Relicensing Study 3.3.1

Instream Flow Habitat Assessments in the Bypass Reach and below Cabot Station

ADDENDUM 1

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight™ Power Resources

Prepared by:

Gomez and Sullivan Engineers

Kleinschmidt

APRIL 2017

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ABBREVIATIONS

cfs	cubic feet per second
FERC	Federal Energy Regulatory Commission
FirstLight or FL	FirstLight Hydro Generating Company
HSI	habitat suitability index
MADFW	Massachusetts Division of Fisheries & Wildlife
NHESP	Natural Heritage and Endangered Species Program
NMFS	National Marine Fisheries Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WUA	weighted usable area

1 INTRODUCTION

On October 14, 2016, FirstLight (FL) filed with the Federal Energy Regulatory Commission (FERC) Study Report No. 3.3.1 *Instream Flow Habitat Assessment in the Bypass Reach and below Cabot Station*. On October 31 and November 1, 2016, FL held its study report meeting in which Study No. 3.3.1 was discussed on October 31. After filing meeting minutes on November 15, 2016, comments on Study No. 3.1.1 were filed by the United States Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and the Massachusetts Division of Fisheries & Wildlife (MADFW). On January 17, 2017, FL filed its responsiveness summary and agreed to file an addendum (Addendum 1) to the report to address the commenters concerns. Section 2 of this addendum includes FL's responses to those items identified in its responsiveness summary.

On February 17, 2017 FERC issued its Determination on Requests for Study Modifications and New Studies. FERC requested additional information be filed relative to Study No. 3.3.1—specifically the development of sea lamprey spawning habitat suitability index (HSI) curves as stated in its Determination letter- see below.

> *FirstLight followed the methodology of the approved study plan by using HSI curves from the literature, which were chosen in consultation with stakeholders. However, data collected during study 3.3.15 describes habitat used by spawning sea lamprey in the project area and could be used to adjust or verify the HSI curves used in Study 3.3.1. HSI curves based on site-specific data would likely represent spawning lamprey habitat preferences in the project area more accurately than the curves taken from the literature. We expect that incorporating this information would require some consultation with stakeholders and potentially rerunning the PHABSIM model, but we would not expect this to be a costly effort (section 5.9(b)(7)). Because this site-specific habitat data is specific to the project area and would be useful for adjusting or verifying the HSI curves taken from the literature, we recommend that FirstLight consult with the agencies and use the data collected at documented sea lamprey spawning sites in study 3.3.15 to make adjustments to (or verify) the literature-based HSI curves. If use of this data results in adjustments to the HSI curves, we recommend that FirstLight incorporate the new curves into the PHABSIM model and produce revised estimates of WUA for sea lamprey spawning in the bypassed* reach and downstream of Cabot Station *and file an addendum to the study by May 15, 2017.*

FL addresses FERC's comment in Section 3.

2 RESPONSES TO STAKEHOLDER COMMENTS

As noted above, comments on Study No. 3.3.1 were received from the USFWS, NMFS, and MADFW. In its response to comments, FL cataloged the comments received such as USFWS-1 (refers to the first USFWS comment on Study No. 3.3.1), USFWS-2, etc. In its response to comments, FL indicated which comments (USFWS-1, etc.) it would address in Addendum 1 to Study No. 3.3.1. Using the same cataloging system, the subsections below list the comment, which is then followed by FL's response.

Prior to reviewing the Addendum 1 responses some further background is needed relative to the mussels as part of the instream flow study (Study No. 3.3.1). Comments pertaining to mussels on Study No. 3.3.1 were provided by the USFWS and MADFW[1]. As noted in its January 17, 2017 responsiveness summary, FL had a conference call with the USFWS and MADFW on January 4, 2017. Following this call, FL agreed to provide USFWS and MADFW with minutes of the call and a proposed enhanced mussel screening level analysis of shear stress parameters at transects in Reach 5. On January 17, 2017, FL emailed the minutes and a draft proposed screening analysis of mussels in Reach 5. The same was filed as Attachment A to Study No. 3.3.1 as part of FL's January 17, 2017 responsiveness summary. On February 27, 2017, MADFW and USFWS emailed FL, separately, its comments on the proposed enhanced screening analysis (see Attachment A for MADFW and USFWS comments). FL is currently reviewing the comments and will consult further with MADFW and USFWS on next steps relative to evaluating mussels in Reach 5. After consulting, FL will update FERC relative to schedule for assessing mussels in Reach 5. Although the bulk of the comments on Study No. 3.3.1 pertained to mussels, this Addendum 1 addresses issues unrelated to mussels in Reach 5.

2.1 USFWS-6 (and MADFW-15, MADFW-18)

Comment: Habitat Time Series (Reach 4): FL states that the habitat time series analysis was done by merging the habitat versus discharge relationships for all target species and life stages with the Montague USGS gage hourly flow data to yield habitat time series for Reach 4. While the output portrayed in Figure 5.5.4-1 shows habitat versus time at a sub-daily time step, the actual output curves provided in Appendix J were at a monthly time step. Monthly habitat duration curves are not helpful in discerning impacts of a daily peaking operation on habitat, as fluctuations in habitat are greatly masked. The curves should represent habitat versus time on a sub-daily time step for representative seasonal periods. In the report, FL acknowledges that habitat time series analysis has yet to be conducted for Reach 3. An addendum will be provided at a later date containing the Reach 3 results. The comments we provided for the Reach 4 analysis also apply to any curves generated for Reach 3.

Response: As both the USFWS and MADFW notes, habitat duration curves were developed in Reach 4 using hourly observed flow data at the Montague USGS Gage for the period January 1, 2000 to October 1, 2015 (plus intervening inflow) and converting the flow to habitat using the weighted usable area (WUA) versus flow curves derived from the steady-state analysis in Reach 4. The computed WUA values were subsequently converted to monthly WUA duration curves. USFWS and MADFW note that the habitat duration curves are not helpful in discerning impacts of a daily peaking operation on habitat. At a stakeholder meeting on December 2, 2016[2], FL and stakeholders discussed the form and format for a habitat

[1] Comments were provided from the Natural Heritage and Endangered Species Program (NHESP), which is under the MADFW.

[2] Minutes from the December 2 meeting are provided on FL's website (http://www.northfieldrelicensing.com/Lists/Document/Attachments/389/120216_IFIM_Meeting_Minutes.pdf).

time series. At that meeting, it was agreed that FL would identify a representative week to develop the habitat versus time plots. In this case, the operations model (Study No. 3.8.1), which was developed on an hourly time step for calendar year 2002, was used to determine the hourly flows in Reach 3 and 4. For existing (baseline conditions) flows for one week in calendar year 2002 were selected and matched with the habitat versus flow curves for the various species and life stages to yield time varying habitat in Reach 4. FL computed the time varying habitat for the following species and life stages:

- American Shad (all life stages)- Figure 2.1-1
- Shortnose sturgeon (all life stages)- Figure 2.1-2
- Fallfish (all life stages)- Figure 2.1-3
- Longnose dace (all life stages)- Figure 2.1-4
- Macroinvertebrates – Figure 2.1-5
- Sea Lamprey (Spawning)- Figure 2.1-6
- Tessellated Darter (Juvenile-Adult)- Figure 2.1-7
- Walleye (all life stages)- Figure 2.1-8
- Deep-Fast, Deep-Slow, Shallow-Fast, Shallow-Slow Guilds- Figure 2.1-9
- White Sucker (all life stages)- Figure 2.1-10

At the December 2nd meeting, FL recognized that other scenarios/species plots may be requested in the future, pending stakeholders review of the weekly habitat time series plots contained herein. For Reach 4, Study Report No. 3.3.1 did not include habitat time series analyses of adult and juvenile life stages of: Tidewater Mucket Mussel, Eastern Pondmussel, and Yellow Lampmussels. Similar habitat time series figures for these mussels in Reach 4 will be filed by June 1, 2017.

Based on reviewing the hourly operations model output for 2002, an 11-day period (June 28 to July 8) was selected for the habitat time series. This time period was selected since it included periods with bypass flows in excess 10,000 cfs (which are typical during spillage during high flows), but also periods when bypass flows were approximately 500 cfs and other times when flows from Station No.1 resulted in flows in the lower part of Reach 2 and entering Reach 3 were around 2,500 cfs. In addition, this time period also included peaking conditions at Cabot resulting in discharges varying from nearly 14,000 cfs during generation to periods lower discharges during off-peak periods. The figures below show the Montague flow from the operations model (not the USGS gage) and the time varying habitat for the various species and life stages in Reach 4.

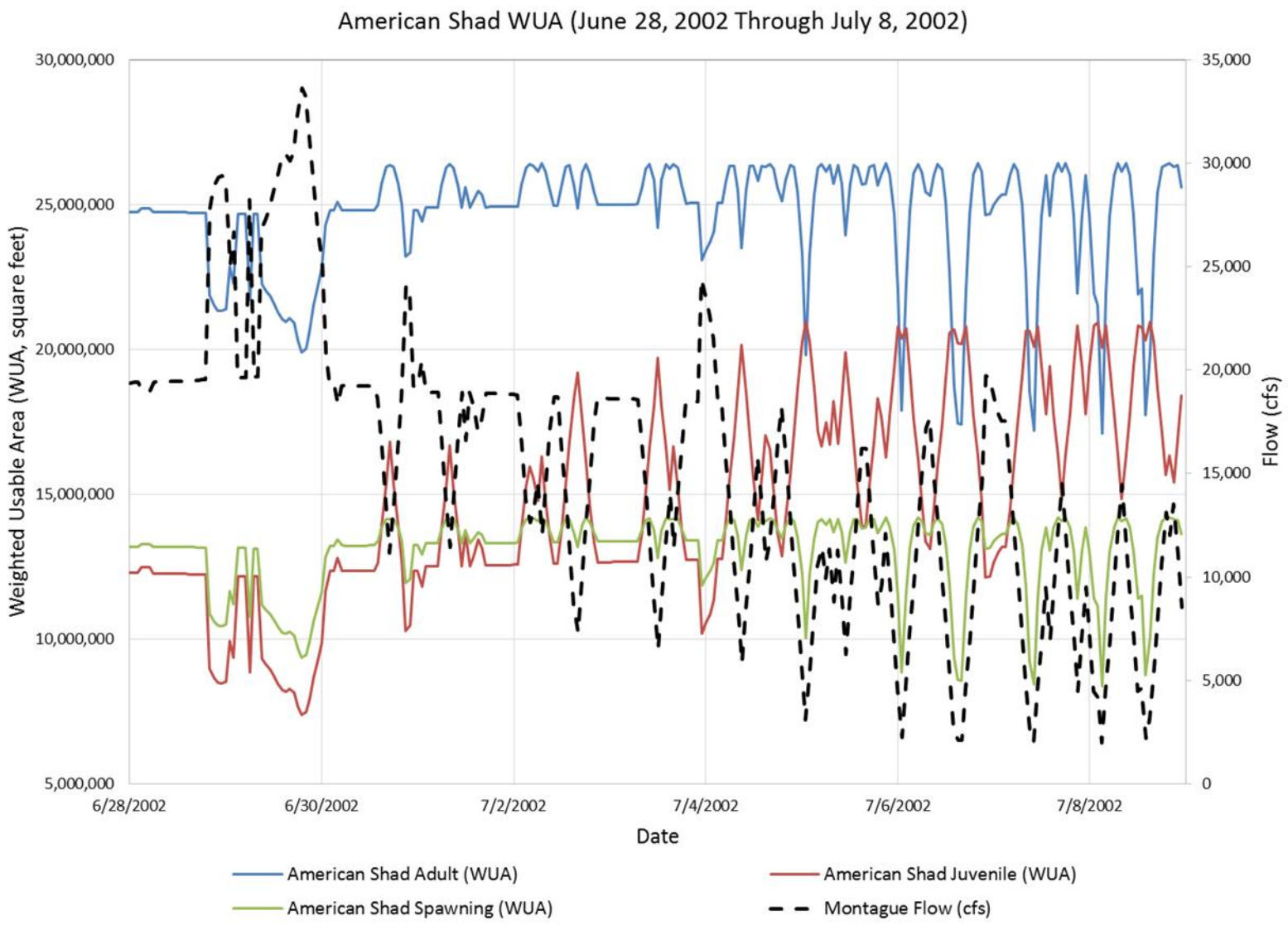


Figure 2.1-1 American Shad (All Life Stages) Habitat Time Series in Reach 4

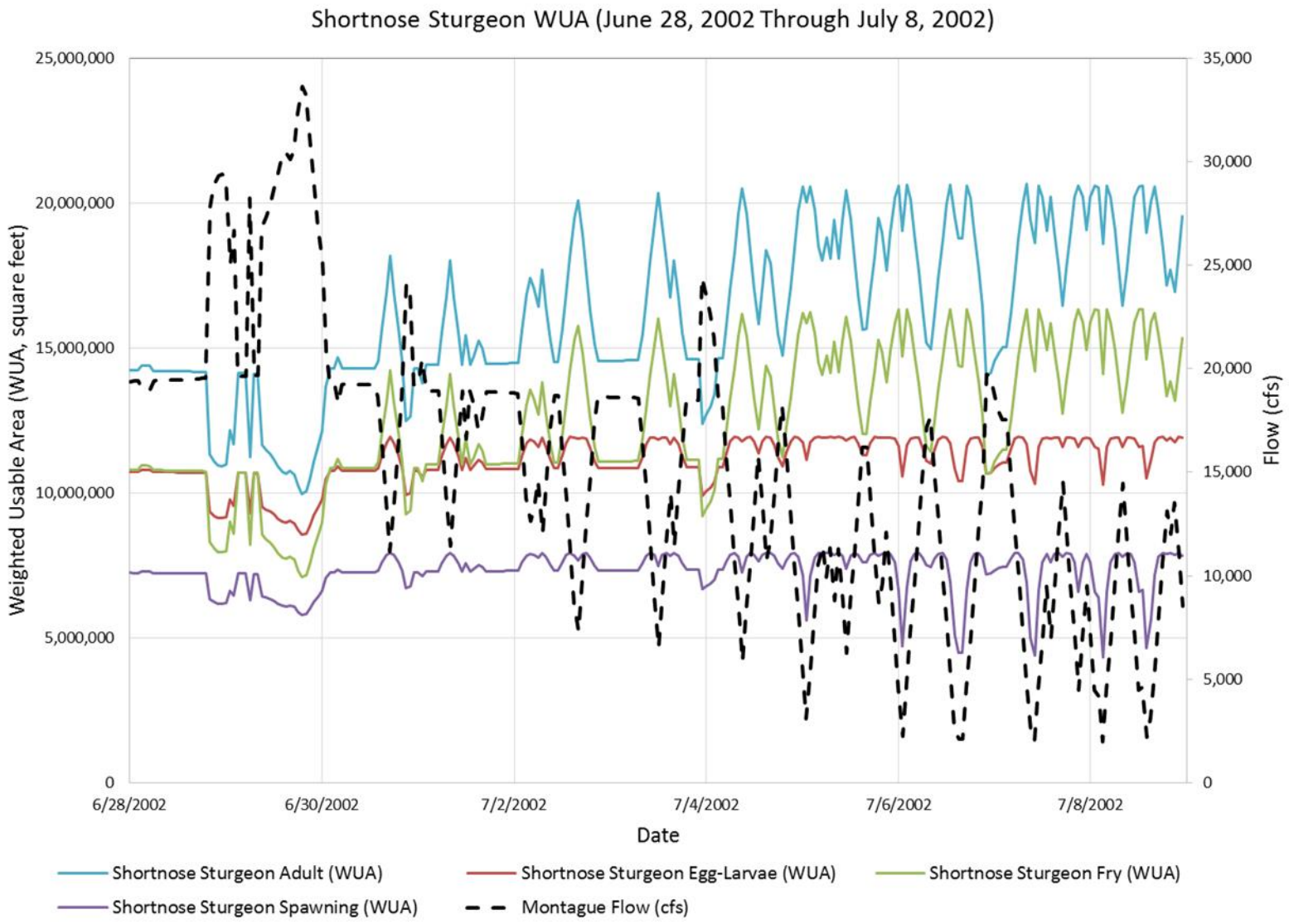


Figure 2.1-2 Shortnose Sturgeon (All Life Stages) Habitat Time Series in Reach 4

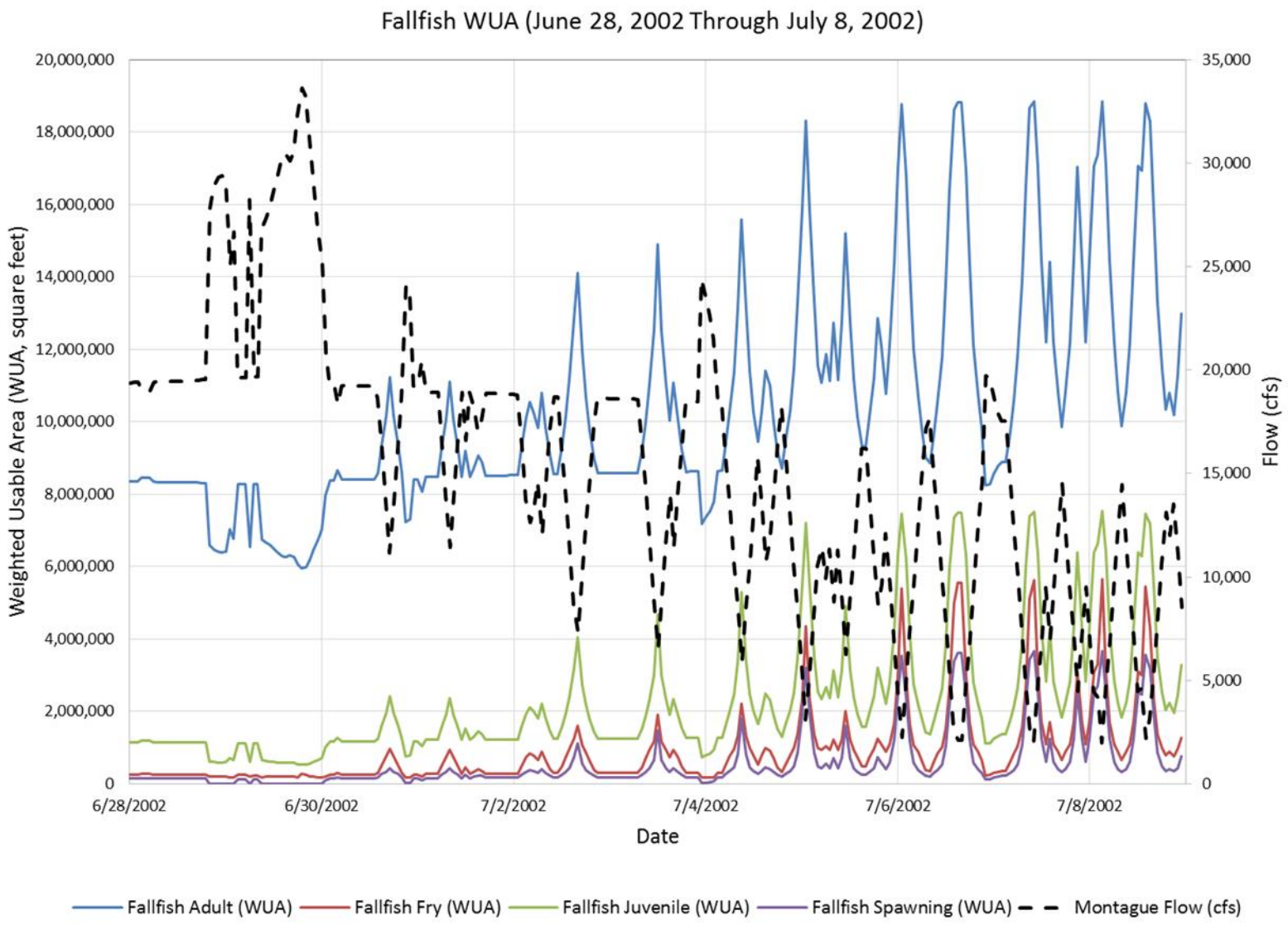


Figure 2.1-3 Fallfish (All Life Stages) Habitat Time Series in Reach 4

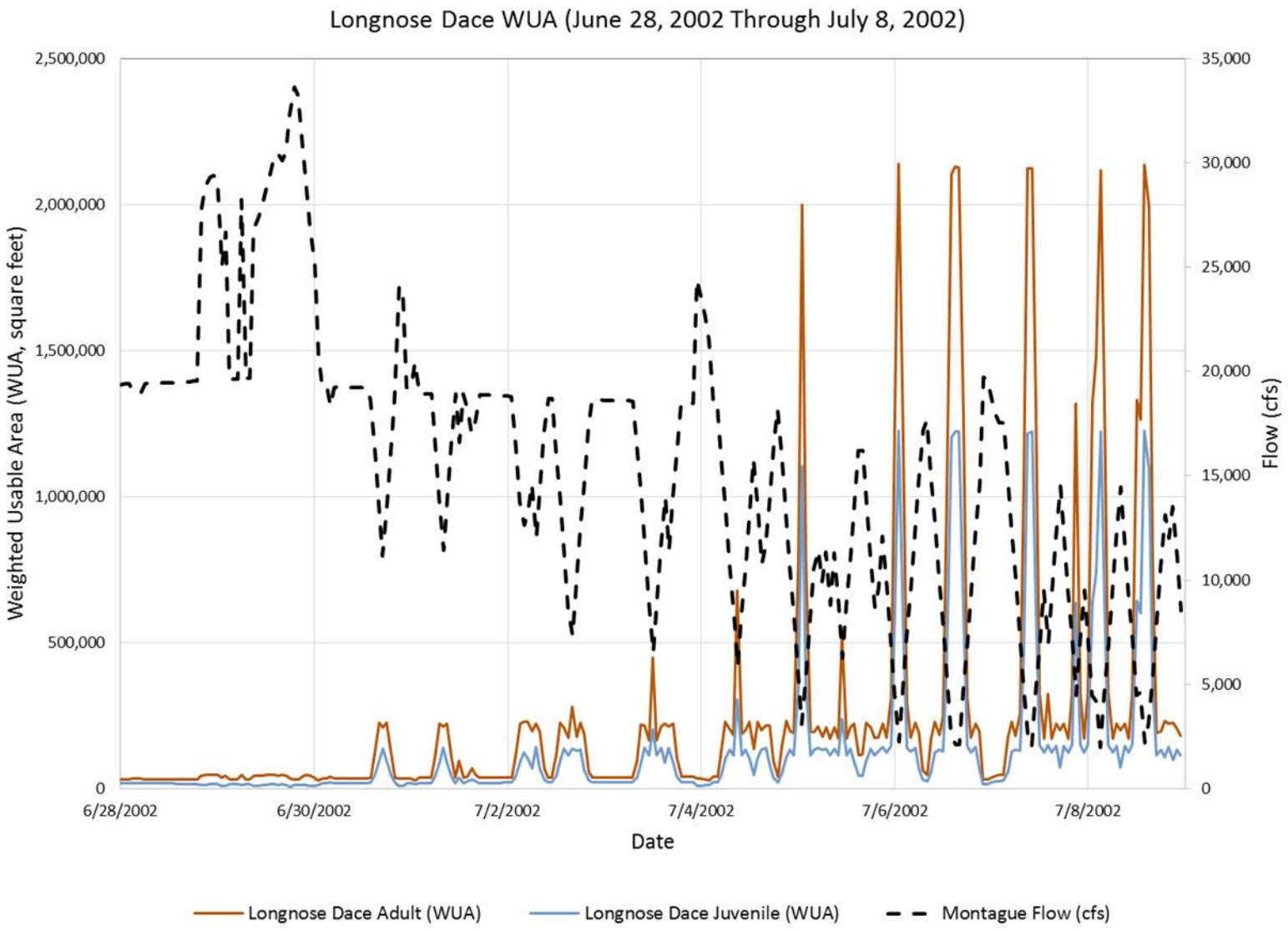


Figure 2.1-4 Longnose Dace (All Life Stages) Habitat Time Series in Reach 4

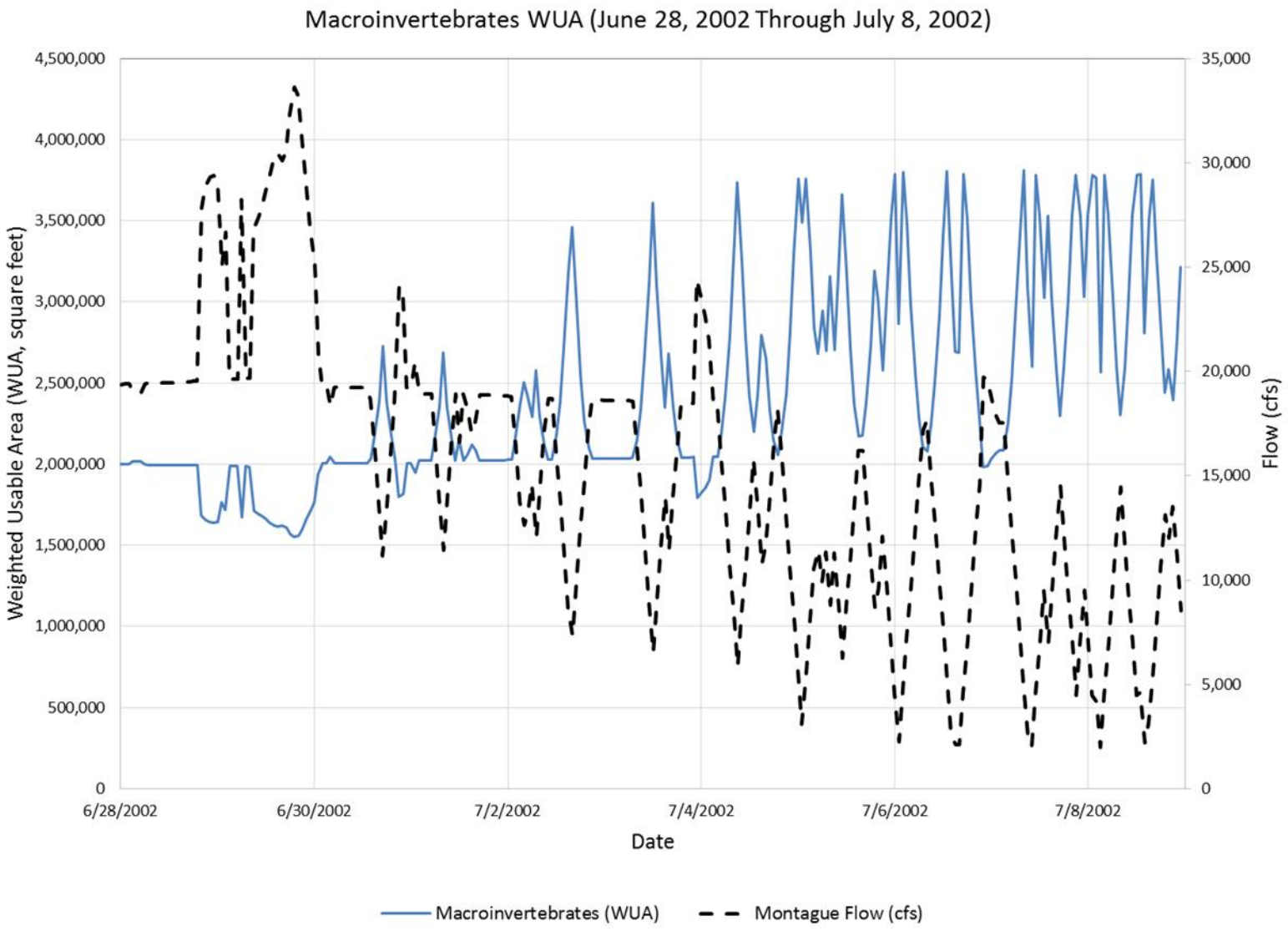


Figure 2.1-5 Macroinvertebrates Habitat Time Series in Reach 4

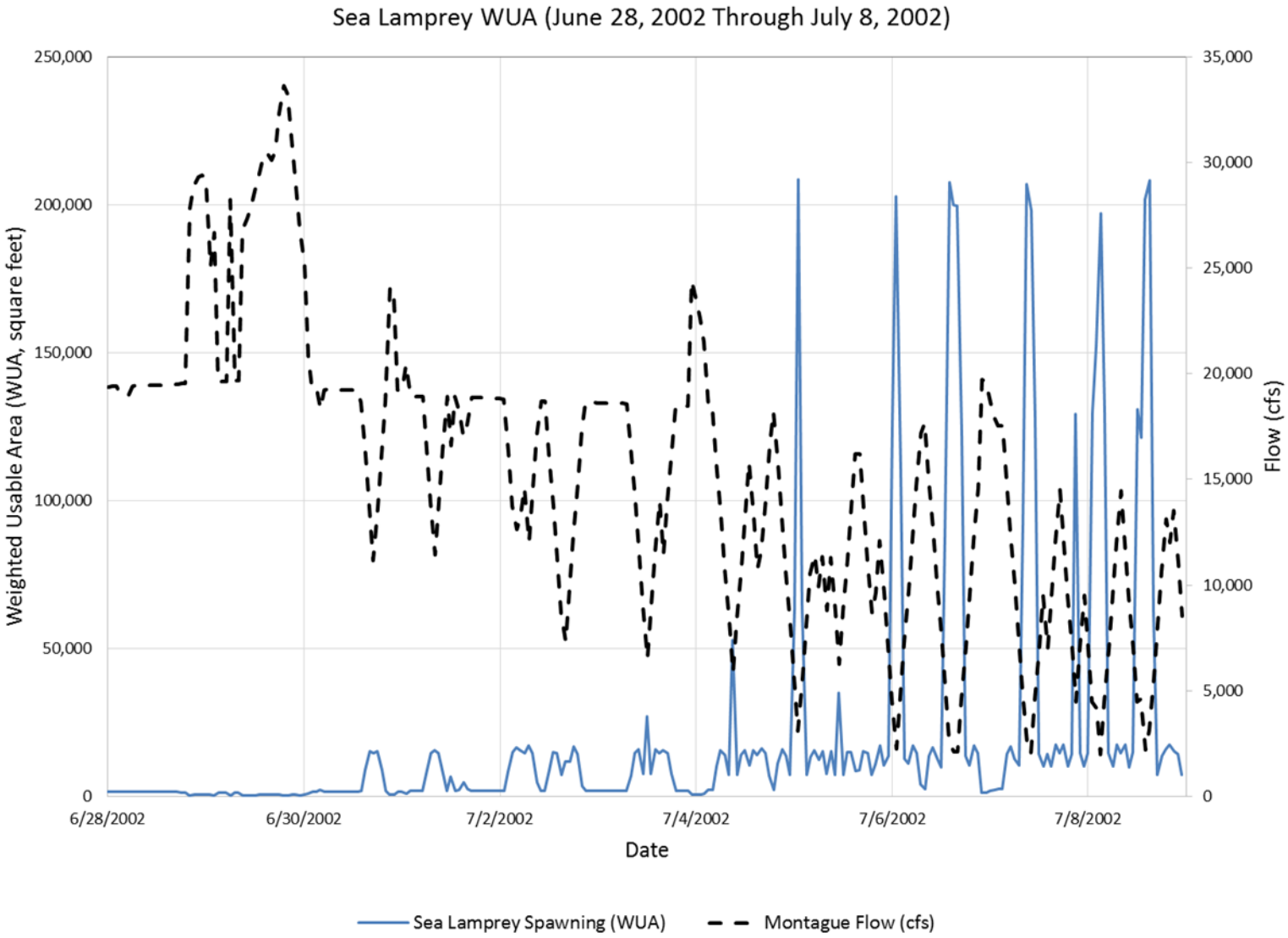


Figure 2.1-6 Sea Lamprey (Spawning) Habitat Time Series in Reach 4

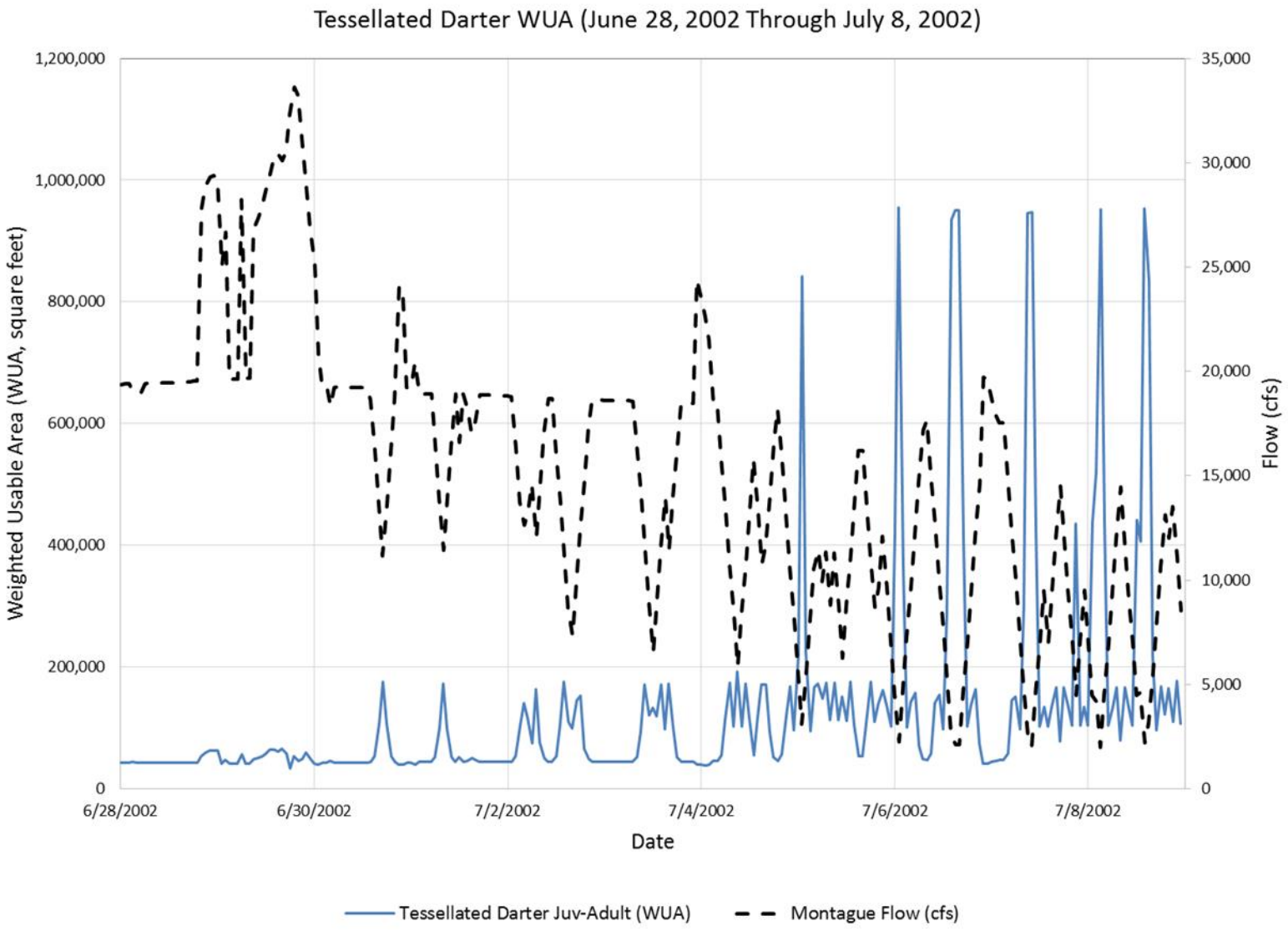


Figure 2.1-7 Tessellated Darter (Juvenile-Adult) Habitat Time Series in Reach 4

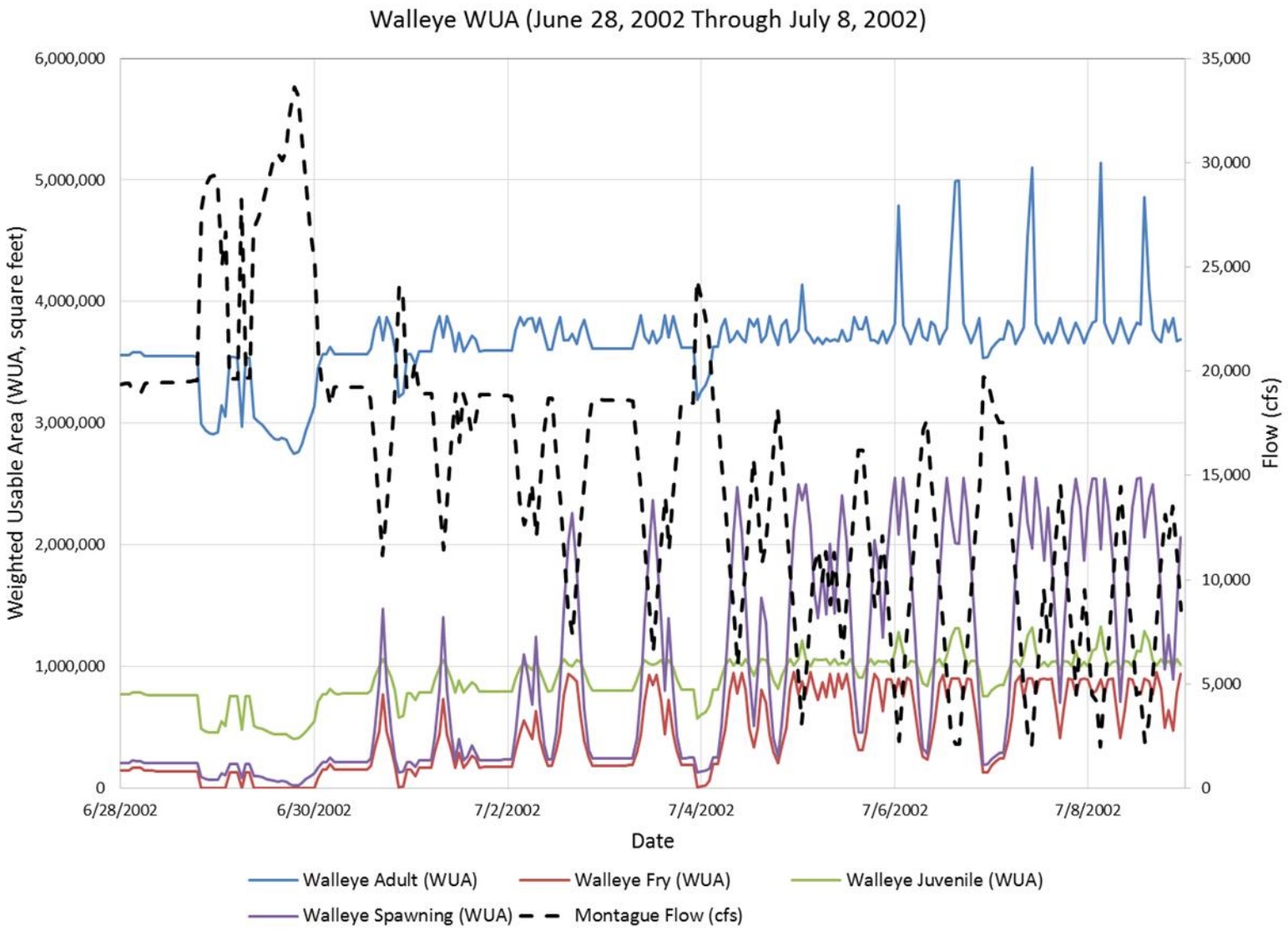


Figure 2.1-8 Walleye (All Life Stages) Habitat Time Series in Reach 4

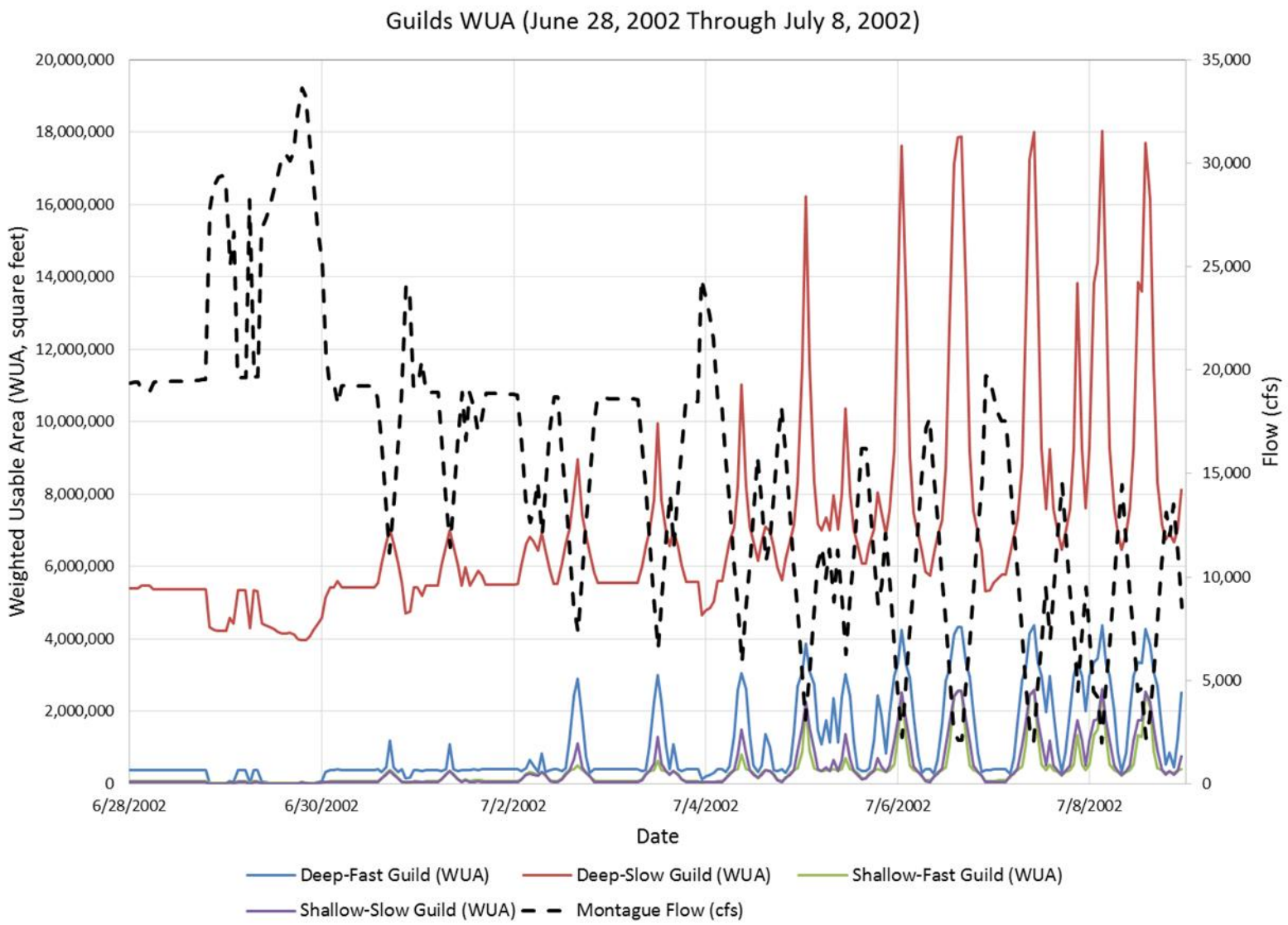


Figure 2.1-9 Deep-Fast, Deep-Slow, Shallow-Fast, and Shallow-Slow Guilds Habitat Time Series in Reach 4

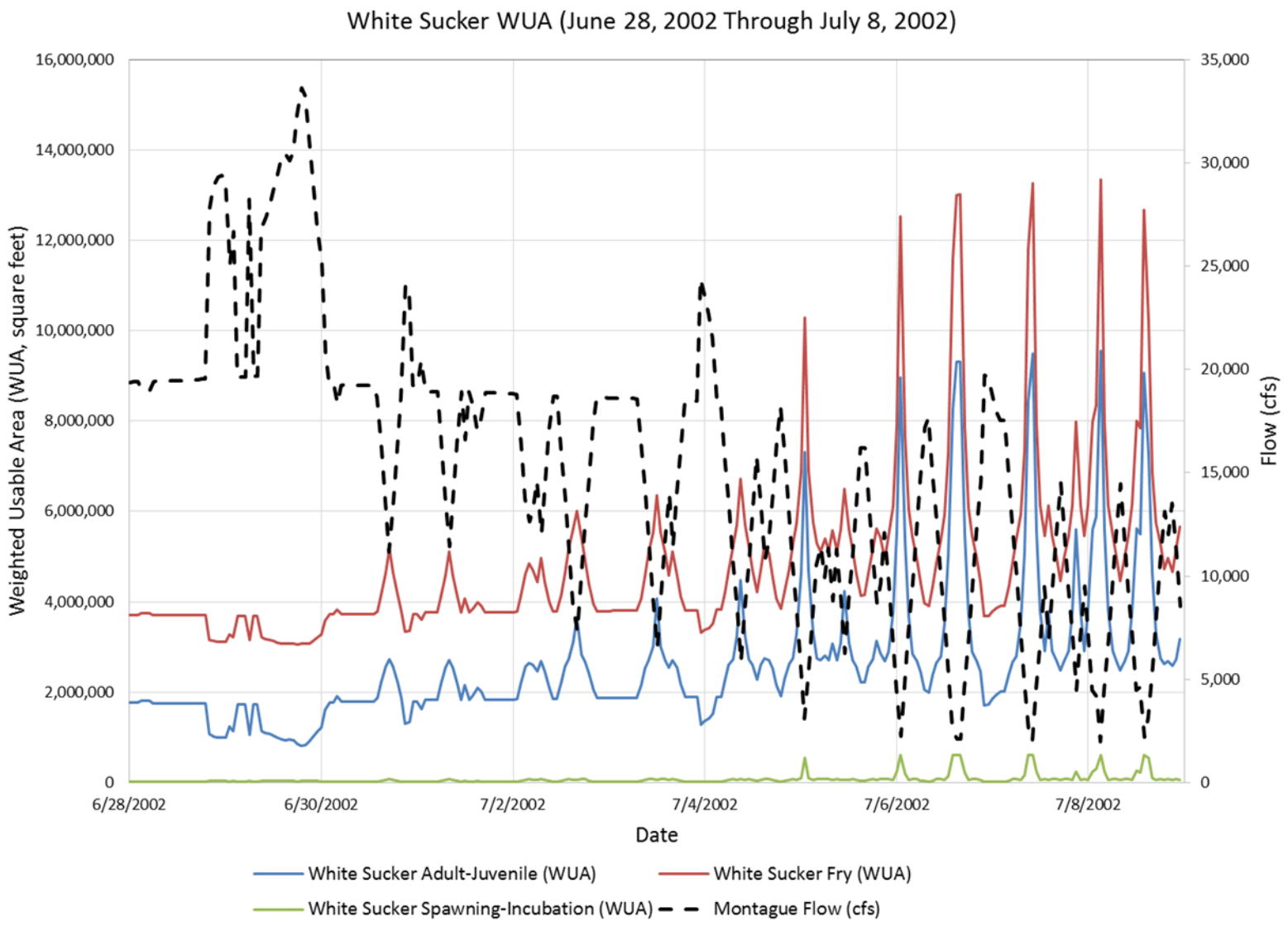


Figure 2.1-10 White Sucker (All Life Stages) Habitat Time Series in Reach 4

2.2 USFWS-8

Comment: Re: Habitat versus Discharge Relationships Reach 3: State-listed mussels have yet to be analyzed. The results of that analysis should be reported in an addendum.

