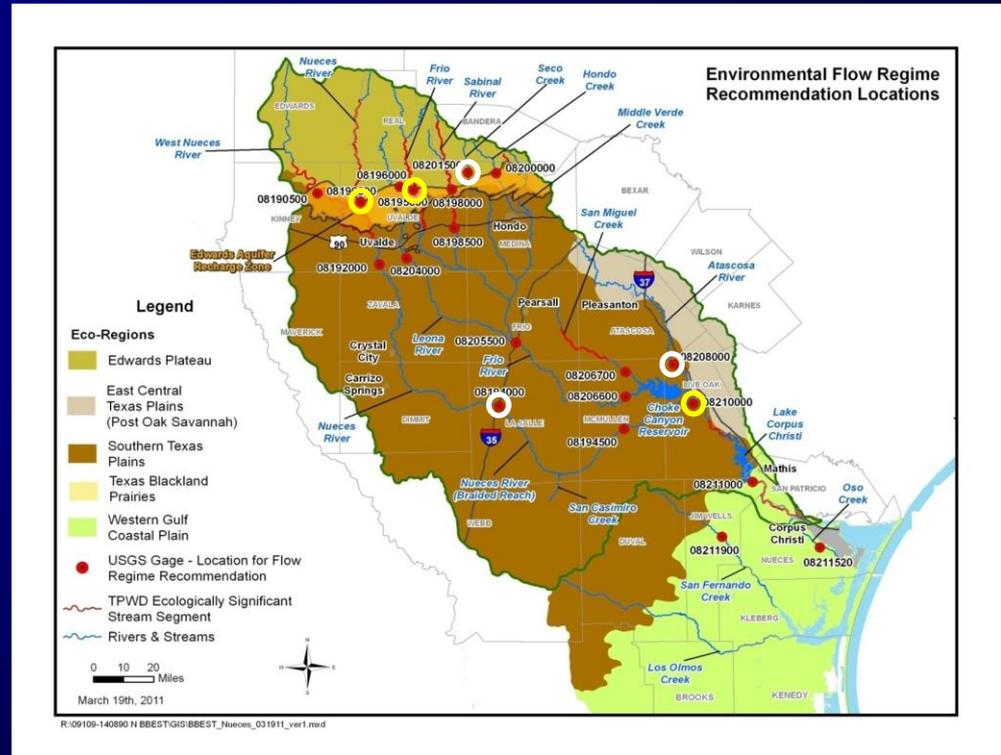


# ***BBASC Scenarios – Instream Habitat***

- ❑ **For BBASC – Evaluate amount of instream habitat maintained by 2 possible BBASC recommendations scenarios**
  - **Modified BBEST A**
  - **Modified BBEST W**
  - **Also, included no E-flow criteria**
  
- ❑ **Do these flow recommendations scenarios maintain adequate instream habitats to maintain SEE?**
  - **Emphasis on base flows, but also subsistence, HFPs**
  
- ❑ **Time series at 2 locations**
  - **Nueces River at Laguna – effects of hypothetical off-channel reservoir**
  - **Nueces River at Three Rivers – effects of upstream Cotulla Reservoir and off-channel reservoir (separate)**
  
- ❑ **Evaluate habitat maintained at all 3 sites under the full 50% diversion in both the Modified BBEST A and W scenarios**

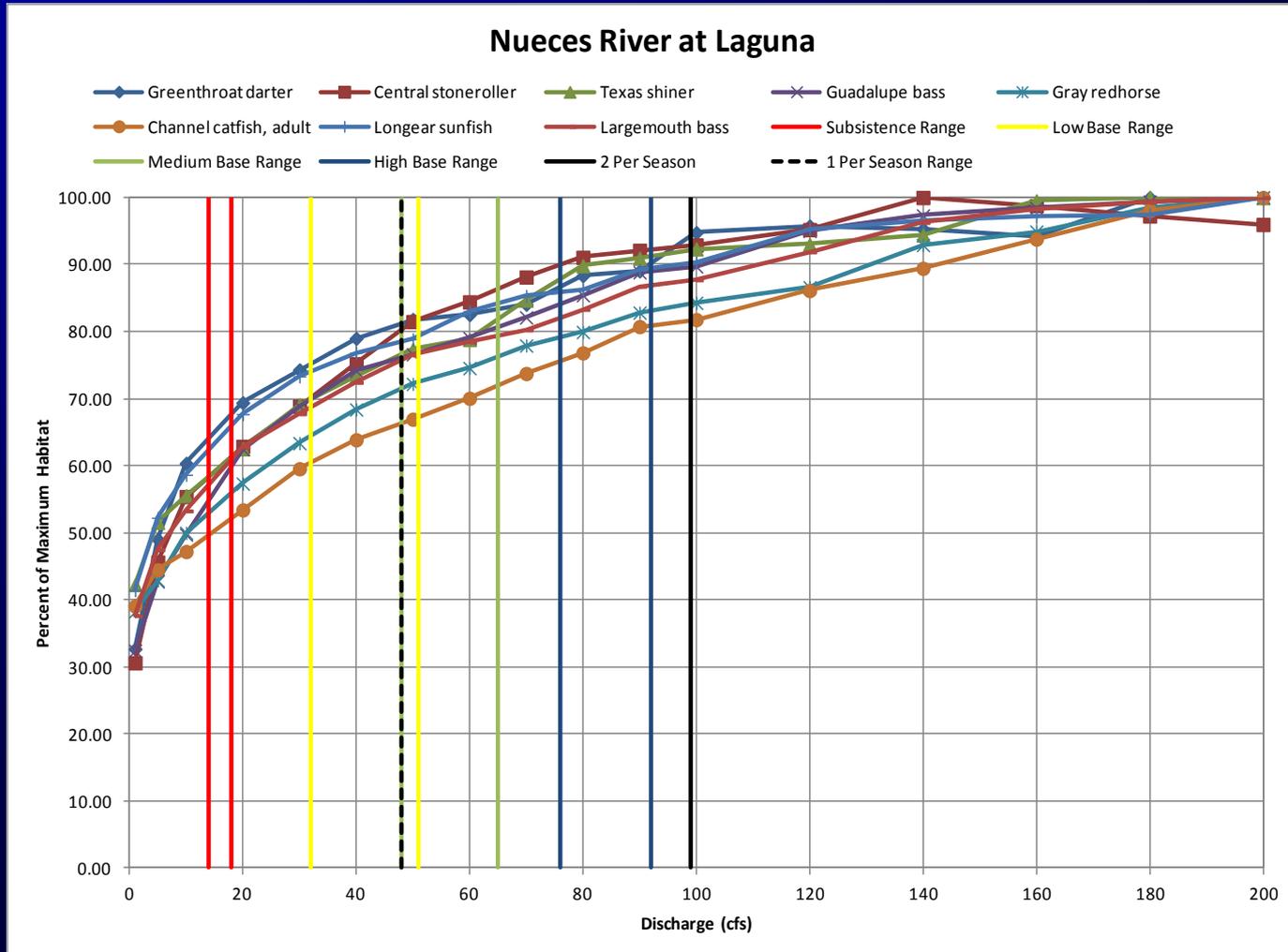
# Background, Methods

- ❑ No existing flow-habitat studies in the Nueces Basin
- ❑ Prioritize site-specific field data
- ❑ Sites – 6 winnowed to 3 (low or no flow at 3)
  - Nueces River @ Laguna
  - Frio River @ Concan
  - Nueces River @ Three Rivers



