

**2.7 – Workshop Solution: Using Statistical Features of HEC-EFM to assess Eco-change**

This solution details each part of the workshop that asked for a response. EFM results are based on relationships listed in the solution to workshop 2.5.

10) What do the statistical results indicate for your relationships? Test the other river.

*Here are the results for the Savannah (left hand side) and the San Joaquin (right hand side). For the Savannah, four of the five relationships show positive change for the gaged flow regime, though results for several of the relationships (habitat for shad and striped bass) are similar in magnitude to those of the natural flow regime. Benthic biodiversity results display the biggest change. According to the 30% criteria, water exchange was good for both regimes, though the increase to 63.8% for the gaged case begs the question, can there be too much exchange?*

*In the San Joaquin analysis, all relationships were significantly altered, with all experiencing a negative effect. Water exchange was reduced from 56.4% to 17.9%.*

The image shows two side-by-side screenshots of the HEC-EFM software interface. Both windows are titled 'EFM Relationships Workshop.efm - HEC-EFM' and show results for a specific date: 04/03/2008 11:34 (left) and 04/03/2008 11:33 (right).

**Left Window (Savannah):**

**Summary Table:**

Relationship	Conf.	Sav Natural		Chg.	Sav Gaged	
		Stage, ft	Flow, cfs		Stage, ft	Flow, cfs
Splittail Spawning	*	10.5	12,105	Pos	14.4	17,025
Shad and Striped Bass Habitat	*	3.2	5,063	Pos	4.2	5,878
Benthic Biodiversity	*	24.0	62,935	Neg	20.9	32,050
Shoals Spider Lily	*	0.0	1,964	Pos	1.9	4,100
Water Exchange	*	4.7	6,263	Pos	6.2	7,620

**Index Values Table:**

Index	Sav Gaged
A - All	13.4
B - Fish	28.4
C - Bugs	-49.1
D - Plants	37.5
E -	n/a

**Reverse Look-ups - Flow Duration Table:**

Relationship	Conf.	Sav Natural		Chg.	Sav Gaged	
		% X, of time	% X, of time		% X, of time	% X, of time
Water Exchange - Reverse Lookup	*		32.8	Pos		63.8

**Right Window (San Joaquin):**

**Summary Table:**

Relationship	Conf.	SJQ Natural		Chg.	SJQ Gaged	
		Stage, ft	Flow, cfs		Stage, ft	Flow, cfs
Splittail Spawning	*	25.5	36,138	Neg	17.6	18,300
Shad and Striped Bass Habitat	*	5.1	3,186	Neg	3.0	1,713
Benthic Biodiversity	*	28.5	44,274	Neg	14.2	12,500
Shoals Spider Lily	*	3.6	2,122	Neg	0.8	330
Water Exchange	*	18.2	19,427	Neg	4.5	2,780

**Index Values Table:**

Index	SJQ Gaged
A - All	-67.5
B - Fish	-47.8
C - Bugs	-71.8
D - Plants	-84.4
E -	n/a

**Reverse Look-ups - Flow Duration Table:**

Relationship	Conf.	SJQ Natural		Chg.	SJQ Gaged	
		% X, of time	% X, of time		% X, of time	% X, of time
Water Exchange - Reverse Lookup	*		56.4	Neg		17.9

- 12) Indices - Check out the results. A positive value suggests that the positive changes outweigh the negatives for the relationships in the index. But this should really be used only as a screening tool. Lumping multiple, and pseudo-independent, relationships into one numeric index is an approach to be used with caution.

Confidence (0-5) is one of the variables used in computing indices. Test the sensitivity of the indices output by switching the confidence of one of the relationships from one star to five. If your index result is positive, switch one of the relationships that showed a negative change, or vice versa. Go to the Tables tab and then hit Recalc. Did the index result reverse the conclusion it had suggested?

Evaluated at: 04/03/2008 11:28

**Summary**

Relationship	Conf.	Sav Natural		Chg.	Sav Gaged	
		Stage, ft	Flow, cfs		Stage, ft	Flow, cfs
Splittail Spawning	*	10.5	12,105	Pos	14.4	17,025
Shad and Striped Bass Habitat	*	3.2	5,063	Pos	4.2	5,878
Benthic Biodiversity	*****	24.0	62,935	Neg	20.9	32,050
Shoals Spider Lily	*	0.0	1,964	Pos	1.9	4,100
Water Exchange	*	4.7	6,263	Pos	6.2	7,620

**Index Values**

Index	Sav Gaged
A - All	-25.9
B - Fish	28.4
C - Bugs	-245.4
D - Plants	37.5
E -	n/a

No reverse lookup flow frequency data sets were analyzed.