Response: Weighted Usable Area (WUA) Curves providing yellow lampmussel habitat in Reach 3 are included in Attachment B.

2.3 USFWS-9

Comment: Re: Tables 6.2.4-1 through 6.2.4-3 of report: The way data are presented in the tables is confusing. For example, a maximum Weighted Usable Area (WUA) of 2,021,880 square feet is identified for American shad *(Alosa sapidissima)* spawning/incubation at a flow of 5,000 cfs, yet the persistent habitat table (H-9) shows that at a bypass flow of 5,000 cfs and Cabot Station operating at 2,500 cfs, there is 1,988,201 square feet of spawning habitat. These same minor discrepancies appear to carry throughout the tables. FL should explain why the values differ between the steady state and persistent habitat analyses.

Response: A detailed response to USFWS-9 was included in the January 17, 2017 response matrix submitted by FL. However, Table 2.3-1, Table 2.3-2, Table 2.3-3 and Table 2.3-4 below are updated tables including bypass flows of 6,500, 8,000, and 10,000 cfs.

Table 2.3-1: Percentage of Peak WUA relative to Total Wetted Area for Reach 3 with Cabot Station Operating at 2,500 cfs and a Deerfield River Flow of 200 cfs

Species	Life stage	Maximum WUA Bypass Flow (cfs)	Maximum WUA (ft^2)	Total Wetted Area at Maximum WUA Flow (ft^2)	% of Available Habitat at Max WUA Flow
American Shad	Spawning/Incu	10,000 cfs	2,350,864	5,641,943	41.7%
American Shad	Juvenile	5,000 cfs	2,282,496	5,264,901	43.4%
American Shad	Adult	10,000 cfs	2,871,437	5,641,943	50.9%
Shortnose Sturgeon	Spawning	8,000 cfs	1,696,981	5,519,334	30.7%
Shortnose Sturgeon	Egg-Larvae	5,000 cfs	2,551,226	5,264,901	48.5%
Shortnose Sturgeon	Fry	5,000 cfs	1,444,448	5,264,901	27.4%
Shortnose Sturgeon	Juvenile	8,000 cfs	1,908,712	5,519,334	34.6%
Shortnose Sturgeon	Adult	6,500 cfs	1,964,490	5,403,672	36.4%
Fallfish	Spawning/Incu	3,000 cfs	576,656	4,900,966	11.8%
Fallfish	Fry	3,000 cfs	825,054	4,900,966	16.8%
Fallfish	Juvenile	3,000 cfs	1,182,746	4,900,966	24.1%
Fallfish	Adult	3,000 cfs	1,780,782	4,900,966	36.3%
Longnose Dace	Juvenile	2,000 cfs	307,054	4,611,704	6.7%
Longnose Dace	Adult	3,000 cfs	547,316	4,900,966	11.2%
White Sucker	Spawning/Incu	3,000 cfs	162,255	4,900,966	3.3%
White Sucker	Fry	120 cfs	2,032,500	3,569,993	56.9%
White Sucker	Adult/Juvenile	3,000 cfs	839,203	4,900,966	17.1%
Walleye	Spawning	8,000 cfs	1,152,541	5,519,334	20.9%
Walleye	Fry	10,000 cfs	166,471	5,641,943	3.0%
Walleye	Juvenile	10,000 cfs	145,400	5,641,943	2.6%
Walleye	Adult	120 cfs	495,345	3,569,993	13.9%
Tessellated Darter	Adult/Juvenile	2,000 cfs	203,018	4,611,704	4.4%
Sea Lamprey	Spawning/Incu	3,000 cfs	134,295	4,900,966	2.7%
Macroinvertebrates	Larva	6,500 cfs	1,254,252	5,403,672	23.2%
Habitat Guilds	Shallow Slow	120 cfs	961,129	3,569,993	26.9%
Habitat Guilds	Shallow Fast	2,000 cfs	483,874	4,611,704	10.5%
Habitat Guilds	Deep Slow	200 cfs	1,699,409	3,649,920	46.6%
Habitat Guilds	Deep Fast	6,500 cfs	947,458	5,403,672	17.5%
Tidewater Mucket	Juvenile	3,000 (cfs)	181,579	4,900,966	3.7%
Tidewater Mucket	Adult	5,000 (cfs)	222,527	5,264,901	4.2%
Eastern Pondmussel	Juvenile	6,500 (cfs)	74,762	5,403,672	1.4%
Eastern Pondmussel	Adult	3,000 (cfs)	181,579	4,900,966	3.7%
Yellow Lampmussel	Juvenile	3,000 (cfs)	181,579	4,900,966	3.7%
Yellow Lampmussel	Adult	5,000 (cfs)	222,527	4,900,966	4.5%

Table 2.3-2 Percentage of Peak WUA relative to Total Wetted Area for Reach 3 with Cabot Station Operating at 4,500 cfs and a Deerfield River Flow of 200 cfs

Species	Life stage	Maximum WUA Bypass Flow (cfs)	Maximum WUA (ft^2)	Total Wetted Area at Maximum WUA Flow (ft^2)	% of Available Habitat at Max WUA Flow
American Shad	Spawning/Incu	10,000 cfs	2,465,089	5,707,780	43.2%
American Shad	Juvenile	3,000 cfs	2,402,571	5,110,830	47.0%
American Shad	Adult	10,000 cfs	3,044,623	5,707,780	53.3%
Shortnose Sturgeon	Spawning	8,000 cfs	1,786,357	5,591,753	31.9%
Shortnose Sturgeon	Egg-Larvae	5,000 cfs	2,612,727	5,353,240	48.8%
Shortnose Sturgeon	Fry	5,000 cfs	1,495,240	5,353,240	27.9%
Shortnose Sturgeon	Juvenile	5,000 cfs	2,014,859	5,353,240	37.6%
Shortnose Sturgeon	Adult	5,000 cfs	2,080,690	5,353,240	38.9%
Fallfish	Spawning/Incu	2,000 cfs	615,874	4,902,191	12.6%
Fallfish	Fry	1,000 cfs	845,174	4,607,494	18.3%
Fallfish	Juvenile	2,000 cfs	1,279,748	4,902,191	26.1%
Fallfish	Adult	3,000 cfs	1,942,460	5,110,830	38.0%
Longnose Dace	Juvenile	2,000 cfs	296,208	4,902,191	6.0%
Longnose Dace	Adult	2,000 cfs	543,699	4,902,191	11.1%
White Sucker	Spawning/Incu	1,000 cfs	143,079	4,607,494	3.1%
White Sucker	Fry	120 cfs	2,333,703	4,100,961	56.9%
White Sucker	Adult/Juvenile	2,000 cfs	953,610	4,902,191	19.5%
Walleye	Spawning	6,500 cfs	1,154,309	5,484,929	21.0%
Walleye	Fry	120 cfs	203,988	4,100,961	5.0%
Walleye	Juvenile	10,000 cfs	164,345	5,707,780	2.9%
Walleye	Adult	120 cfs	498,647	4,100,961	12.2%
Tessellated Darter	Adult/Juvenile	1,000 cfs	188,754	4,607,494	4.1%
Sea Lamprey	Spawning/Incu	3,000 cfs	128,019	5,110,830	2.5%
Macroinvertebrates	Larva	5,000 cfs	1,251,779	5,353,240	23.4%
Habitat Guilds	Shallow Slow	120 cfs	1,098,720	4,100,961	26.8%
Habitat Guilds	Shallow Fast	1,000 cfs	523,572	4,607,494	11.4%
Habitat Guilds	Deep Slow	300 cfs	1,888,547	4,229,796	44.6%
Habitat Guilds	Deep Fast	5,000 cfs	1,045,934	5,353,240	19.5%
Tidewater Mucket	Juvenile	3,000 (cfs)	181,579	4,900,966	3.7%
Tidewater Mucket	Adult	5,000 (cfs)	222,527	5,264,901	4.2%
Eastern Pondmussel	Juvenile	6,500 (cfs)	74,762	5,403,672	1.4%
Eastern Pondmussel	Adult	3,000 (cfs)	181,579	4,900,966	3.7%
Yellow Lampmussel	Juvenile	3,000 (cfs)	181,579	4,900,966	3.7%
Yellow Lampmussel	Adult	5,000 (cfs)	222,527	4,900,966	4.5%

Table 2.3-3 Percentage of Peak WUA relative to Total Wetted Area for Reach 3 with Cabot Station Operating at 7,000 cfs and a Deerfield River Flow of 200 cfs

Species	Life stage	Maximum WUA Bypass Flow (cfs)	Maximum WUA (ft^2)	Total Wetted Area at Maximum WUA Flow (ft^2)	% of Available Habitat at Max WUA Flow
American Shad	Spawning/Incu	10,000 cfs	2,627,680	5,785,689	45.4%
American Shad	Juvenile	3,000 cfs	2,560,399	5,251,481	48.8%
American Shad	Adult	10,000 cfs	3,275,848	5,785,689	56.6%
Shortnose Sturgeon	Spawning	8,000 cfs	1,880,946	5,679,603	33.1%
Shortnose Sturgeon	Egg-Larvae	5,000 cfs	2,655,661	5,464,035	48.6%
Shortnose Sturgeon	Fry	3,000 cfs	1,580,581	5,251,481	30.1%
Shortnose Sturgeon	Juvenile	3,000 cfs	2,148,224	5,251,481	40.9%
Shortnose Sturgeon	Adult	3,000 cfs	2,217,609	5,251,481	42.2%
Fallfish	Spawning/Incu	700 cfs	624,183	4,886,402	12.8%
Fallfish	Fry	300 cfs	854,381	4,764,555	17.9%
Fallfish	Juvenile	1,000 cfs	1,386,325	4,952,664	28.0%
Fallfish	Adult	1,000 cfs	2,274,837	4,952,664	45.9%
Longnose Dace	Juvenile	500 cfs	259,263	4,822,272	5.4%
Longnose Dace	Adult	700 cfs	478,846	4,886,402	9.8%
White Sucker	Spawning/Incu	500 cfs	135,048	4,822,272	2.8%
White Sucker	Fry	120 cfs	2,672,528	4,686,165	57.0%
White Sucker	Adult/Juvenile	500 cfs	1,301,146	4,822,272	27.0%
Walleye	Spawning	5,000 cfs	1,080,048	5,464,035	19.8%
Walleye	Fry	120 cfs	259,690	4,686,165	5.5%
Walleye	Juvenile	120 cfs	191,661	4,686,165	4.1%
Walleye	Adult	120 cfs	643,593	4,686,165	13.7%
Tessellated Darter	Adult/Juvenile	200 cfs	158,731	4,731,280	3.4%
Sea Lamprey	Spawning/Incu	1,000 cfs	119,562	4,952,664	2.4%
Macroinvertebrates	Larva	5,000 cfs	1,207,274	5,464,035	22.1%
Habitat Guilds	Shallow Slow	120 cfs	991,787	4,686,165	21.2%
Habitat Guilds	Shallow Fast	300 cfs	509,290	4,764,555	10.7%
Habitat Guilds	Deep Slow	500 cfs	2,425,550	4,822,272	50.3%
Habitat Guilds	Deep Fast	3,000 cfs	1,072,859	5,251,481	20.4%
Tidewater Mucket	Juvenile	1,000 (cfs)	202,556	4,952,664	4.1%
Tidewater Mucket	Adult	3,000 (cfs)	235,104	5,251,481	4.5%
Eastern Pondmussel	Juvenile	3,000 (cfs)	79,081	5,251,481	1.5%
Eastern Pondmussel	Adult	1,000 (cfs)	202,556	4,952,664	4.1%
Yellow Lampmussel	Juvenile	1,000 (cfs)	202,556	4,952,664	4.1%
Yellow Lampmussel	Adult	3,000 (cfs)	235,104	5,251,481	4.5%

Table 2.3-4 Percentage of Peak WUA relative to Total Wetted Area for Reach 3 with Cabot Station Operating at 14,000 cfs and a Deerfield River Flow of 200 cfs

Species	Life stage	Maximum WUA Bypass Flow (cfs)	Maximum WUA (ft^2)	Total Wetted Area at Maximum WUA Flow (ft^2)	% of Available Habitat at Max WUA Flow
American Shad	Spawning/Incu	10,000 cfs	2,834,060	5,961,407	47.5%
American Shad	Juvenile	2,000 cfs	2,717,823	5,529,020	49.2%
American Shad	Adult	8,000 cfs	3,750,369	5,886,469	63.7%
Shortnose Sturgeon	Spawning	10,000 cfs	2,022,058	5,961,407	33.9%
Shortnose Sturgeon	Egg-Larvae	8,000 cfs	2,688,983	5,886,469	45.7%
Shortnose Sturgeon	Fry	3,000 cfs	1,623,318	5,612,533	28.9%
Shortnose Sturgeon	Juvenile	3,000 cfs	2,387,668	5,612,533	42.5%
Shortnose Sturgeon	Adult	3,000 cfs	2,411,757	5,612,533	43.0%
Fallfish	Spawning/Incu	1,000 cfs	252,754	5,439,761	4.6%
Fallfish	Fry	500 cfs	355,081	5,369,470	6.6%
Fallfish	Juvenile	1,000 cfs	835,582	5,439,761	15.4%
Fallfish	Adult	1,000 cfs	2,510,276	5,439,761	46.1%
Longnose Dace	Juvenile	2,000 cfs	75,967	5,529,020	1.4%
Longnose Dace	Adult	2,000 cfs	136,099	5,529,020	2.5%
White Sucker	Spawning/Incu	5,000 cfs	25,776	5,753,693	0.4%
White Sucker	Fry	300 cfs	2,435,549	5,341,766	45.6%
White Sucker	Adult/Juvenile	1,000 cfs	1,138,260	5,439,761	20.9%
Walleye	Spawning	5,000 cfs	610,524	5,753,693	10.6%
Walleye	Fry	120 cfs	240,439	5,298,908	4.5%
Walleye	Juvenile	700 cfs	239,228	5,393,620	4.4%
Walleye	Adult	300 cfs	938,221	5,341,766	17.6%
Tessellated Darter	Adult/Juvenile	2,000 cfs	47,028	5,529,020	0.9%
Sea Lamprey	Spawning/Incu	3,000 cfs	22,772	5,612,533	0.4%
Macroinvertebrates	Larva	5,000 cfs	890,586	5,753,693	15.5%
Habitat Guilds	Shallow Slow	120 cfs	386,037	5,298,908	7.3%
Habitat Guilds	Shallow Fast	1,000 cfs	192,389	5,439,761	3.5%
Habitat Guilds	Deep Slow	200 cfs	2,509,620	5,313,816	47.2%
Habitat Guilds	Deep Fast	3,000 cfs	612,566	5,612,533	10.9%
Tidewater Mucket	Juvenile	2,000 (cfs)	200,190	5,529,020	3.6%
Tidewater Mucket	Adult	5,000 (cfs)	243,458	5,753,693	4.2%
Eastern Pondmussel	Juvenile	3,000 (cfs)	83,421	5,612,533	1.5%
Eastern Pondmussel	Adult	2,000 (cfs)	200,190	5,529,020	3.6%
Yellow Lampmussel	Juvenile	2,000 (cfs)	200,190	5,529,020	3.6%
Yellow Lampmussel	Adult	5,000 (cfs)	243,458	5,753,693	4.2%

2.4 USFWS-18 (and MADFW-1)

Comment: Re: Habitat Time Series (Reach 4): As noted in our comments under Section 5.5.4, we do not believe that converting habitat versus time curves to monthly habitat duration curves is appropriate. The objective of this type of analysis is to assess how project operations affect target species/life stage habitat at the relevant time step. In this case, because Turners Falls Project operates as a daily peaking facility, a daily time step is appropriate. FL should generate curves that represent habitat versus time on a sub- daily time step for representative seasonal periods.

Likewise, habitat time series should not be restricted to certain life stages. One of the benefits of this type of analysis is the ability to understand how temporal changes to the quantity of suitable habitat could impact any particular life stage. For instance, a theoretical habitat time series curve for juvenile fallfish in Reach 4 under typical August flow conditions would show nearly 8 million square feet of habitat during base flow conditions interspersed with dramatic drops down to 2 million square feet of habitat during peak generation. The frequency, duration and magnitude of those fluctuations have important implications on intraspecific competition as suitable habitat becomes restricted/limiting.

Output format and specific production runs for the Habitat Time Series analysis for Reach 3 were discussed at a meeting held on December 2, 2016. FL and the stakeholders agreed that FL would provide habitat versus time hydrographs (e.g., one week per month) for the current operating conditions using a typical water year (e.g., 2002) for the species and life stages used in the persistence and steady state analyses for that reach. Based on those results, stakeholders will be able to provide additional recommended run scenarios (i.e., using different water years and/or operational constraints) if needed.

Response: Figures providing habitat time series for Reach 4 were provided earlier in FL's response to USFWS-6.

For existing (baseline conditions) flows for one week in calendar year 2002 were selected and matched with the habitat versus flow curves for the various species and life stages to yield time varying habitat. The same 11-day period (June 28-July 8, 2002) was selected; the same as Reach 4. FL computed the habitat time series for the following species and life stages in Reach 3:

- American Shad (all life stages)- Figure 2.4-1
- Shortnose sturgeon (all life stages)- Figure 2.4-2
- Fallfish (all life stages)- Figure 2.4-3
- Longnose dace (all life stages)- Figure 2.4-4
- Macroinvertebrates – Figure 2.4-5
- Sea Lamprey (Spawning)- Figure 2.4-6
- Tessellated Darter (Juvenile-Adult)- Figure 2.4-7
- Walleye (all life stages)- Figure 2.4-8
- Deep-Fast, Deep-Slow, Shallow-Fast, Shallow-Slow Guilds- Figure 2.4-9
- White Sucker (all life stages)- Figure 2.4-10
- Adult and Juvenile Tidewater Mucket Mussel, Eastern Pondmussel and Yellow Lampmussel- Figure 2.4-11

The figures show the Cabot discharge, Deerfield River flow and Bypass flow from the operations model under baseline conditions.

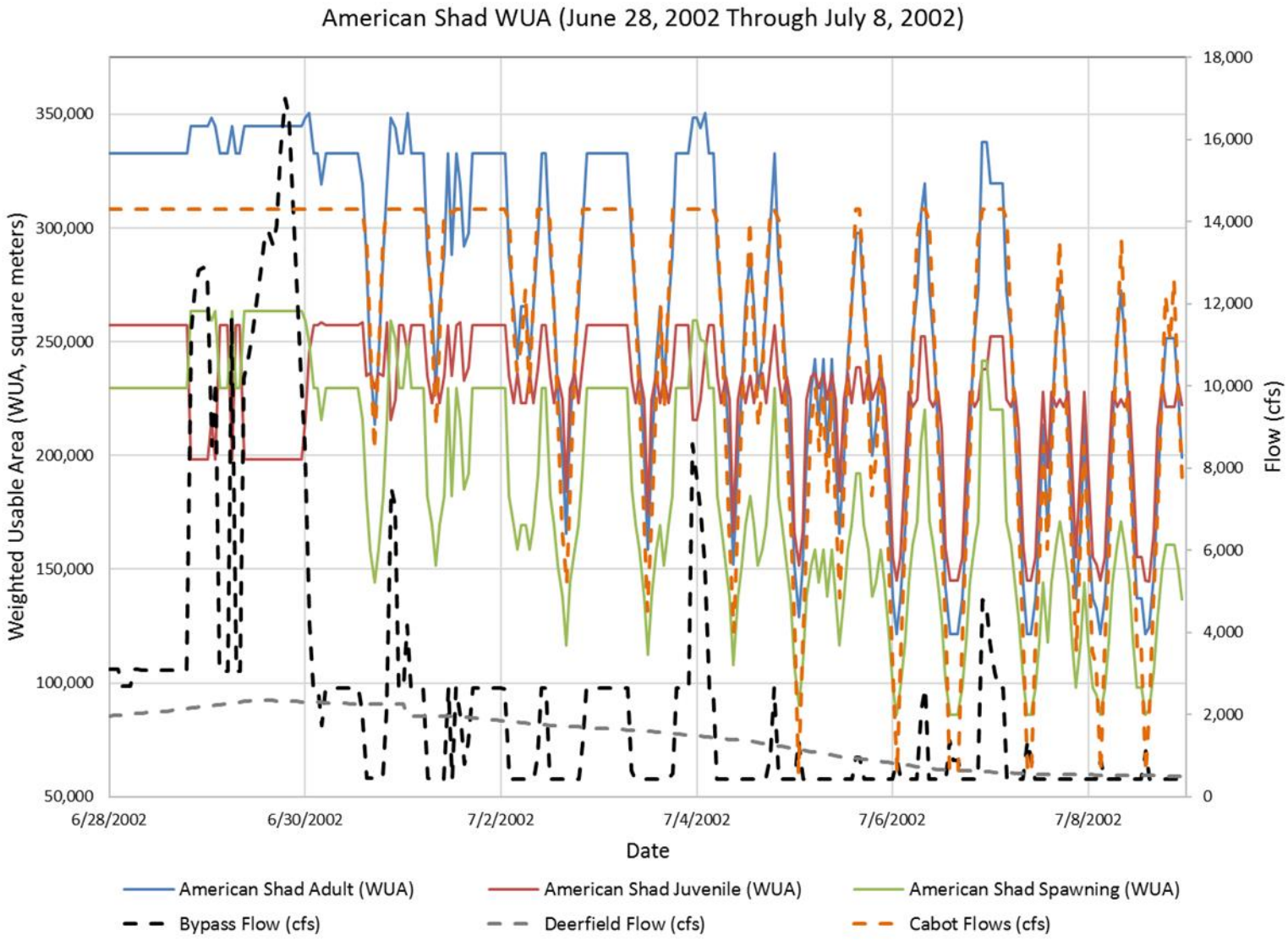


Figure 2.4-1 American Shad (all Life Stage) Habitat Time Series in Reach 3

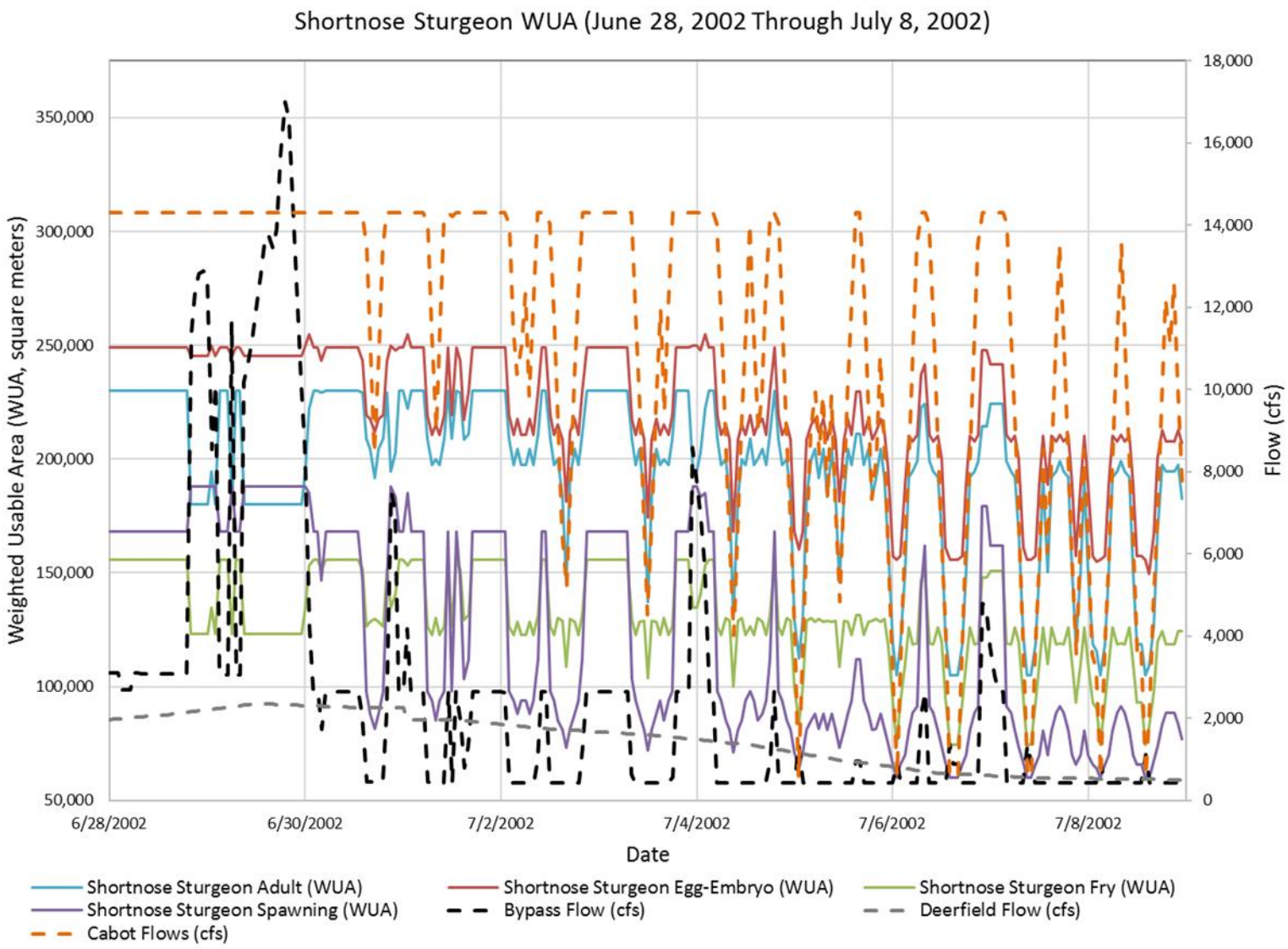


Figure 2.4-2 Shortnose sturgeon (all Life Stages) Habitat Time Series in Reach 3

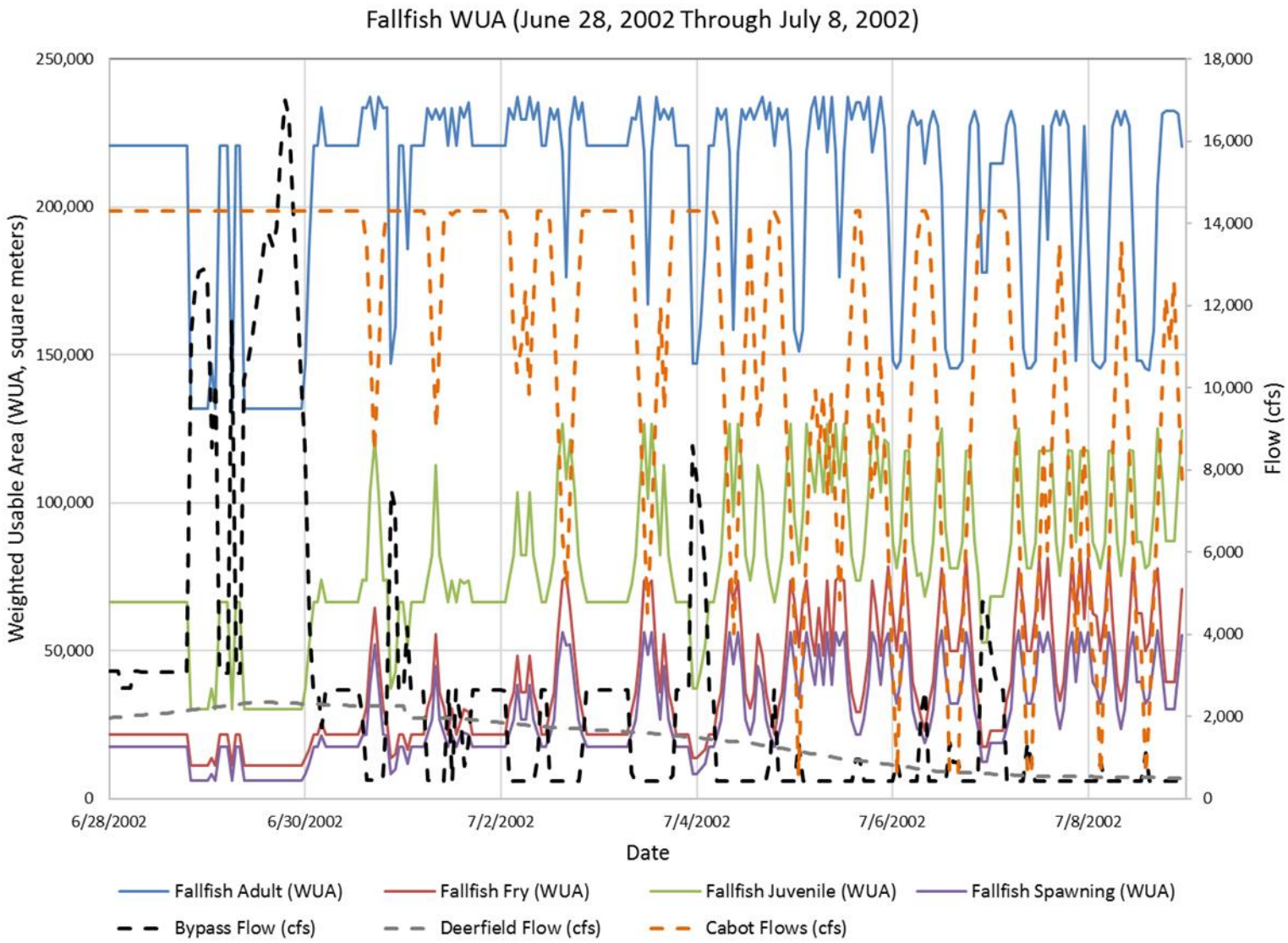


Figure 2.4-3 Fallfish (all life stages) Habitat Time Series in Reach 3

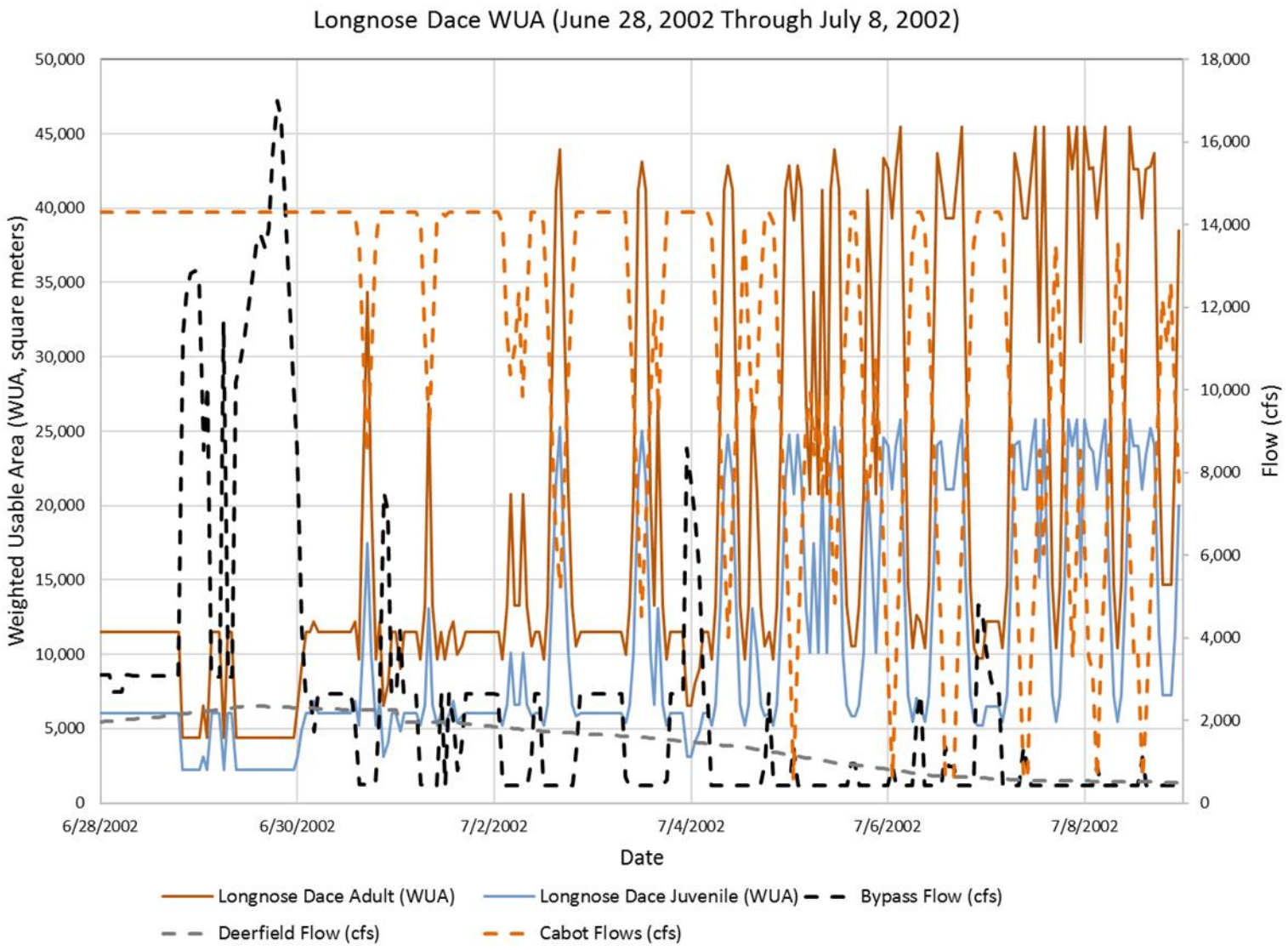


Figure 2.4-4 Longnose dace (all life stages) Habitat Time Series in Reach 3

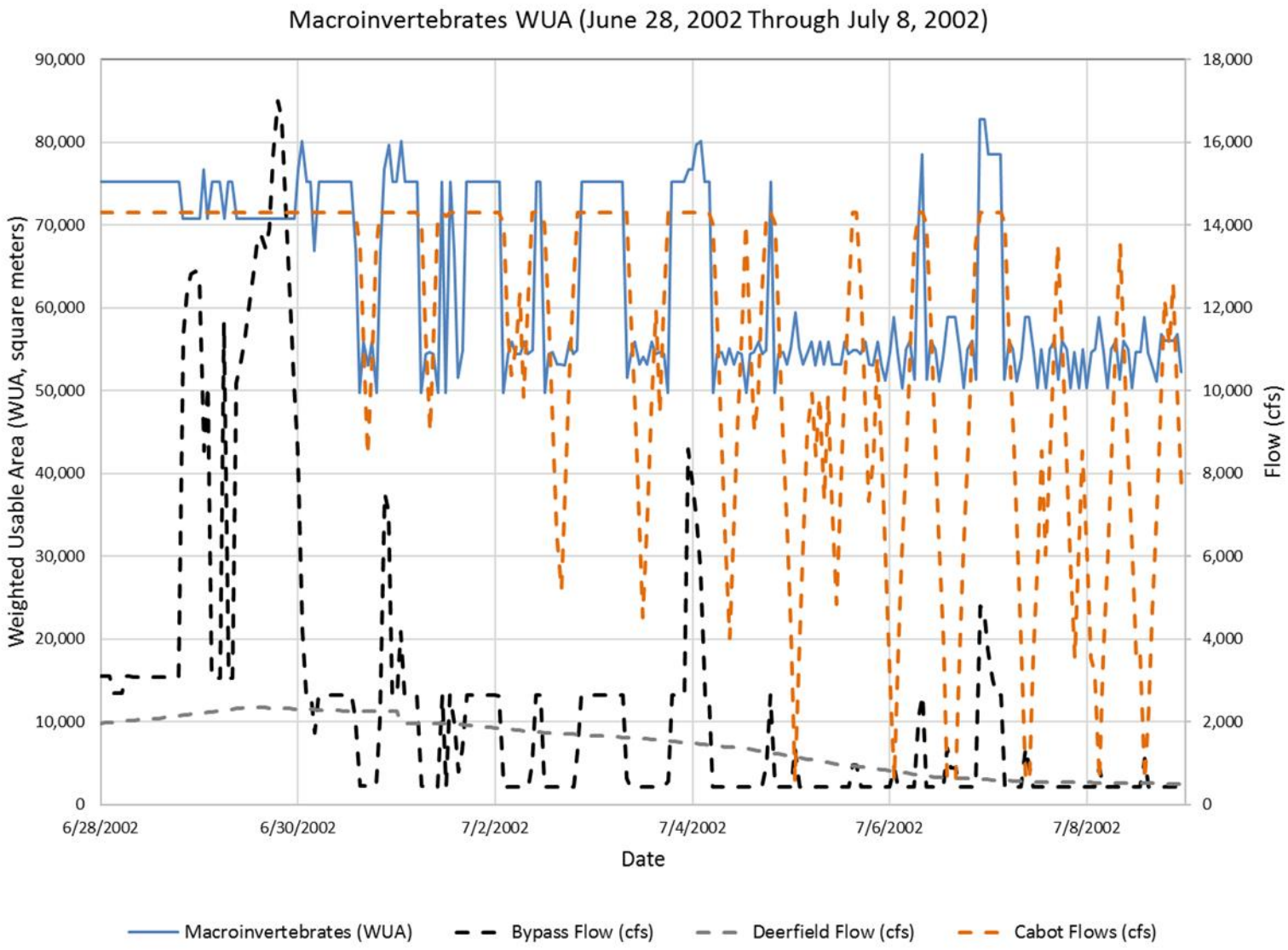


Figure 2.4-5 Macroinvertebrates Habitat Time Series in Reach 3

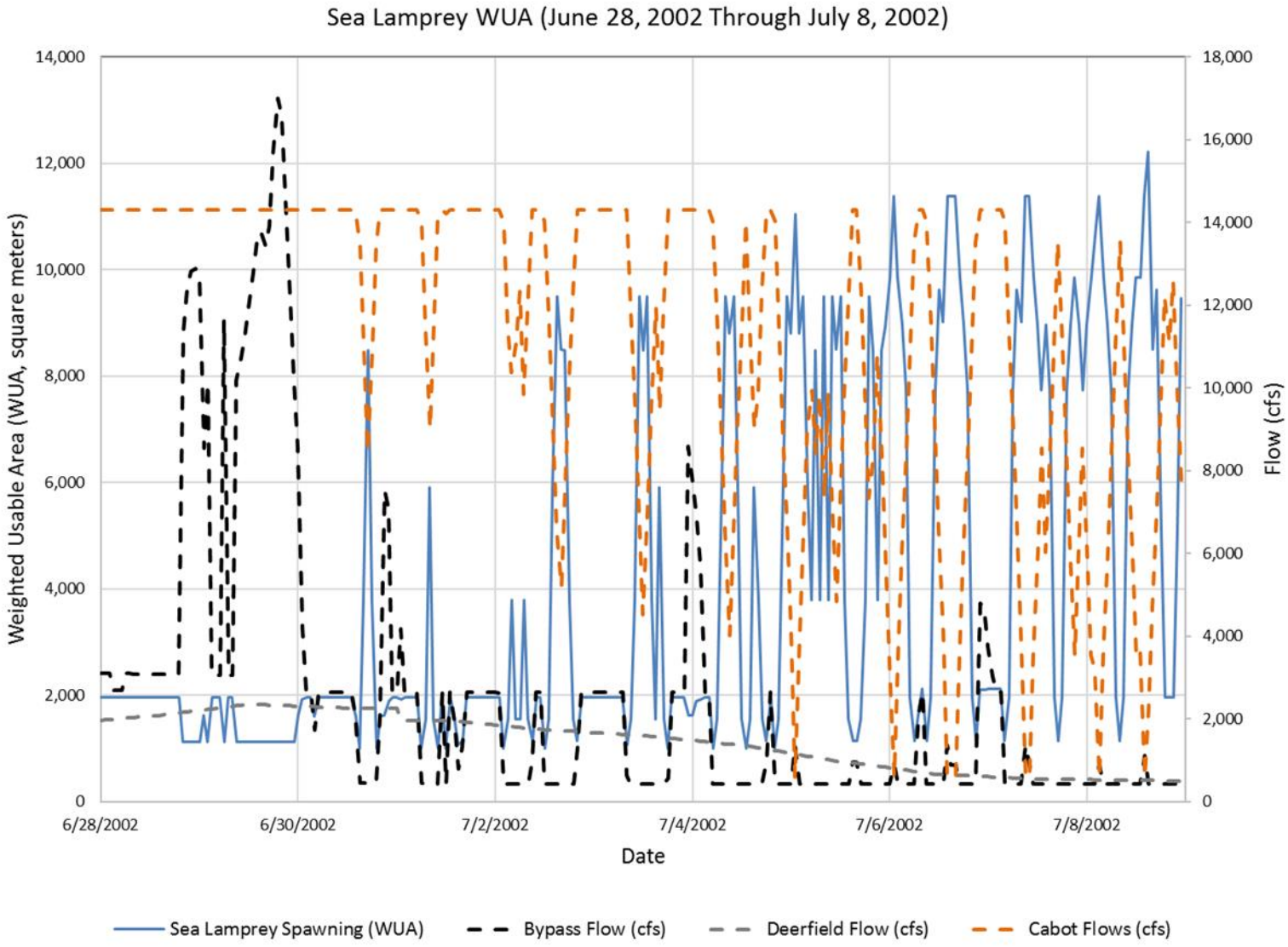


Figure 2.4-6 Sea Lamprey (Spawning) Habitat Time Series in Reach 3

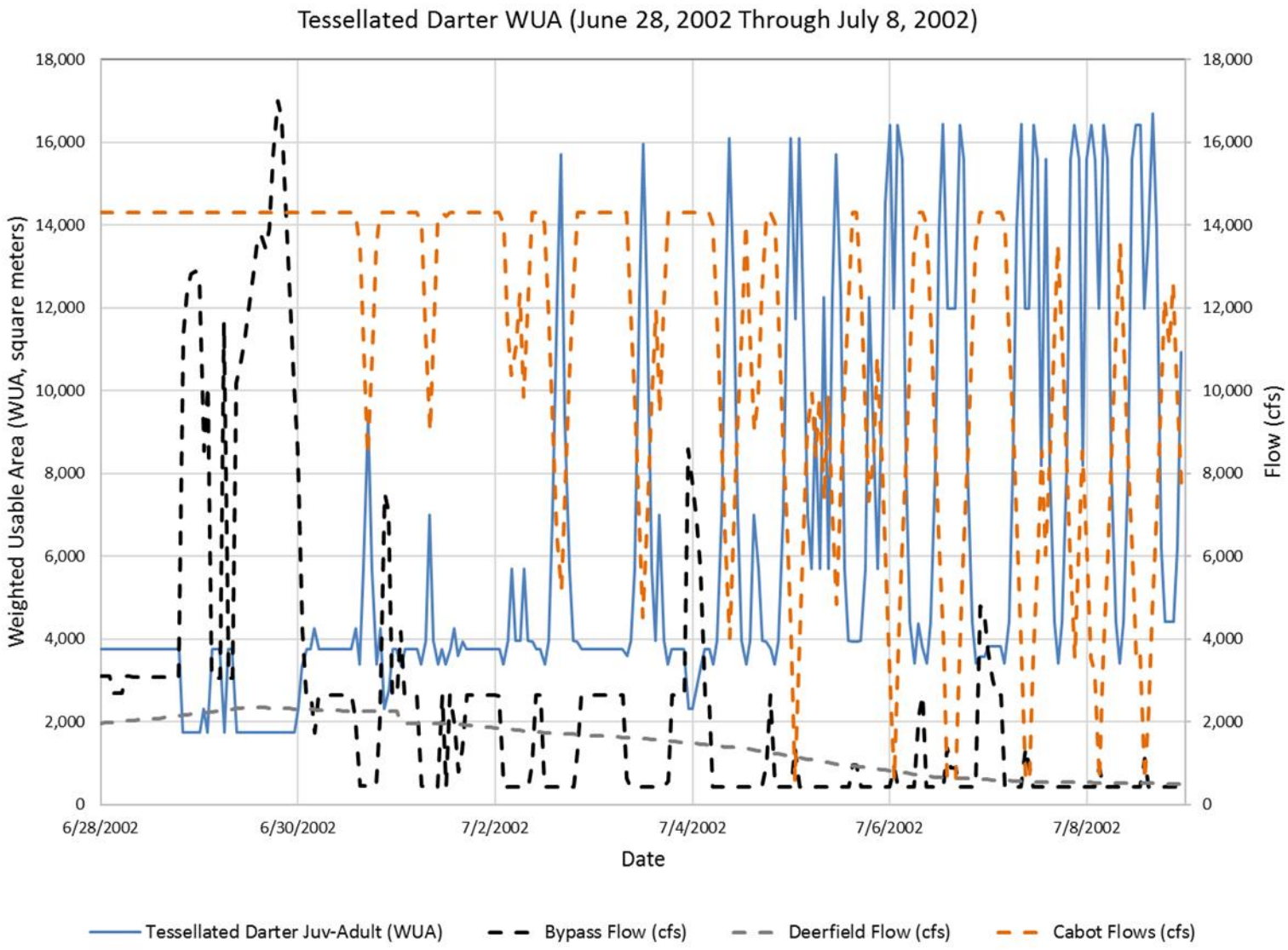


Figure 2.4-7 Tessellated Darter (Juvenile-Adult) Habitat Time Series in Reach 3

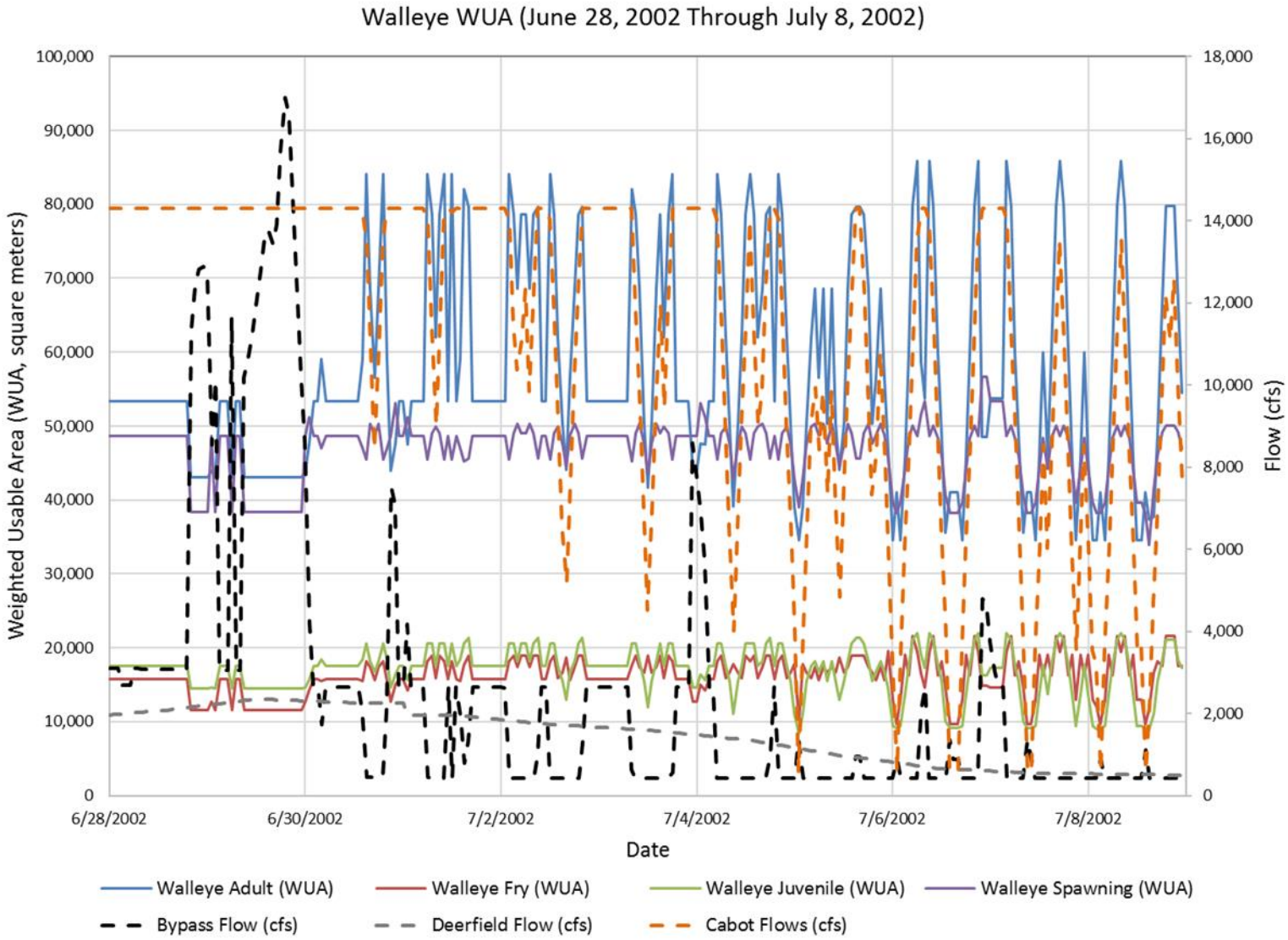


Figure 2.4-8 Walleye (all life stages) Habitat Time Series in Reach 3

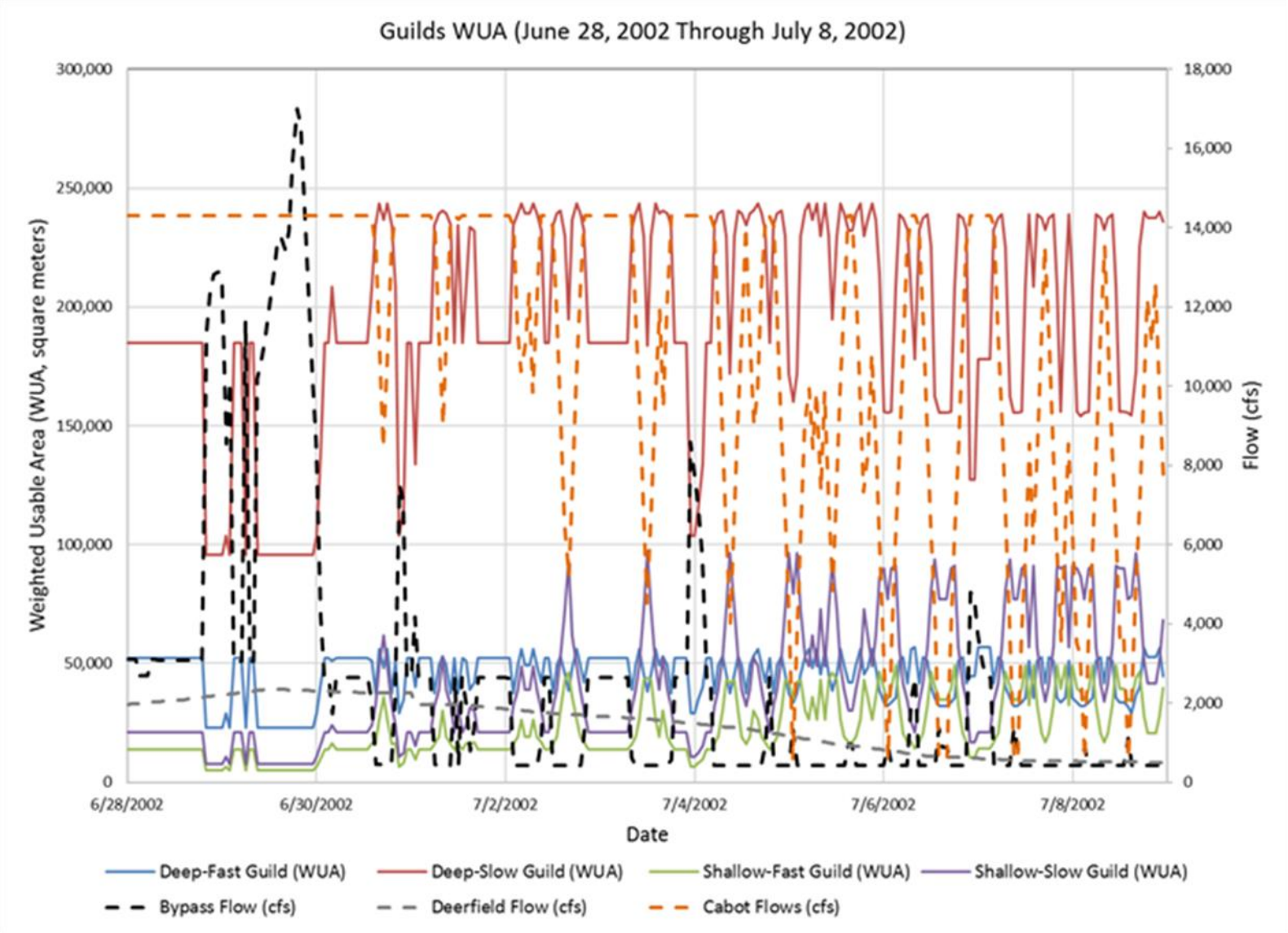


Figure 2.4-9 Deep-Fast, Deep-Slow, Shallow-Fast, and Shallow-Slow Guilds Habitat Time Series in Reach 3