# Laguna – % Max WUA, 0.5 Threshold

How much is “enough”? – we used 75% for base flows, 20% for subsistence



# Laguna – “enoughness” assessment

❑ Full BBEST recommendation (Table 3.3.3 from BBEST report)

❑ Percent of maximum WUA thresholds

- 75% for base flows
- 20% for subsistence flows

Focal Species	Flow Component	Percent of Maximum Weighted Usable Area			
		Winter	Spring	Summer	Fall
Greenthroat darter	Subsistence	64%	68%	66%	63%
	Base-Low	82%	80%	75%	79%
	Base-Medium	84%	83%	81%	83%
	Base-High	91%	89%	87%	93%
Central stoneroller	Subsistence	58%	61%	60%	58%
	Base-Low	82%	78%	70%	76%
	Base-Medium	88%	86%	80%	85%
	Base-High	92%	92%	90%	93%
Texas shiner	Subsistence	58%	61%	60%	58%
	Base-Low	78%	75%	70%	74%
	Base-Medium	84%	81%	77%	80%
	Base-High	92%	91%	88%	92%
Guadalupe bass	Subsistence	55%	60%	57%	54%
	Base-Low	77%	75%	70%	74%
	Base-Medium	82%	80%	76%	80%
	Base-High	89%	87%	84%	89%
Gray redbhorse	Subsistence	53%	56%	54%	52%
	Base-Low	72%	70%	64%	69%
	Base-Medium	78%	76%	71%	75%
	Base-High	83%	82%	79%	84%
Channel catfish, adult	Subsistence	50%	52%	51%	49%
	Base-Low	67%	65%	60%	64%
	Base-Medium	73%	71%	66%	71%
	Base-High	81%	79%	76%	81%
Longear sunfish	Subsistence	62%	66%	64%	61%
	Base-Low	79%	78%	74%	77%
	Base-Medium	85%	84%	78%	83%
	Base-High	90%	88%	86%	90%
Largemouth bass	Subsistence	57%	61%	59%	56%
	Base-Low	77%	74%	69%	73%
	Base-Medium	80%	79%	76%	79%
	Base-High	87%	85%	82%	87%

# Laguna – “enoughness” assessment

## □ Modified BBEST A

- “Base-Medium 50%” = % of maximum WUA maintained by flow resulting from full 50% diversion between Base-Medium and Subsistence

Focal Species	Flow Component	Percent of Maximum Weighted Usable Area			
		Winter	Spring	Summer	Fall
greenthroat darter	Subsistence	64%	68%	66%	63%
	Base-Medium 50%	79%	80%	75%	79%
	Base-Medium	84%	83%	81%	83%
central stoneroller	Subsistence	58%	61%	60%	58%
	Base-Medium 50%	75%	76%	70%	75%
	Base-Medium	88%	86%	80%	85%
Texas shiner	Subsistence	58%	61%	60%	58%
	Base-Medium 50%	73%	74%	70%	73%
	Base-Medium	84%	81%	77%	80%
Guadalupe bass	Subsistence	55%	60%	57%	54%
	Base-Medium 50%	74%	75%	70%	73%
	Base-Medium	82%	80%	76%	80%
gray redbhorse	Subsistence	53%	56%	54%	52%
	Base-Medium 50%	68%	69%	64%	68%
	Base-Medium	78%	76%	71%	75%
channel catfish, adult	Subsistence	50%	52%	51%	49%
	Base-Medium 50%	64%	64%	60%	64%
	Base-Medium	73%	71%	66%	71%
longear sunfish	Subsistence	62%	66%	64%	61%
	Base-Medium 50%	77%	77%	74%	77%
	Base-Medium	85%	84%	78%	83%
largemouth bass	Subsistence	57%	61%	59%	56%
	Base-Medium 50%	72%	73%	69%	72%
	Base-Medium	80%	79%	76%	79%

# Laguna – “enoughness” assessment

## □ Modified BBEST W

- “Base-High 50%” = % of maximum WUA maintained by flow resulting from full 50% diversion between Base-High and Subsistence