**Reverse Look-ups - Flow Duration**

Relationship	Conf.	Sav Natural		Chg.	Sav Gaged	
		% X, of time			% X, of time	
Water Exchange - Reverse Lookup	*		32.8	Pos		63.8

Evaluated at: 04/03/2008 11:31

**Summary**

Relationship	Conf.	SJQ Natural		Chg.	SJQ Gaged	
		Stage, ft	Flow, cfs		Stage, ft	Flow, cfs
Splittail Spawning	*	25.5	36,138	Neg	17.6	18,300
Shad and Striped Bass Habitat	*	5.1	3,186	Neg	3.0	1,713
Benthic Biodiversity	*****	28.5	44,274	Neg	14.2	12,500
Shoals Spider Lily	*	3.6	2,122	Neg	0.8	330
Water Exchange	*	18.2	19,427	Neg	4.5	2,780

**Index Values**

Index	SJQ Gaged
A - All	-124.9
B - Fish	-47.8
C - Bugs	-358.8
D - Plants	-84.4
E -	n/a

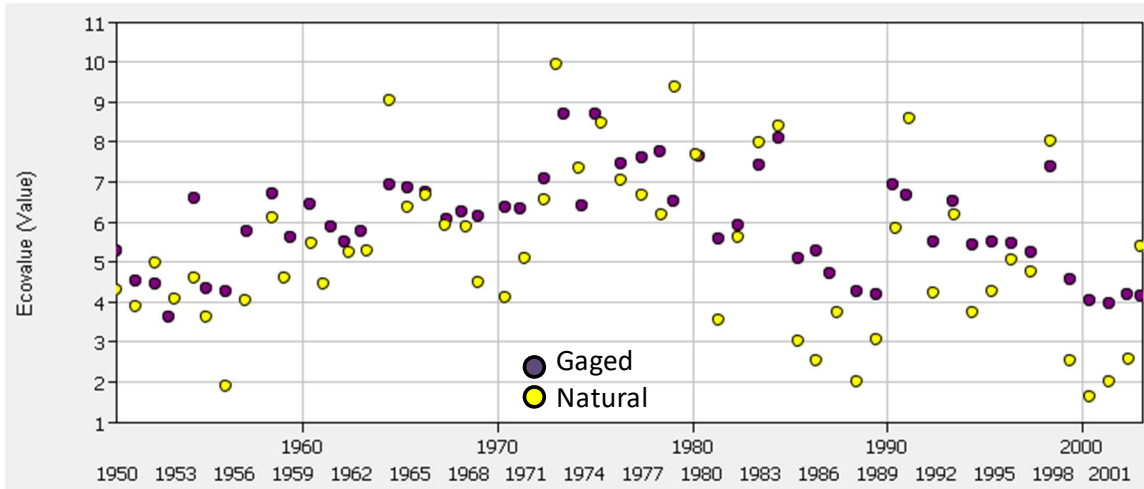
No reverse lookup flow frequency data sets were analyzed.

**Reverse Look-ups - Flow Duration**

Relationship	Conf.	SJQ Natural		Chg.	SJQ Gaged	
		% X, of time			% X, of time	
Water Exchange - Reverse Lookup	*		56.4	Neg		17.9

*Benthic Biodiversity was the only relationship to go against the general positive trend for the Savannah River. When its confidence tracking was increased from one to five stars, index A (All) reversed its conclusion about net effect for the Savannah Gaged flow regime! This shows that indices can be sensitive to individual relationships and that care should be taken to understand how each relationship contributes to the index before using indices as screening tools.*

## Bonus Questions



B1) Do you recognize any noteworthy differences in the character of ecovalues when contrasting patterns for natural and gaged flow regimes?