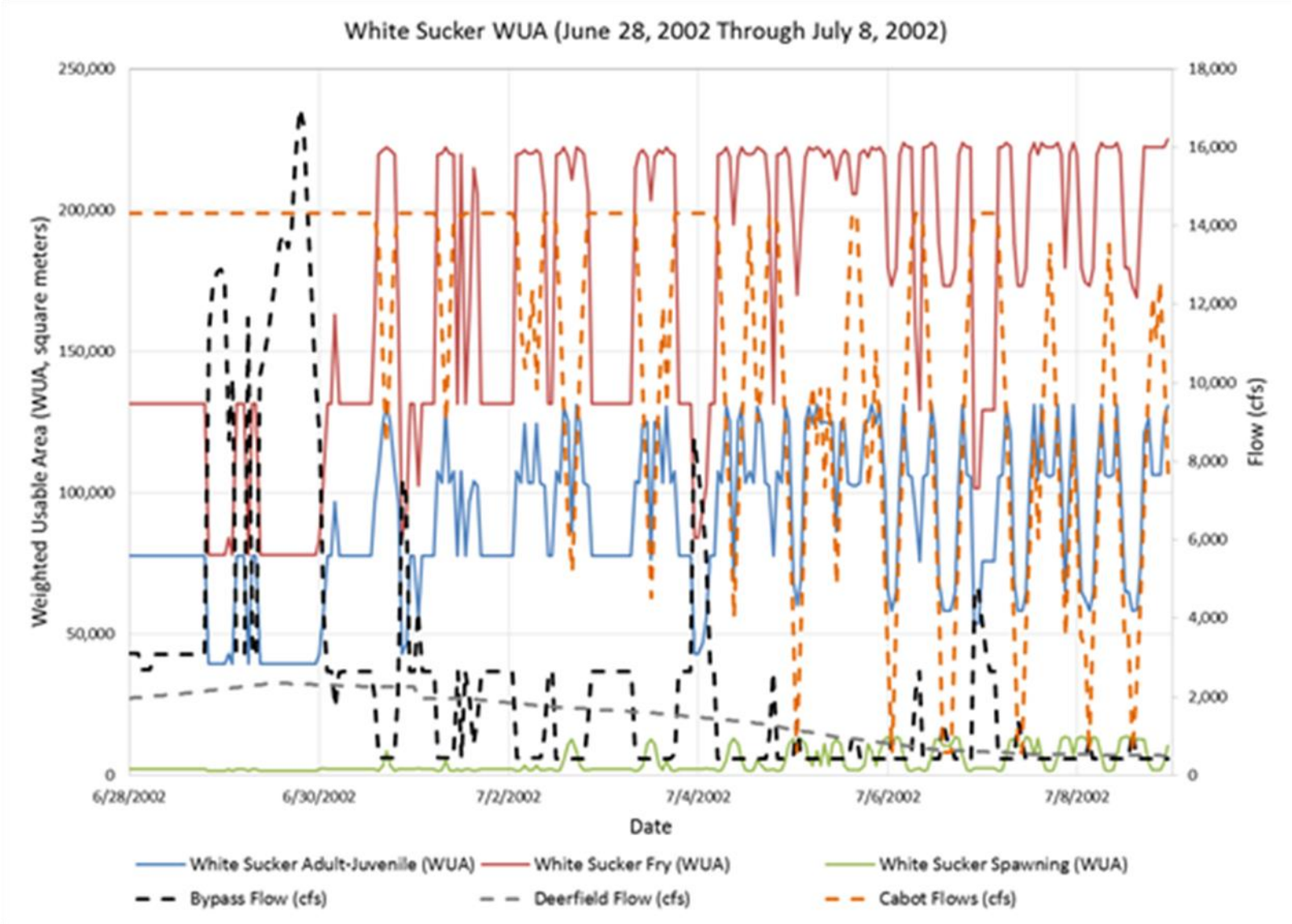


Figure 2.4-10 White Sucker (all life stages) Habitat Time Series in Reach 3

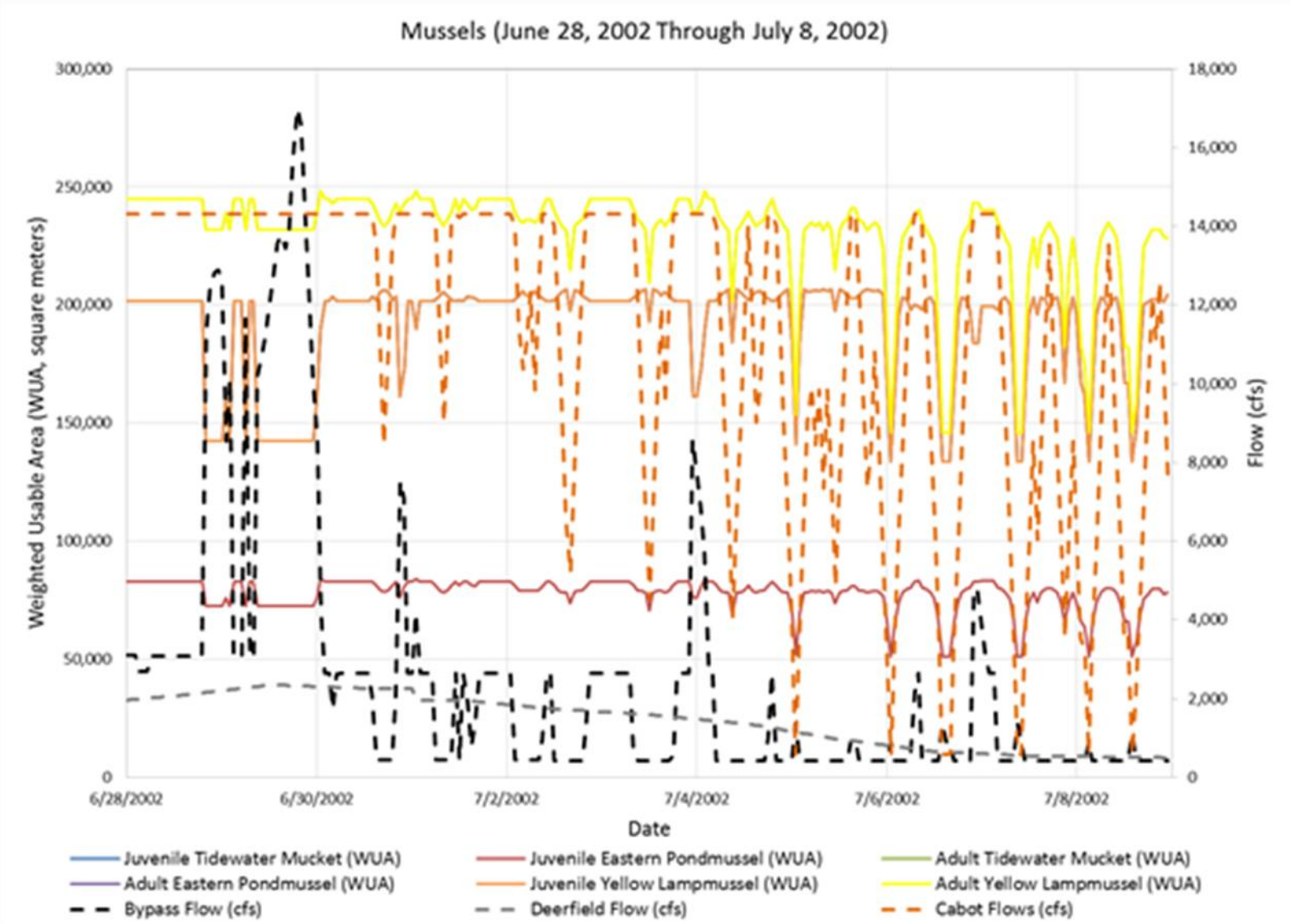


Figure 2.4-11 Adult and Juvenile Tidewater Mucket Mussel, Eastern Pondmussel, and Yellow Lampmussel Habitat Time Series in Reach 3

2.5 USFWS-21 (and MADFW-17)

Comment: Re: Appendix F - Reach 4 - Habitat Versus Discharge Relationships: It is unclear why the x-axis has flows well beyond the operational capacity of the project. We recommend that the figures only graph flows from 0 cfs up to 20,000 cfs (or 30,000); that way, it would be easier to see what flows correspond to what WUA in the flow range controlled by the project.

Response: Based on this comment, the figures were revised to limit the x-axis to a maximum value of 20,000 cfs and the figures are in Attachment C. Figure 2.5-1 is an example of habitat versus flow curves for all life stages of American Shad in Reach 4.

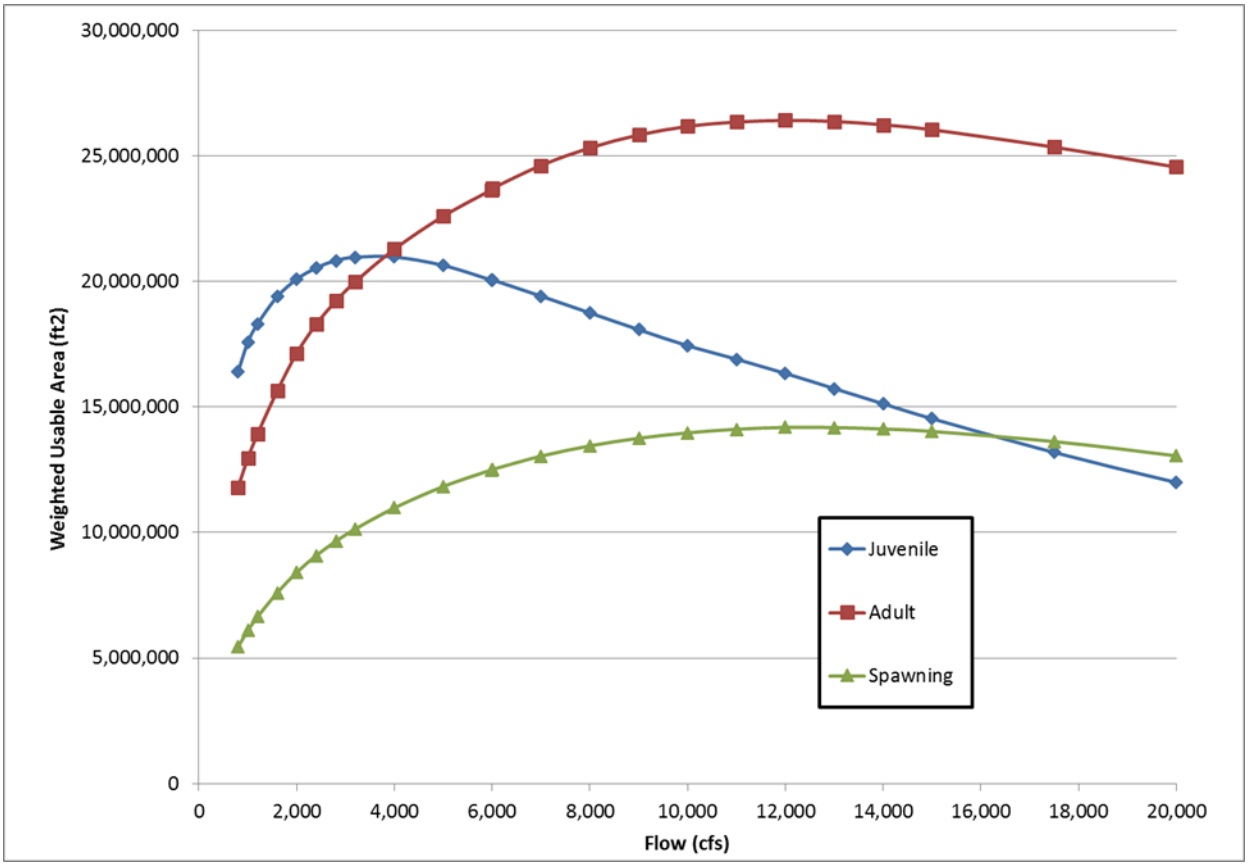


Figure 2.5-1 Example WUA Curve for American Shad (all Life Stages)

2.6 USFWS-22

Comment: Re: Appendix J – Reach 4 – Habitat Time Series Results – Monthly Habitat Duration Curves: The graphs in this section portray monthly habitat duration curves. For daily peaking projects, monthly habitat duration curves do little to inform how habitat changes over the course of a peaking cycle. FL should redo the figures to show habitat on the y-axis, and time (either daily or weekly) on the x-axis, by species/life stage for each reach for a representative time period (e.g., a week in late May/early June for shad spawning). In order to capture a range of conditions, the analysis should be run for a representative "wet," "dry," and "average" water year.

Response: See the figures in response to USFWS-6.

2.7 NMFS-1

Comment: Re: Appendix E - Figures E-1, E-2 and E-3 display WUA and percent of maximum WUA results for spawning and incubation, juvenile and adult life stages of American shad, respectively. The overall trend of these results is that for a given Cabot Station flow, increasing flows in the bypass reach increase the total amount of usable area for American shad of all life stages in Reach 3. These results do not display at what flow the maximum WUA is achieved.

Response: Based on a request from stakeholders at a meeting held on December 2, 2016, additional model runs with higher bypass flows (6,500 and 8,000) were conducted for the 2D modeling area in Reach 3. To create an upper boundary for bypass flows, in a habitat modeling sense, FL also completed modeling runs with a bypass flow of 10,000 cfs. The revised figures and diagrams are included in Attachment B to reflect bypass flows of 6,500, 8,000 and 10,000 cfs. These figures and diagrams show that for some species and life stages, such as American Shad Spawning and Shortnose Sturgeon Spawning, even at very high bypass flows, and maximum generation flows from Cabot, the WUA curves continue a slight upward slope. Figure 2.7-1 is the revised WUA curve for American Shad spawning which indicates a slight increase in WUA even between bypass flows of 8,000 to 10,000 cfs.

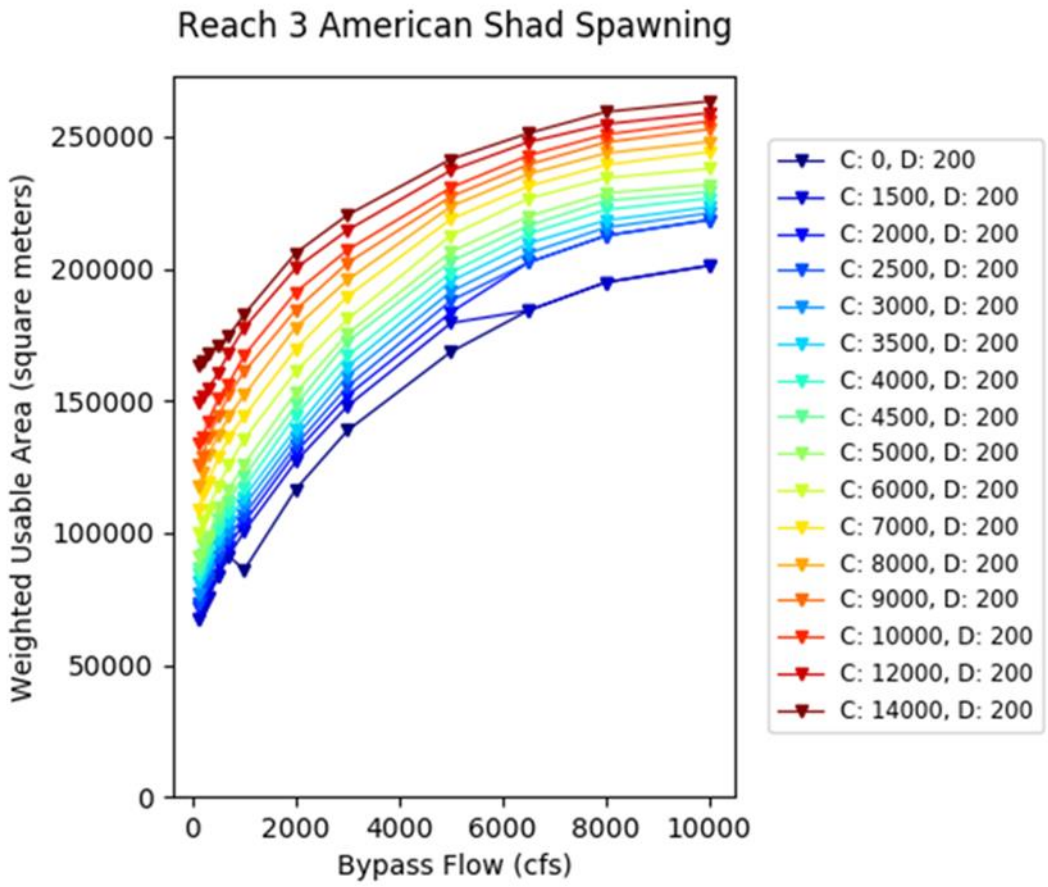


Figure 2.7-1: WUA versus Flow Curves for American Shad Spawning in Reach 3

Due to simulating higher bypass flows, new combined suitability index habitat maps for Reach 3 are provided in Attachment D which includes the following species:

- American Shad- spawning, juvenile and adult
- Shortnose Sturgeon- spawning, egg, fry, juvenile and adult
- Yellow Lampmussel- juvenile and adult
- Sea Lamprey- spawning
- Longnose Dace- juvenile and adult
- Tessellated Darter- juvenile/adult
- Deep-Fast Guild
- Deep-Slow Guild

Similarly, new persistent habitat maps using the higher bypass flows and species/life stages and scenarios specified by the stakeholders were completed (Attachment E) as summarized below.

Persistent Habitat Scenarios for Reach 3 Spawning

Species	Life Stage
American Shad	Spawning
Shortnose Sturgeon	Spawning
Shortnose Sturgeon	Egg-Larvae
Shortnose Sturgeon	Fry
Yellow Lampmussel	Juvenile
Yellow Lampmussel	Adult
Sea Lamprey	Spawning / Incub

Bypass Flow (cfs)	Cabot Flow 1 (cfs)	Cabot Flow 2 (cfs)
200	2,500	7,000
500	2,500	14,000
1,000	4,500	9,000
3,000	4,500	14,000
5,000	7,000	14,000
6,500		

Persistent Habitat Scenarios for Reach 3 Non-Spawning Residents

Species	Life Stage
Tessellated Darter	Adult/Juvenile
Longnose Dace	Juvenile
Deep Fast Guild	
Deep Slow Guild	
Yellow Lampmussel	Juvenile
Yellow Lampmussel	Adult

Bypass Flow (cfs)	Cabot Flow 1 (cfs)	Cabot Flow 2 (cfs)
200	2,500	7,000
500	2,500	14,000
1,000	4,500	9,000
2,000	4,500	14,000

2.8 MADFW-14

Comment: Re: Tables 6.2.1-1, 6.2.2-1, 6.2.2-2, 6.2.3-1, 6.2.4-1 through 6.2.4-3 and 6.2.5-1: The way data are presented in the tables is confusing. A graph with the percentage of Max habitat available as flows increase is much easier to understand. This analysis was done for reach 4 (6.2.5 Figures F1-F10).

Response: Tables 7.1.1.1-1, 7.1.1.2-1, 7.1.1.2-2, 7.1.2-1, 7.1.3-1, 7.1.3-2, 7.1.3-3, and 7.1.4-1 in the Study Report provided the percent of maximum habitat over the range of operational flows at the Project. However, since additional model runs with bypass flows of 6,500, 8,000, and 10,000 cfs were completed for Reach 3, the tables associated with Reach 3 were updated and are included in Attachment F. In addition, this attachment includes another table with Cabot flows of 4,500 cfs based on the request of the stakeholders during the December 2, 2016 meeting. With data from the requested higher modeled bypass flows, revised WUA curves and plots showing the % of Maximum WUA are provided in Attachment B.

3 FERC STUDY PLAN DETERMINATION LETTER

On February 17, 2017 FERC issued its Determination on Requests for Study Modifications and New Studies. FERC requested additional information be filed relative to Study No. 3.3.1—specifically the development of sea lamprey spawning habitat suitability index (HSI) curves as stated in its Determination letter- see below.

> *FirstLight followed the methodology of the approved study plan by using HSI curves from the literature, which were chosen in consultation with stakeholders. However, data collected during study 3.3.15 describes habitat used by spawning sea lamprey in the project area and could be used to adjust or verify the HSI curves used in Study 3.3.1. HSI curves based on site-specific data would likely represent spawning lamprey habitat preferences in the project area more accurately than the curves taken from the literature. We expect that incorporating this information would require some consultation with stakeholders and potentially rerunning the PHABSIM model, but we would not expect this to be a costly effort (section 5.9(b)(7)). Because this site-specific habitat data is specific to the project area and would be useful for adjusting or verifying the HSI curves taken from the literature, we recommend that FirstLight consult with the agencies and use the data collected at documented sea lamprey spawning sites in study 3.3.15 to make adjustments to (or verify) the literature-based HSI curves. If use of this data results in adjustments to the HSI curves, we recommend that FirstLight incorporate the new curves into the PHABSIM model and produce revised estimates of WUA for sea lamprey spawning in the bypassed reach and downstream of Cabot Station and file an addendum to the study by May 15, 2017.*

On March 16, 2017, FL held a study meeting to discuss five reports previously filed with FERC. Given that FL was meeting with stakeholders, it included on the March 16th agenda a method for developing HSI curves for spawning sea lamprey as requested by FERC. FL proposed the following methods:

- Develop Type II Utilization Curves based on the frequency analysis of fish observed and habitat variables measured.
- A frequency curve would be fit to a histogram and then normalized so the peak of the curve has a suitability index value of 1.
- The resulting function represents the probability of occurrence of depth and velocity given presence of fish.
- Provide the new habitat suitability index curves to stakeholders for review and comment.

As noted in Study 3.3.15 *Assessment of Adult Sea Lamprey within Turners Project and Northfield Mountain Project Area* data was collected at five redd locations as follows:

- Connecticut River below Cabot Station near the Hatfield S Curve
- Connecticut River near Stebbins Island below Vernon Dam
- Fall River (tributary to Connecticut River bypass reach just below Turners Falls Dam)
- Millers River (tributary to Connecticut River below Northfield Mountain Tailrace)
- Ashuelot River (tributary to Connecticut River below Vernon Dam)

As discussed at the meeting, FirstLight agreed to make adjustments to, or verify, the existing HSI curves for sea lamprey using the field data collected during Study No. 3.3.15: a) using data from all five redd

locations and b) using data only from the two Connecticut River sites. These HSI curves would be provided to the stakeholders for review and comment prior to utilizing them in the instream flow study.

ATTACHMENT A: EMAIL CORRESPONDENCE WITH USFWS AND NHESP RE: SCREENING ANALYSIS FOR MUSSELS IN REACH 5

From:	Leddick, Jesse (FWE)
To:	Gary Lemay; Grader, Melissa; Hazelton, Peter (FWE); Marold, Misty-Anne (FWE)
Cc:	Mark Wamser; Jason George; Ian Kiraly; Tom Sullivan; James.Donohue; Nedeau, Ethan; Brandon.Cherry@ferc.gov; William.Connelly@ferc.gov
Subject:	RE: Turners Falls IFIM Reach 5 Mussel Analysis Follow-Up
Date:	Monday, February 27, 2017 12:26:30 PM
Attachments:	Attachment_A_Study_3_3_3_Response_Matrix.docx

Gary (and project team),

We greatly appreciate the opportunity to review FL's updated proposal, and overall, for FL's willingness to work with the Division and USFWS to come up with a modified approach to assessing mussels in Reach 5. Having reviewed FL's proposal (Attachment A) with our staff as well as USFWS, we have provided comments below that we hope will help refine the proposal and ensure that it produces accurate results. Of course, USFWS may have additional comments. Don't hesitate to contact me with any questions on the comments below and, if helpful, we would be happy to arrange a follow up conversation with you and USFWS to discuss further.

1. **Model Calibration:** In Reach 4, GSE collected WSEL data at three calibration flows (2318, 5988 and 14844 cfs) and mean column velocity at one flow (5988 cfs). In Reach 5, GSE collected new bathymetry data at 11 of the 16 proposed transects. This also allowed GSE to concurrently collect water surface elevations, transect flow, and water velocity data (mean column and vertical profiles), though GSE stated that velocity data was not collected at 5 of the 16 transects (River Mile 94.3 through 96.7). Additionally, GSE stated that it is not known whether velocity data from the November 2016 field effort are usable (River Mile 99.2 through 106.3; 4 of 16 transects) and did not provide additional information clarifying this issue in its proposal. Finally, GSE stated that data collection at each transect occurred at a single flow but that flows ranged from 3,000 to 12,000 cfs (based on data from the Montague Gage) during the November 2016 field effort, suggesting that flows varied between transects. The conditions under which data were collected in July 2016 (7 of 16 transects) are unclear.

   The FERC SPD (dated February 21, 2014; p. B-11 and B-12) stated that FL should "*collect mean column and benthic velocity data at representative transects at all three calibration flows in reach 4 and 5 to validate mean column velocities and any simulated benthic velocities.*" The SPD also stated that "*this validation effort should ensure velocity data, including other dependent hydraulic parameters such as shear stress, are accurate through the project's operational flow range and provide reliable information to conduct our environmental analysis.*"

   We remain concerned that the calibration range would be uncertain and limited in Reach 5 under GSE's proposed approach. More generally, extrapolating results of a hydraulic model beyond the calibrated range may yield inaccurate results; this would be of particular concern for proposed flow scenarios 5 through 8 (Table 2), even if appropriate calibration occurred for lower flows. Therefore, we recommend that GSE follow the FERC-approved methodology for Reach 4 and 5 by collecting mean column velocity data at representative transects at all three calibration flows. This approach would ensure accurate calibration of the model as

well as the range to which it could be appropriately applied; further discussion is likely needed to evaluate if the model could be applied to higher flows, and under what conditions.

2. **Transect Representativeness:** The proposal includes a single transect (River Mile 106.3) between the transect at River Mile 101.1 and the southern-most transect in Reach 4 (near River Mile 109.5, which GSE has not proposed to include in this analysis). This area constitutes over one third the total length of Reach 5. Project effects are most likely to be seen with increasing proximity to Cabot Station and Turners Falls Dam, and based on surveys performed for the Holyoke Hydroelectric Project, state-listed mussels are either absent or in low abundance in the northern third of Reach 5. We are concerned by the lack of transects in the northern portions of Reach 5. In our November 14, 2014 comments on the ISR, in addition to transects at or near River Mile 101.1 and 106.3, the Division expressed similar concern and recommended placing three (3) additional transects in between River Mile 101.1 and 106.3 to document flow conditions in areas with no or low mussel abundance.

   Additionally, in the SPD FERC confirmed that "*it is necessary to ensure that each habitat type in the river is represented; thus allowing for an evaluation of how potential changes in project operations and flows may influence suitability in each habitat type. Therefore, it is not appropriate to preclude specific habitat types, including unsuitable habitat, as FirstLight proposes (section 5.9(b)(6)). As such, we recommend FirstLight include all habitat types when placing IFIM transects in reach 4.*"

   However, with the exception one transect located in a cobble run, all other transects in Reach 5 are located in run habitats with either gravel or sand substrates. We understand that this is largely due to the nature of Reach 5, which is predominately characterized by sandy runs. However, we note that a large pool (substrate unknown) and a sandy glide are located in Reach 5 between River Mile 101.1 and 106.3; these mesohabitats (unique to Reach 5) also correspond with a significant bend/contraction in the river. Per FERC's SPD, all habitats should be modeled to allow for an evaluation of how project operations may influence suitability in each habitat type under a variety of flows. This is especially important in the northerly portions of Reach 5, where project effects are more likely to be detected (and to be severable from the Holyoke Dam effects). Therefore, we recommend:

   a. Including three additional transects between River Miles 106.3 and 101.1 (e.g., River Mile 105, 103, and 102, corresponding to 2005 Mussel Survey Sites 3, 6 and 7, respectively) to document conditions in this portion of the reach. We also note that this will help clarify hydrologic conditions before and after the significant bend/contraction as well as capture the diversity of mesohabitats in this area. Exact transect placement should be finalized in consultation with the Division and USFWS; if there are transects from pre-licensing baseline studies located in this area, we would also be happy to review these locations; and

   b. Including the existing, southern-most transect in Reach 4 (at or near the Route 116 Bridge in Sunderland) in this analysis. This will enable GSE to adequately represent flow conditions entering (and therefore characterizing the northerly portion of) Reach 5.

We agree with GSE that, if the full-scale IFIM is conducted, additional transects - beyond the existing transects and the four (4) additional transects outlined above - may be needed if said transects do not fully represent all of Reach 5 mesohabitats or significant bends/contractions.

3. **Potential Host Fish:** Small and largemouth bass should be added to the list of host fish for Eastern Pondmussel, as they have been identified as suitable hosts in propagation trials.

   The Division does not believe that Banded killifish (Family Fundulidae, the "topminnows") is an important host for any of the three mussel species listed, as all three species are known to use visual lures that are likely associated with piscivorous fish hosts (Haag, 2012). Further, although the topminnows are known as a host for multiple species of mussels, they are considered only marginal or non-primary hosts (Haag 2012). While Kneeland & Rhymer (2008) identified 21 Tidewater Mucket glochidia and single Yellow Lampmussel glochidium on Banded Killifish, these samples represent only one fish (per mussel species) out of 30 fish specimens processed. Therefore, although we support the modeling of suitable habitat for this species in the IFIM, we warn that the utility of the Banded Killifish as a host should not be given equal weight to the other species provided in the table (and small and largemouth bass for Eastern Pondmussel).

Haag, W. (2012). North American Freshwater Mussels: Natural History, Ecology, and Conservation. New York: Cambridge University Press.

Kneeland, C., & Rhymer, J. (2008). Determination of fish host use by wild populations of rare freshwater mussels using a molecular identification key to identify glochidia. Journal of the North American Benthological Society, 27(1), 150-160.

4. **Full-Scale IFIM:** The Division previously asked what the threshold would be for triggering a full-scale IFIM versus accepting the results of the quasi-IFIM. GSE stated that they weren't sure and would need to review what was proposed in the study plan. GSE hasn't clarified this threshold in its proposal.

5. **Additional Note:** The tables of RSS calculations (Study Report 3.3.16) appear to use the Shields parameter (0.032) in the denominator of the RSS values. The Shields parameter must be converted to actual, location-specific critical bed shears (in lbf/ft3) for the calculation of RSS. As a result, the RSS values in this appendix appear too large and may greatly misrepresent estimates of incipient motion in the channel.

Jesse Leddick
Endangered Species Review Biologist
Massachusetts Division of Fisheries & Wildlife
1 Rabbit Hill Road, Westborough, MA 01581
p: (508) 389-6386 | e: Jesse.Leddick@state.ma.us
mass.gov/masswildlife | facebook.com/masswildlife

From:	Grader, Melissa
To:	Gary Lemay
Cc:	Leddick, Jesse (FWE); Hazelton, Peter (FWE); Marold, Misty-Anne (FWE); Mark Wamser; Jason George; Ian Kiraly; Tom Sullivan; James.Donohue; Nedeau, Ethan; Brandon.Cherry@ferc.gov; William.Connelly@ferc.gov; Brett Towler
Subject:	Re: Turners Falls IFIM Reach 5 Mussel Analysis Follow-Up
Date:	Monday, February 27, 2017 2:48:32 PM

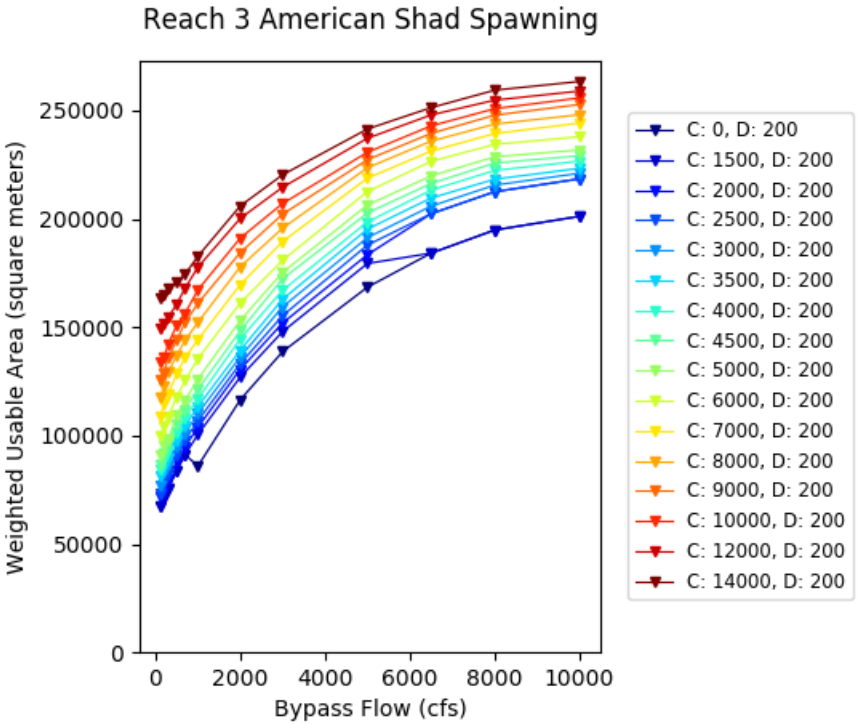
In addition to the Service supporting NHESP's comments, our hydraulic engineer had the following additional comments (some of which are captured in NHESP's comments):

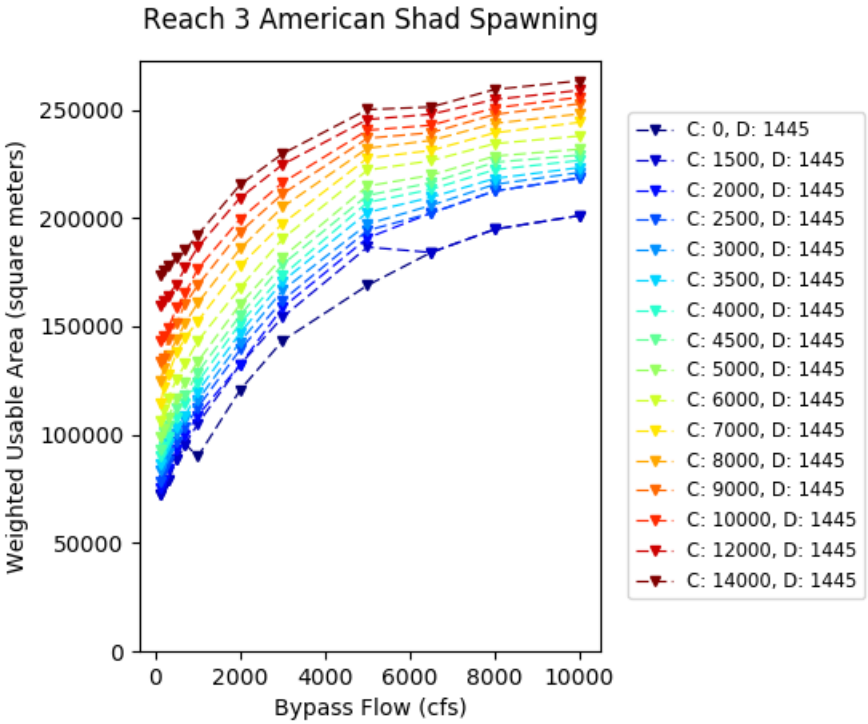
1. In general, HEC-RAS (or other hydraulic/hydrodynamic models) should capture transects at locations where rapid spatial changes may influence hydraulics. We note several locations along Reach 5, for example, where transects were not taken at bends and contractions. If losses were not accounted for at transects using contraction/expansion loss coefficients and Coriolis coefficients, the calibration process may inappropriately lump losses into Manning's n; such a simplification may inflate n and misrepresent velocities in the model. The magnitude of the effect on n and channel velocities cannot be evaluated from the study results.
2. Transects should also be taken in and around the locations of interest. As the hydraulic/hydrodynamic models relates to the mussel survey, there are a number of mussel survey locations with no nearby transects. For surveys that covered a significant length of the reach (e.g., Fig. 5.3.5-1), one would ideally take transects at the bounding ends. This would allow one to evaluate hydraulic conditions at the upstream and downstream ends and estimate how conditions are changing over the surveyed area.
3. Calibration to water surface elevations seem good overall based on agreement within +/- 5% (corresponding to 0.25 at gage). This definition is consistent with the USGS methodology for accuracy in stream gage rating curves. While the accuracy of the Manning's n calibration is good, it is important to note that the calibration range appears limited. "In general, Mannings' n values should be calibrated whenever observed water surface elevation information (gaged data, as well as high water marks) is available" (USACOE, 2016, "HEC-RAS Hydraulic Reference Manual, pg. 3-13) Extrapolating the results of any hydraulic model beyond the calibrated range is not recommended. For example, the Reach 4 PHABSIM model was calibrated to water surface elevations recorded at 14,844 cfs (pg. 5-10, Study 3.3.1). Caution is recommended in applying the model to habitat persistence above these calibrated high flows.
4. Recommend that the authors of Study 3.3.16 check the estimates of relative shear stress (RSS). The tables of RSS calculations provided in the appendices (pg. 57/63 of the PDF file) appear to use the Shields parameter (0.032) in the denominator of the RSS values. The Shields parameter is a dimensionless term that must be converted to (location-specific) actual critical bed shears (in lbf/ft3) for the calculation of RSS. As a result, the RSS values in this appendix appear too large and may greatly misrepresent estimates of incipient motion in the channel.