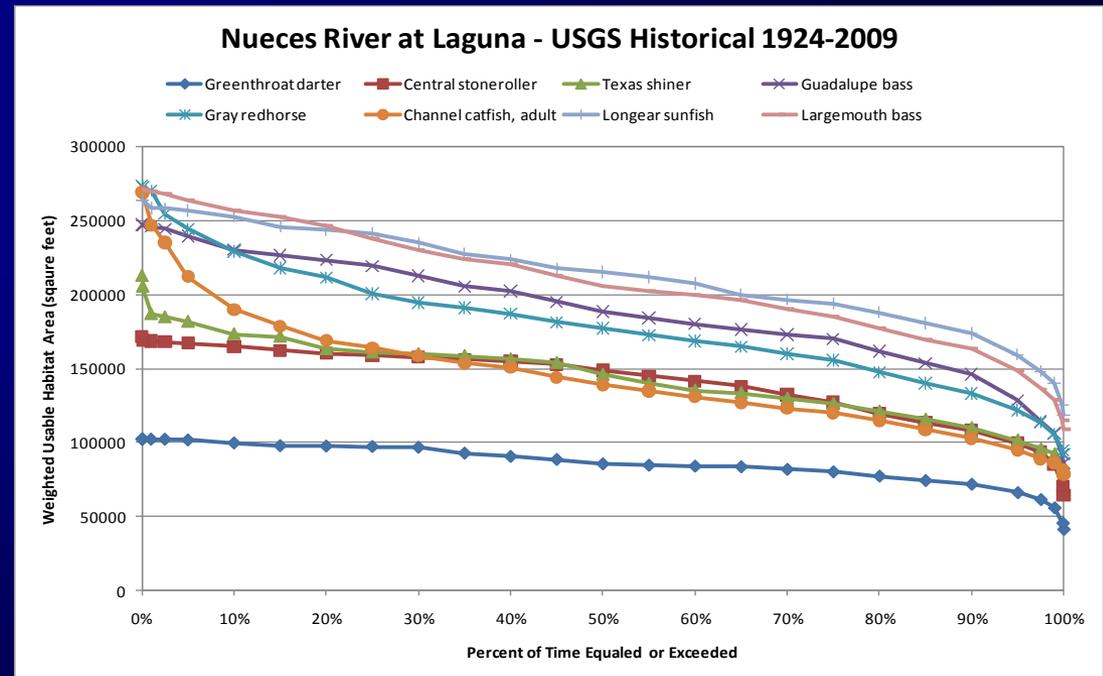
Focal Species	Flow Component	Percent of Maximum Weighted Usable Area			
		Winter	Spring	Summer	Fall
greenthroat darter	Subsistence	64%	68%	66%	63%
	Base-High 50%	82%	82%	81%	82%
	Base-High	91%	89%	87%	93%
central stoneroller	Subsistence	58%	61%	60%	58%
	Base-High 50%	82%	83%	79%	82%
	Base-High	92%	92%	90%	93%
Texas shiner	Subsistence	58%	61%	60%	58%
	Base-High 50%	78%	78%	76%	78%
	Base-High	92%	91%	88%	92%
Guadalupe bass	Subsistence	55%	60%	57%	54%
	Base-High 50%	77%	78%	76%	77%
	Base-High	89%	87%	84%	89%
gray redbhorse	Subsistence	53%	56%	54%	52%
	Base-High 50%	73%	73%	71%	73%
	Base-High	83%	82%	79%	84%
channel catfish, adult	Subsistence	50%	52%	51%	49%
	Base-High 50%	68%	68%	66%	68%
	Base-High	81%	79%	76%	81%
longear sunfish	Subsistence	62%	66%	64%	61%
	Base-High 50%	80%	81%	78%	80%
	Base-High	90%	88%	86%	90%
largemouth bass	Subsistence	57%	61%	59%	56%
	Base-High 50%	77%	77%	75%	77%
	Base-High	87%	85%	82%	87%

# Laguna – Habitat Time Series

□ Habitat time series and attainment frequency of 75% threshold

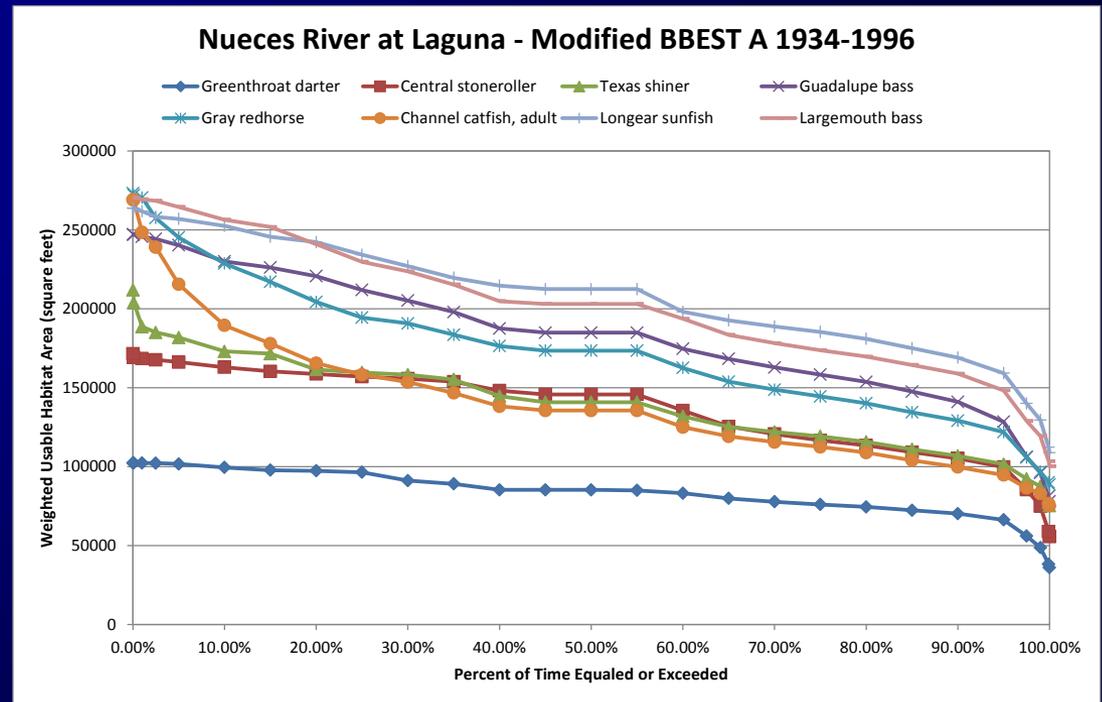
- BBEST: historical flows, FRAT output for 3 scenarios at Laguna, pre-/post-Choke Canyon for Three Rivers

□ Just modeled flows (flows up to 850 cfs, not all flows)