*Ecovalues for the gaged flow regime are generally more consistent than for the natural flow regime. They also tend to be higher. Both of these characteristics are positive indicators for the overwintering success of adult Shad and Striped Bass in the Savannah River under the gaged flow regime.*

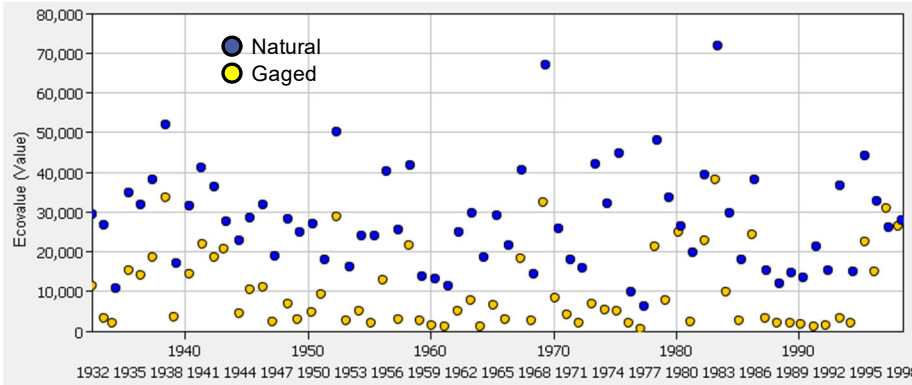
B2) The Shad and Bass habitat relationship was about stress caused by persistent low flow conditions in winter-spring months. The Savannah River experienced a severe drought in the early 2000's. Based on the ecovalues, what information could you convey to fisheries managers about drought effects on overwintering success of shad and striped bass (ie, historical severity, comparison to natural)?

*The influence of the drought is quite visible in the ecovalue results. For the gaged flow regime, each ecovalue between 2000 and 2003 was the poorest conditions since the historical low of 1956. Given the magnitude of the poor conditions and that they persisted for 4 consecutive years, if elevated stress led to mortality, population levels of adult shad and striped bass should have been depressed. On a positive note, the gaged flow regime offered some benefit in comparison to the natural flow regime, which experienced the poorest conditions in the period of record in 2000.*

B3) Switch the data being viewed to "Ecovalue Shift". In what percentage of years, does the Gaged flow regime provide higher ecovalues than the Natural flow regime?

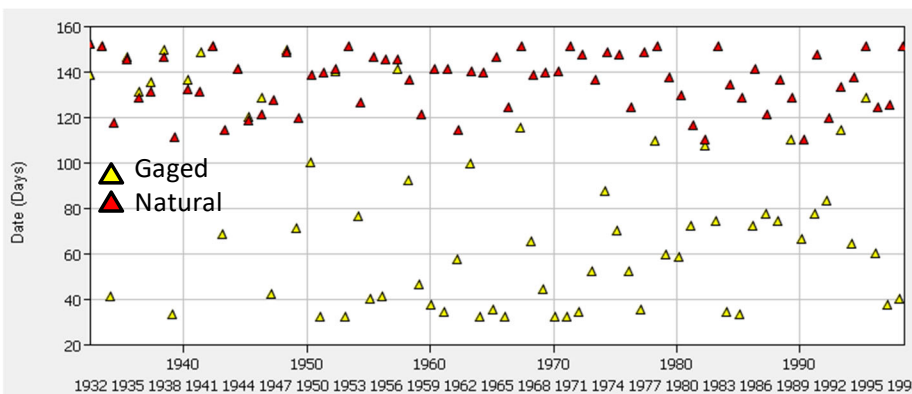
*Seasonal ecovalue shifts compare the ecovalues provided by two different flow regimes. In this case, the natural flow regime is the reference flow regime and gaged is the alternative flow regime compared with natural. Shift values are associated with alternative flow regimes.*

*Gaged outperforms natural in ~77% of years.*



B4) What do you see that might explain a change in abundance for hatching splittails between the natural and gaged flow regimes and how do you predict that abundance will change (ie, more or less young fish under the gaged flow regime)?

*Ecovalue results show that the gaged flow regime consistently performs worse than the natural. This indicates that spawning success is lower and there will be less young fish under the gaged regime.*



B5) Do you see any noteworthy differences in date values when comparing flow regimes?

*Spawning in the gaged flow regime consistently occurs earlier than in the natural flow regime.*

B6) If all else is the same (food, predation, etc), how do you predict that size of young-of-the-year recruits will change (ie, bigger or smaller young fish under the gaged flow regime)?

*The additional time as hatched fish should give them more time to grow. So they will be bigger, though there will be less of them.*

B7) View the Date shift results. In what percentage of years, do spawning conditions occur earlier in the Gaged flow regime as compared to the Natural flow regime?

*Seasonal date shifts compare when ecosystem dynamics occur for two different flow regimes. In this case, the natural flow regime is the reference flow regime and gaged is the alternative flow regime compared with natural. As with ecovalues, shift values are associated with alternative flow regimes.*

*Spawning conditions (as represented in the relationship) for the gaged flow regime occur earlier than for the natural flow regime in ~81% of years. And in ~50% of years spawning conditions occur at least 2 months earlier.*