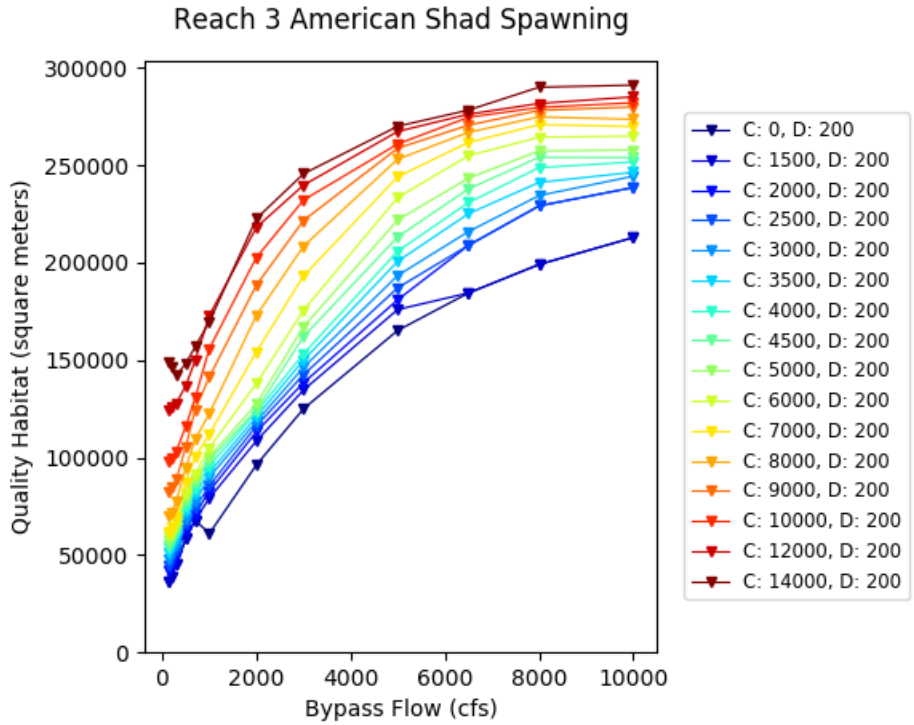
Regards,

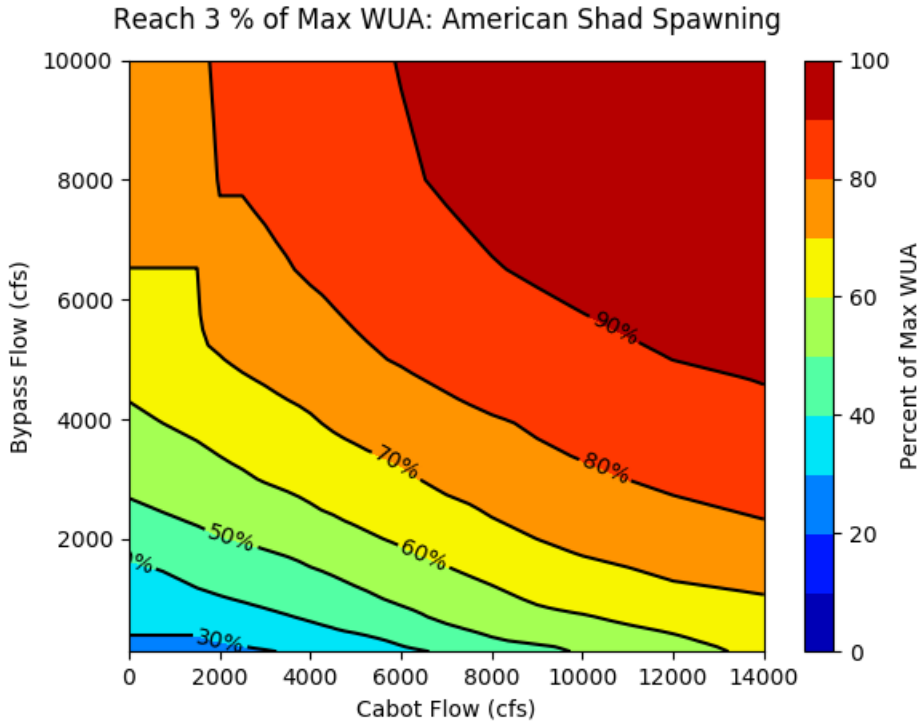
Melissa Grader
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service - New England Field Office

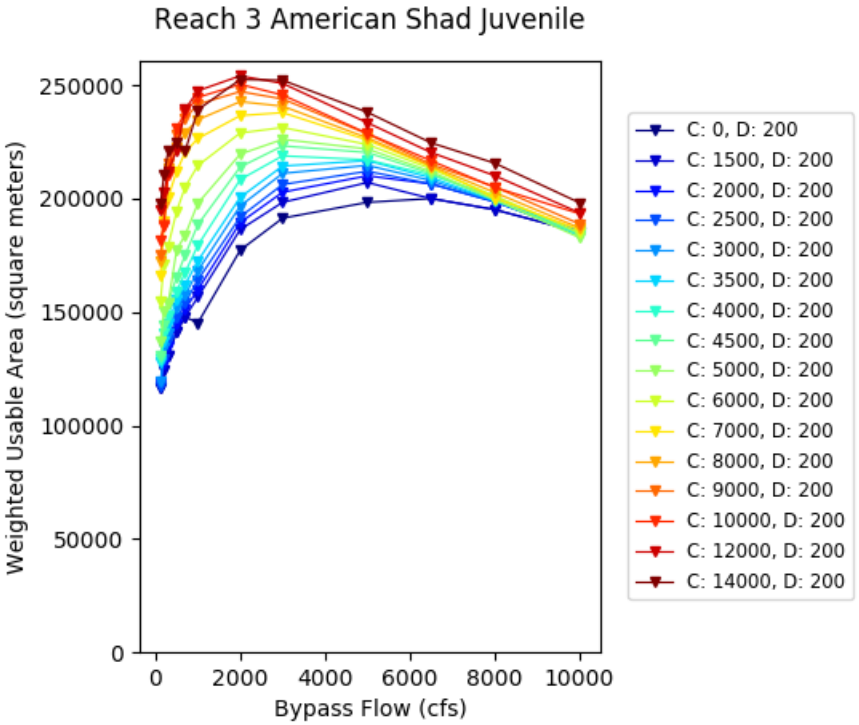
ATTACHMENT B: NEW WUA CURVES IN REACH 3 TO INCLUDE BYPASS FLOWS OF 6,500, 8,000 AND 10,000 CFS

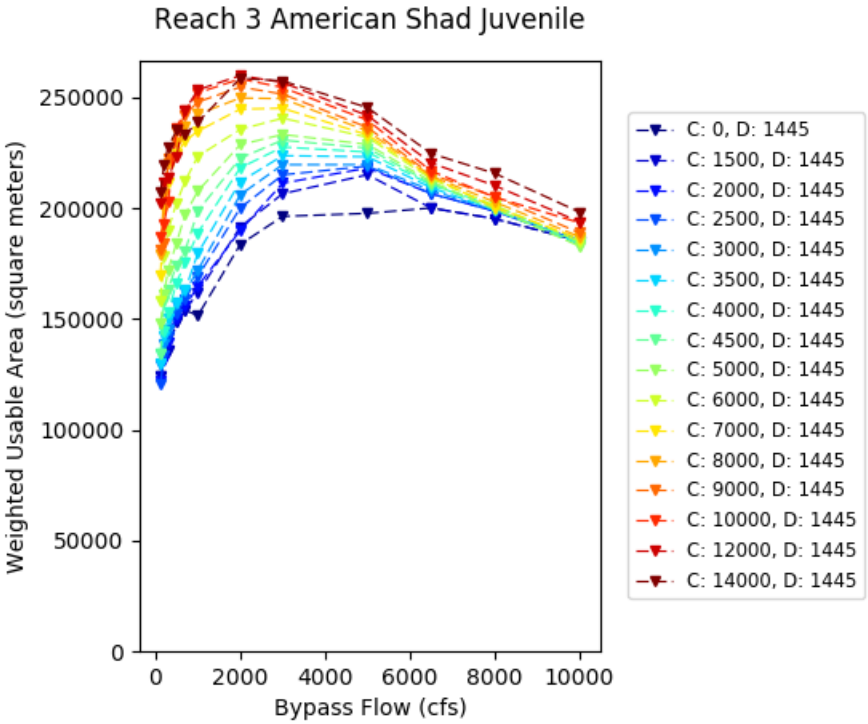

Reach 3 American Shad Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

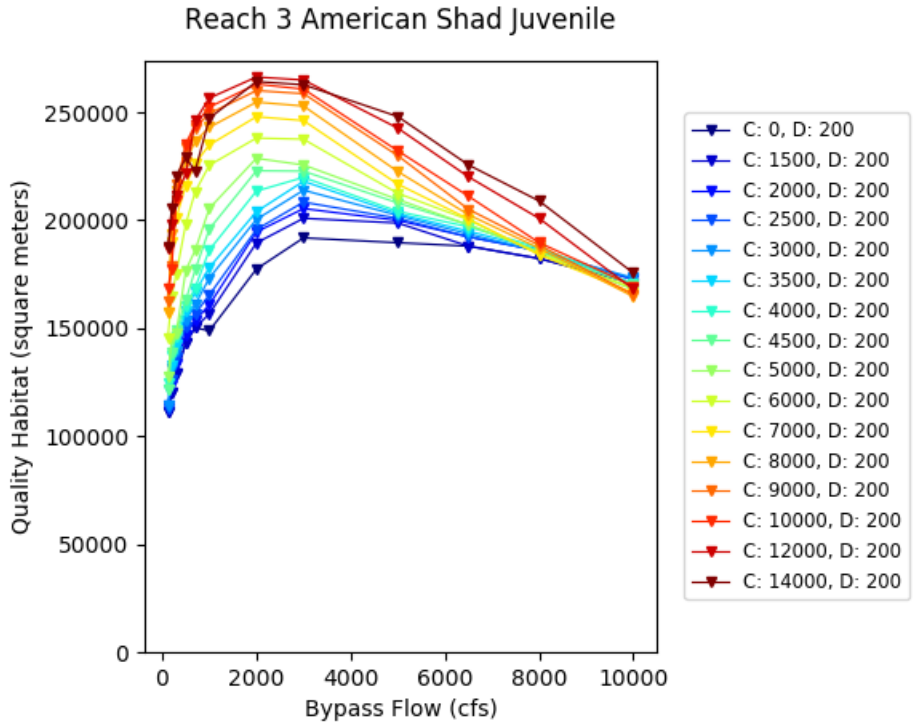

Reach 3 American Shad Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

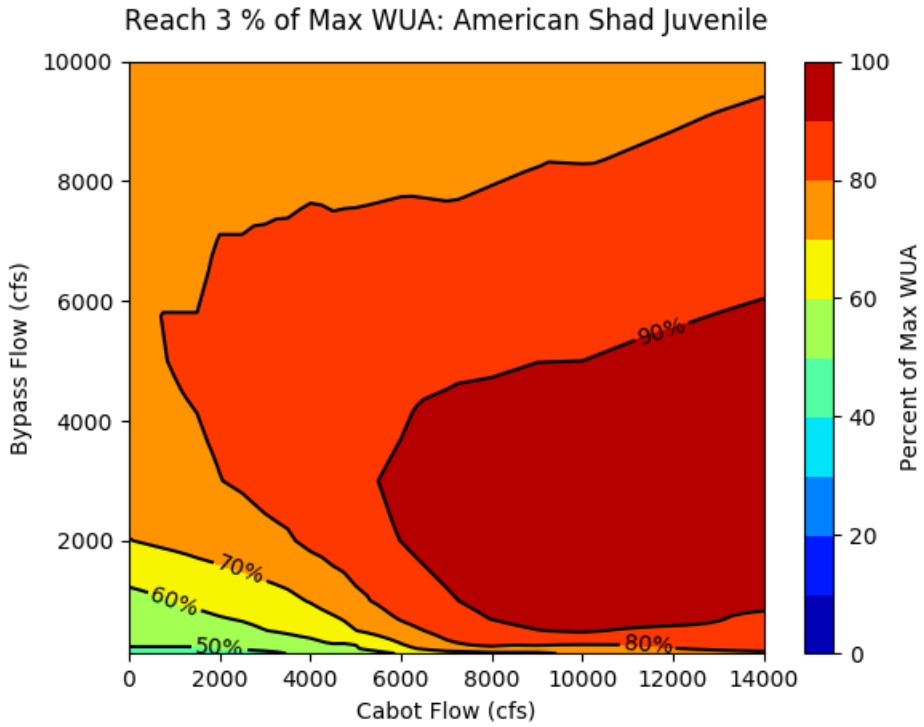

Reach 3 American Shad Spawning
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

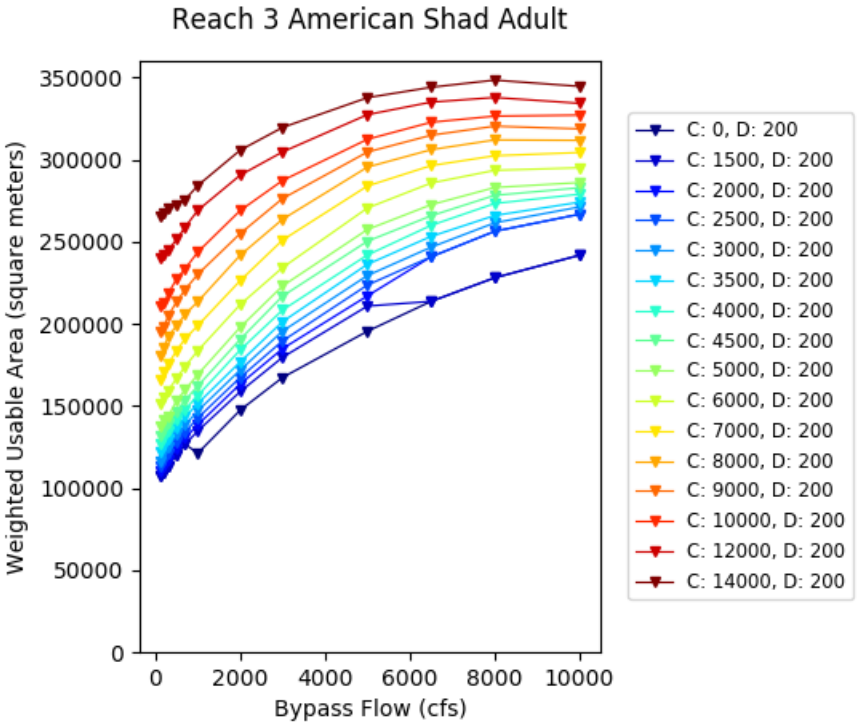

Reach 3 % of Max WUA: American Shad Spawning
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
90%
80%
70%
60%
50%
30%

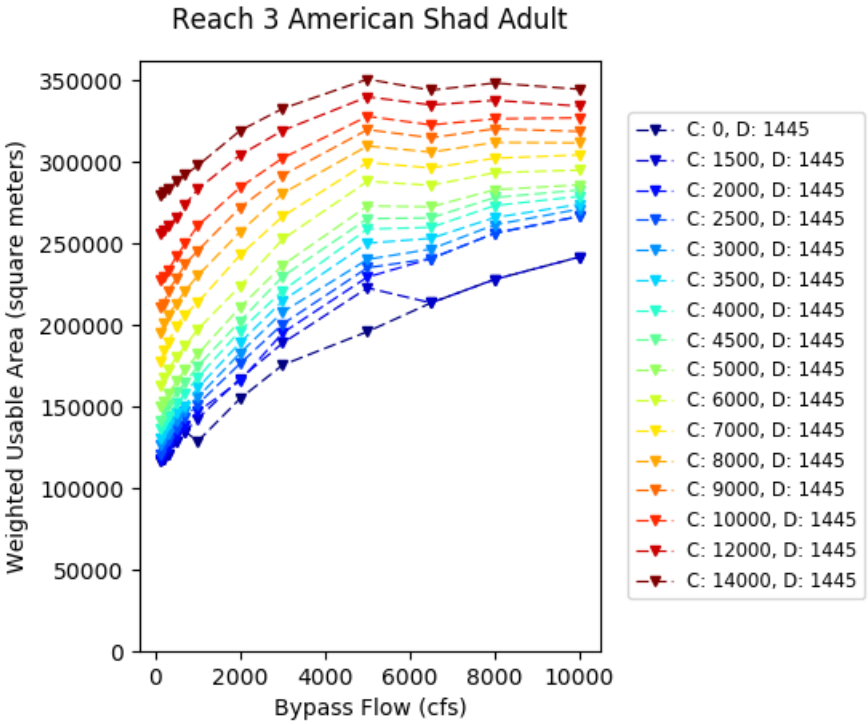

Reach 3 American Shad Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

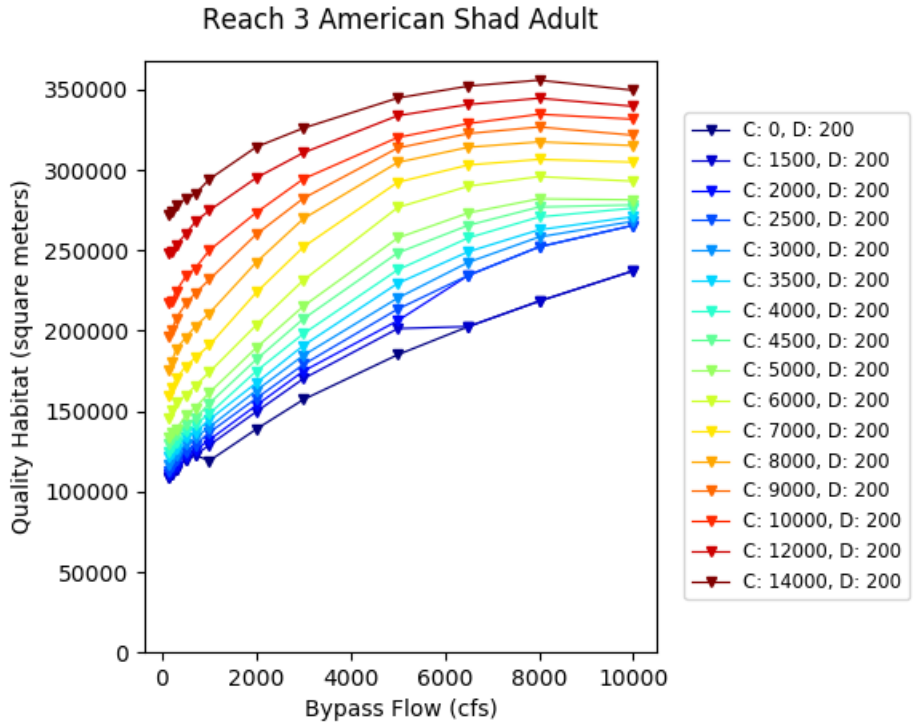

Reach 3 American Shad Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

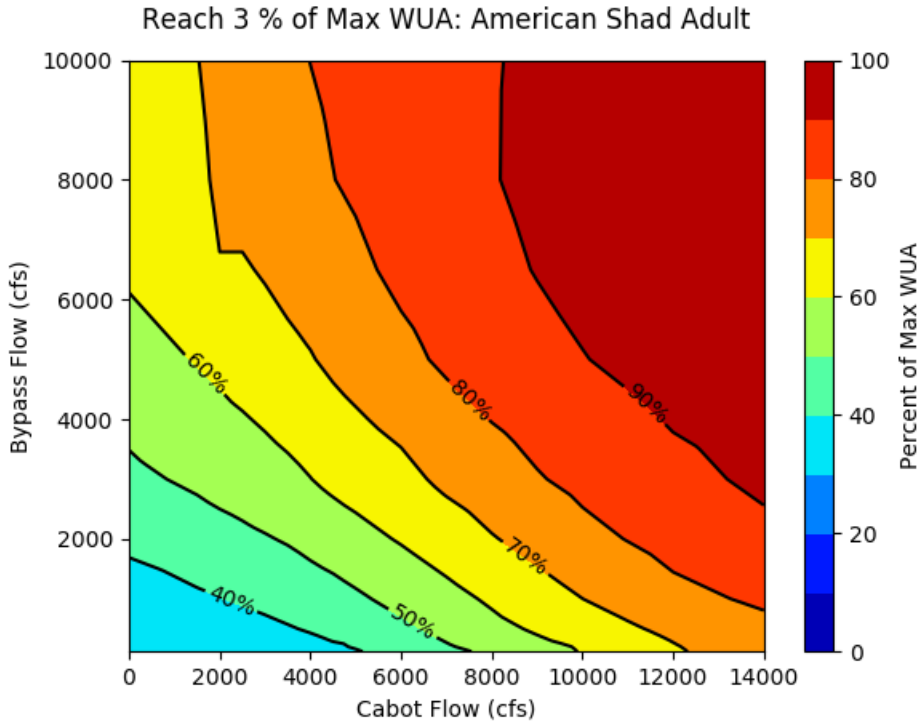

Reach 3 American Shad Juvenile
Quality Habitat (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

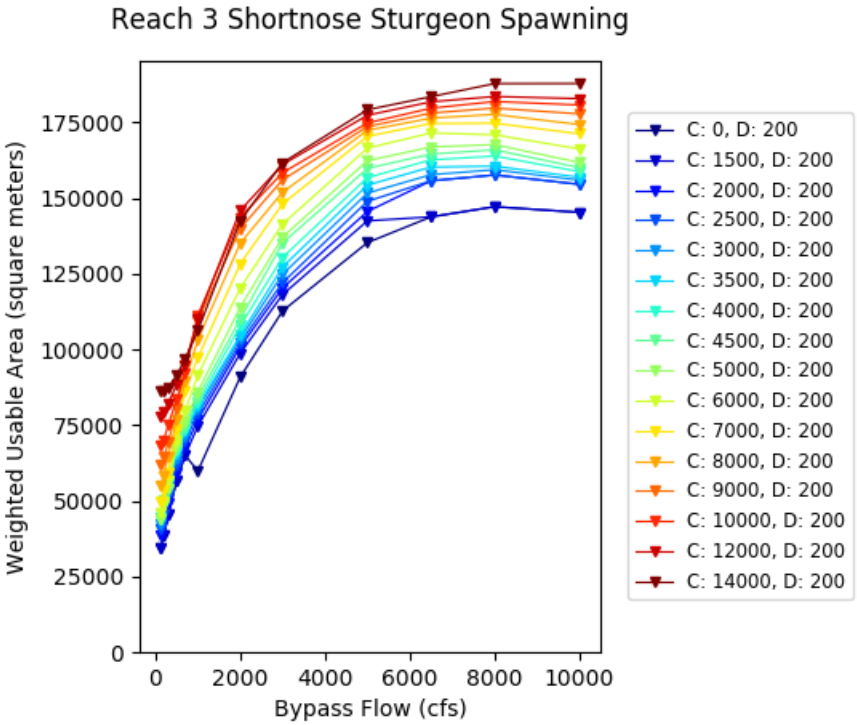

Reach 3 % of Max WUA: American Shad Juvenile
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
90%
80%
70%
60%
50%

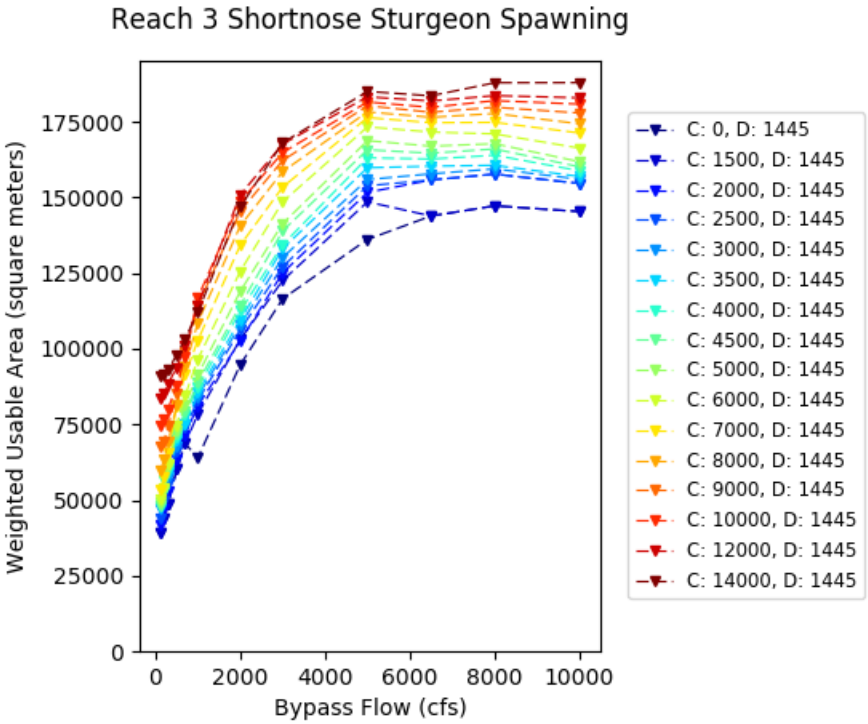

Reach 3 American Shad Adult
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
300000
350000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

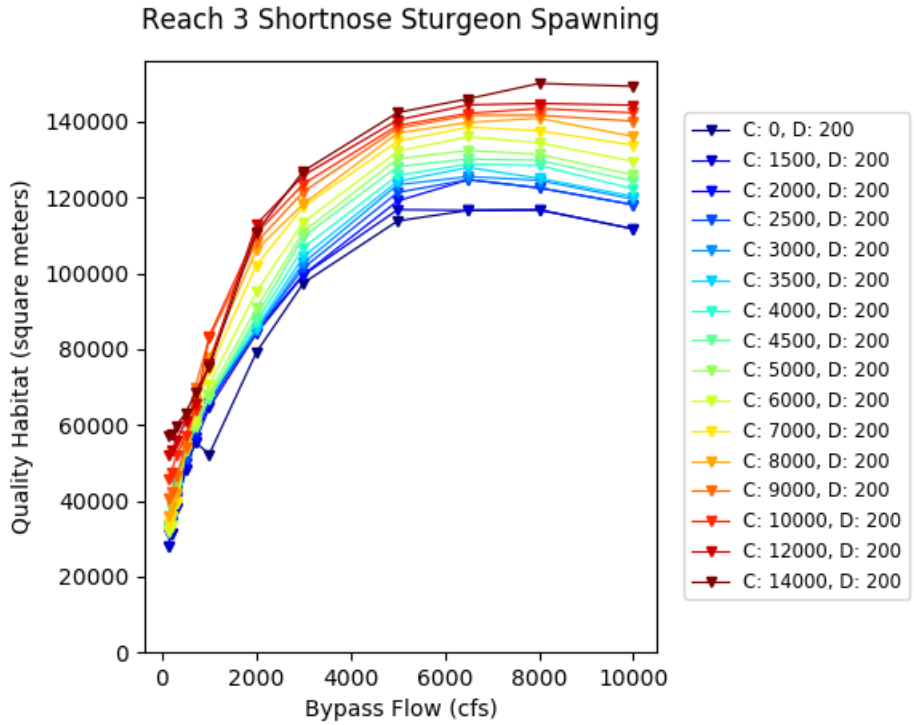

Reach 3 American Shad Adult
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
300000
350000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

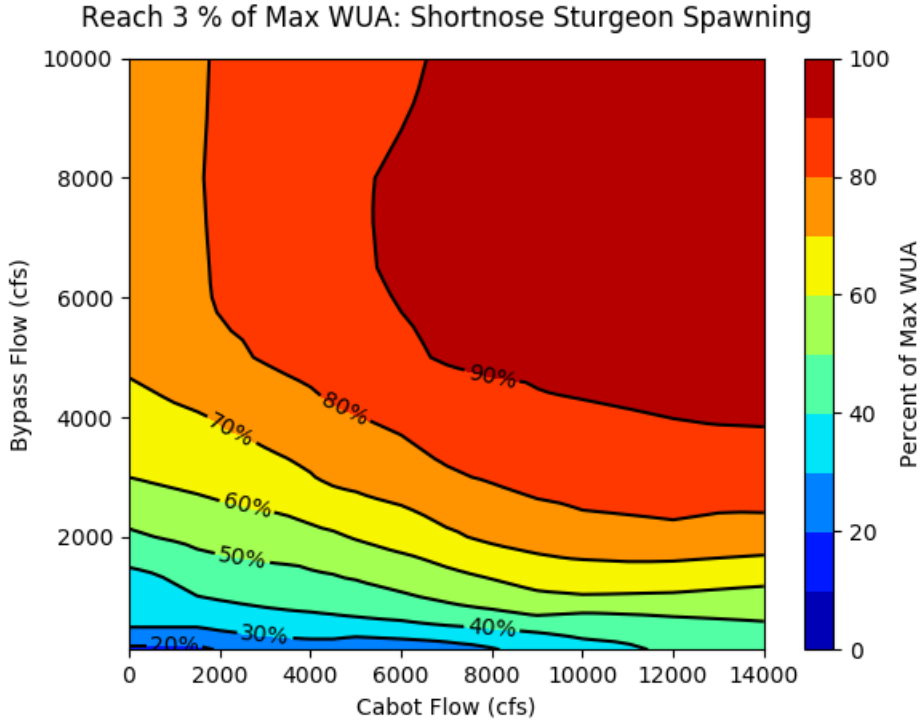

Reach 3 American Shad Adult
Quality Habitat (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
300000
350000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

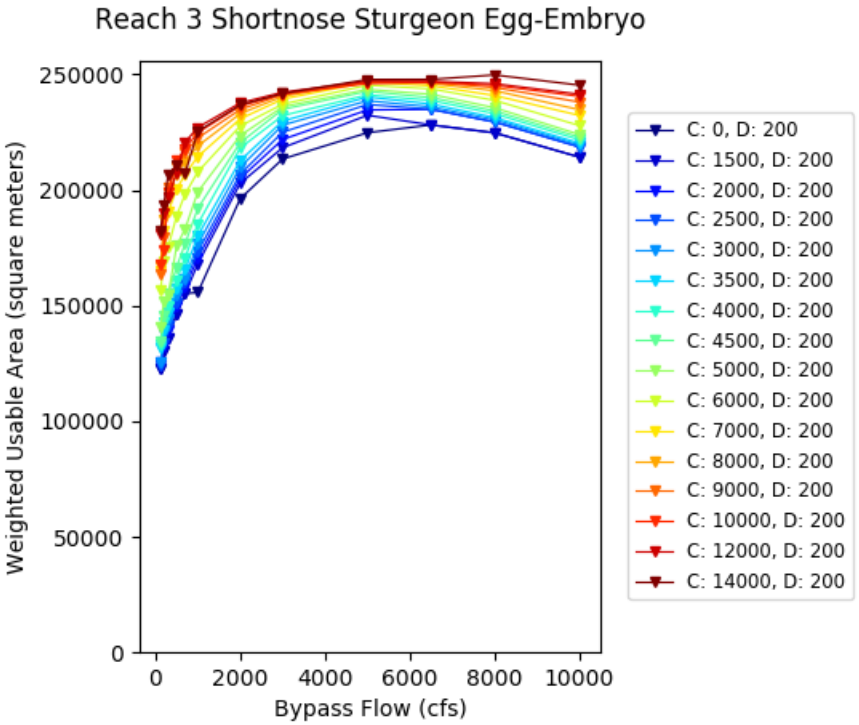

Reach 3 % of Max WUA: American Shad Adult
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
40%
50%
60%
70%
80%
90%

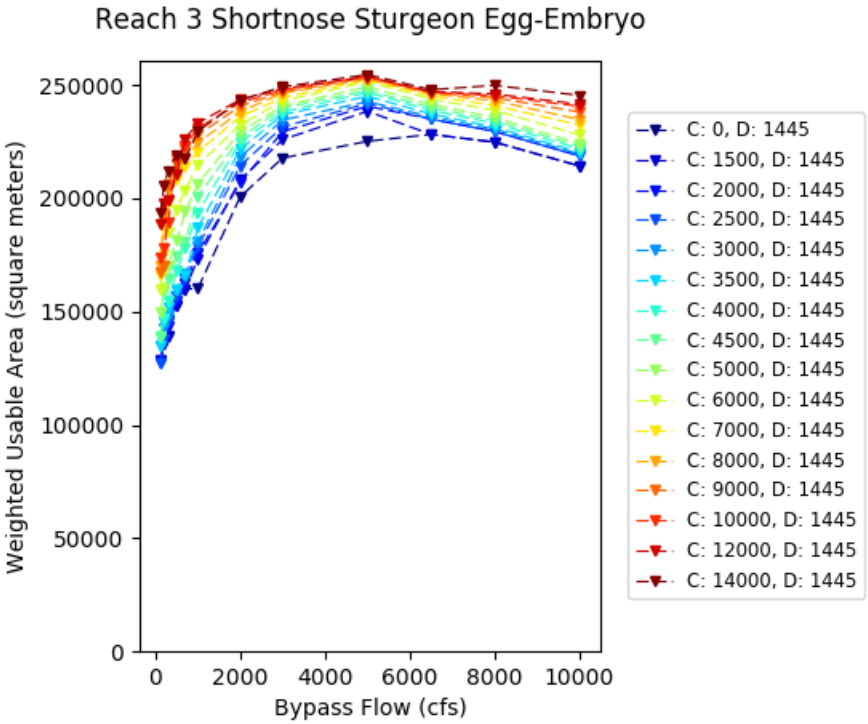

Reach 3 Shortnose Sturgeon Spawning
Weighted Usable Area (square meters)
0
25000
50000
75000
100000
125000
150000
175000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

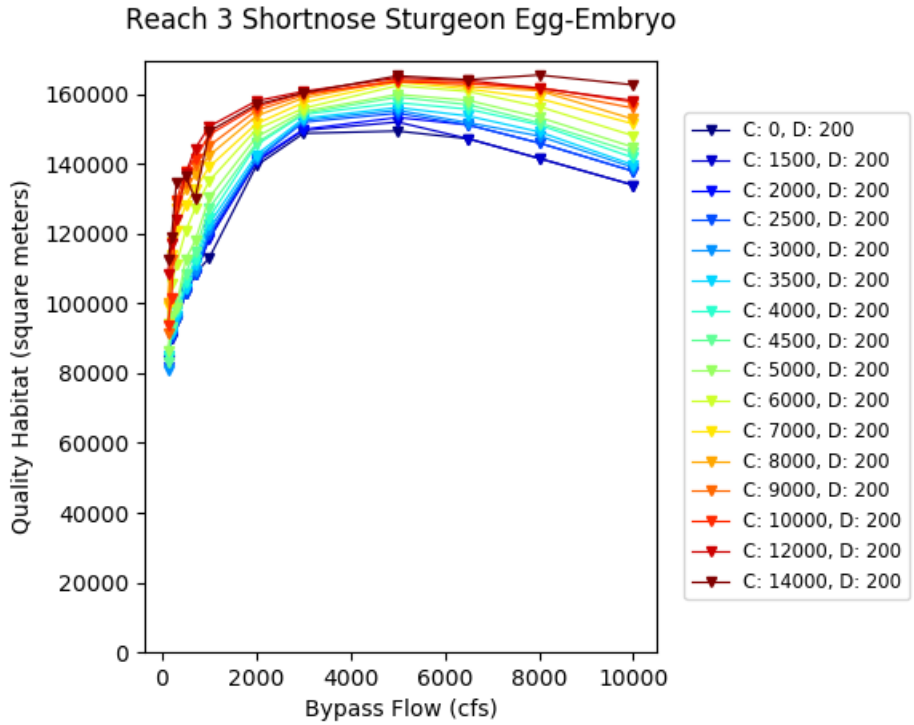

Reach 3 Shortnose Sturgeon Spawning
Weighted Usable Area (square meters)
0
25000
50000
75000
100000
125000
150000
175000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

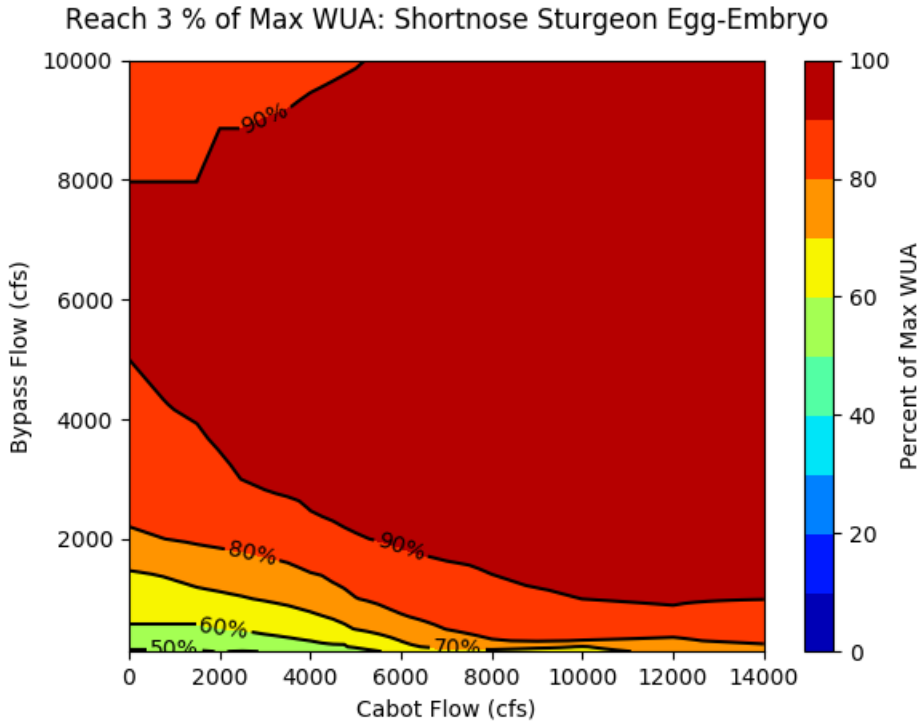

Reach 3 Shortnose Sturgeon Spawning
Quality Habitat (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
140000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

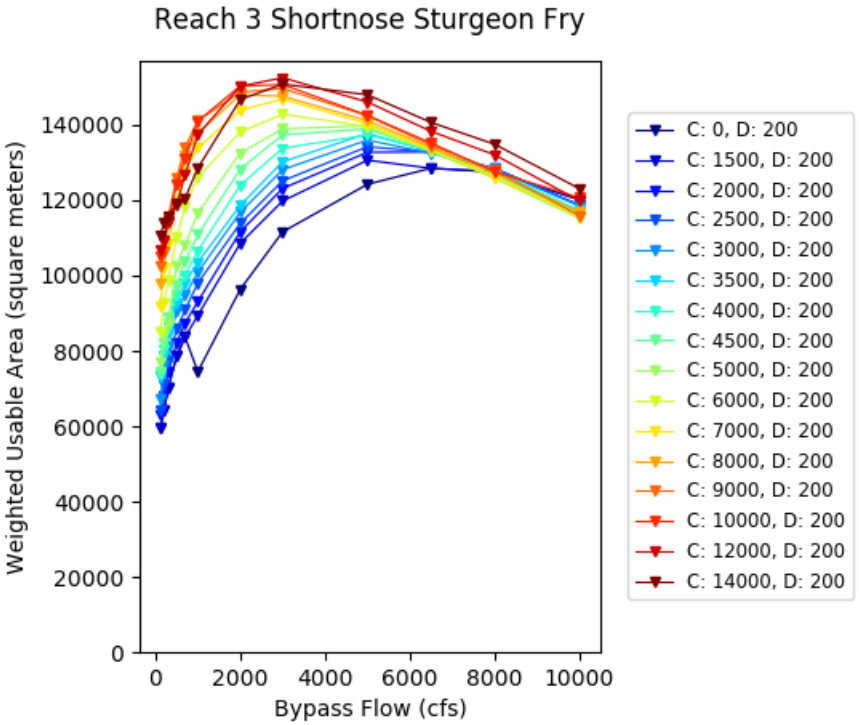

Reach 3 % of Max WUA: Shortnose Sturgeon Spawning
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
90%
80%
70%
60%
50%
40%
30%
20%

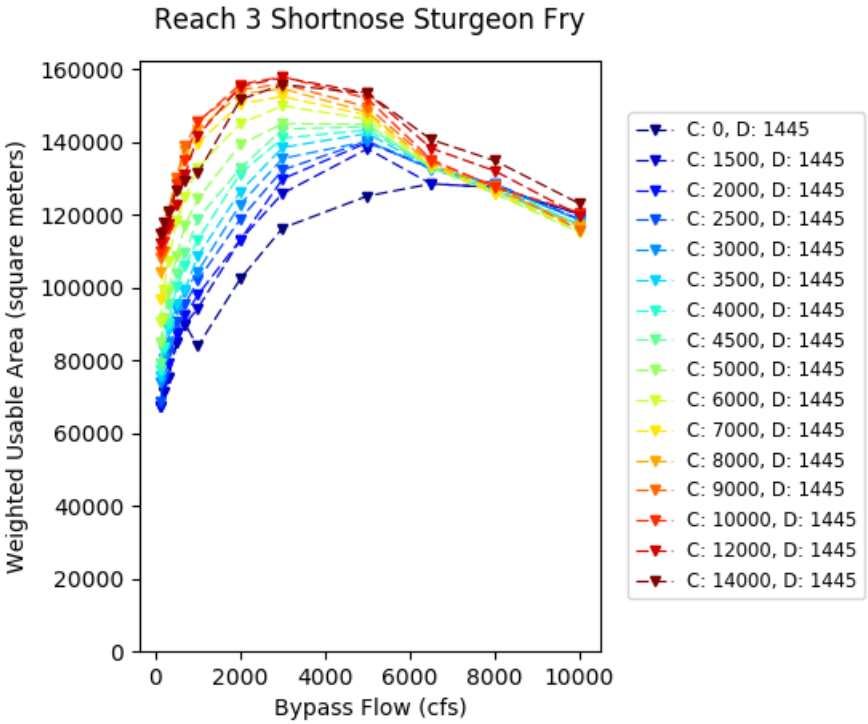

Reach 3 Shortnose Sturgeon Egg-Embryo
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

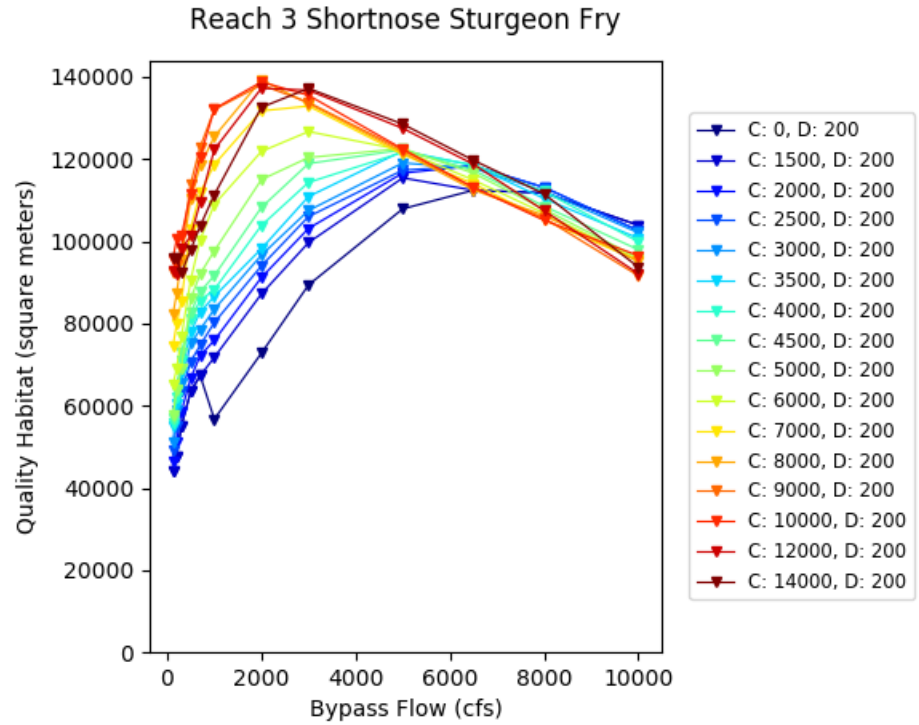

Reach 3 Shortnose Sturgeon Egg-Embryo
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

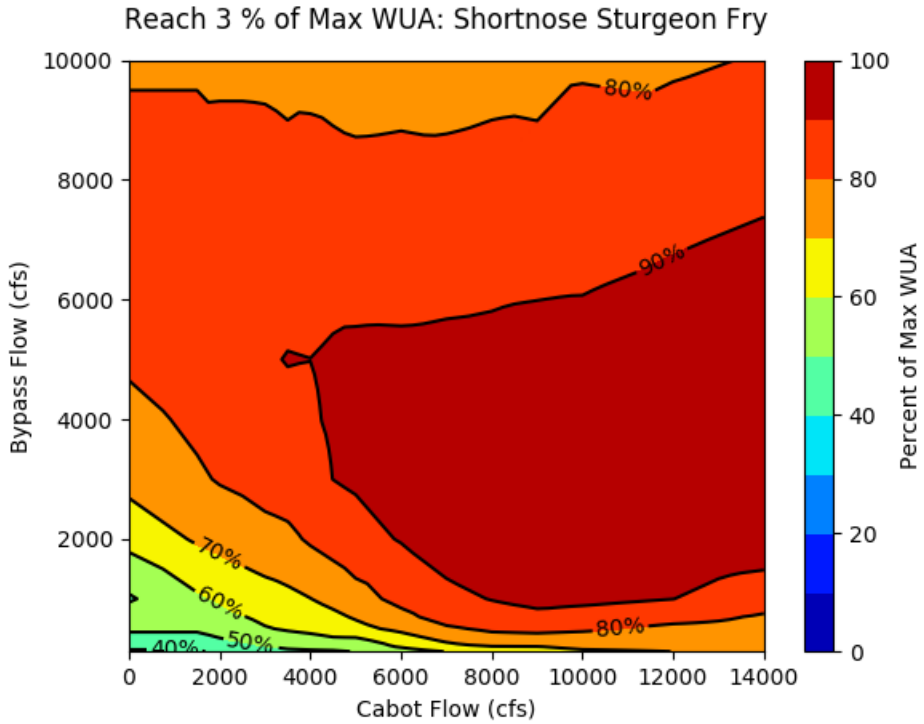

Reach 3 Shortnose Sturgeon Egg-Embryo
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

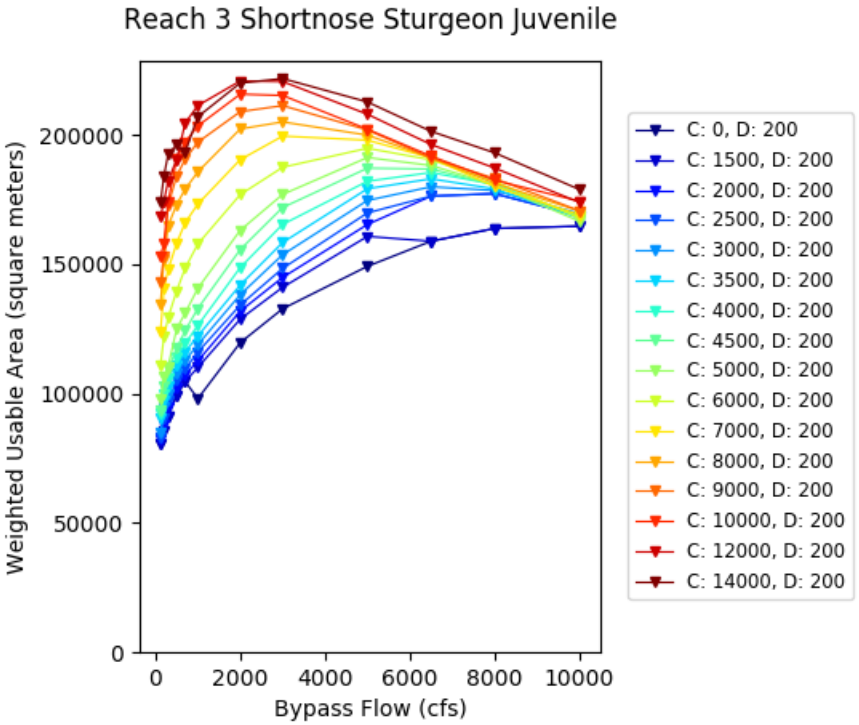

Reach 3 % of Max WUA: Shortnose Sturgeon Egg-Embryo
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
90%
80%
60%
50%
70%

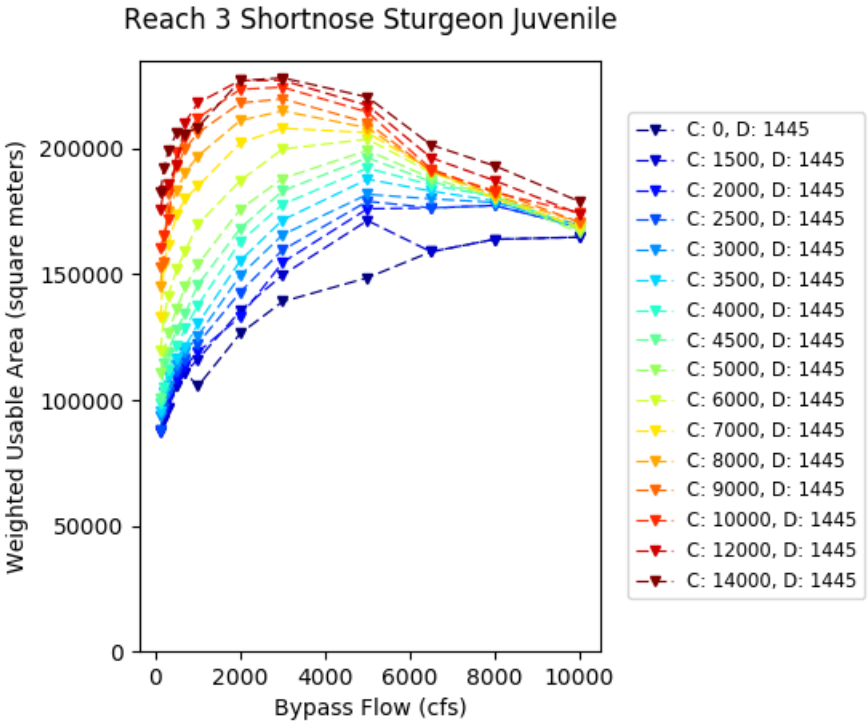

Reach 3 Shortnose Sturgeon Fry
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
140000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200