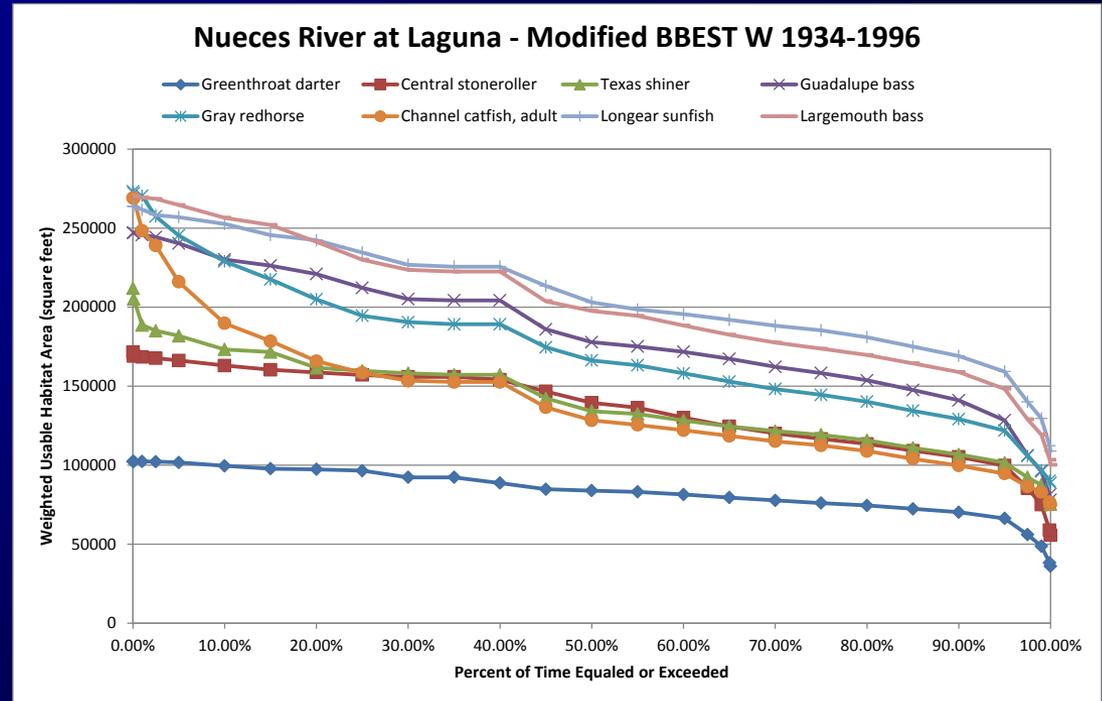
# Laguna – Habitat Time Series

## Modified BBEST A



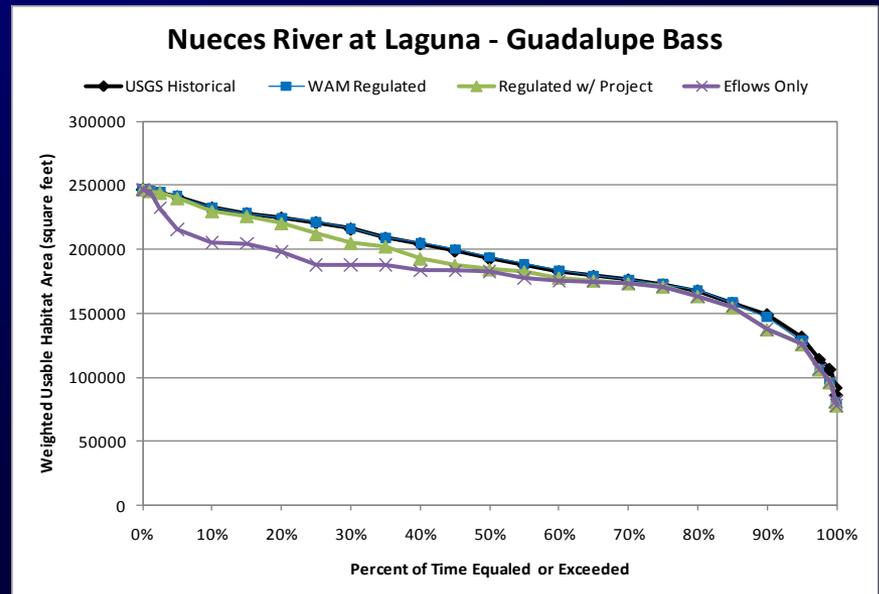
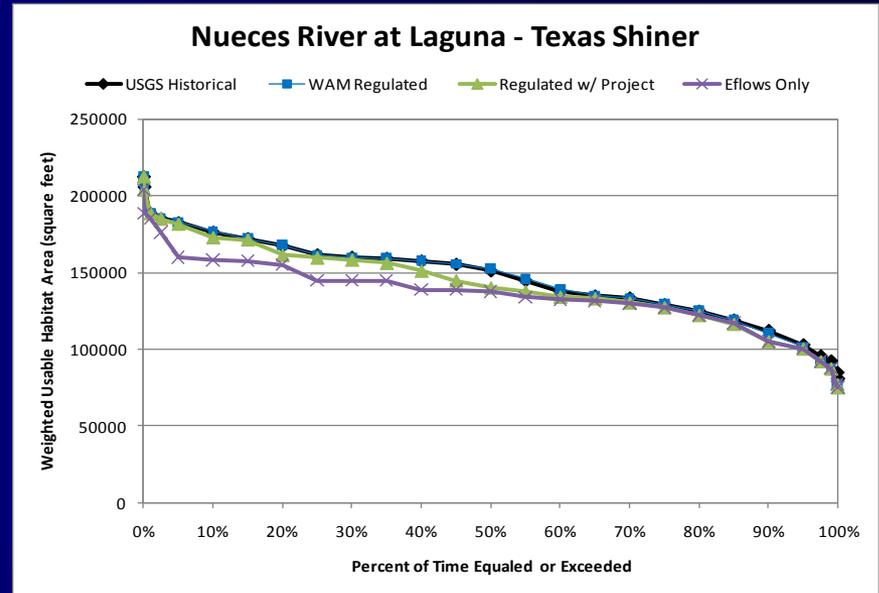
# Laguna – Habitat Time Series

## Modified BBEST W



# Laguna – Habitat Time Series

- ❑ Evaluation of instream habitat under example application scenarios
- ❑ FRAT used to generate flow time series
- ❑ BBEST: 4 scenarios
  - USGS historical
  - WAM regulated baseline
  - Project with flow recommendations
  - Flow recommendations only

