%	90%	0%	88%	75%	89%	78%	92%
	Fall	0%	63%	79%	70%	86%	77%	92%	0%	87%	71%	92%	81%	93%

# Three Rivers – Concerns

- Concerns

- Channel catfish (juveniles): **Total habitat is >90% of max only in the Base-High range**, Base-Medium is only 29% of max; the Riffle cross-section is better, but Base-Medium is only 71-81%, **Base-High is at 100%**
- Smallmouth buffalo: **Total habitat is >90% of max only in the Base-High range**, Base-Medium is only 49-54% of max; Run cross-sections are similar, Base-Medium at 44-50%; Pool cross-sections are somewhat better with Base-Medium at 83-87%
- Blue catfish: **Total habitat is >90% of max only in the Base-High range**, Base-Medium is only 45-52% of max; Run cross-sections are similar, with Base-Medium at 34-45%; Pool cross-sections are somewhat better with Base-Medium at 73-77%
- Flathead catfish (juveniles): **Total habitat is >90% of max only in the Base-High range**, Base-Medium is only 59-78% of max; Run cross-sections are at 0%, more habitat in riffles
- Freshwater drum: **Total habitat is >90% of max only in the Base-High range**, Base-Medium is only 60-71% of max; Run cross-sections are similar, with Base-Medium at 55-56%; Pool cross-sections are better with Base-Medium at 87-88%
- Spotted gar: **Total habitat is >90% of max only in the Base-High range**, Base-Medium is only 50-57% of max; Pool cross-sections are better, with Base-Medium still only at 78-82%

- Maybe

- Channel catfish (adults): Total habitat is >90% of max only in the Base-High range, Base-Medium is only 40-46% of max; Run cross-sections are also poor; Pool cross-sections are good with Base-Medium at 90-92%
- Largemouth bass: **Total habitat is >90% of max only in the Base-High range**, Base-Medium is only 71-77% of max; but Pool cross-sections are good

# Three Rivers – Solutions

- Potential: Adjust Period of Record – How?

# Conclusions

- Concan, Laguna: Results with Quality Threshold of 0.8 indicate that the Full Period of Record HEFR base flow numbers maintain instream habitats for focal species
  - Minor potential habitat issues for few species at each site
  - Late POR would improve, but is it necessary?
- Three Rivers: More concerns

# OLD Concan – Summary

- Table: % of max habitat, for each species, by total and each mesohab type, each of 3 base flow ranges (highest of 4 seasons), FULL POR

Species	Total			Riffle			Run			Pool		
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
greenthroat darter	69	85	100	31	46	79						
central stoneroller	82	97	98	39	60	80	88	100	96			
Texas shiner	82	94	99				88	93	97			
Guadalupe bass	88	97	95				87	100	98			
gray redbhorse	85	91	95				85	86	95			
channel catfish	92	93	94				87	87	88	99	97	97
longear sunfish	90	91	95							87	92	98
largemouth bass	89	90	98							98	99	99



# OLD Concan – Concerns

- Concern
  - Greenthroat darter: >90% of max only in Total habitat in Base-High range, Base-Medium is at 85% of max; riffle cross sections are only 79% of max in Base-High range
- Maybe
  - Gray redhorse: marginal habitat in Runs, but good in Total
  - Channel catfish (adults): poor habitat in Runs, but good in Total

# OLD Laguna – Summary

- Table: % of max habitat, for each species, by total and each mesohab type, each of 3 base flow ranges (highest of 4 seasons), FULL POR

Species	Total			Riffle			Run			Pool		
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
greenthroat darter	98	100	96	98	100	97						
central stoneroller	95	100	100	96	100	98	72	71	89			
Texas shiner	75	85	96				99	100	99			
Guadalupe bass	83	90	96				90	84	79			
gray redbhorse	78	86	97				88	99	100			
channel catfish	82	84	89				92	96	98	100	98	92
longear sunfish	80	89	90							77	71	68
largemouth bass	80	88	98							98	98	100

# OLD Laguna – Concerns

- Concerns
  - Longear sunfish: Total habitat is >90% of max only in the Base-High range (and only barely), Base-Medium is at 89% of max; Pool cross-sections are poor, with none of the Base ranges even over 75%
- Maybe
  - Texas shiner: Run cross-sections are good, but Total habitat is >90% of max only in the Base-High range, Base-Medium is at 85% of max
  - Gray redhorse: Run cross-sections are good, but Total habitat is >90% of max only in the Base-High range, Base-Medium is at 86% of max
  - Channel catfish (adults): Run and Pool cross-sections are good, but Total habitat is not >90% of max in any Base range, Base-Medium is at 84% of max
  - Largemouth bass: Pool cross-sections are good, but Total habitat is >90% of max only in the Base-High range, Base-Medium is at 88% of max

# OLD Three Rivers – Summary

- Table: % of max habitat, for each species, by total and each mesohab type, each of 3 base flow ranges (highest of 4 seasons), FULL POR

Species	Total			Riffle			Run			Pool		
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
channel catfish (juv.)	2	29	100	8	81	100						
red shiner	53	95	98				49	96	97			
weed shiner	70	100	90				59	100	95			
bullhead minnow	60	93	98				48	90	97			
smallmouth buffalo	37	60	94				23	58	94	70	88	96
blue catfish	37	60	91				19	59	92			
channel catfish	44	60	94				36	51	91			
flathead catfish (juv.)	35	78	100				0	0	0			
freshwater drum	50	71	100				42	56	100			
river carpsucker	70	100	42							65	74	69
longear sunfish	60	96	97							98	91	87
spotted gar	37	62	91							66	82	96
largemouth bass	53	78	100							87	92	98

# OLD Three Rivers – Concerns

- Concerns
  - Channel catfish (juveniles): Total habitat is >90% of max only in the Base-High range, Base-Medium is only 29% of max; the Riffle cross-section is better, but Base-Medium is only 81%, Base-High is at 100%
  - Smallmouth buffalo: Total habitat is >90% of max only in the Base-High range, Base-Medium is only 60% of max; Run cross-sections are similar, Base-Medium at 58%; Pool cross-sections are somewhat better with Base-Medium at 88%
  - Blue catfish: Total habitat is >90% of max only in the Base-High range, Base-Medium is only 60% of max; Run cross-sections are similar, with Base-Medium at 59%
  - Channel catfish (adults): Total habitat is >90% of max only in the Base-High range, Base-Medium is only 60% of max; Run cross-sections are similar, with Base-Medium at 51%
  - Flathead catfish (juveniles): Total habitat is >90% of max only in the Base-High range, Base-Medium is only 78% of max; Run cross-sections are at 0%, but is likely a data error
  - Freshwater drum: Total habitat is >90% of max only in the Base-High range, Base-Medium is only 71% of max; Run cross-sections are similar, with Base-Medium at 56%
  - Spotted gar: Total habitat is >90% of max only in the Base-High range, Base-Medium is only 62% of max; Pool cross-sections are better, with Base-Medium still only at 82%
- Maybe
  - River carpsucker: Total habitat is good, but Pool cross-sections only reach 74% of maximum in the Base-Medium range
  - Largemouth bass: Total habitat is >90% of max only in the Base-High range, Base-Medium is only 78% of max; but Pool cross-sections are good