Reach 3 Shortnose Sturgeon Fry
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
140000
160000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

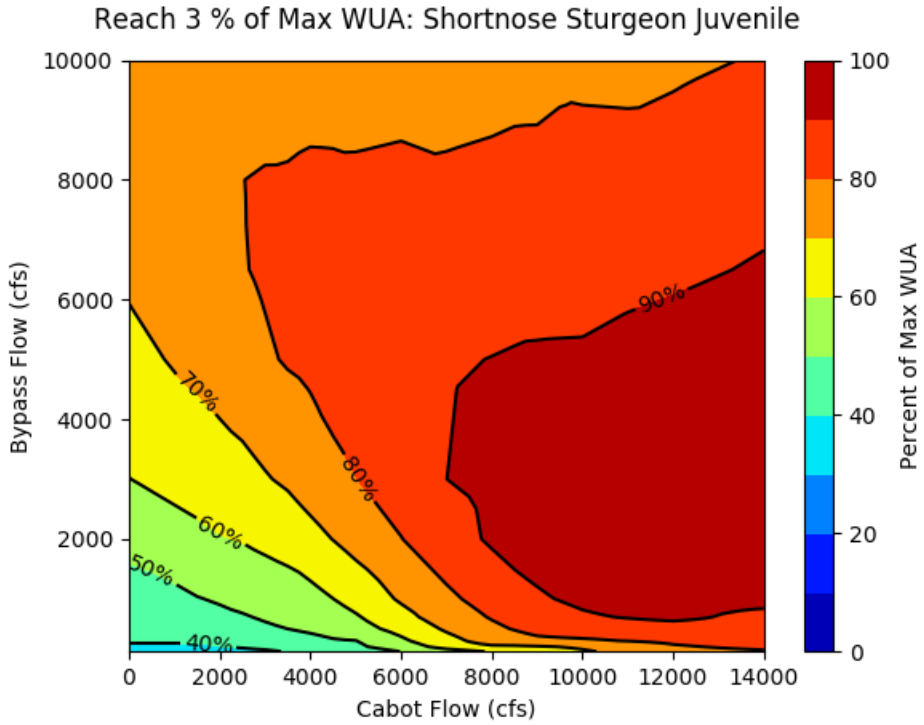

Reach 3 Shortnose Sturgeon Fry
Quality Habitat (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
140000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200


Reach 3 % of Max WUA: Shortnose Sturgeon Fry
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
80%
90%
70%
60%
50%
80%

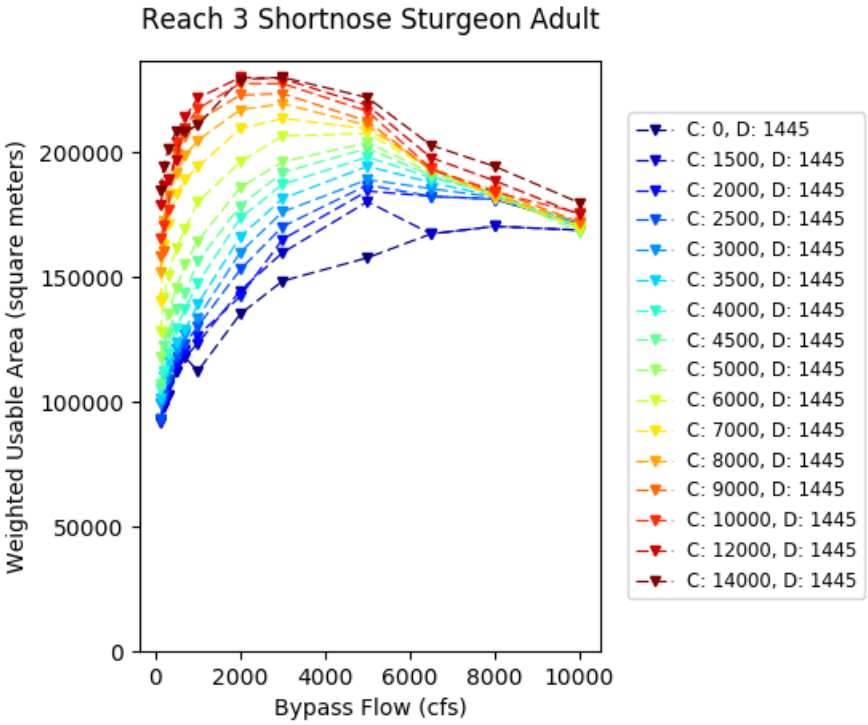

Reach 3 Shortnose Sturgeon Juvenile
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200


Reach 3 Shortnose Sturgeon Juvenile
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

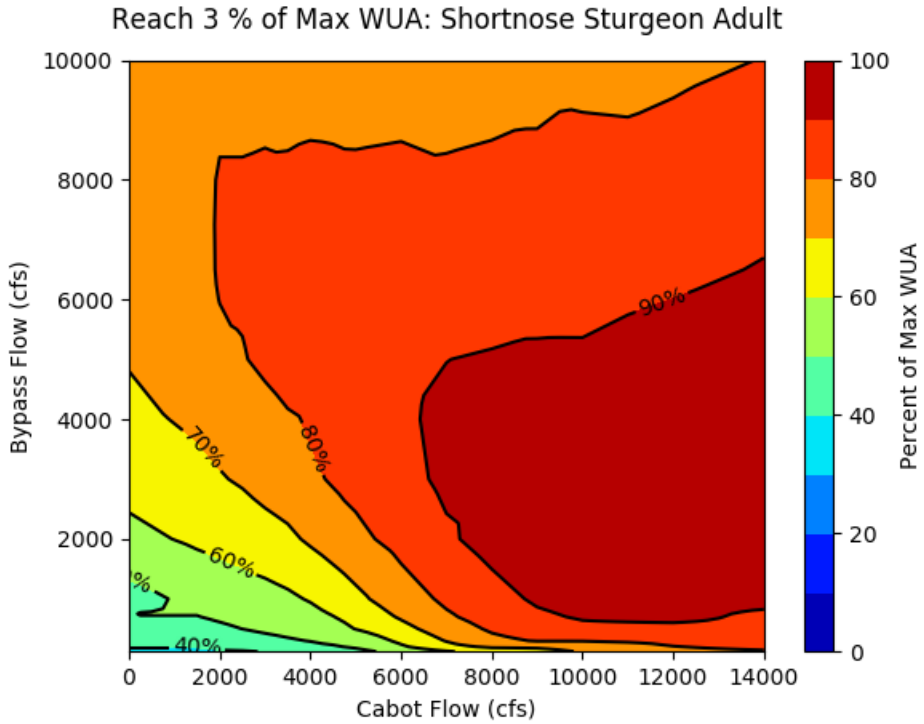

Reach 3 Shortnose Sturgeon Juvenile
Quality Habitat (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

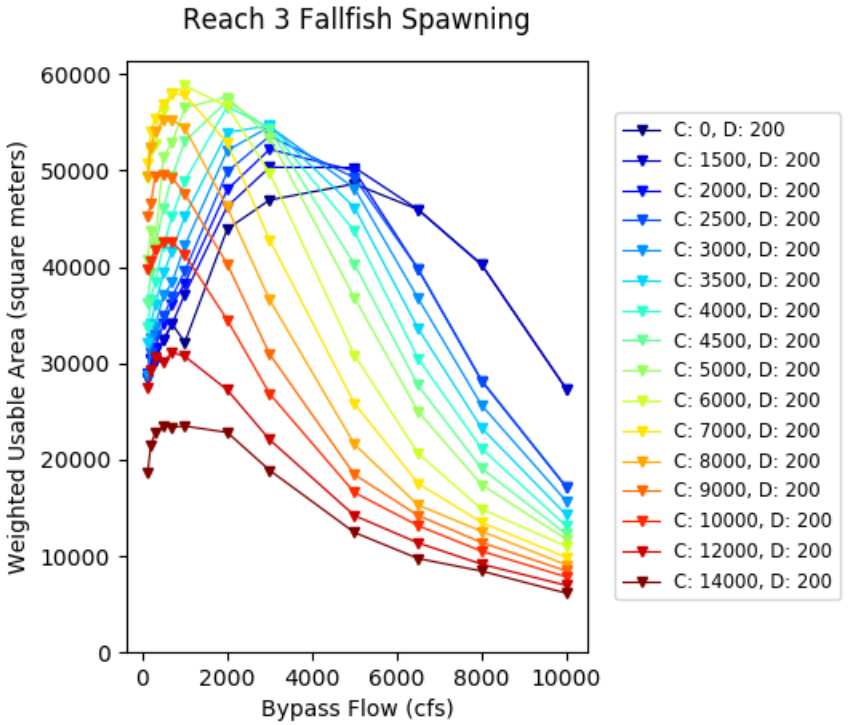

Reach 3 % of Max WUA: Shortnose Sturgeon Juvenile
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
0
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
90%
70%
80%
60%
50%
40%

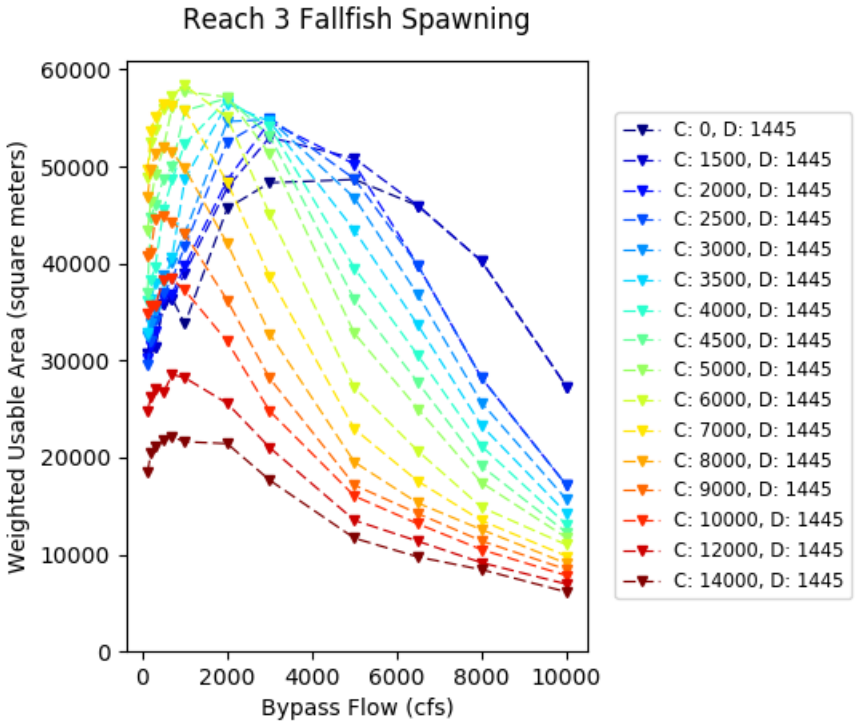

Reach 3 Shortnose Sturgeon Adult
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

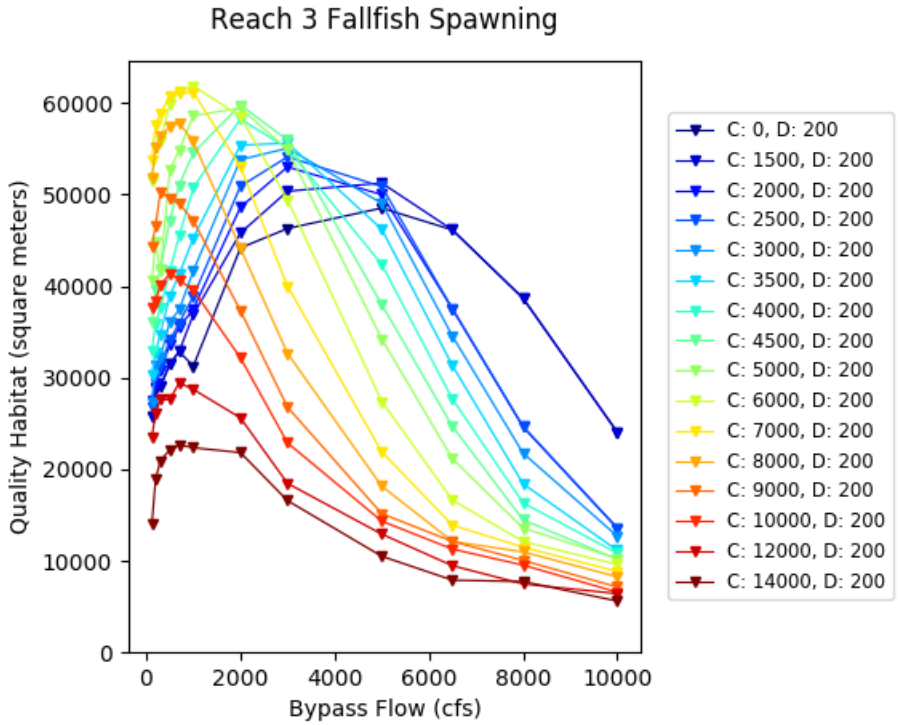

Reach 3 Shortnose Sturgeon Adult
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

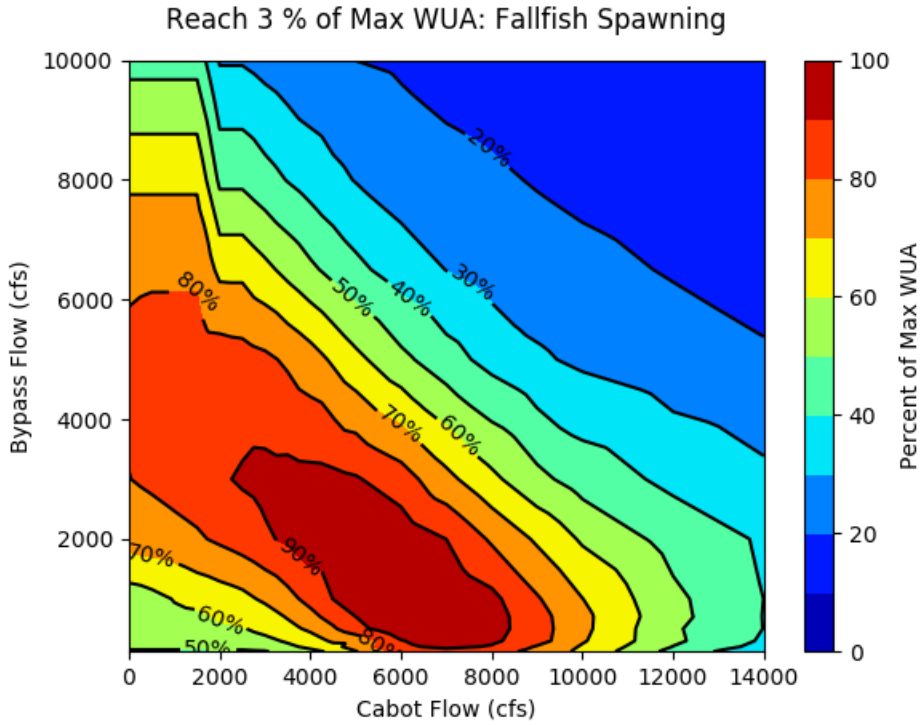

Reach 3 Shortnose Sturgeon Adult
Quality Habitat (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

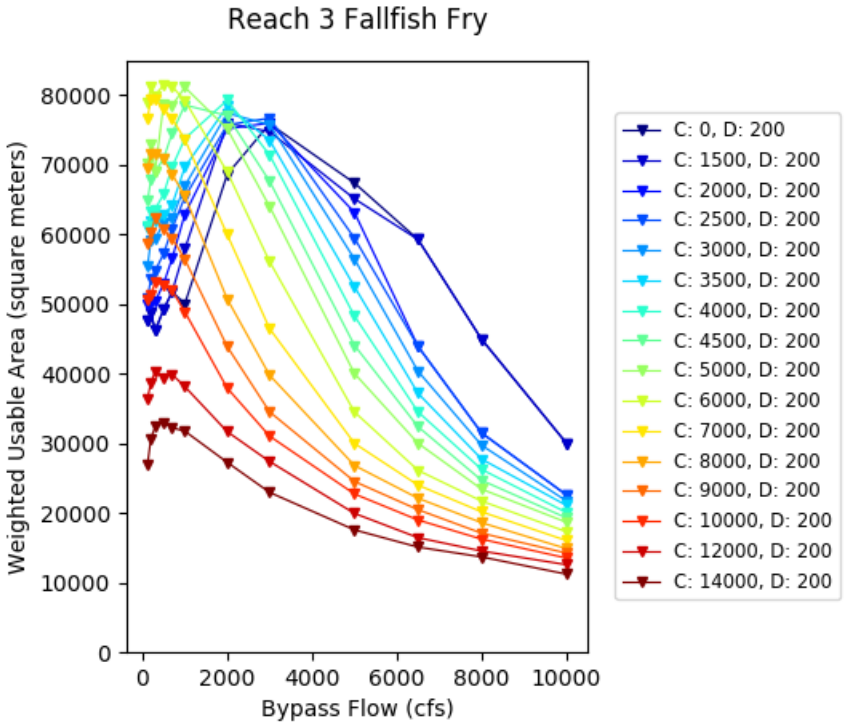

Reach 3 % of Max WUA: Shortnose Sturgeon Adult
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
90%
80%
70%
60%
40%
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100

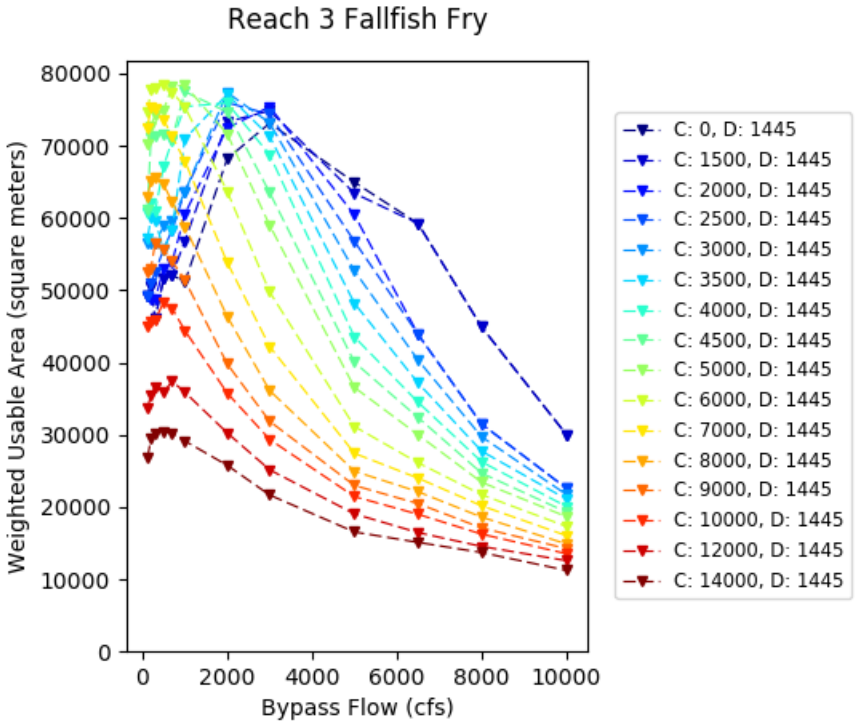

Reach 3 Fallfish Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
60000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

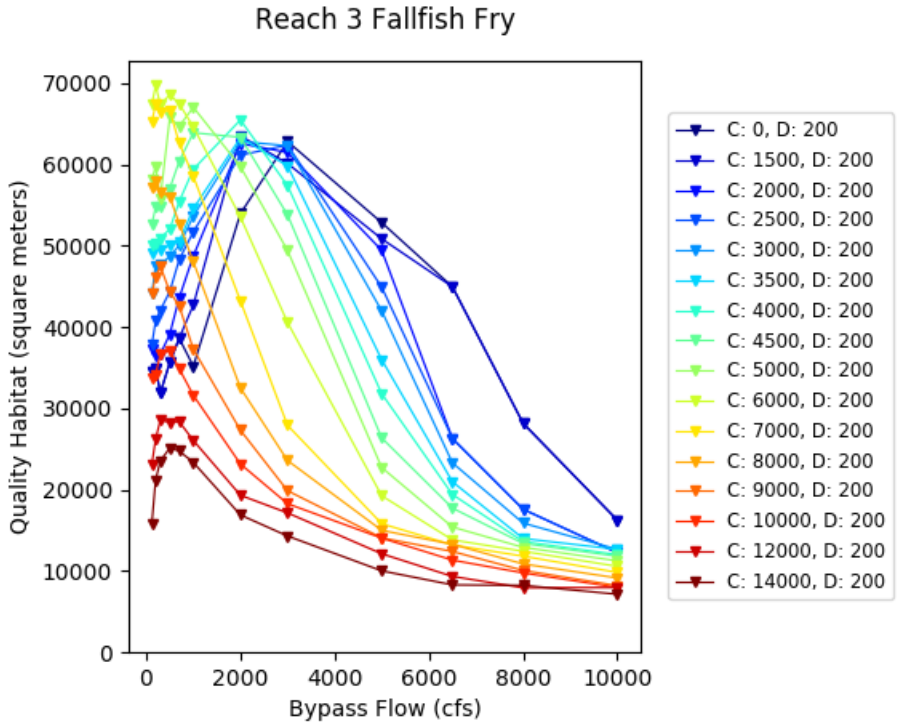

Reach 3 Fallfish Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
60000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

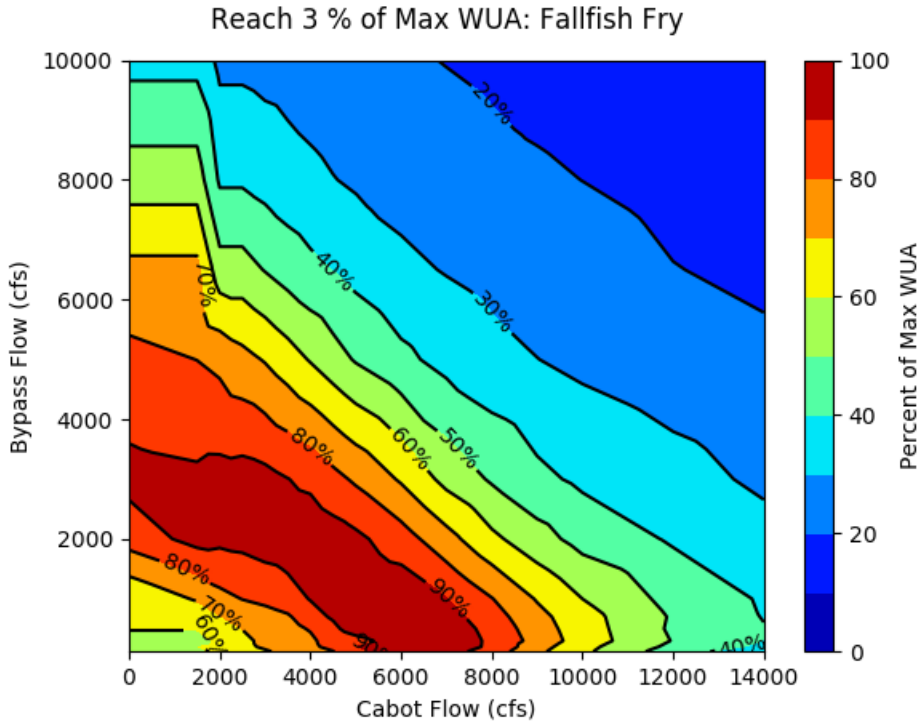

Reach 3 Fallfish Spawning
Quality Habitat (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
60000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

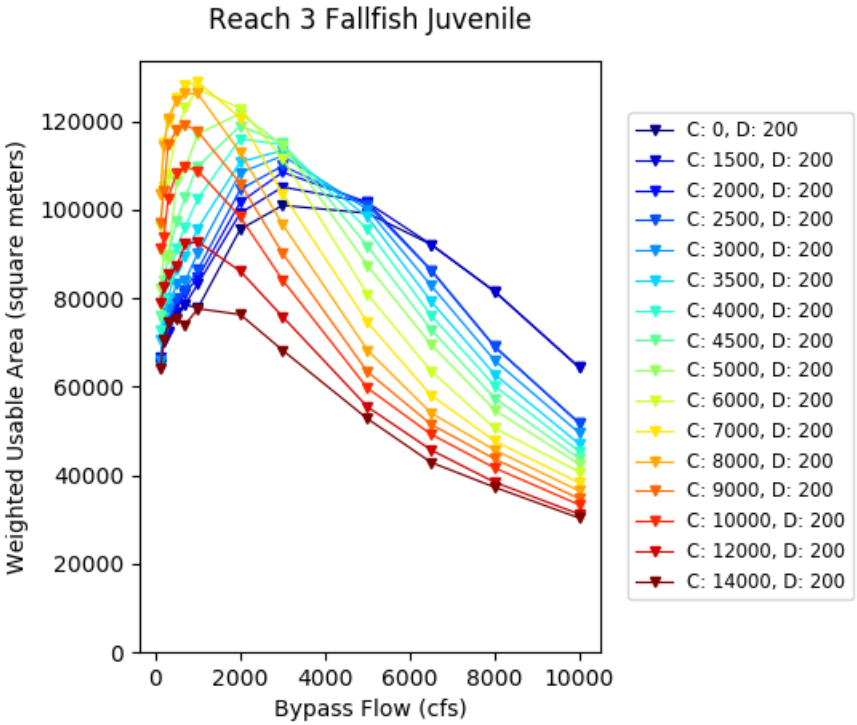

Reach 3 % of Max WUA: Fallfish Spawning
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
20%
30%
40%
50%
60%
70%
80%
90%

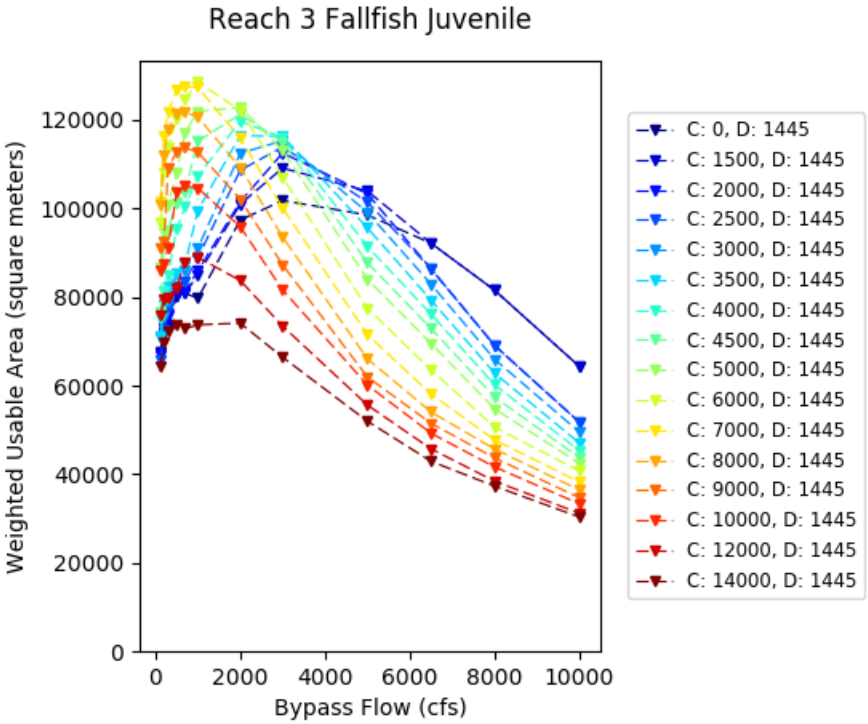

Reach 3 Fallfish Fry
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
60000
70000
80000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

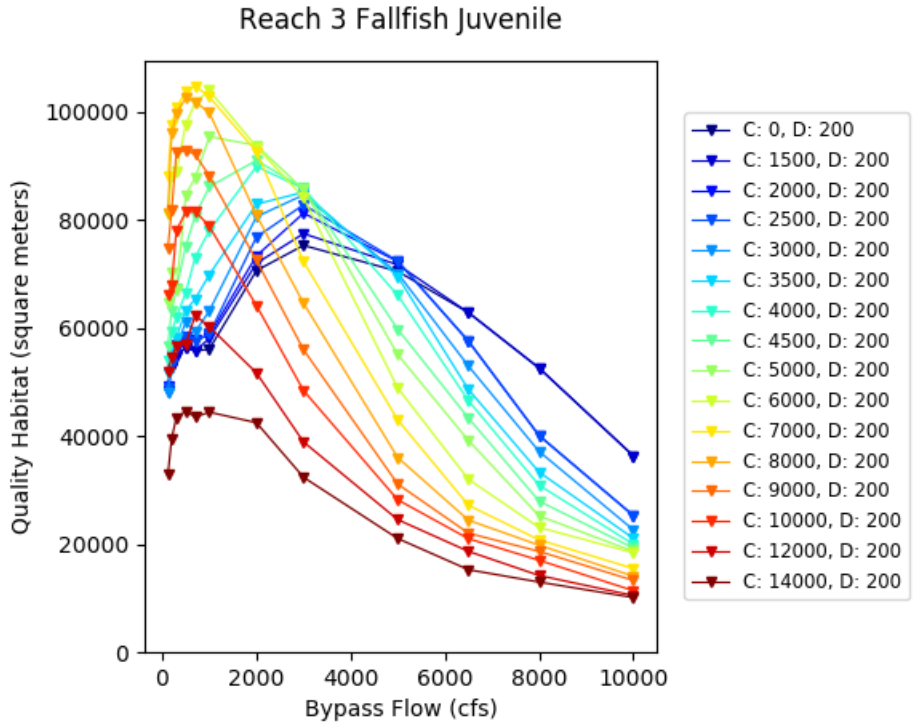

Reach 3 Fallfish Fry
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
60000
70000
80000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

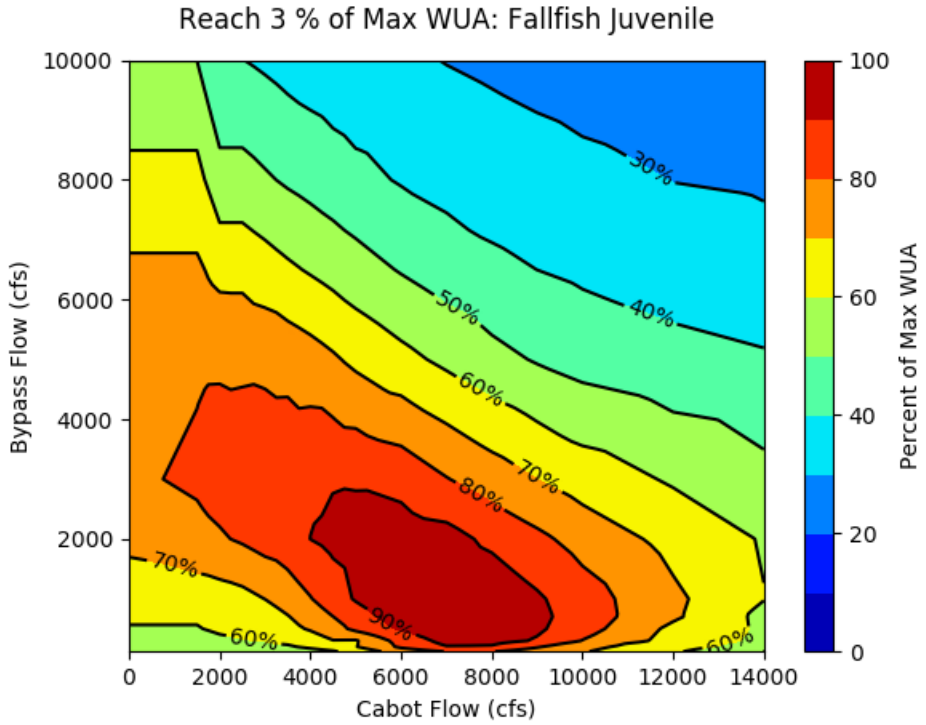

Reach 3 Fallfish Fry
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

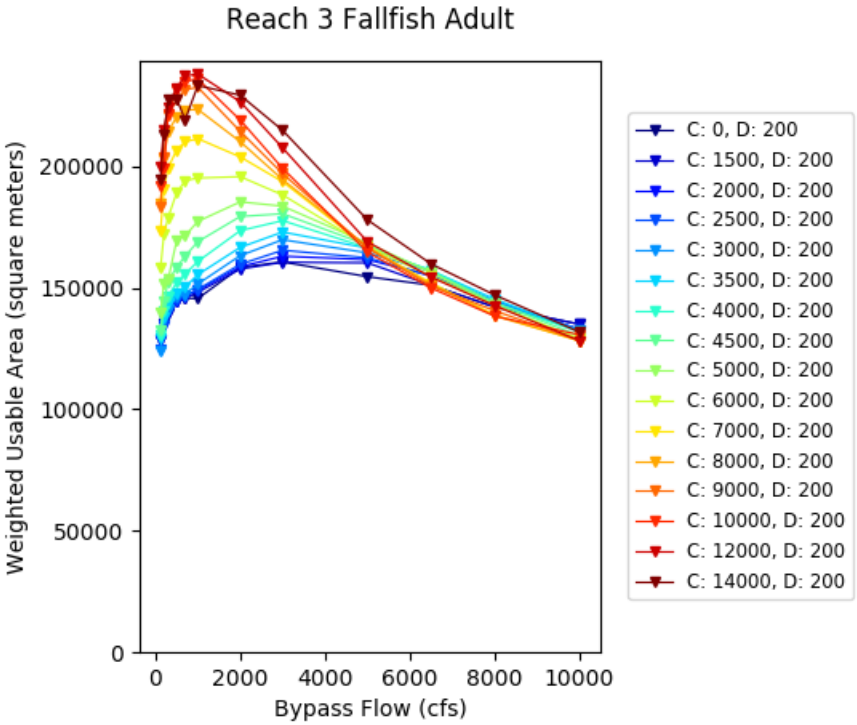

Reach 3 % of Max WUA: Fallfish Fry
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
20%
30%
40%
50%
60%
70%
80%
90%

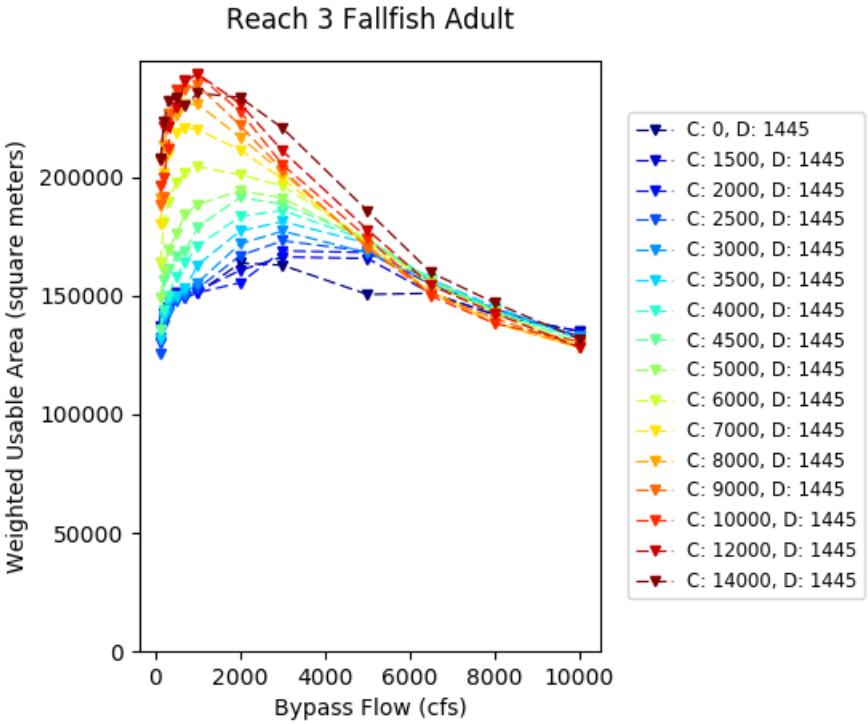

Reach 3 Fallfish Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

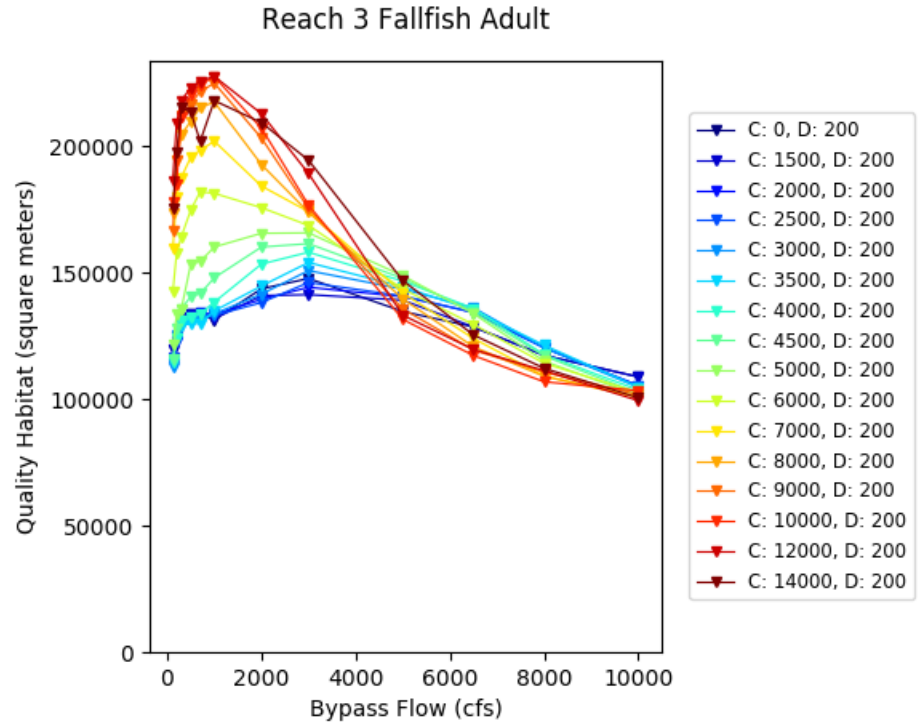

Reach 3 Fallfish Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

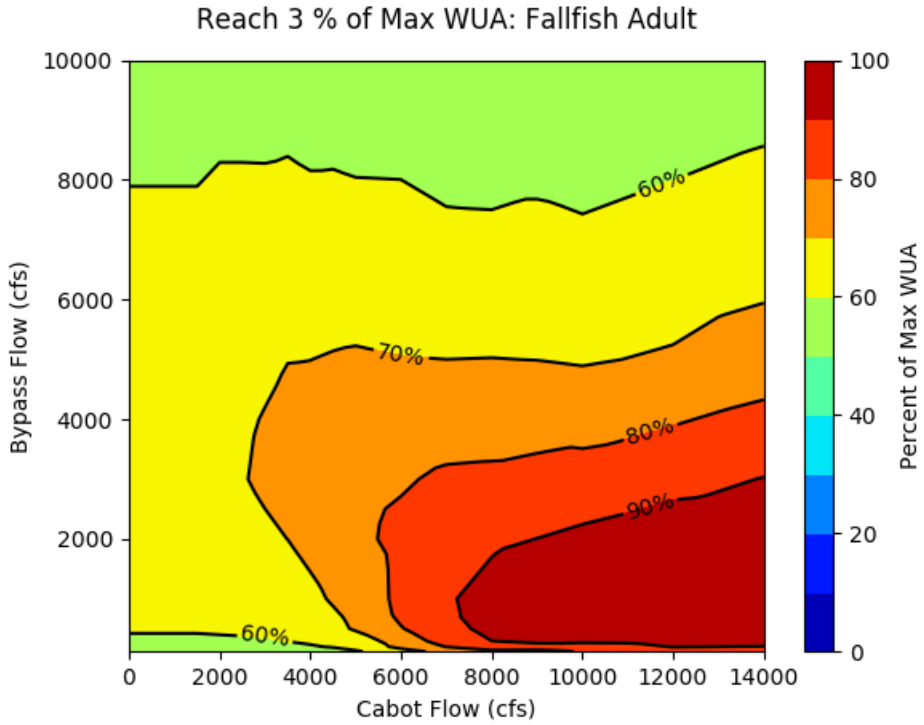

Reach 3 Fallfish Juvenile
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

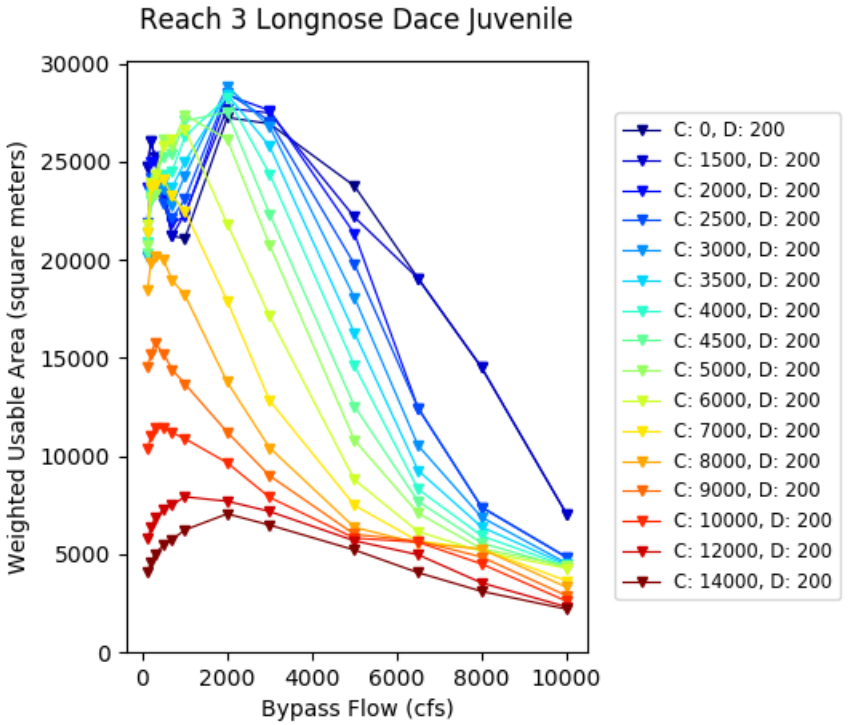

Reach 3 % of Max WUA: Fallfish Juvenile
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
30%
40%
50%
60%
70%
80%
90%

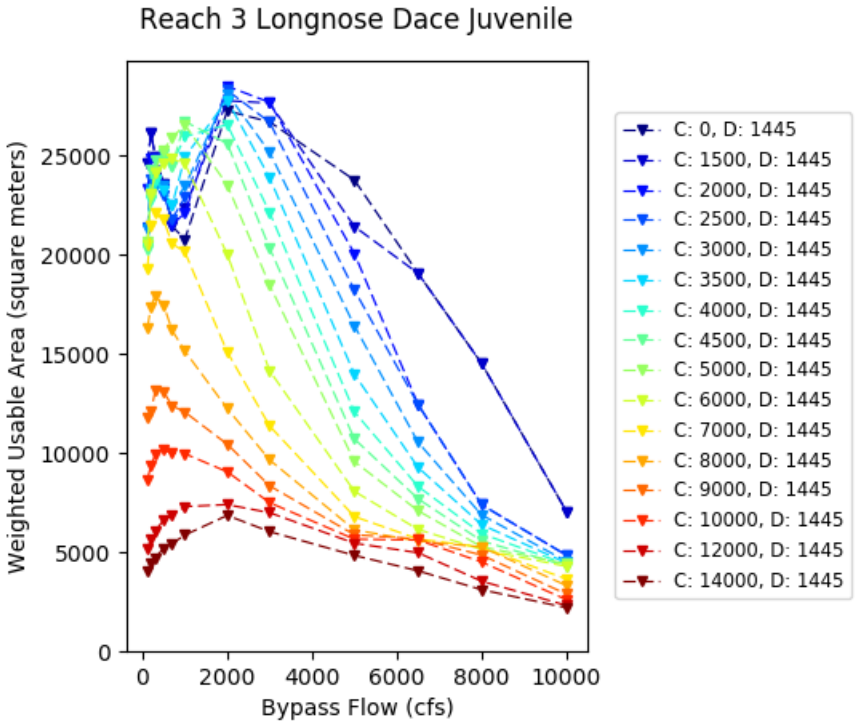

Reach 3 Fallfish Adult
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

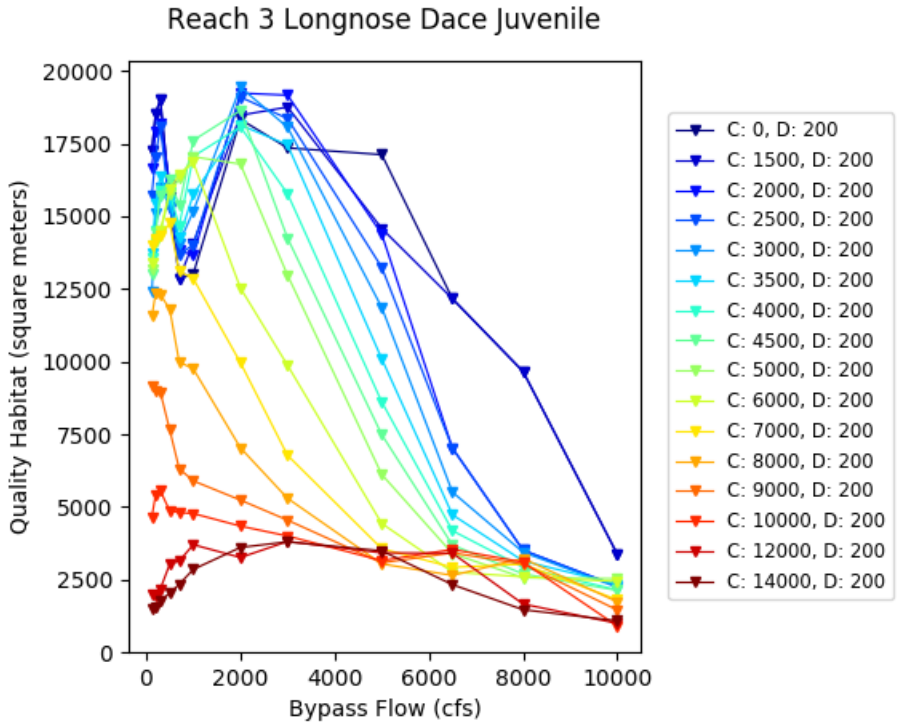

Reach 3 Fallfish Adult
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

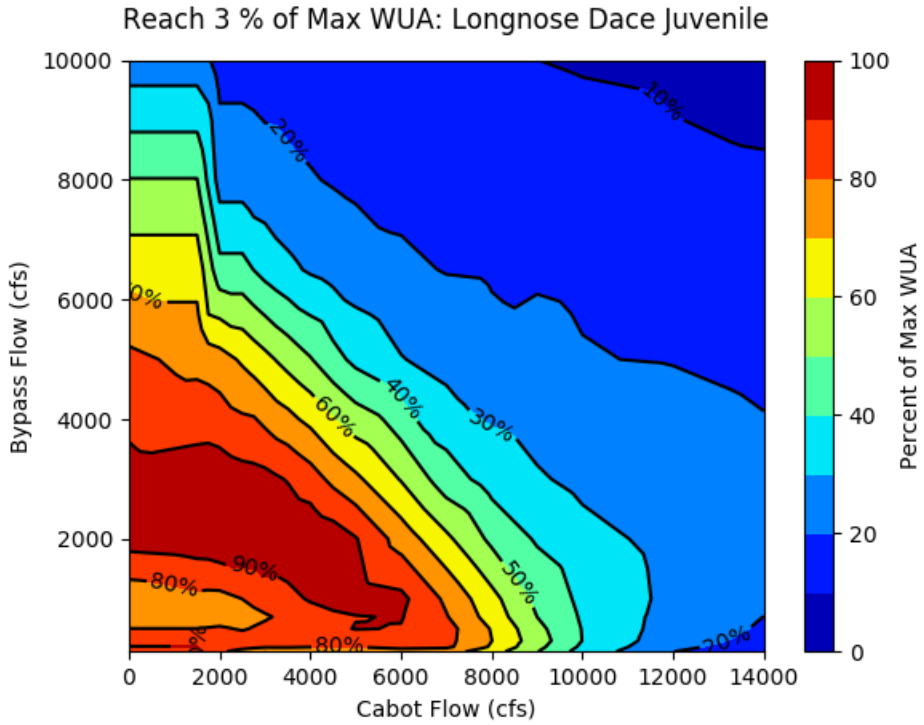

Reach 3 Fallfish Adult
Quality Habitat (square meters)
Bypass Flow (cfs)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