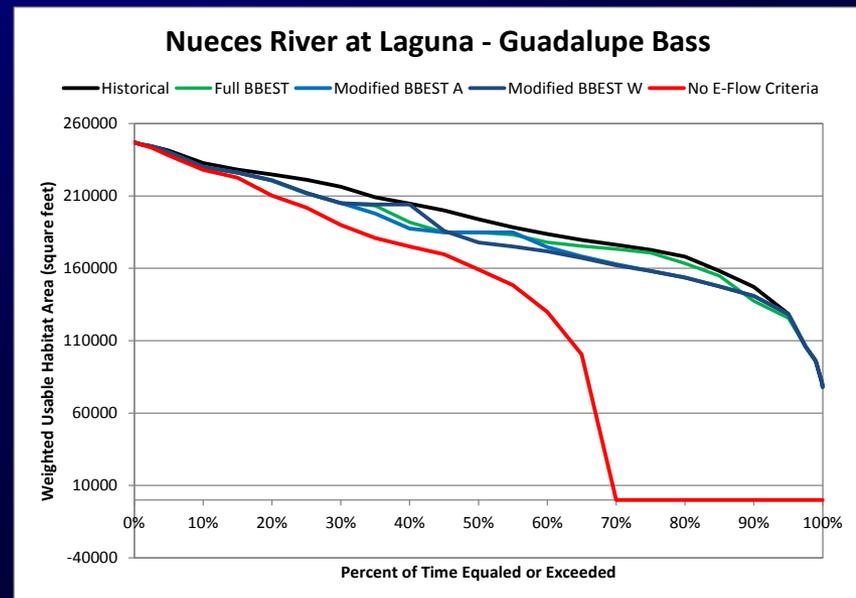
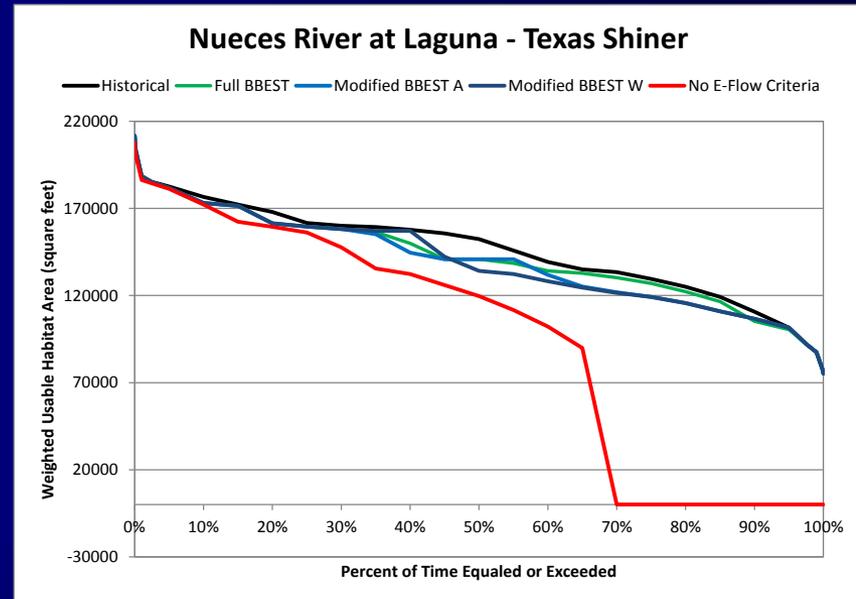




# Laguna – Habitat Time Series

## BBASC: 5 scenarios

- Historical
- Full BBEST
- Modified BBEST A
- Modified BBEST W
- No E-Flow criteria

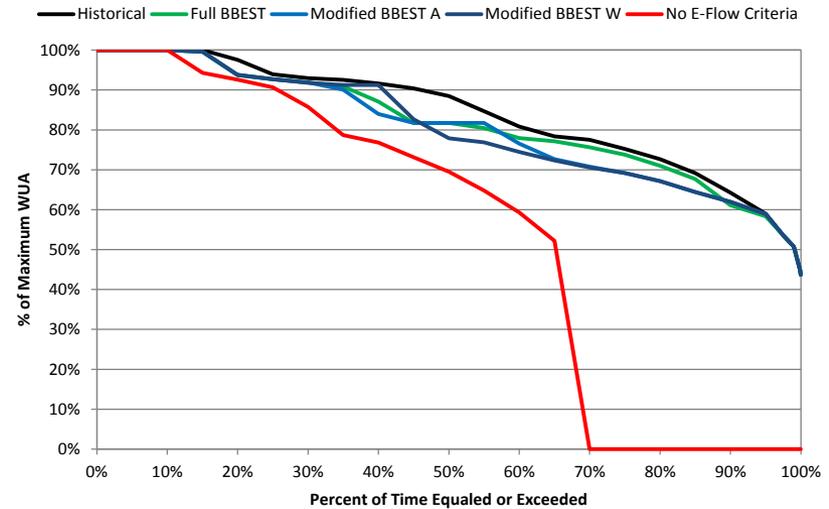


# Laguna – Habitat Time Series

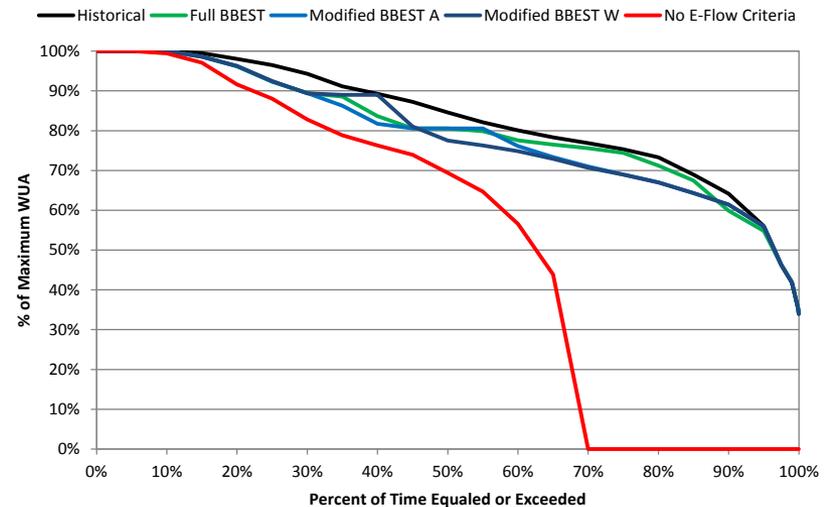
## BBASC: 5 scenarios

- Historical
- Full BBEST
- Modified BBEST A
- Modified BBEST W
- No E-Flow criteria

Nueces River at Laguna - Texas Shiner - % Max



Nueces River at Laguna - Guadalupe Bass - % Max







# Laguna – Habitat Time Series (BBASC)

Frequency of meeting 75% of Maximum WUA threshold under the different scenarios

Focal Species	Historical	Full BBEST		Modified A		Modified W		No E-Flows	
	Attainment Frequency	Attainment Frequency	Change from Hist.						
Greenthroat darter	80%	80%	0%	70%	-10%	70%	-10%	50%	-30%
Central stoneroller	75%	75%	0%	60%	-15%	60%	-15%	45%	-30%
Texas shiner	75%	70%	-5%	60%	-15%	55%	-20%	40%	-35%
Guadalupe bass	75%	70%	-5%	60%	-15%	60%	-15%	40%	-35%
Gray redhorse	60%	55%	-5%	55%	-5%	45%	-15%	30%	-30%
Channel catfish, adult	50%	40%	-10%	35%	-15%	40%	-10%	25%	-25%
Longear sunfish	80%	80%	0%	70%	-10%	70%	-10%	45%	-35%
Largemouth bass	70%	70%	0%	60%	-10%	55%	-15%	40%	-30%