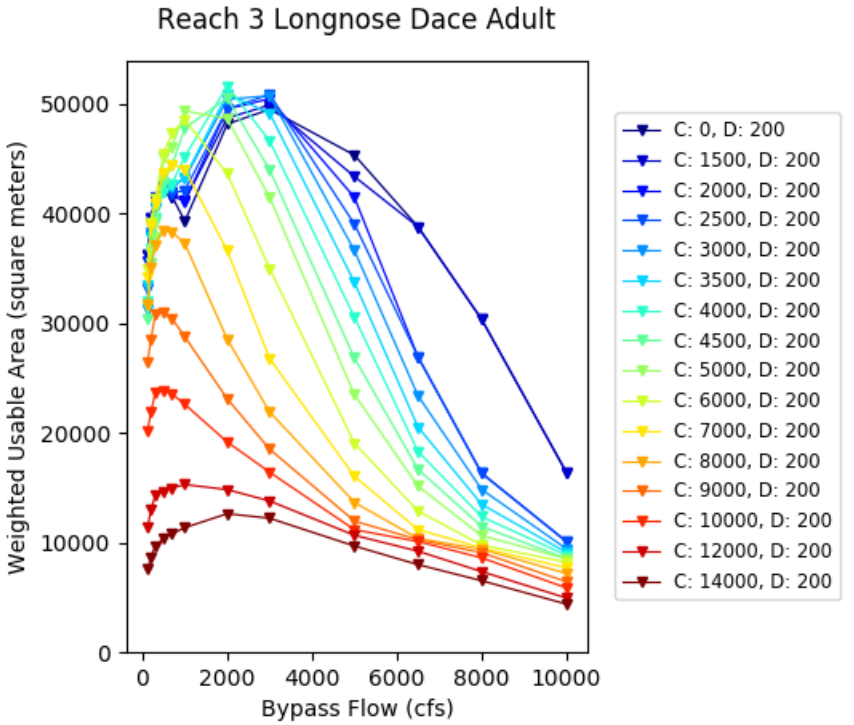

Reach 3 % of Max WUA: Fallfish Adult
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
60%
70%
80%
90%
60%

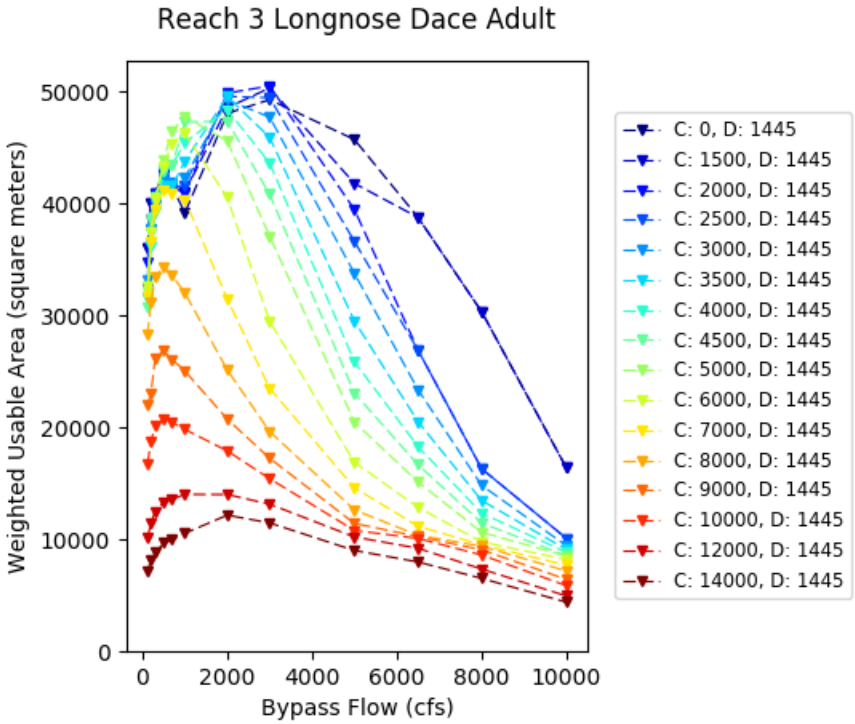

Reach 3 Longnose Dace Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
5000
10000
15000
20000
25000
30000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

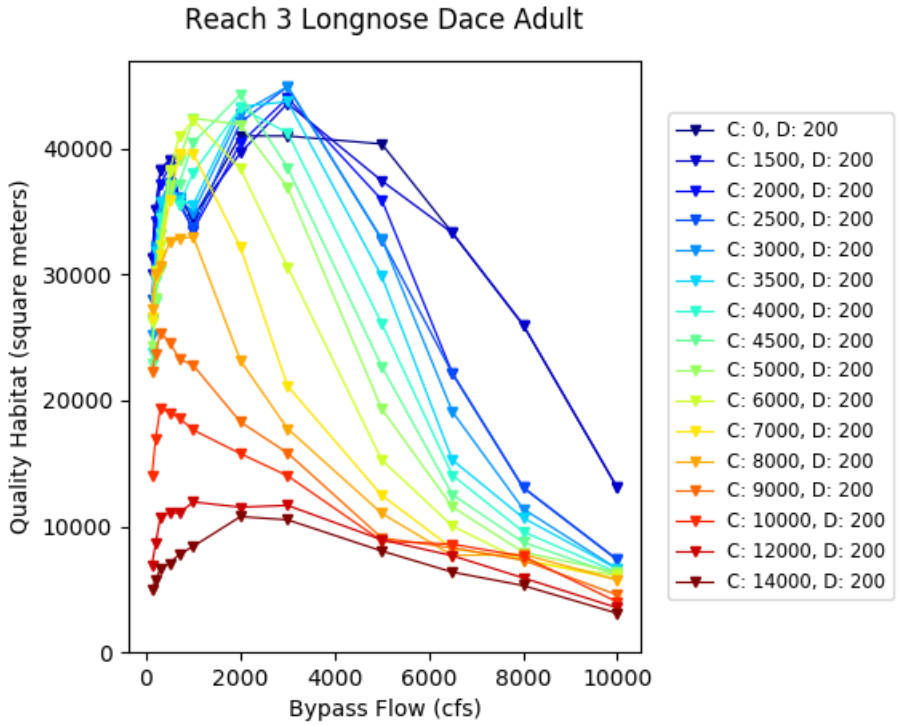

Reach 3 Longnose Dace Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
5000
10000
15000
20000
25000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

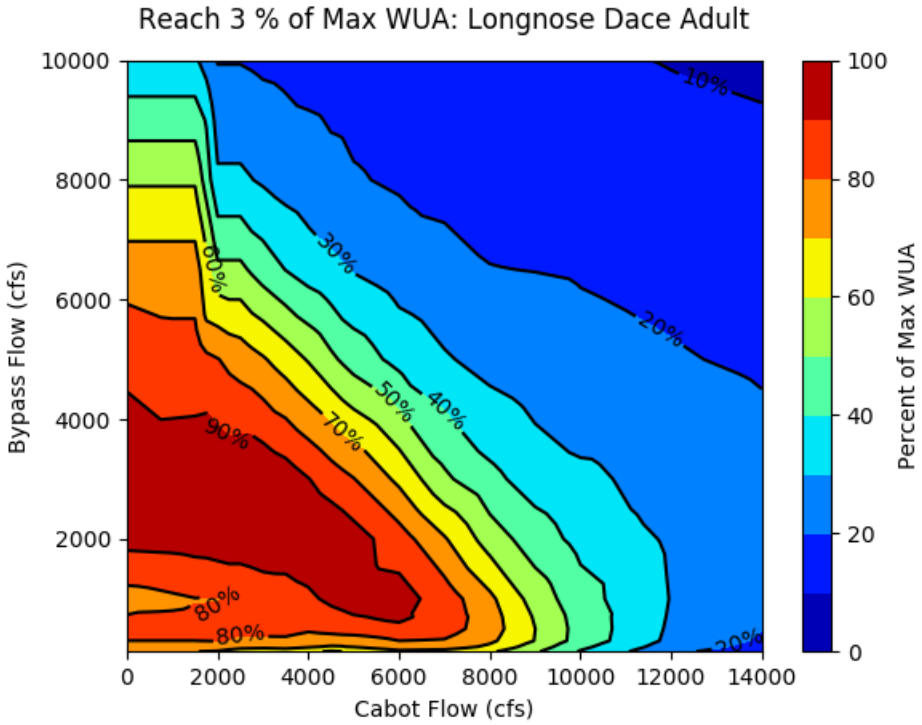

Reach 3 Longnose Dace Juvenile
Quality Habitat (square meters)
Bypass Flow (cfs)
0
2500
5000
7500
10000
12500
15000
17500
20000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

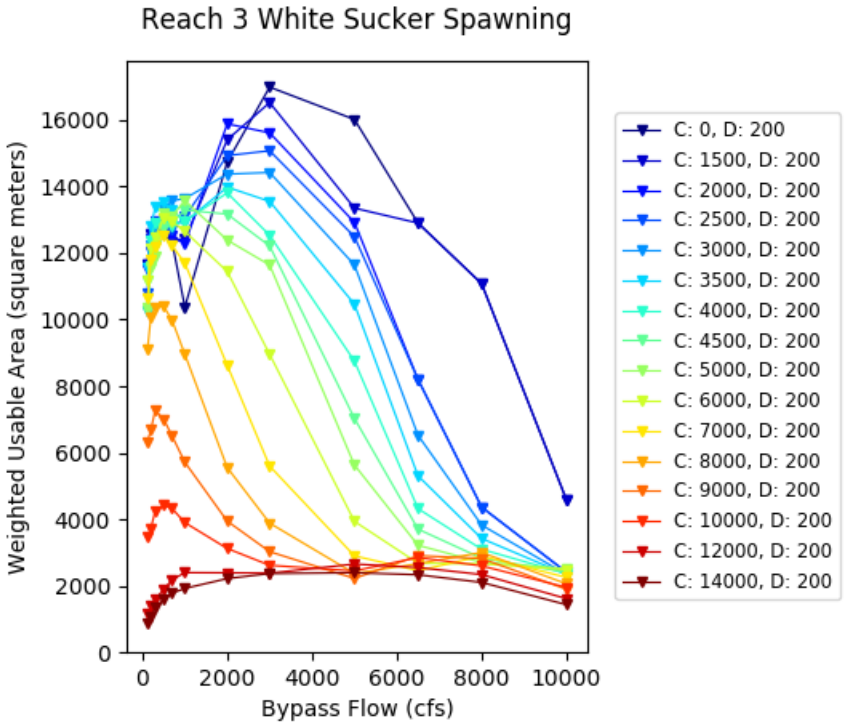

Reach 3 % of Max WUA: Longnose Dace Juvenile
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
0
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
10%
20%
30%
40%
50%
60%
80%
90%

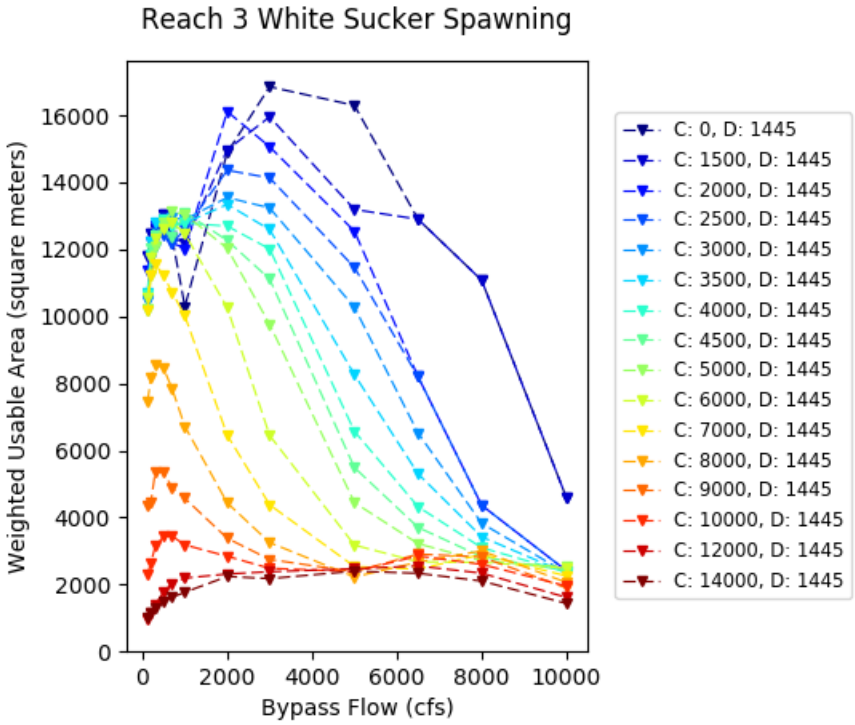

Reach 3 Longnose Dace Adult
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

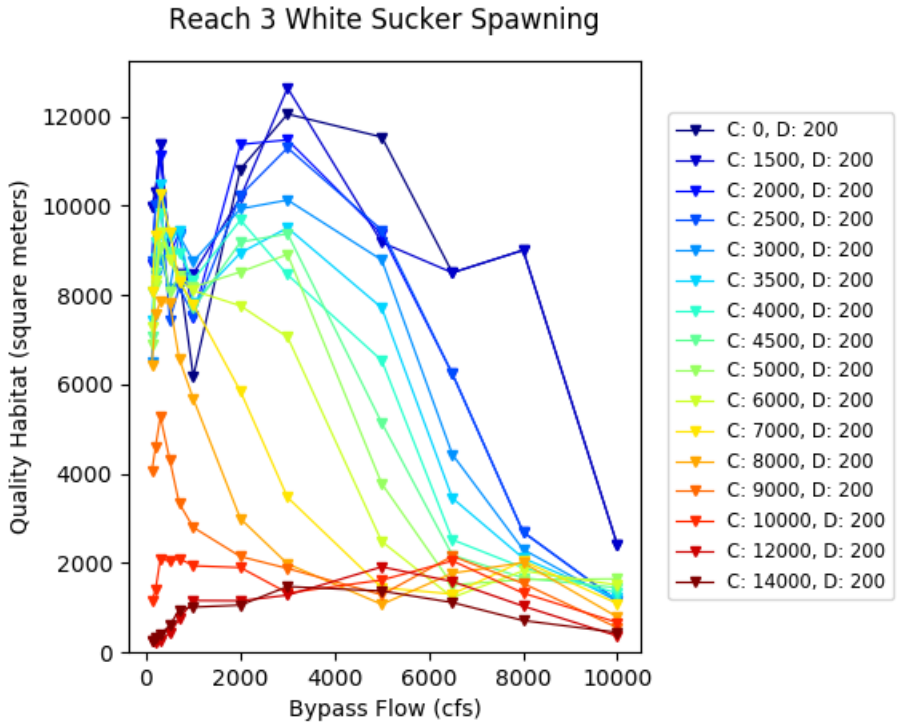

Reach 3 Longnose Dace Adult
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

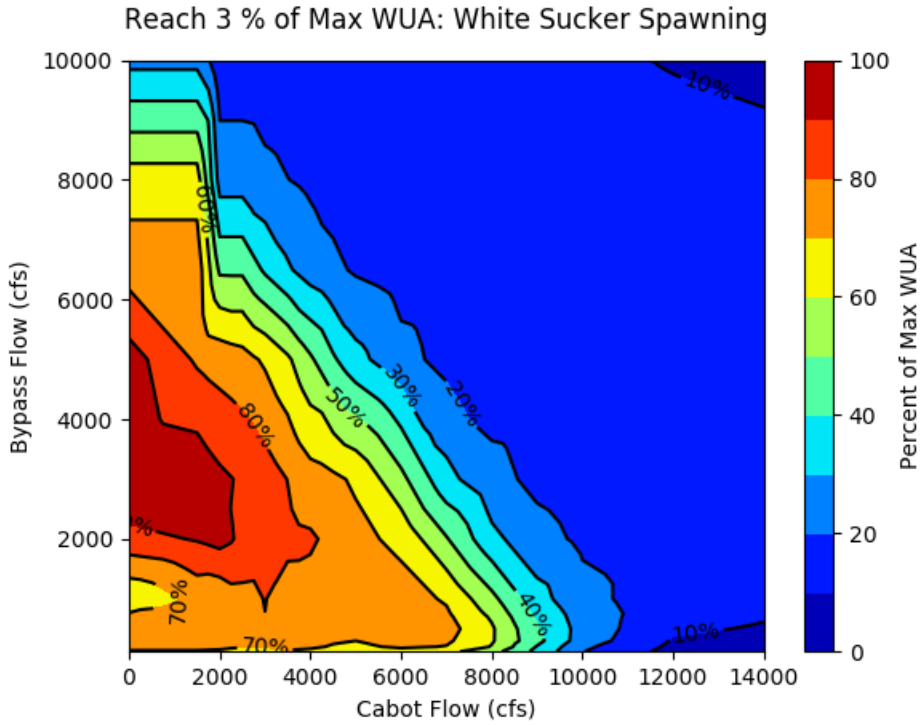

Reach 3 Longnose Dace Adult
Quality Habitat (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

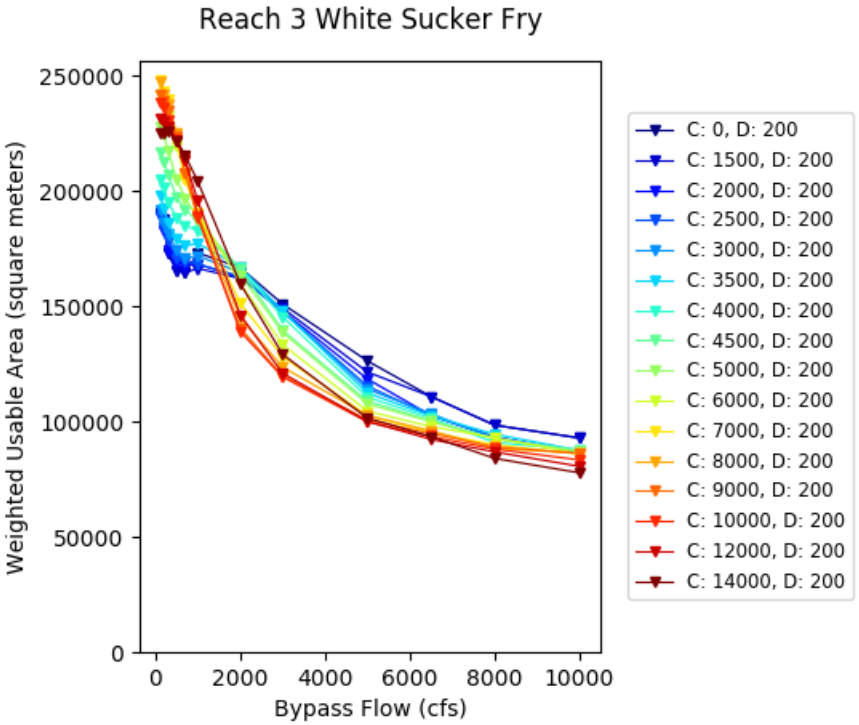

Reach 3 % of Max WUA: Longnose Dace Adult
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
10000
8000
6000
4000
2000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
10%
20%
30%
40%
50%
60%
70%
80%
90%

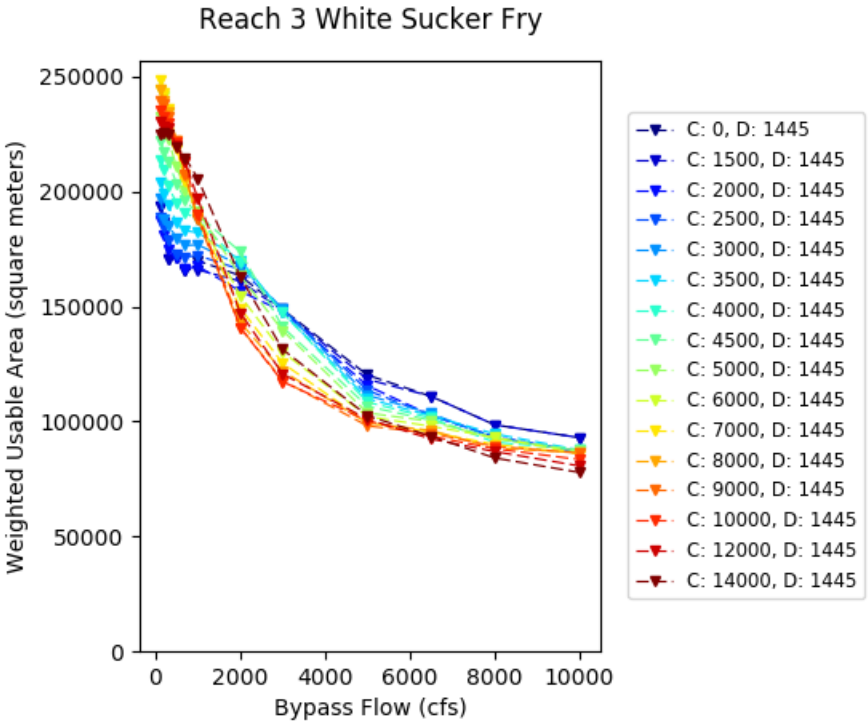

Reach 3 White Sucker Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
2000
4000
6000
8000
10000
12000
14000
16000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

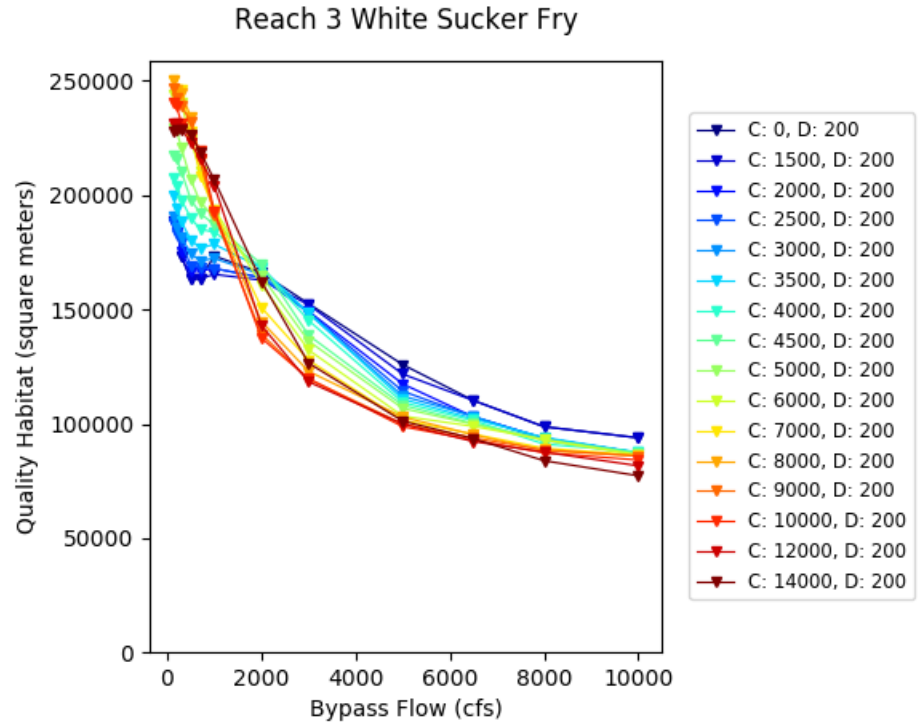

Reach 3 White Sucker Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
2000
4000
6000
8000
10000
12000
14000
16000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

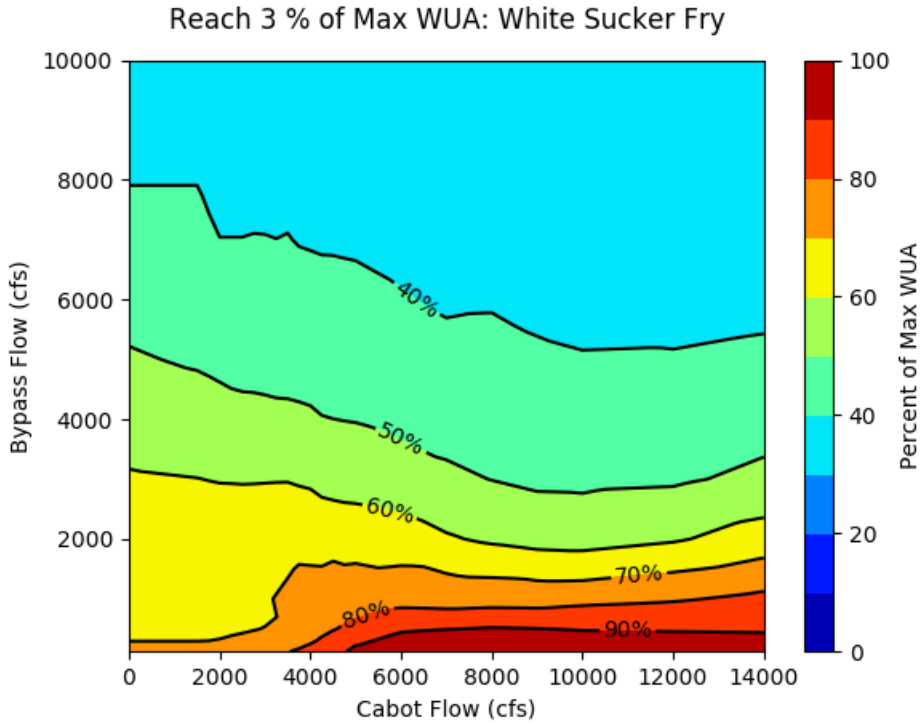

Reach 3 White Sucker Spawning
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

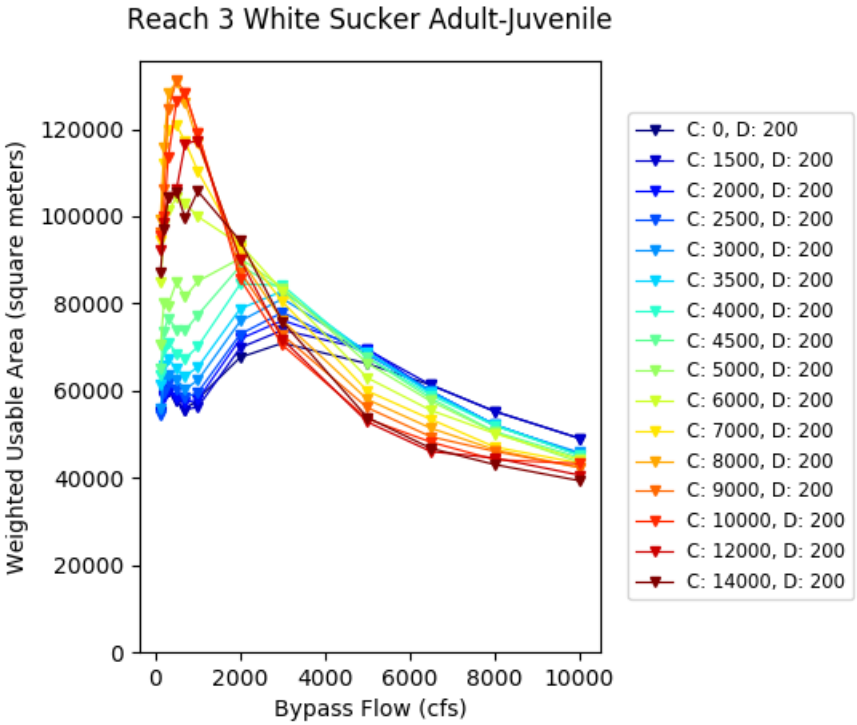

Reach 3 % of Max WUA: White Sucker Spawning
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
10%
20%
30%
40%
50%
60%
70%
80%
90%

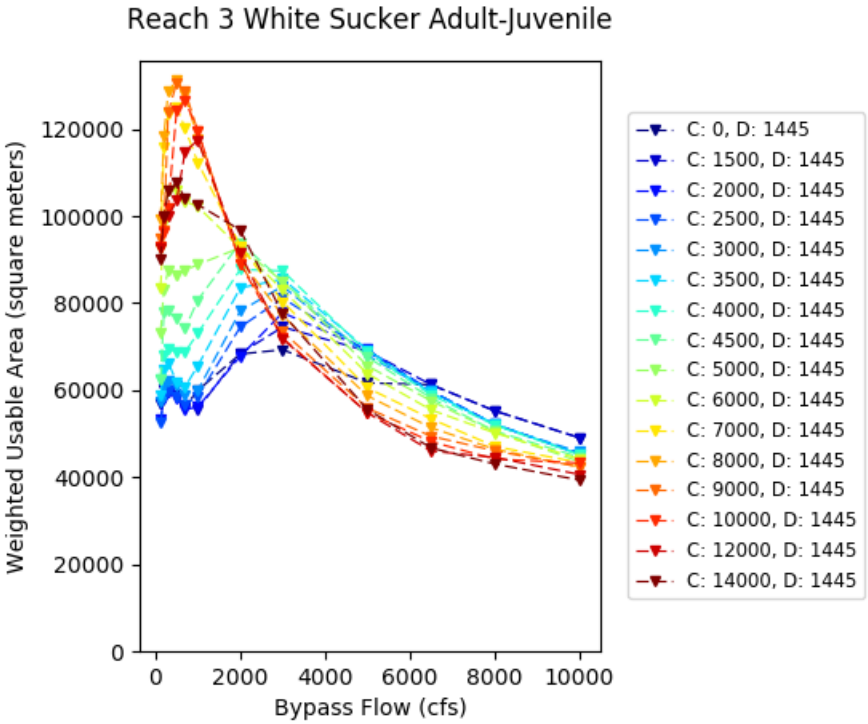

Reach 3 White Sucker Fry
Weighted Usable Area (square meters)
250000
200000
150000
100000
50000
0
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

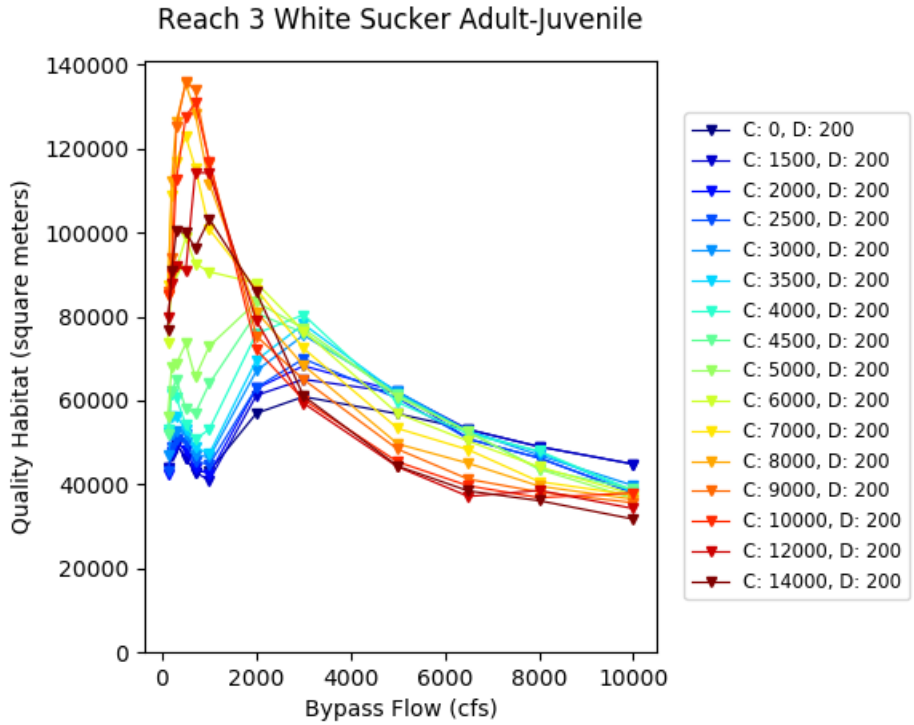

Reach 3 White Sucker Fry
Weighted Usable Area (square meters)
250000
200000
150000
100000
50000
0
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

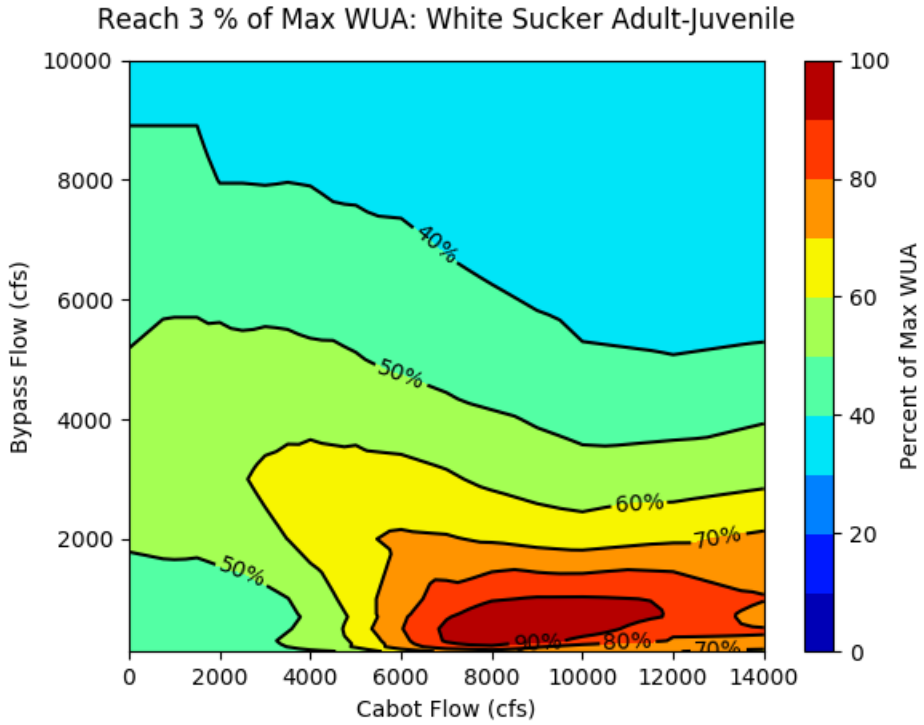

Reach 3 White Sucker Fry
Quality Habitat (square meters)
250000
200000
150000
100000
50000
0
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

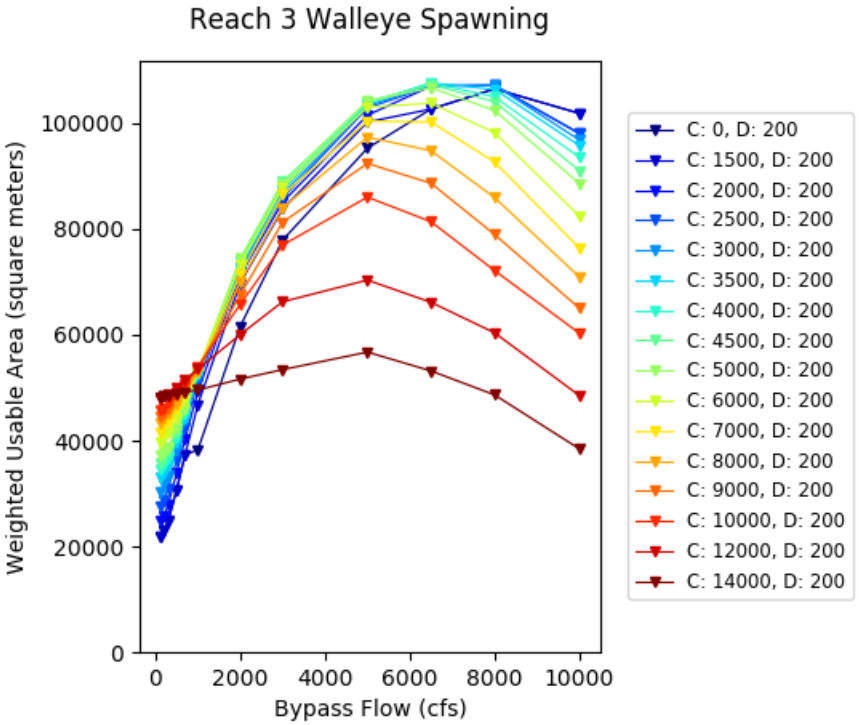

Reach 3 % of Max WUA: White Sucker Fry
Bypass Flow (cfs)
10000
8000
6000
4000
2000
0
2000
4000
6000
8000
10000
12000
14000
Cabot Flow (cfs)
40%
50%
60%
70%
80%
90%
Percent of Max WUA
100
80
60
40
20
0

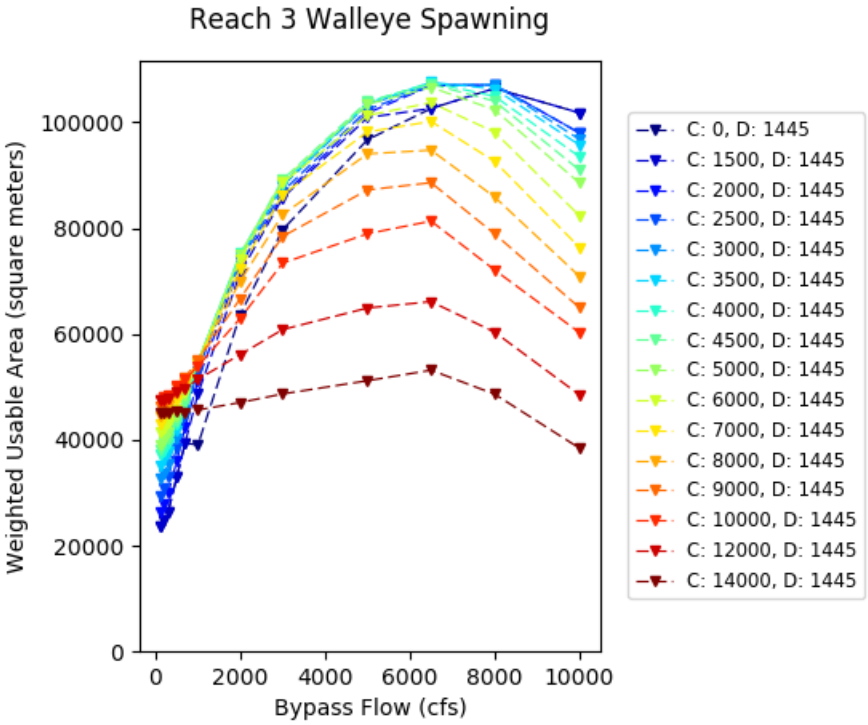

Reach 3 White Sucker Adult-Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

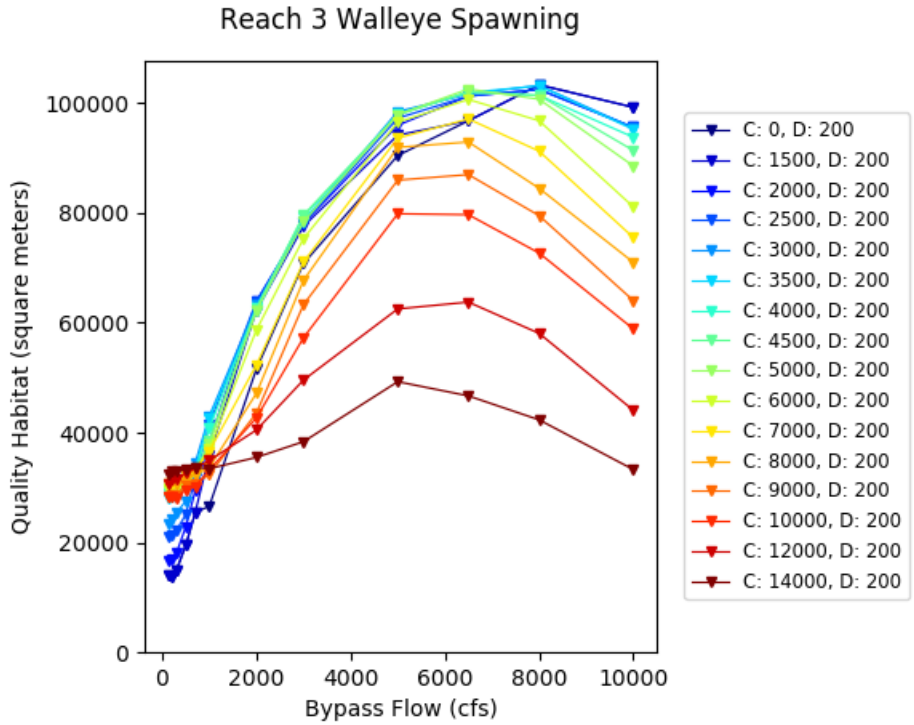

Reach 3 White Sucker Adult-Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

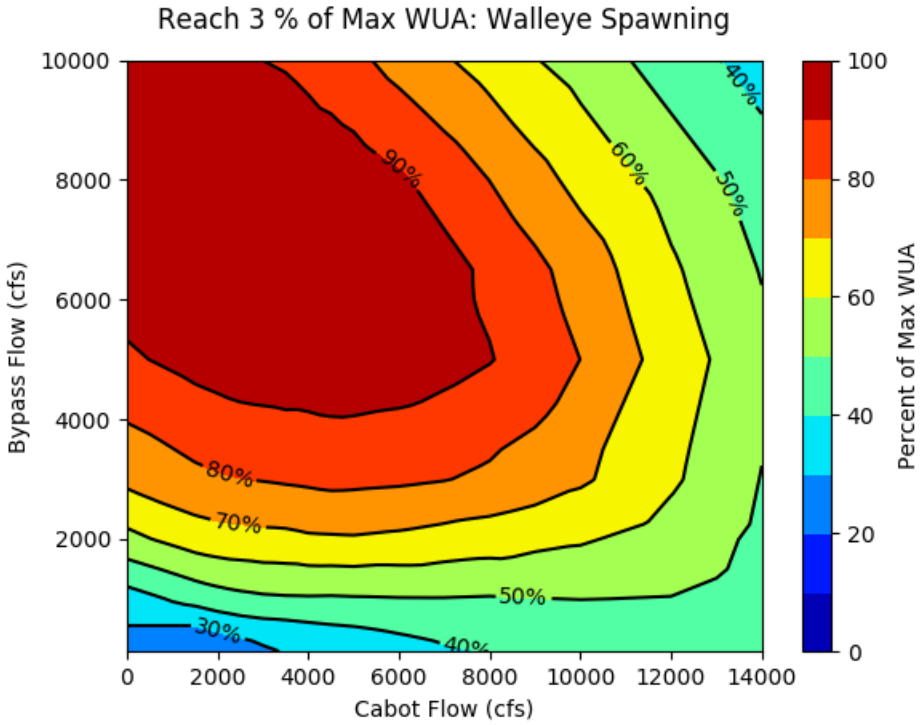

Reach 3 White Sucker Adult-Juvenile
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

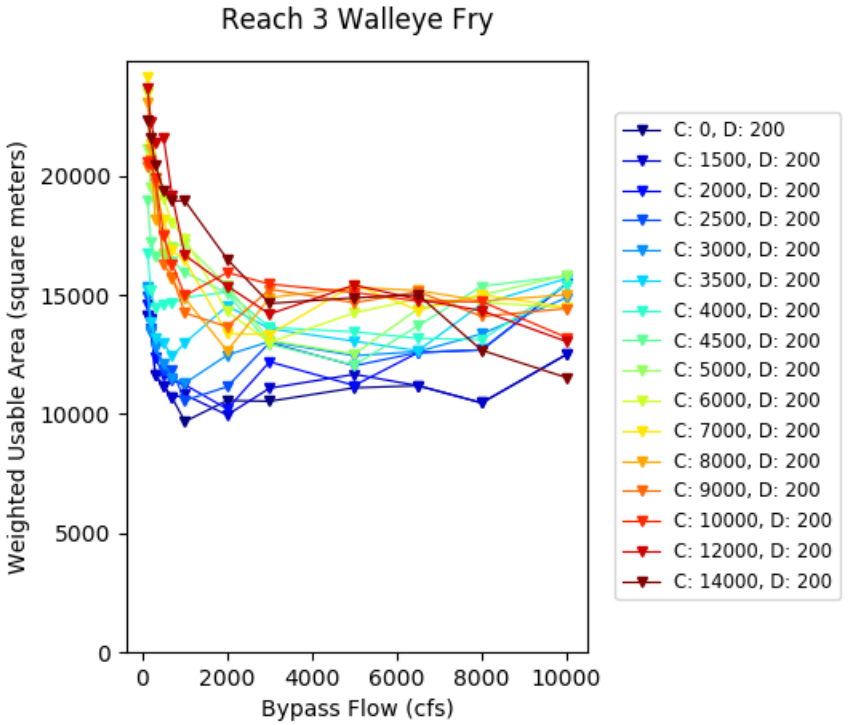

Reach 3 % of Max WUA: White Sucker Adult-Juvenile
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
40%
50%
60%
70%
80%
90%

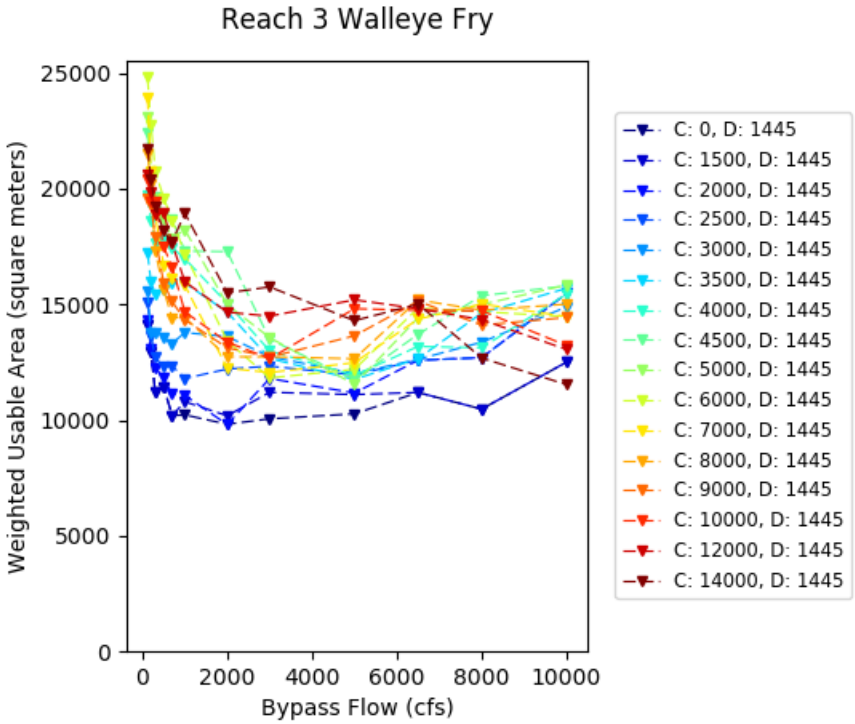

Reach 3 Walleye Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

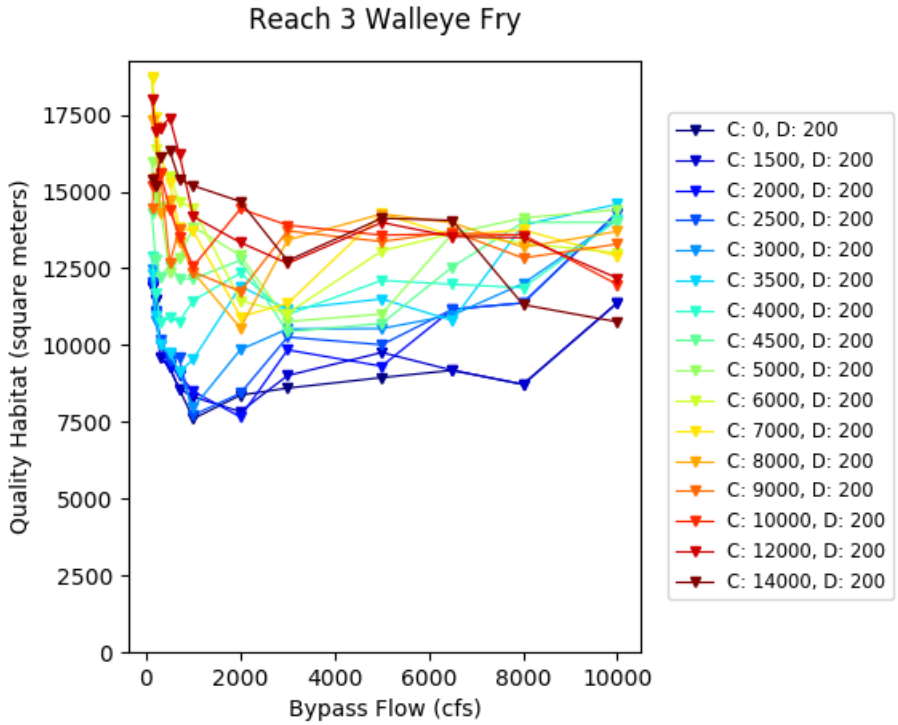

Reach 3 Walleye Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

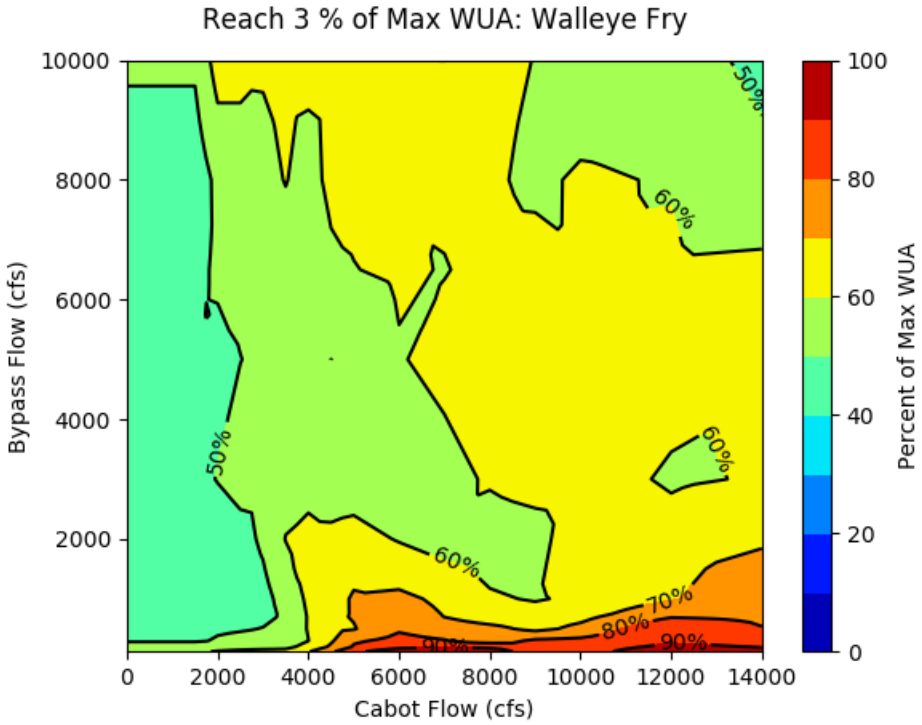

Reach 3 Walleye Spawning
Quality Habitat (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

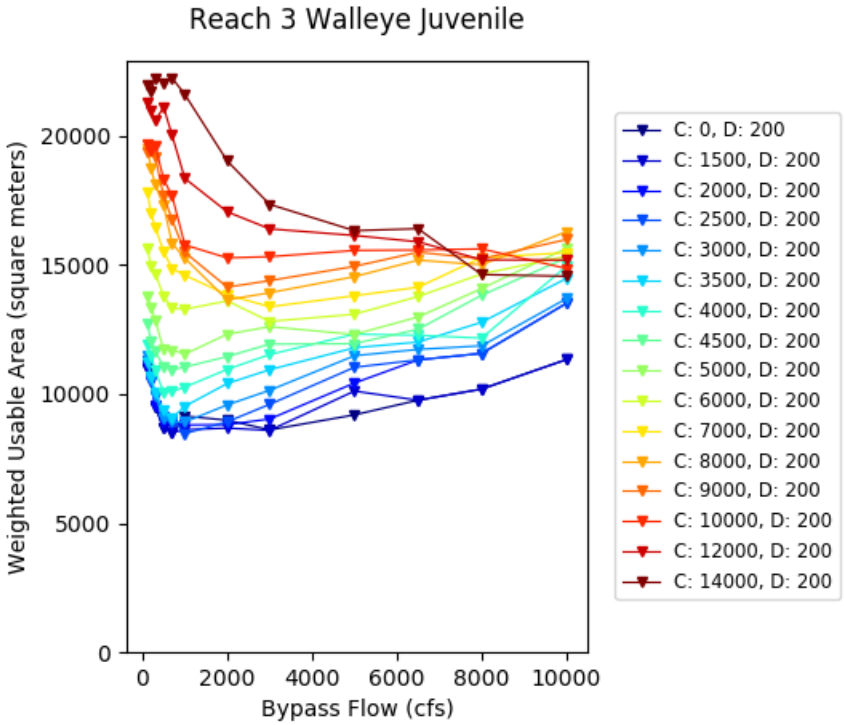

Reach 3 % of Max WUA: Walleye Spawning
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
90%
80%
70%
60%
50%
40%
30%
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100

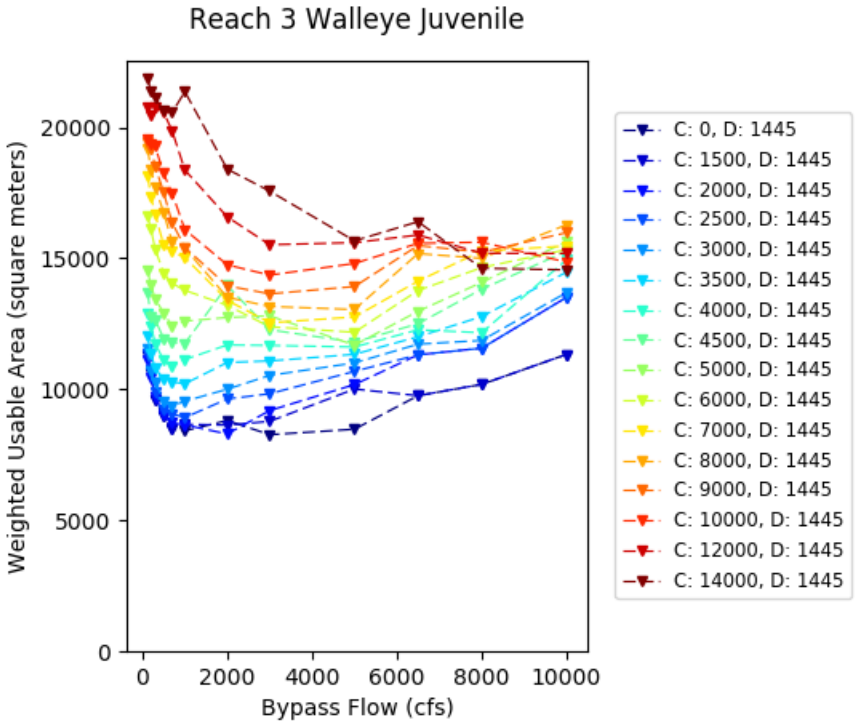

Reach 3 Walleye Fry
Weighted Usable Area (square meters)
0
5000
10000
15000
20000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

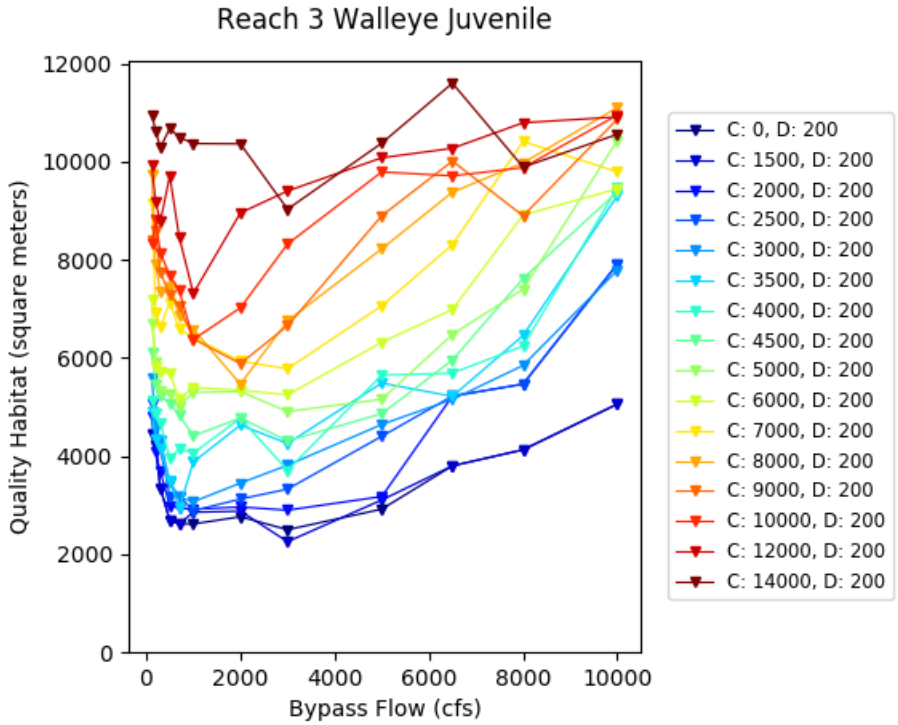

Reach 3 Walleye Fry
Weighted Usable Area (square meters)
0
5000
10000
15000
20000
25000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

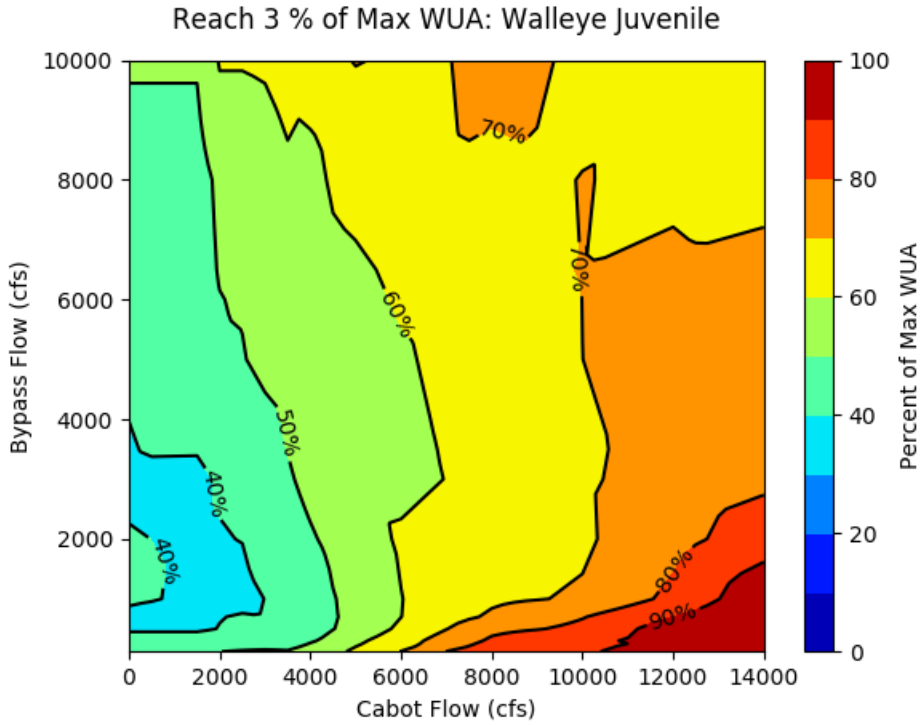

Reach 3 Walleye Fry
Quality Habitat (square meters)
Bypass Flow (cfs)
0
2500
5000
7500
10000
12500
15000
17500
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

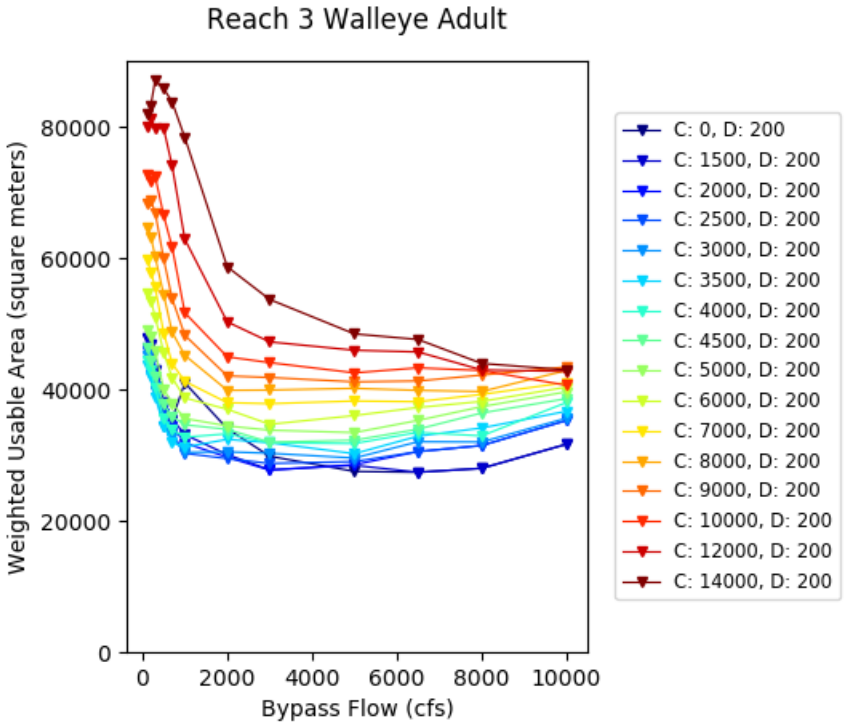

Reach 3 % of Max WUA: Walleye Fry
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
50%
60%
70%
80%
90%

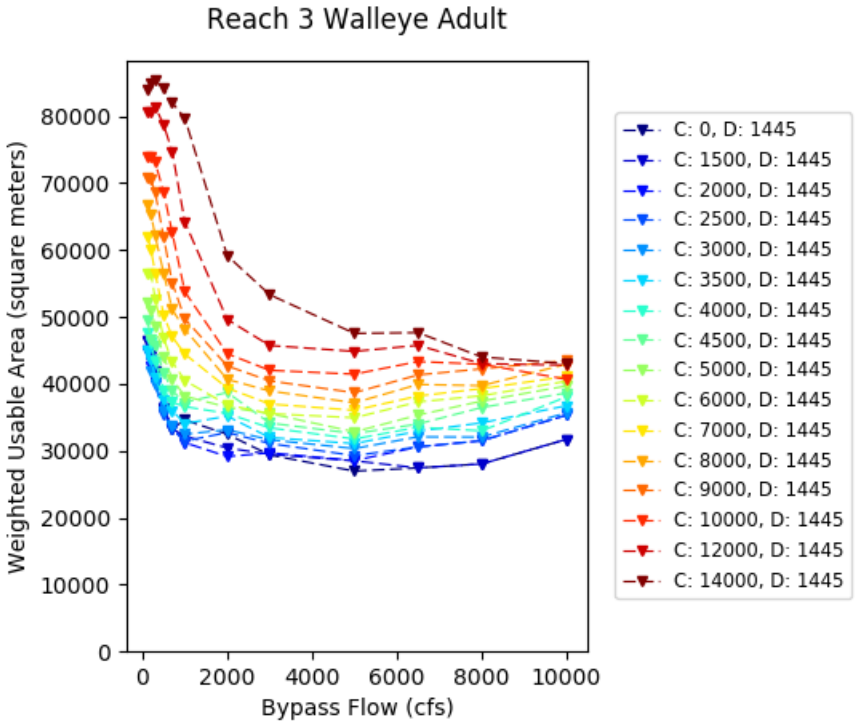

Reach 3 Walleye Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
5000
10000
15000
20000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

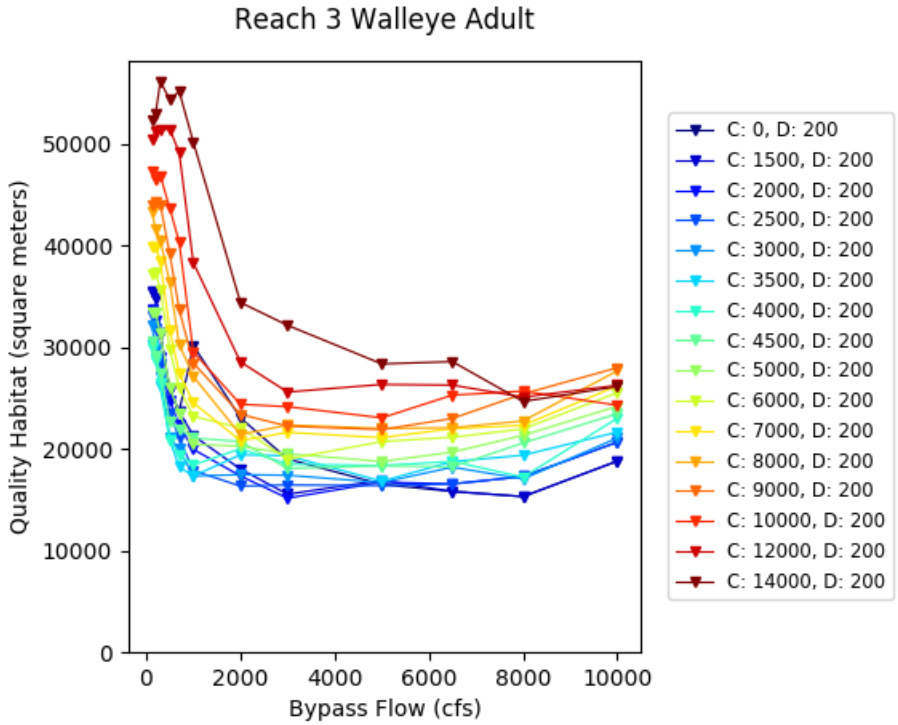

Reach 3 Walleye Juvenile
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
5000
10000
15000
20000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

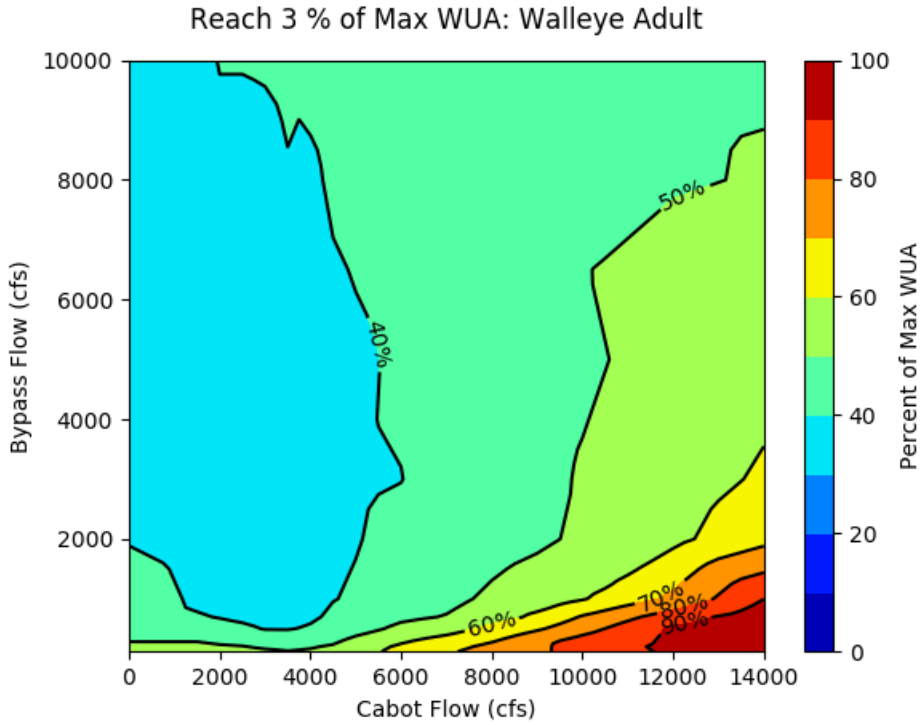

Reach 3 Walleye Juvenile
Quality Habitat (square meters)
Bypass Flow (cfs)
0
2000
4000
6000
8000
10000
12000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

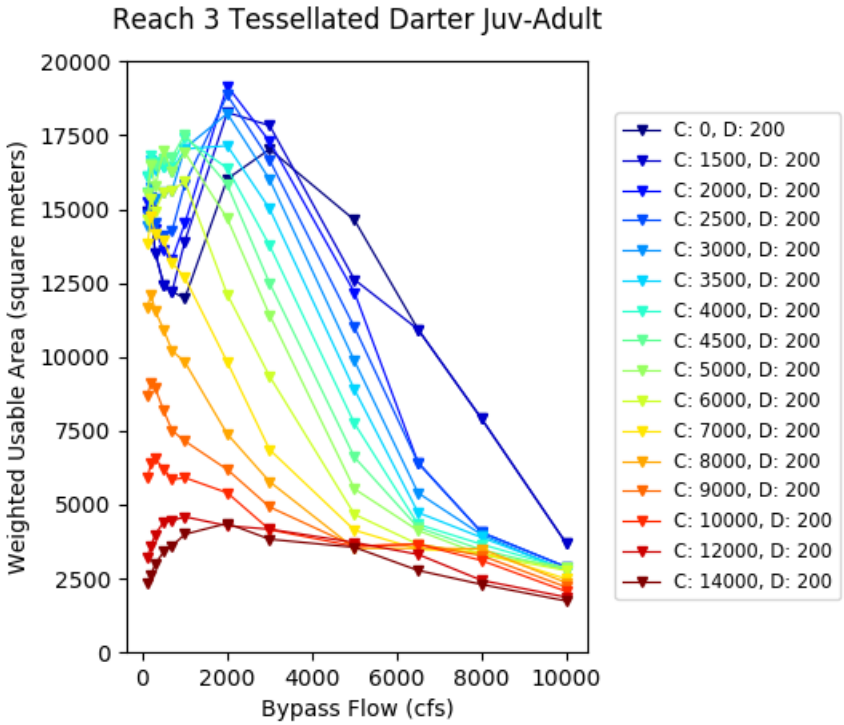

Reach 3 % of Max WUA: Walleye Juvenile
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
40%
40%
50%
60%
70%
80%
90%

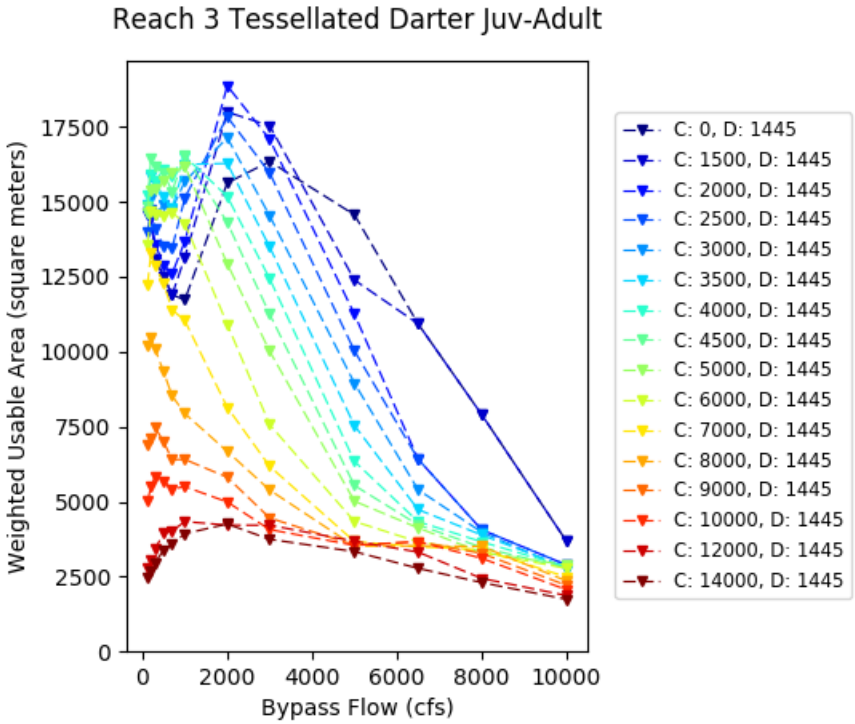

Reach 3 Walleye Adult
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

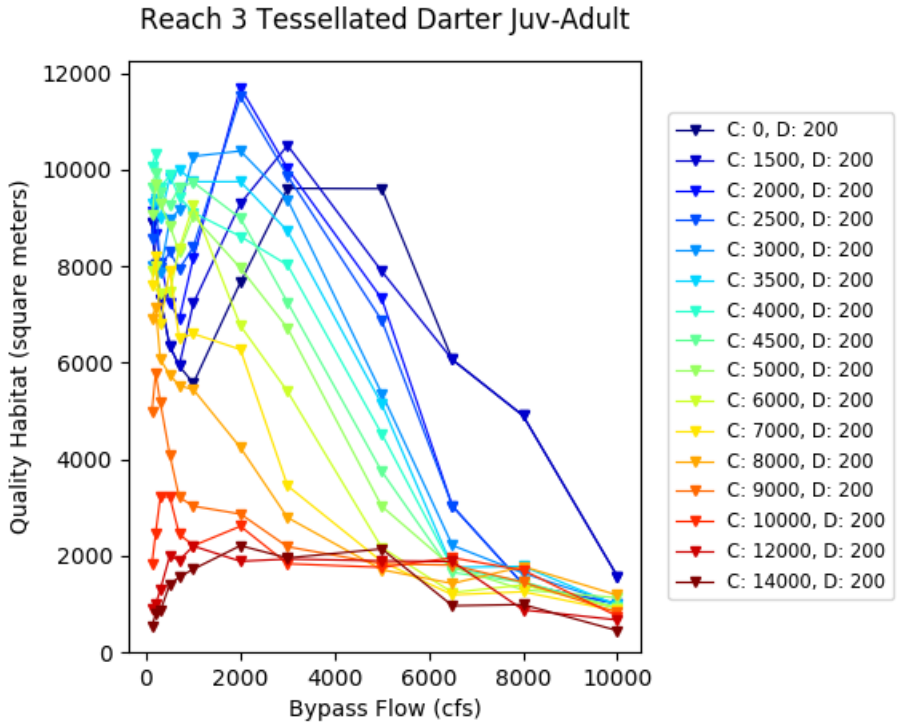

Reach 3 Walleye Adult
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
60000
70000
80000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

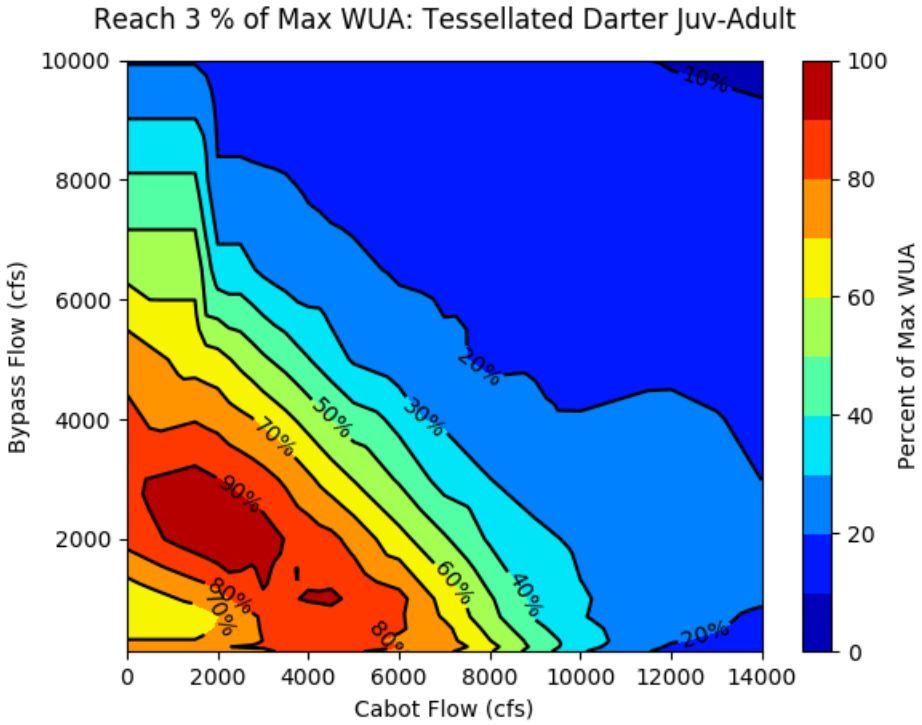

Reach 3 Walleye Adult
Quality Habitat (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

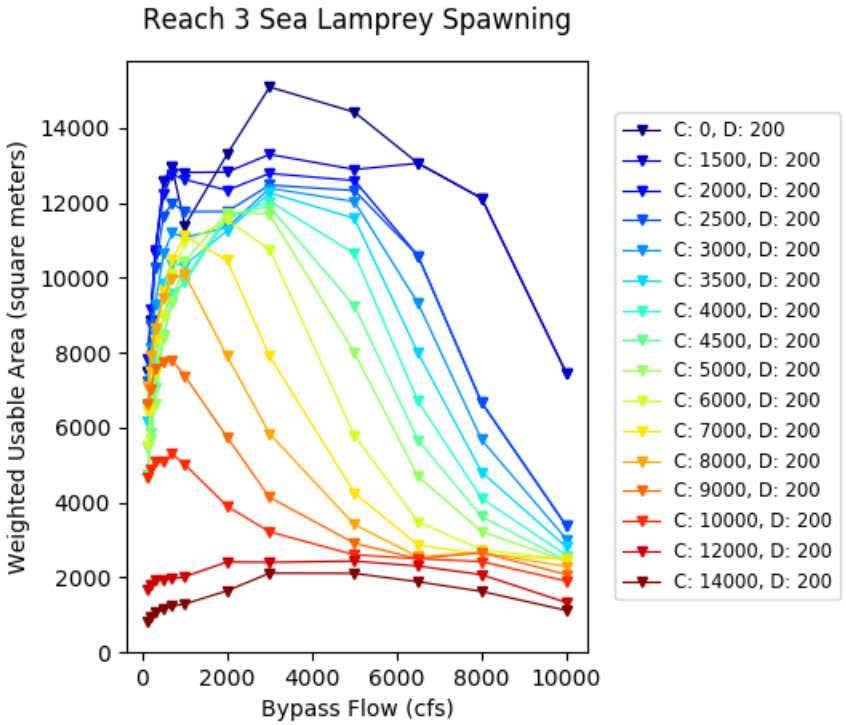

Reach 3 % of Max WUA: Walleye Adult
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100
40%
50%
60%
70%
80%
90%

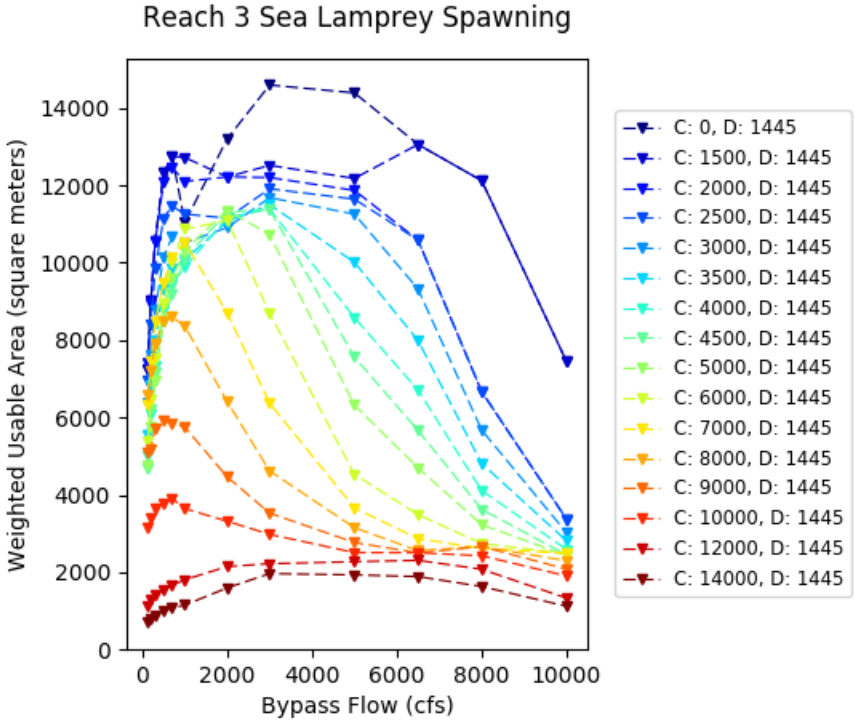

Reach 3 Tessellated Darter Juv-Adult
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
2500
5000
7500
10000
12500
15000
17500
20000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

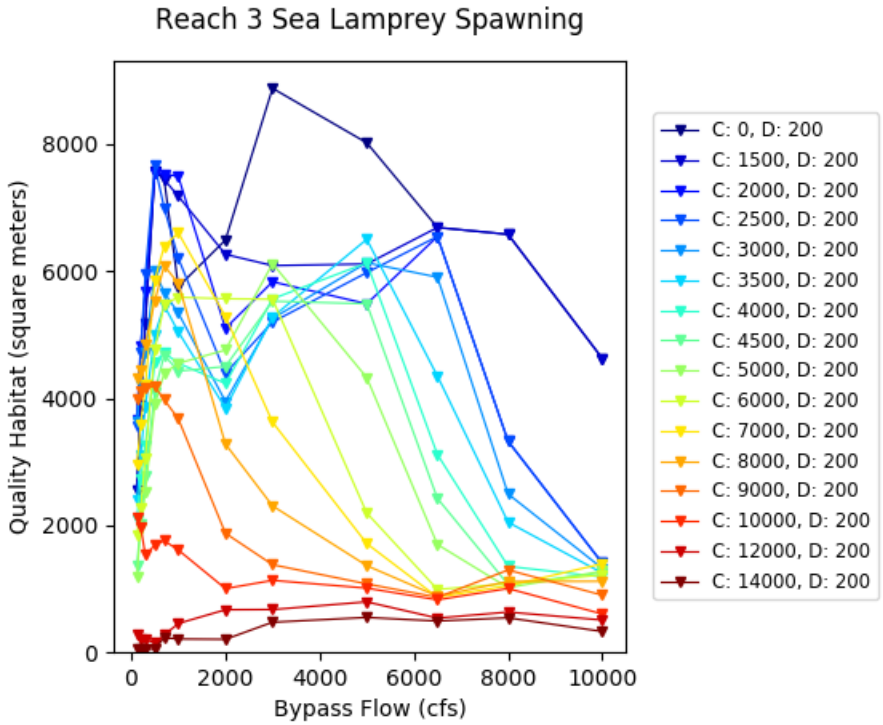

Reach 3 Tessellated Darter Juv-Adult
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
2500
5000
7500
10000
12500
15000
17500
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

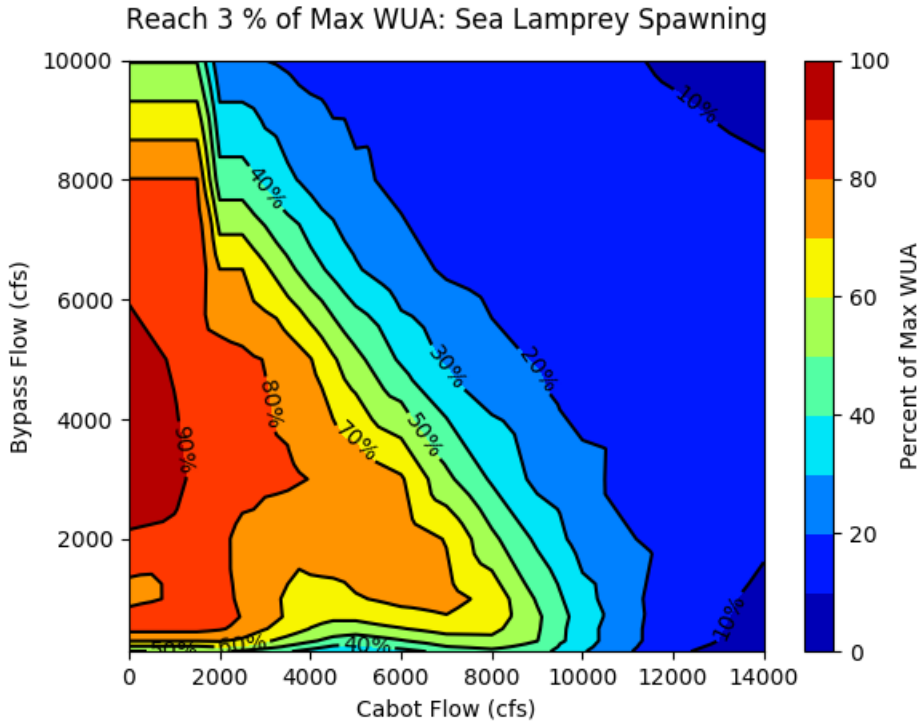

Reach 3 Tessellated Darter Juv-Adult
Quality Habitat (square meters)
Bypass Flow (cfs)
0
2000
4000
6000
8000
10000
12000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

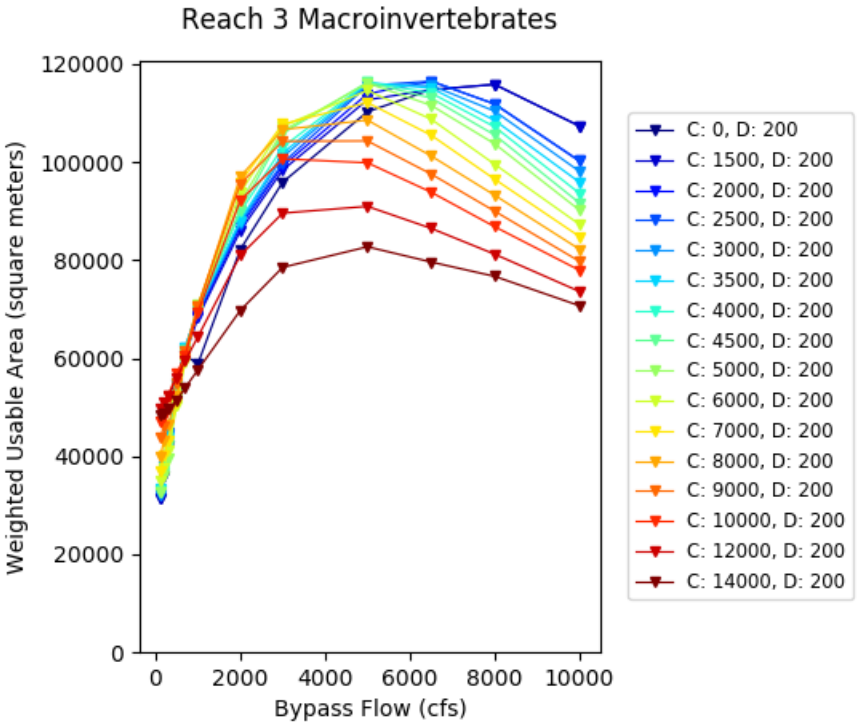

Reach 3 % of Max WUA: Tessellated Darter Juv-Adult
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
10%
20%
30%
40%
50%
60%
70%
80%
90%

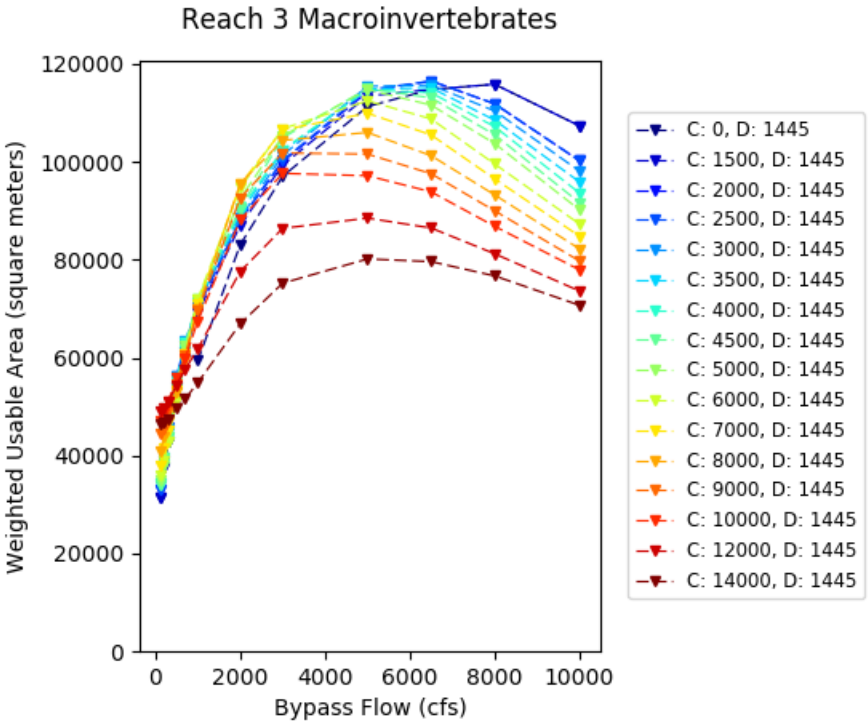

Reach 3 Sea Lamprey Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
2000
4000
6000
8000
10000
12000
14000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

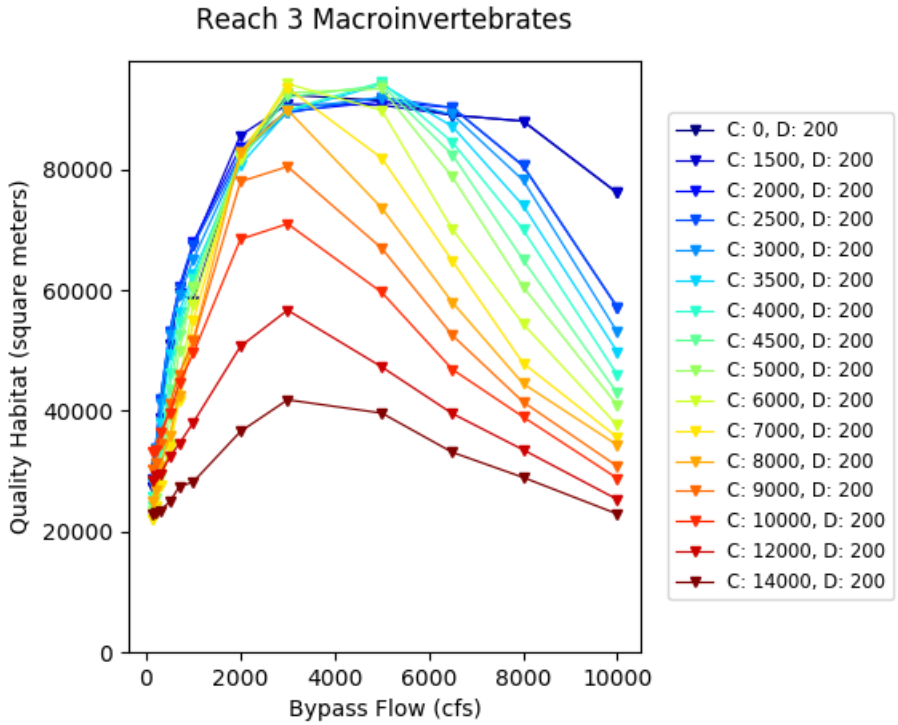

Reach 3 Sea Lamprey Spawning
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
2000
4000
6000
8000
10000
12000
14000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

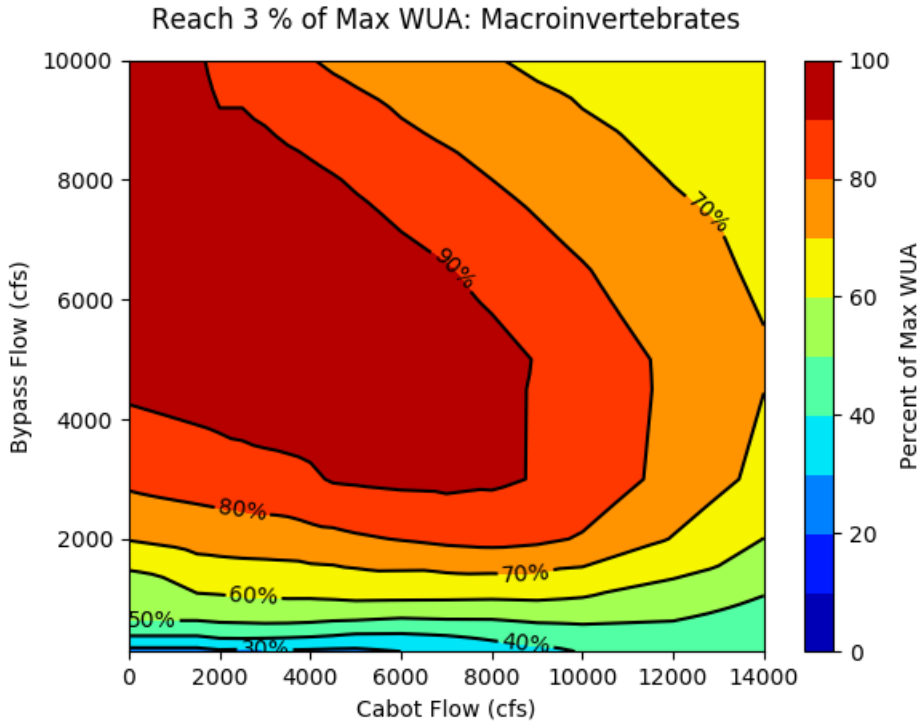

Reach 3 Sea Lamprey Spawning
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