# *Laguna Summary*

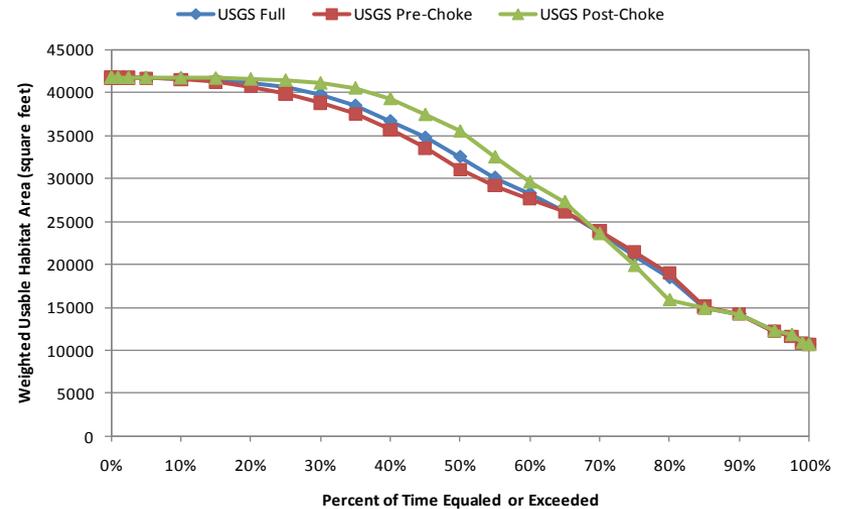
## □ Laguna

- “Enough” habitat (i.e., per 75% minimum threshold of Maximum WUA used by BBEST) is maintained for fewer species under the full 50% diversion of Modified BBEST A scenario
  - But, in most cases it is not far below 75%
  - Guadalupe bass, Texas shiner (TPWD SGCNs) do not meet 75%
- “Enough” maintained for more species by Modified BBEST W scenario
- Time Series: Both Modified BBEST A and W result in a 10-15% reduction for most focal species in the historical attainment frequency of the BBEST’s 75% of Maximum WUA threshold

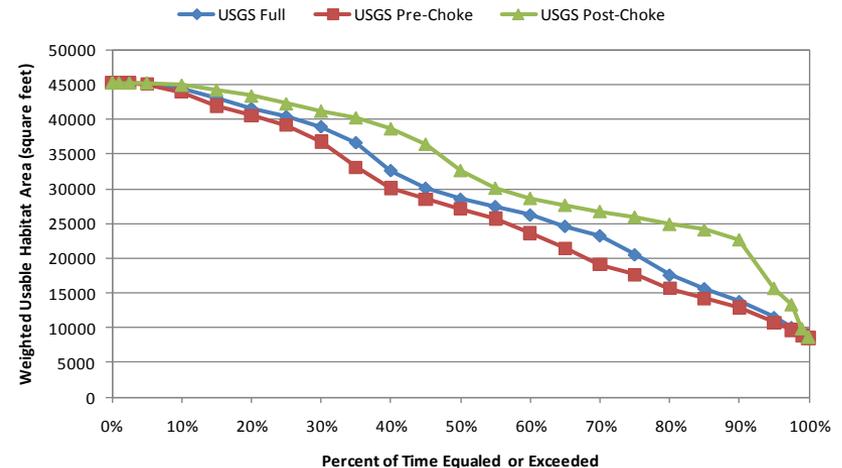
# Three Rivers – Habitat Time Series

- Evaluation of instream habitat under 3 periods of record (USGS gage)
  - Pre-Choke Canyon Reservoir
  - Post-Choke Canyon Reservoir
  - Full period (which was used for flow recommendations)

Nueces River at Three Rivers - Weed Shiner



Nueces River at Three Rivers - Smallmouth Buffalo

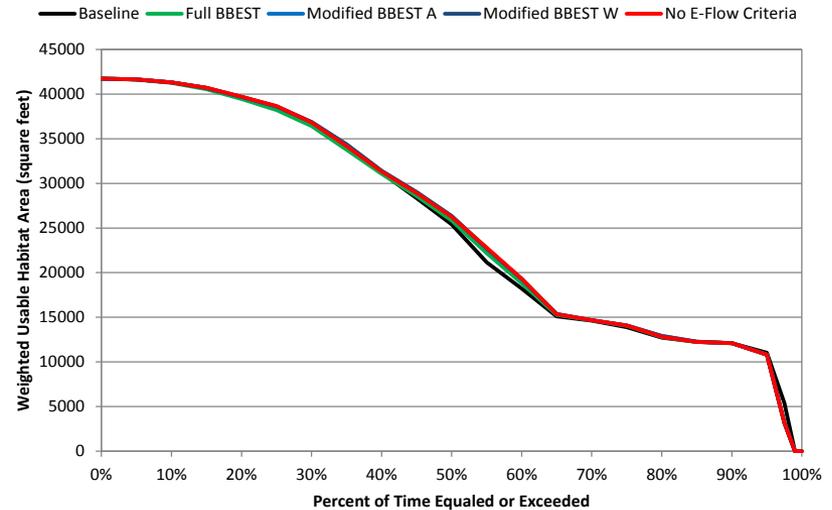


# Three Rivers – Habitat Time Series

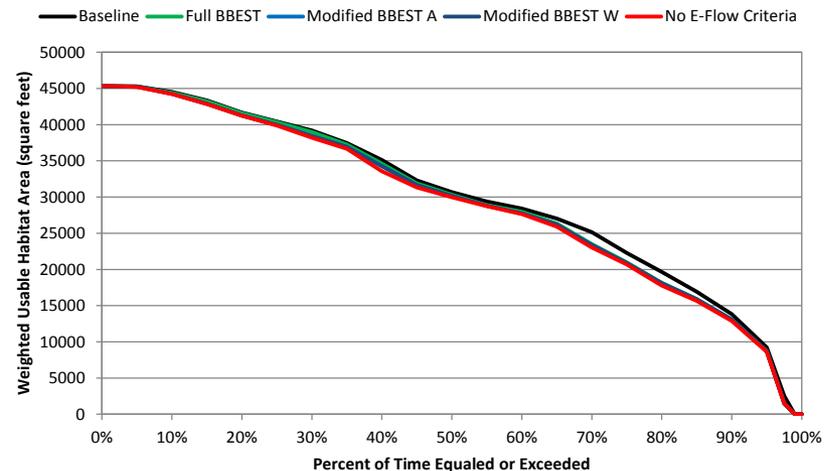
## BBASC: with Cotulla Reservoir, 5 scenarios

- Baseline
- Full BBEST
- Modified BBEST A
- Modified BBEST W
- No E-Flow criteria

### Nueces River at Three Rivers - Weed Shiner

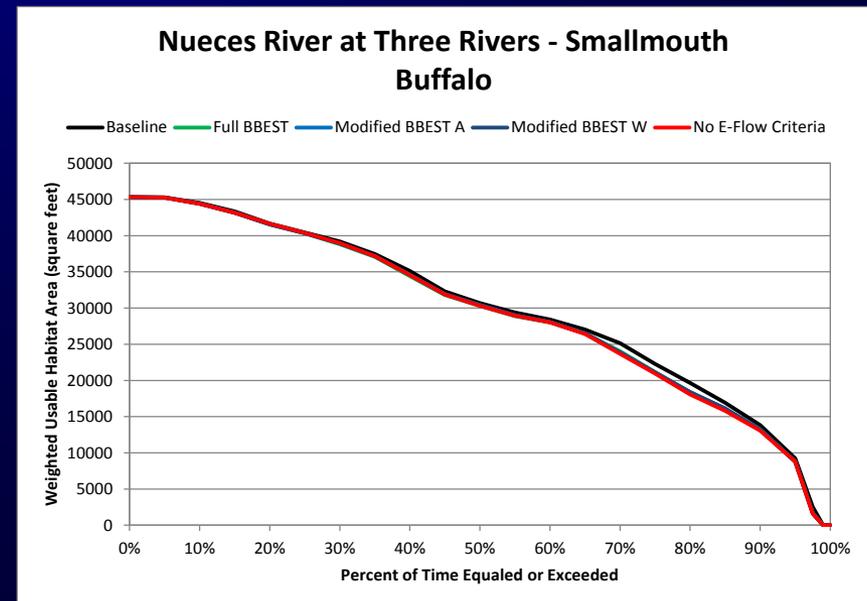
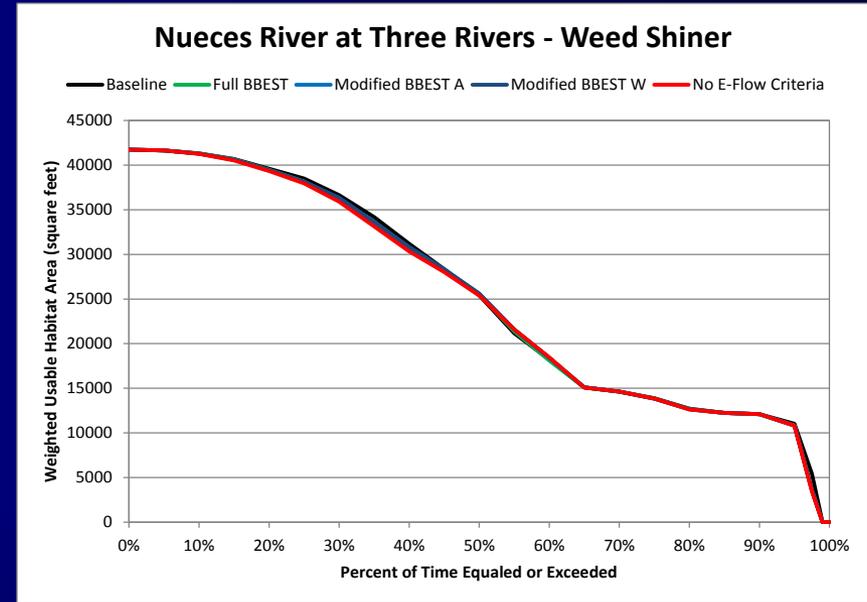


### Nueces River at Three Rivers - Smallmouth Buffalo



# Three Rivers – Habitat Time Series

- **BBASC: with off-channel reservoir (OCR), 5 scenarios**
  - **Baseline**
  - **Full BBEST**
  - **Modified BBEST A**
  - **Modified BBEST W**
  - **No E-Flow criteria**



# Three Rivers – “enoughness” assessment

## □ Modified BBEST A

- “Base-Medium 50%” = % of maximum WUA maintained by flow resulting from full 50% diversion between Base-Medium and Subsistence

Focal Species	Flow Component	Percent of Maximum Weighted Usable Area			
		Winter	Spring	Summer	Fall
Channel catfish, Juvenile	Subsistence	20%	20%	20%	20%
	Base-Medium 50%	88%	88%	75%	88%
	Base-Medium	98%	99%	99%	98%
Red shiner	Subsistence	40%	40%	40%	40%
	Base-Medium 50%	88%	88%	80%	88%
	Base-Medium	97%	97%	95%	97%
Weed shiner	Subsistence	44%	44%	44%	44%
	Base-Medium 50%	90%	90%	82%	90%
	Base-Medium	100%	100%	100%	100%
Bullhead minnow	Subsistence	38%	38%	38%	38%
	Base-Medium 50%	76%	76%	71%	76%
	Base-Medium	97%	96%	92%	96%
Smallmouth buffalo	Subsistence	19%	19%	19%	19%
	Base-Medium 50%	44%	44%	41%	44%
	Base-Medium	57%	56%	52%	56%
Blue catfish	Subsistence	16%	16%	16%	16%
	Base-Medium 50%	41%	41%	38%	41%
	Base-Medium	55%	53%	49%	54%
Channel catfish, Adult	Subsistence	22%	22%	22%	22%
	Base-Medium 50%	46%	46%	43%	46%
	Base-Medium	58%	57%	54%	58%
Flathead catfish, juvenile	Subsistence	54%	54%	54%	54%
	Base-Medium 50%	88%	88%	82%	88%
	Base-Medium	99%	98%	96%	98%
Freshwater drum	Subsistence	27%	27%	27%	27%
	Base-Medium 50%	56%	56%	52%	56%
	Base-Medium	70%	69%	65%	69%
River carpsucker	Subsistence	41%	41%	41%	41%
	Base-Medium 50%	91%	91%	83%	91%
	Base-Medium	98%	98%	100%	98%
Longear sunfish	Subsistence	40%	40%	40%	40%
	Base-Medium 50%	83%	83%	76%	83%
	Base-Medium	96%	96%	94%	96%
Spotted gar	Subsistence	24%	24%	24%	24%
	Base-Medium 50%	85%	75%	61%	66%
	Base-Medium	70%	68%	62%	69%
Largemouth bass	Subsistence	34%	34%	34%	34%
	Base-Medium 50%	95%	92%	86%	89%
	Base-Medium	91%	90%	87%	90%

# Three Rivers – “enoughness” assessment

## □ Modified BBEST W

- “Base-High 50%” = % of maximum WUA maintained by flow resulting from full 50% diversion between Base-High and Subsistence

Focal Species	Flow Component	Percent of Maximum Weighted Usable Area			
		Winter	Spring	Summer	Fall
Channel catfish, Juvenile	Subsistence	20%	20%	20%	20%
	Base-Medium 50%	97%	98%	98%	99%
	Base-Medium	98%	100%	97%	98%
Red shiner	Subsistence	40%	40%	40%	40%
	Base-Medium 50%	100%	98%	95%	96%
	Base-Medium	94%	97%	100%	99%
Weed shiner	Subsistence	44%	44%	44%	44%
	Base-Medium 50%	99%	100%	99%	100%
	Base-Medium	89%	94%	99%	97%
Bullhead minnow	Subsistence	38%	38%	38%	38%
	Base-Medium 50%	100%	98%	90%	95%
	Base-Medium	86%	94%	100%	99%
Smallmouth buffalo	Subsistence	19%	19%	19%	19%
	Base-Medium 50%	62%	59%	51%	55%
	Base-Medium	89%	83%	65%	74%
Blue catfish	Subsistence	16%	16%	16%	16%
	Base-Medium 50%	62%	58%	48%	52%
	Base-Medium	88%	77%	65%	70%
Channel catfish, Adult	Subsistence	22%	22%	22%	22%
	Base-Medium 50%	65%	60%	53%	56%
	Base-Medium	88%	83%	71%	78%
Flathead catfish, juvenile	Subsistence	54%	54%	54%	54%
	Base-Medium 50%	100%	99%	95%	97%
	Base-Medium	95%	95%	99%	97%
Freshwater drum	Subsistence	27%	27%	27%	27%
	Base-Medium 50%	77%	72%	64%	68%
	Base-Medium	98%	100%	84%	95%
River carpsucker	Subsistence	41%	41%	41%	41%
	Base-Medium 50%	95%	97%	99%	99%
	Base-Medium	84%	89%	93%	92%
Longear sunfish	Subsistence	40%	40%	40%	40%
	Base-Medium 50%	100%	98%	93%	95%
	Base-Medium	94%	98%	100%	100%
Spotted gar	Subsistence	24%	24%	24%	24%
	Base-Medium 50%	85%	75%	61%	66%
	Base-Medium	95%	92%	88%	90%
Largemouth bass	Subsistence	34%	34%	34%	34%
	Base-Medium 50%	95%	92%	86%	89%
	Base-Medium	97%	100%	97%	99%

# ***Ryan Smith Conclusions***

## **☐ Three Rivers**

- **Time Series: Little effect of either the upstream Cotulla Reservoir or the hypothetical off-channel reservoir on habitat frequencies at Nueces River at Three Rivers relative to the WAM regulated flows baseline (not to historical flows)**
- **“Enough” habitat (i.e., per 75% minimum threshold of Maximum WUA used by BBEST) is not maintained for all species at Three Rivers under the full 50% diversion of Modified BBEST A scenario**
  - **But, neither is it under the Full BBEST recommendation**
  - **“Enough” maintained for more species by Modified BBEST W scenario**

# Frio Concan – “enoughness” assessment

## □ Modified BBEST A

- “Base-Medium 50%” = % of maximum WUA maintained by flow resulting from full 50% diversion between Base-Medium and Subsistence

Focal Species	Flow Component	Percent of Maximum Weighted Usable Area			
		Winter	Spring	Summer	Fall
greenthroat darter	Subsistence	41%	38%	38%	38%
	Base-Medium 50%	77%	77%	70%	74%
	Base-Medium	90%	89%	83%	86%
central stoneroller	Subsistence	60%	56%	56%	56%
	Base-Medium 50%	90%	90%	85%	88%
	Base-Medium	97%	98%	95%	97%
Texas shiner	Subsistence	57%	55%	55%	55%
	Base-Medium 50%	79%	79%	77%	79%
	Base-Medium	90%	89%	83%	87%
Guadalupe bass	Subsistence	63%	61%	61%	61%
	Base-Medium 50%	81%	81%	77%	79%
	Base-Medium	89%	88%	85%	87%
gray redhorse	Subsistence	78%	76%	77%	77%
	Base-Medium 50%	89%	89%	87%	88%
	Base-Medium	94%	93%	91%	92%
channel catfish, adult	Subsistence	74%	73%	73%	73%
	Base-Medium 50%	82%	82%	81%	82%
	Base-Medium	87%	87%	84%	86%
longear sunfish	Subsistence	78%	77%	77%	77%
	Base-Medium 50%	89%	89%	87%	88%
	Base-Medium	94%	93%	91%	92%
largemouth bass	Subsistence	81%	80%	80%	80%
	Base-Medium 50%	91%	91%	89%	90%
	Base-Medium	93%	93%	92%	93%

# Frio Concan – “enoughness” assessment

## □ Modified BBEST W

- “Base-High 50%” = % of maximum WUA maintained by flow resulting from full 50% diversion between Base-High and Subsistence

Focal Species	Flow Component	Percent of Maximum Weighted Usable Area			
		Winter	Spring	Summer	Fall
greenthroat darter	Subsistence	41%	38%	38%	38%
	Base-High 50%	82%	82%	82%	82%
	Base-High	96%	96%	93%	96%
central stoneroller	Subsistence	60%	56%	56%	56%
	Base-High 50%	94%	94%	94%	94%
	Base-High	97%	97%	97%	97%
Texas shiner	Subsistence	57%	55%	55%	55%
	Base-High 50%	82%	82%	82%	82%
	Base-High	95%	94%	92%	94%
Guadalupe bass	Subsistence	63%	61%	61%	61%
	Base-High 50%	85%	85%	85%	85%
	Base-High	94%	94%	92%	94%
gray redhorse	Subsistence	78%	76%	77%	77%
	Base-High 50%	91%	91%	91%	91%
	Base-High	95%	95%	94%	95%
channel catfish, adult	Subsistence	74%	73%	73%	73%
	Base-High 50%	84%	84%	84%	84%
	Base-High	89%	89%	89%	89%
longear sunfish	Subsistence	78%	77%	77%	77%
	Base-High 50%	91%	91%	91%	91%
	Base-High	96%	96%	95%	96%
largemouth bass	Subsistence	81%	80%	80%	80%
	Base-High 50%	92%	92%	92%	92%
	Base-High	97%	97%	95%	97%

# ***Ryan Smith Conclusions***

## **□ Frio River at Concan**

- **“Enough” habitat (i.e., per 75% minimum threshold of Maximum WUA used by BBEST) is maintained for all species at Concan under the full 50% diversion of both the Modified BBEST A and W scenario**

# ***Methods, Decision Points***

- ❑ **8 focal species**
- ❑ **Measure**
  - **WUA and % of maximum WUA**
- ❑ **Quality threshold**
  - **0.5 Minimum habitat suitability score to evaluate highest quality habitats**
- ❑ **“Enoughness”**
  - **75% of max WUA for base flow (at least one season-base flow level), 20% for subsistence**
- ❑ **Cross-section subsets?**
  - **All cross-sections, but results for riffle, run, pool subsets in Appendix**
- ❑ **Time series**

# Laguna – WUA, 0.5 Quality Threshold