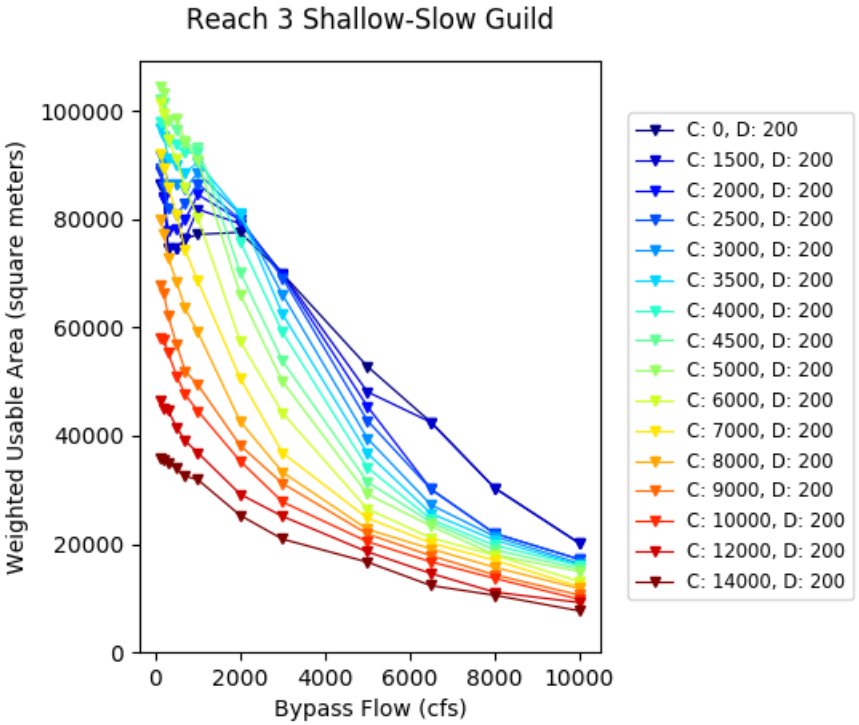

Reach 3 % of Max WUA: Sea Lamprey Spawning
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
10%
20%
30%
40%
50%
70%
80%
90%

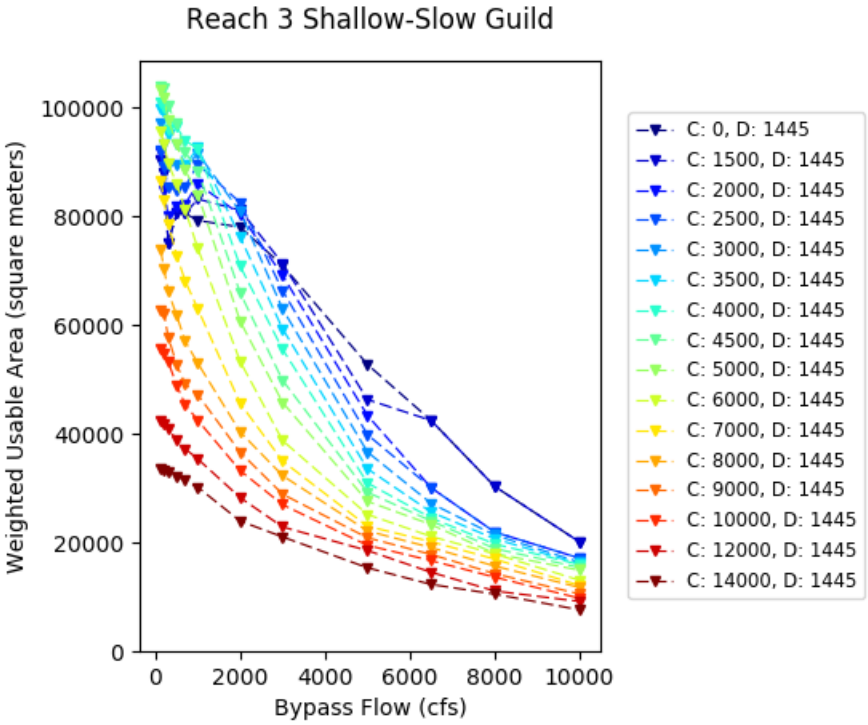

Reach 3 Macroinvertebrates
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

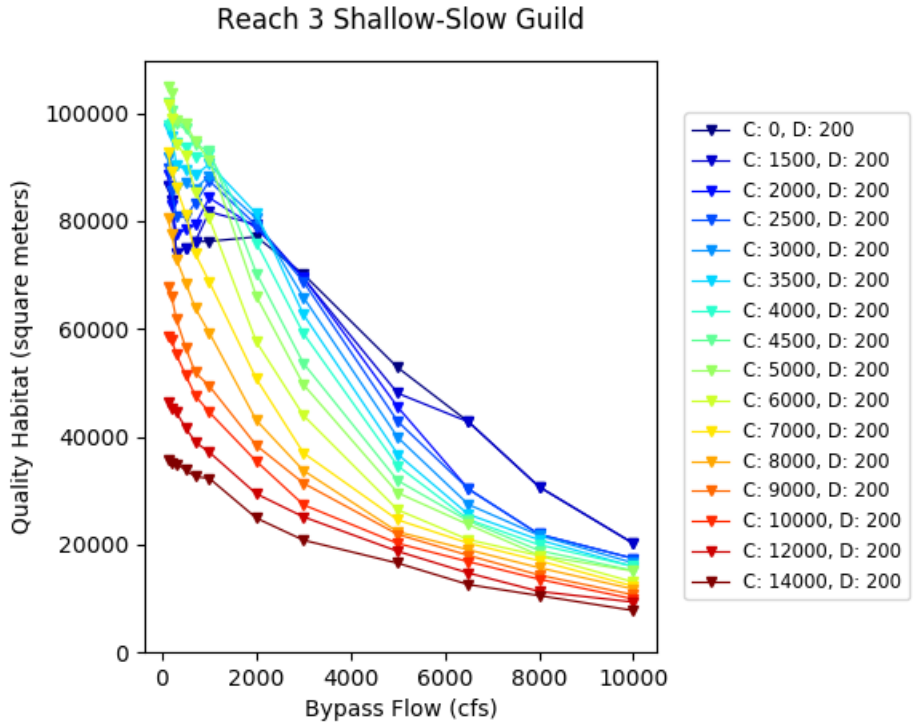

Reach 3 Macroinvertebrates
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
120000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

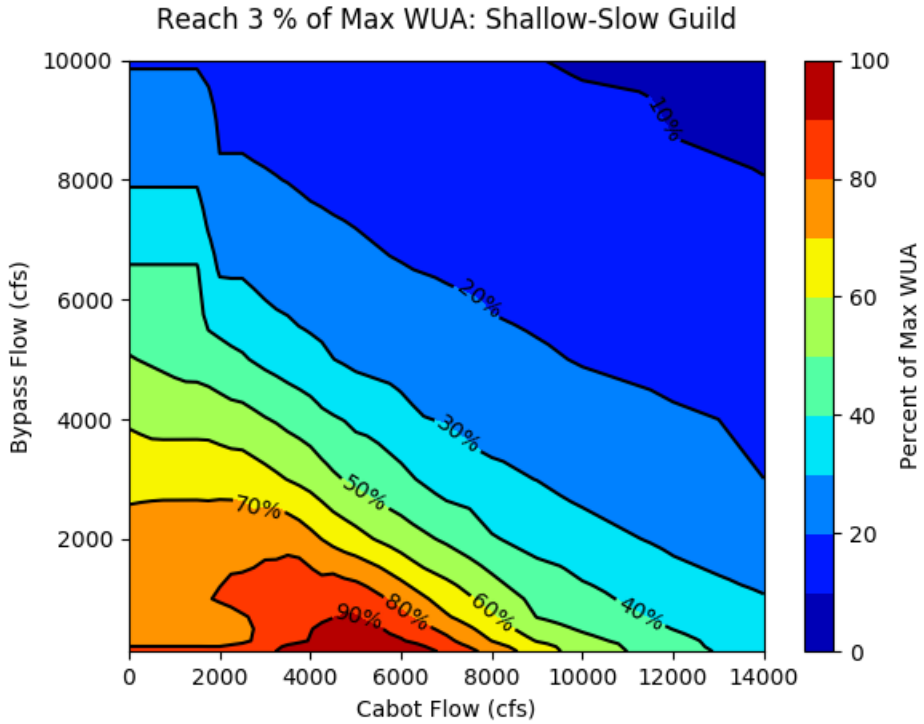

Reach 3 Macroinvertebrates
Quality Habitat (square meters)
0
20000
40000
60000
80000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

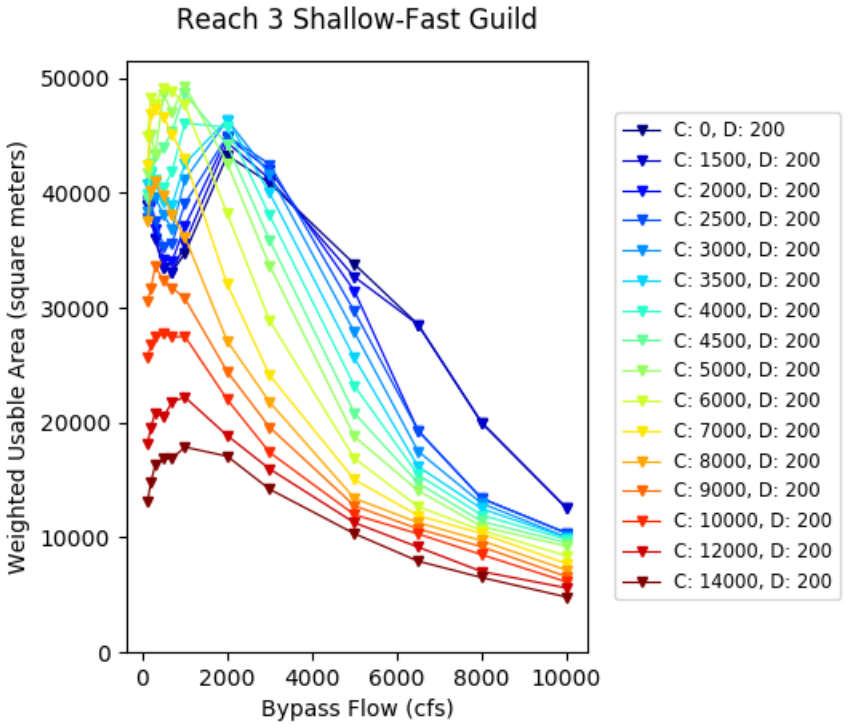

Reach 3 % of Max WUA: Macroinvertebrates
Bypass Flow (cfs)
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
Cabot Flow (cfs)
90%
80%
70%
60%
50%
40%
70%
Percent of Max WUA
0
20
40
60
80
100

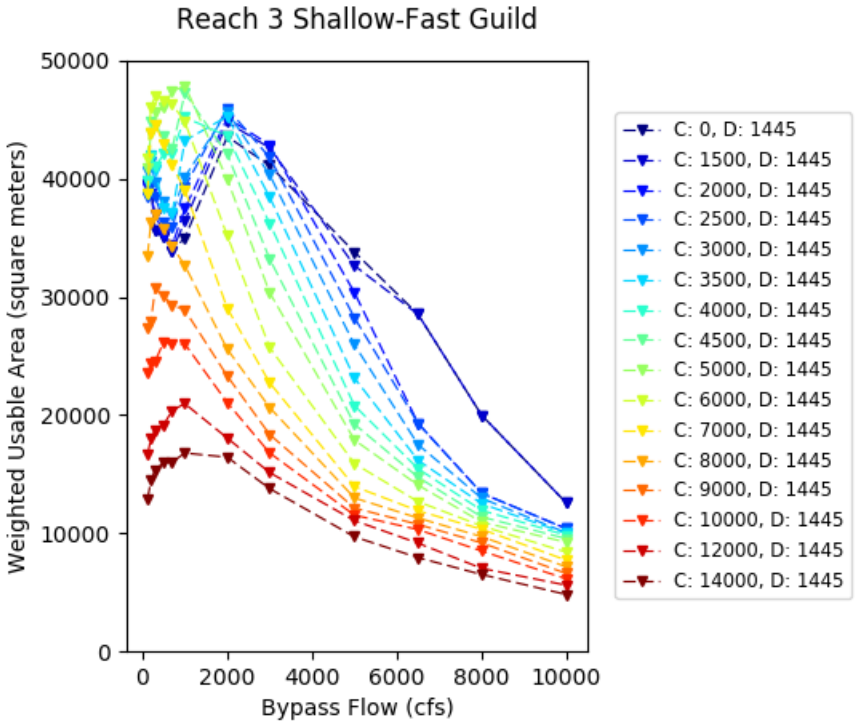

Reach 3 Shallow-Slow Guild
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

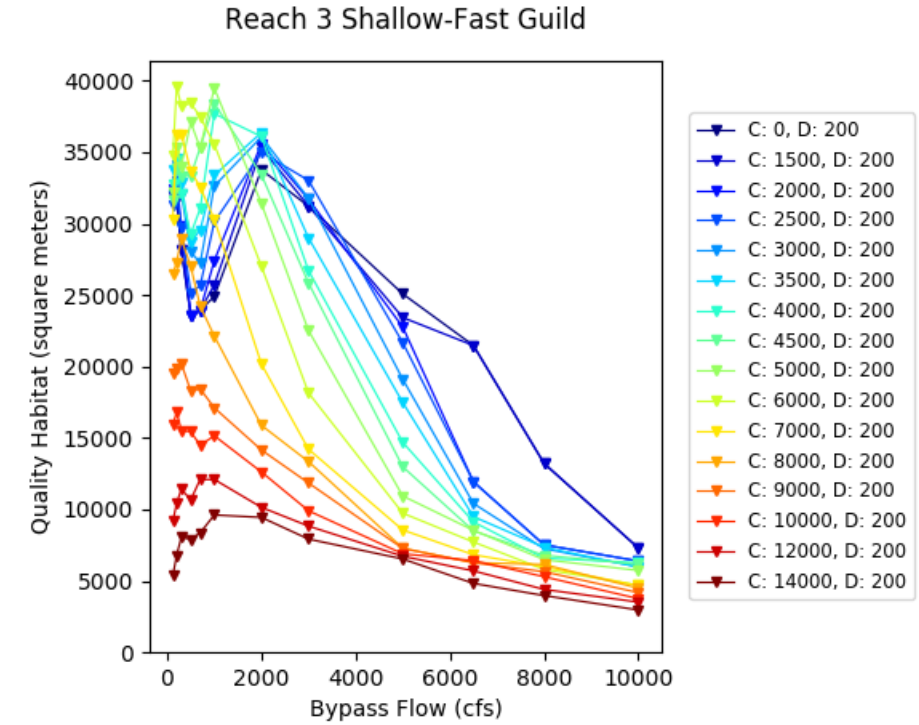

Reach 3 Shallow-Slow Guild
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

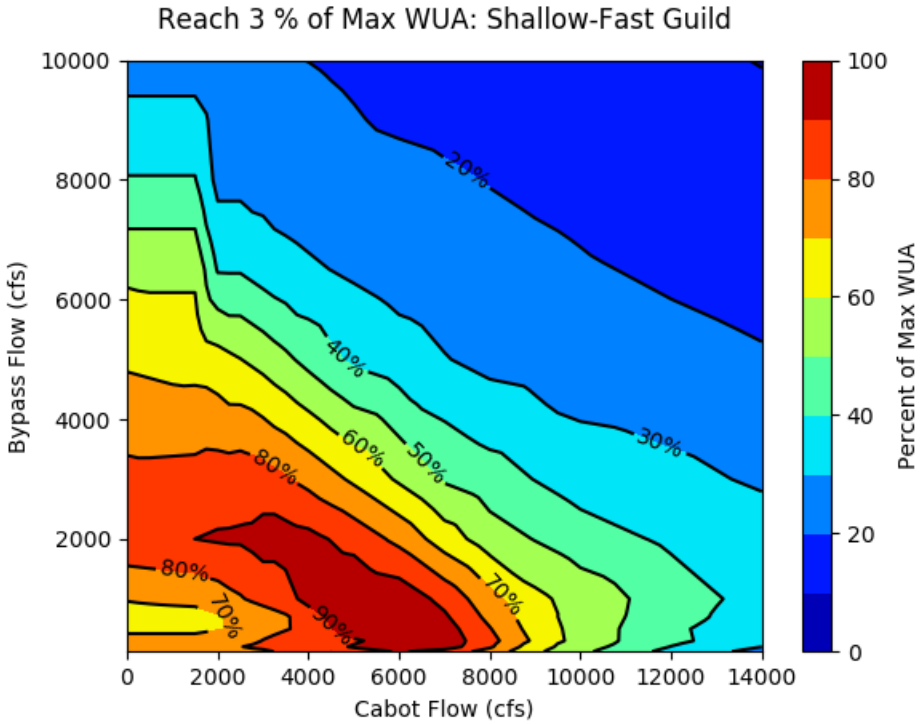

Reach 3 Shallow-Slow Guild
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

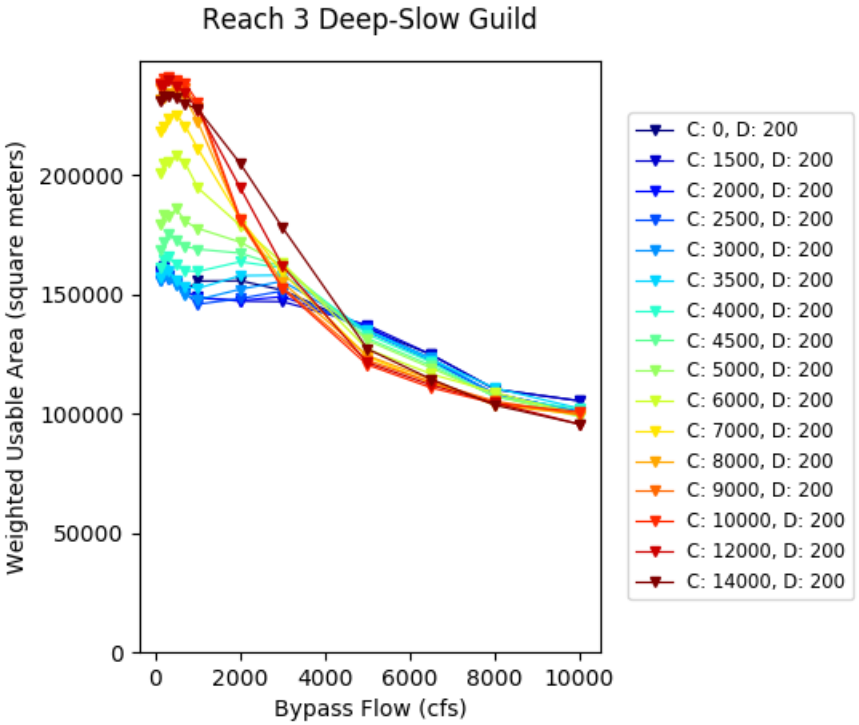

Reach 3 % of Max WUA: Shallow-Slow Guild
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
10%
20%
30%
40%
50%
60%
70%
80%
90%

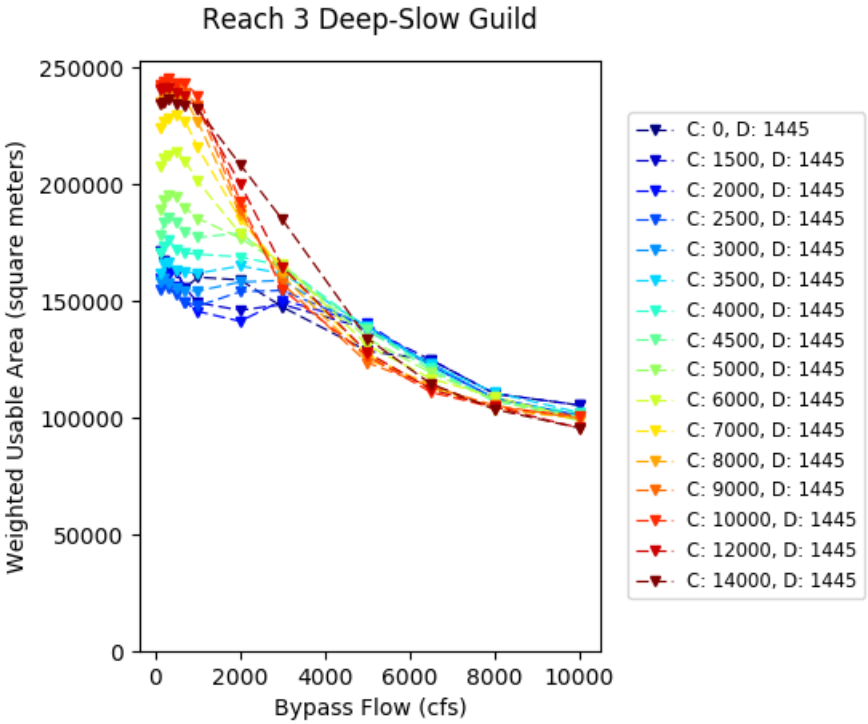

Reach 3 Shallow-Fast Guild
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

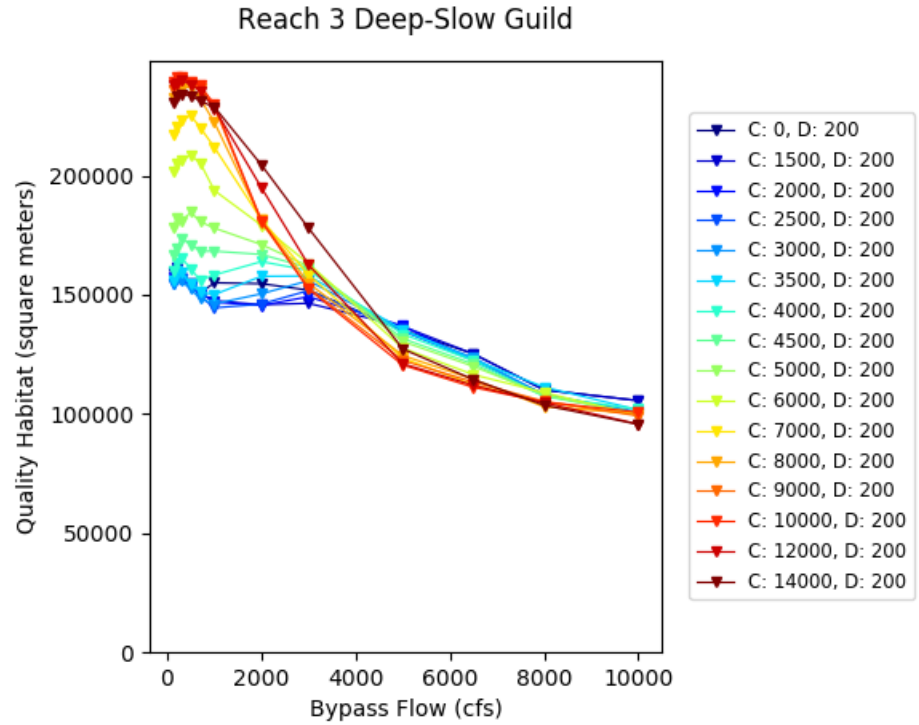

Reach 3 Shallow-Fast Guild
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

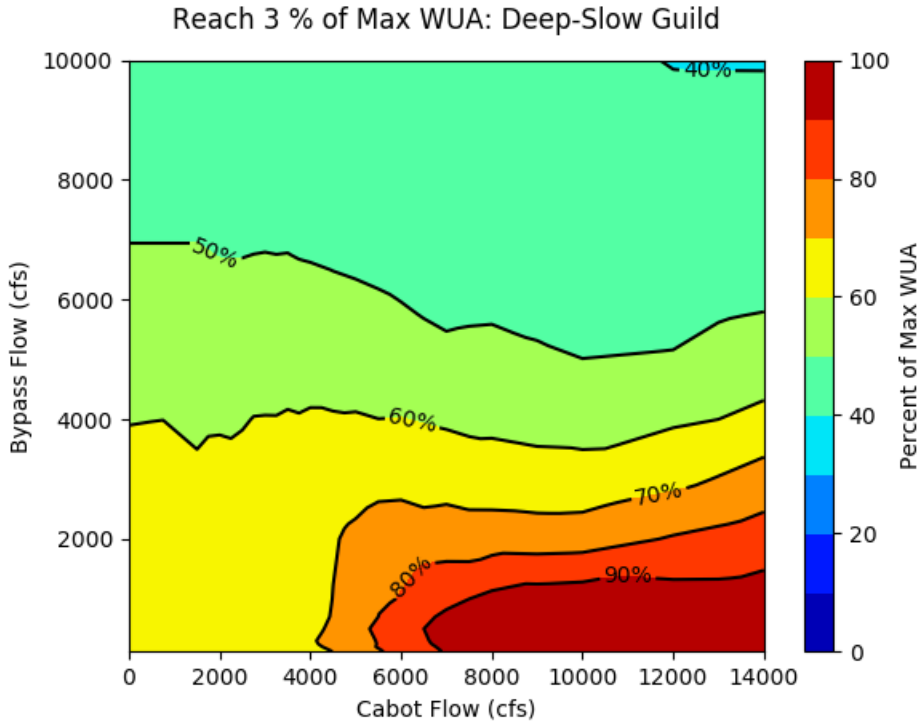

Reach 3 Shallow-Fast Guild
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

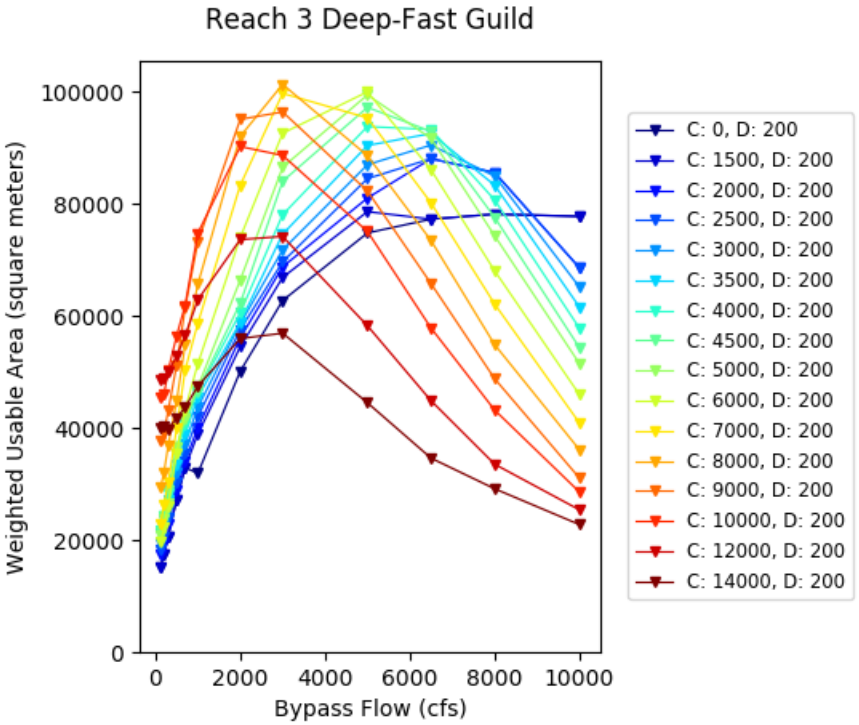

Reach 3 % of Max WUA: Shallow-Fast Guild
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
20%
30%
40%
50%
60%
70%
80%
90%

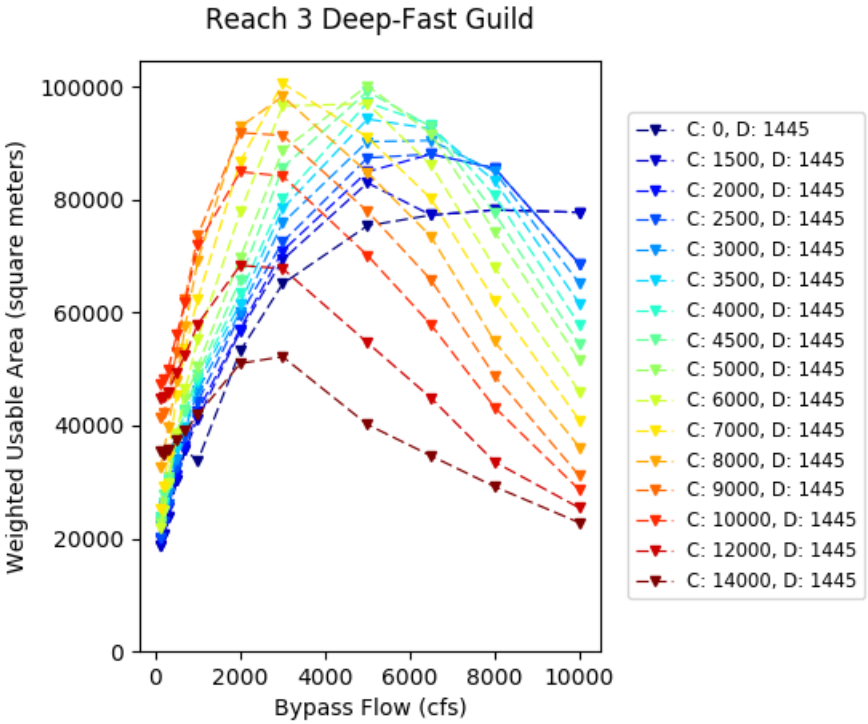

Reach 3 Deep-Slow Guild
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

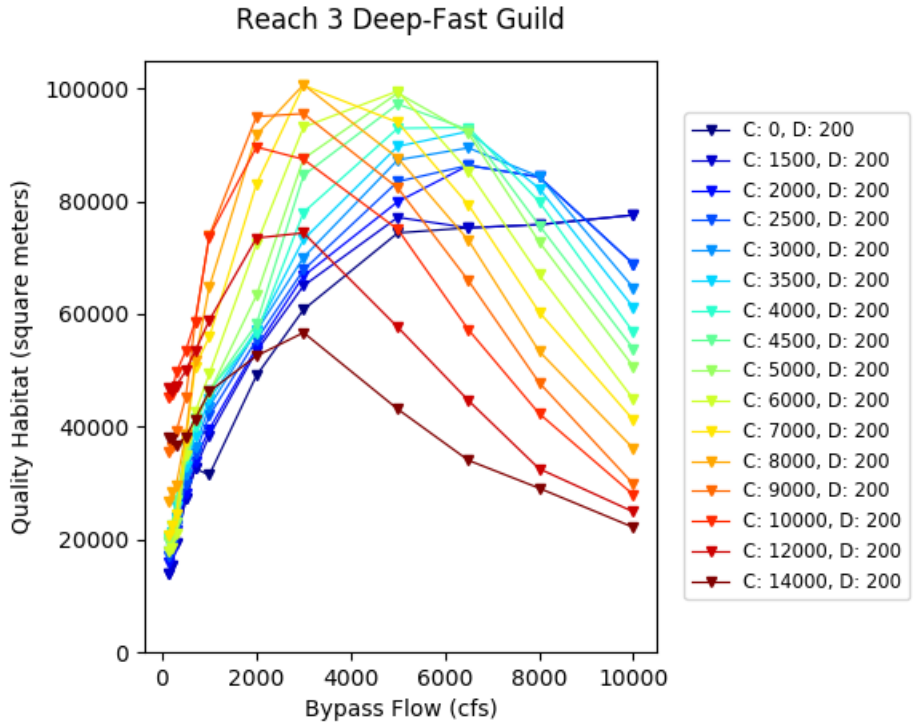

Reach 3 Deep-Slow Guild
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

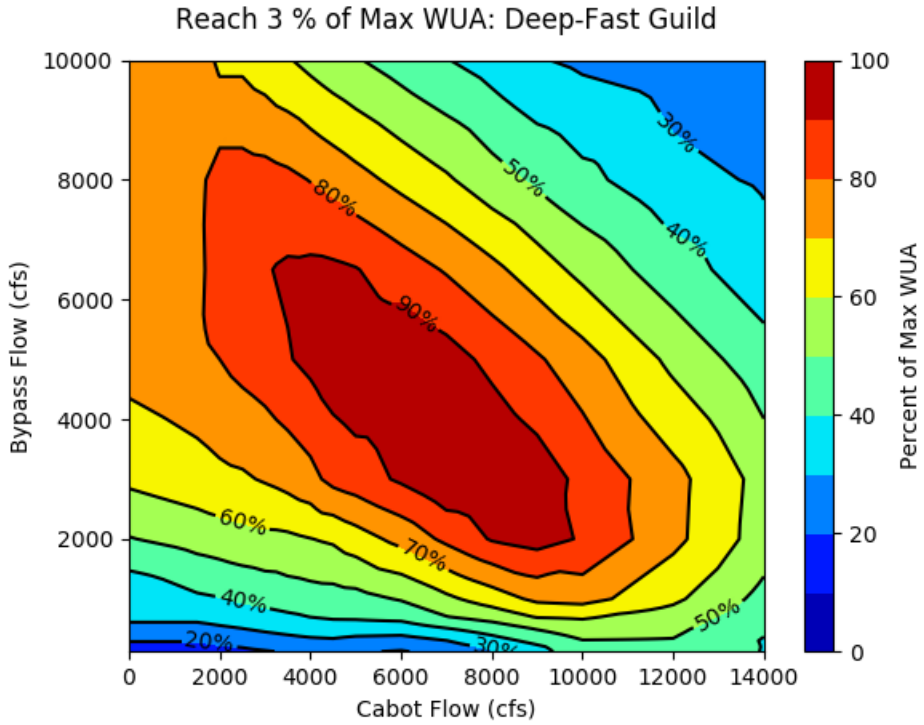

Reach 3 Deep-Slow Guild
Quality Habitat (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

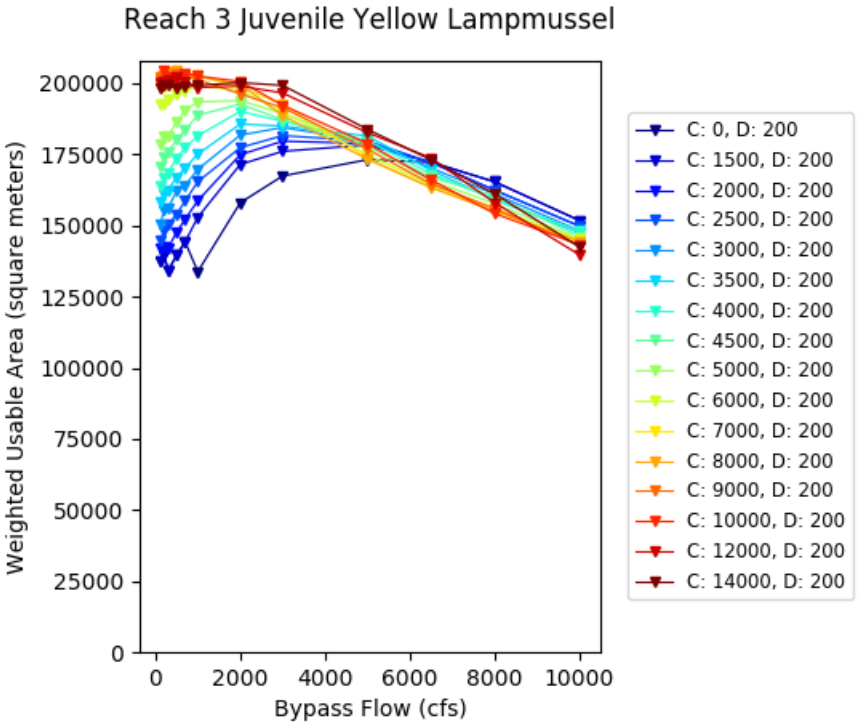

Reach 3 % of Max WUA: Deep-Slow Guild
Bypass Flow (cfs)
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
Cabot Flow (cfs)
40%
50%
60%
70%
80%
90%
Percent of Max WUA
0
20
40
60
80
100

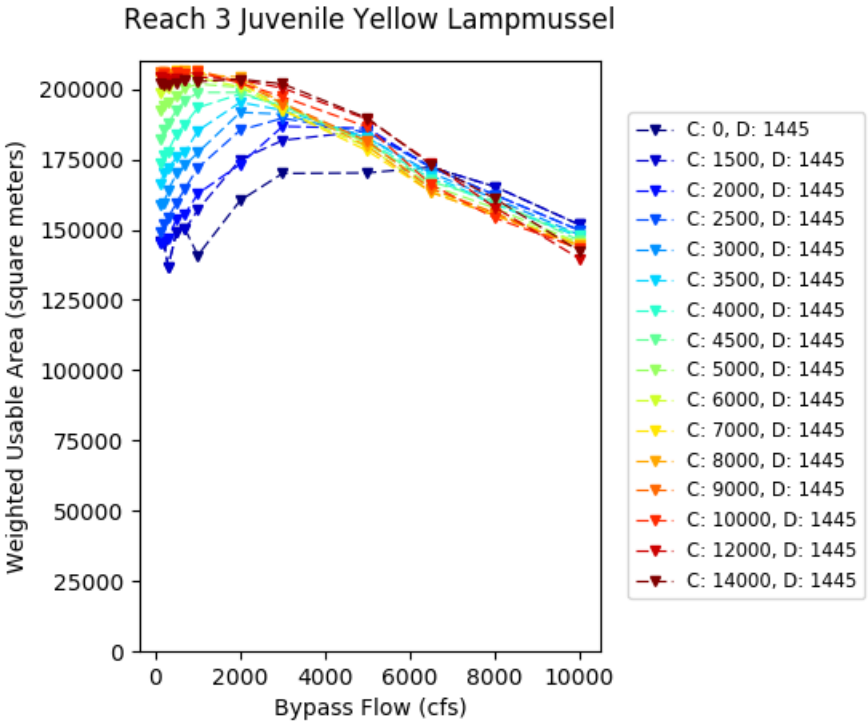

Reach 3 Deep-Fast Guild
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

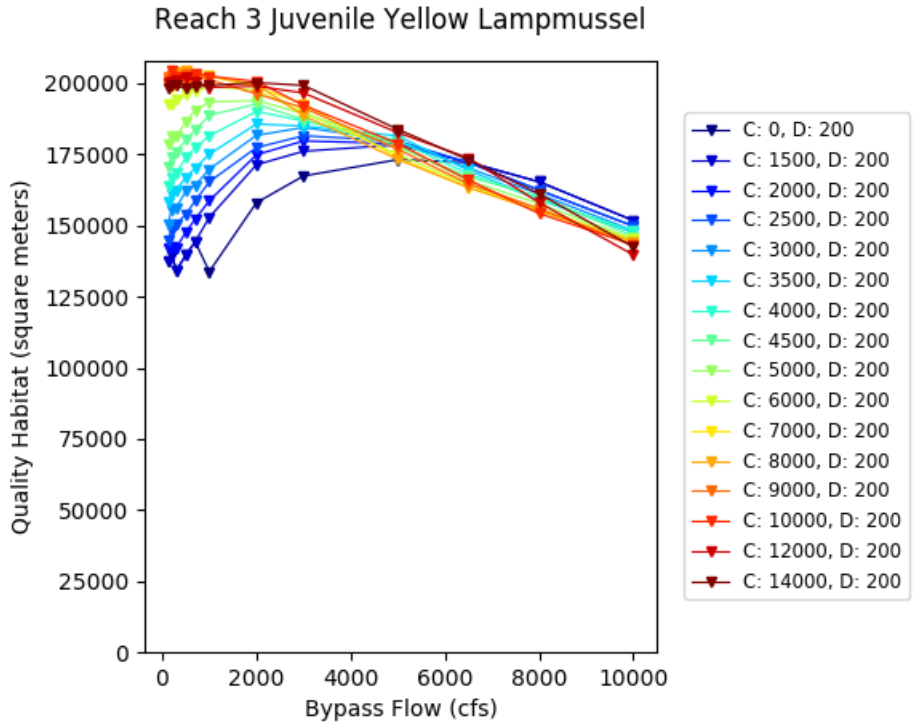

Reach 3 Deep-Fast Guild
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
20000
40000
60000
80000
100000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

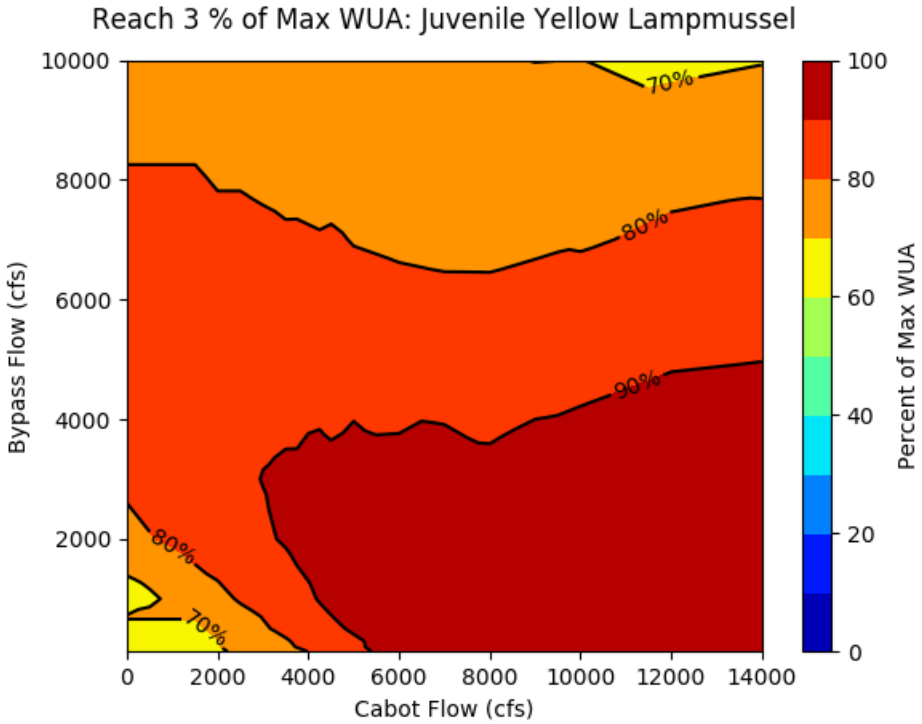

Reach 3 Deep-Fast Guild
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

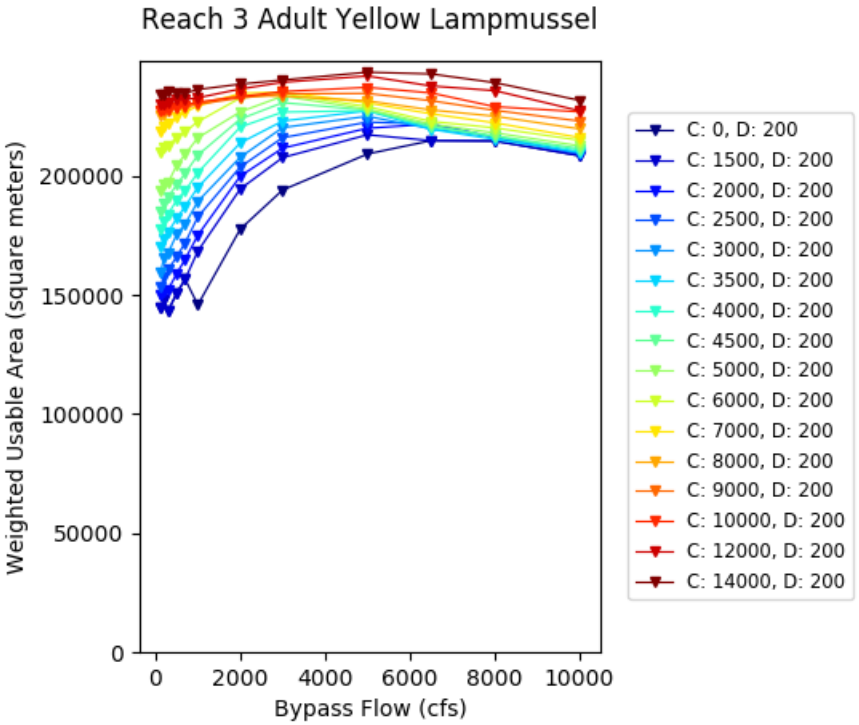

Reach 3 % of Max WUA: Deep-Fast Guild
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
90%
80%
70%
60%
50%
40%
30%
20%

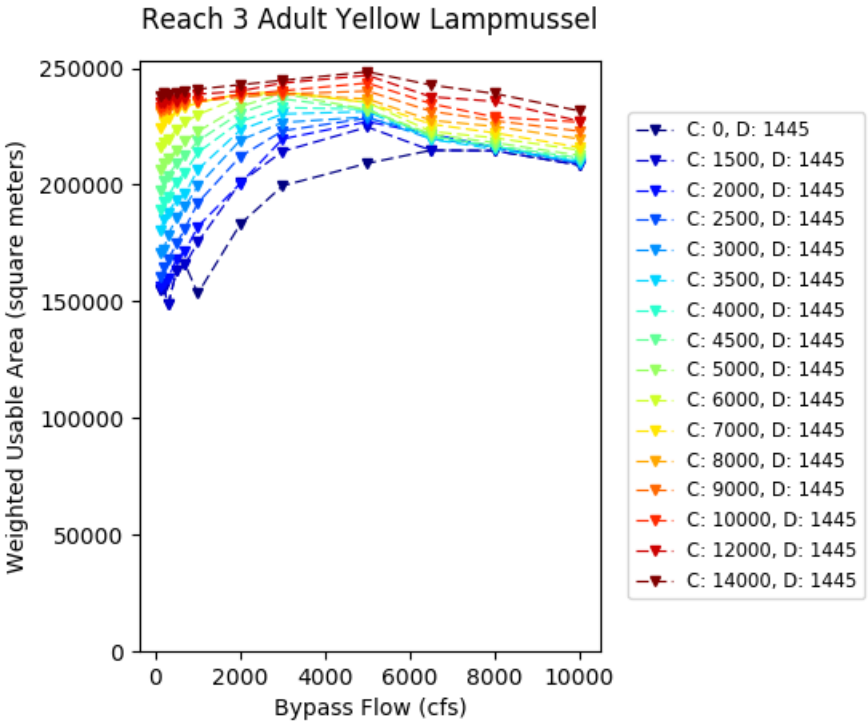

Reach 3 Juvenile Yellow Lampmussel
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
25000
50000
75000
100000
125000
150000
175000
200000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

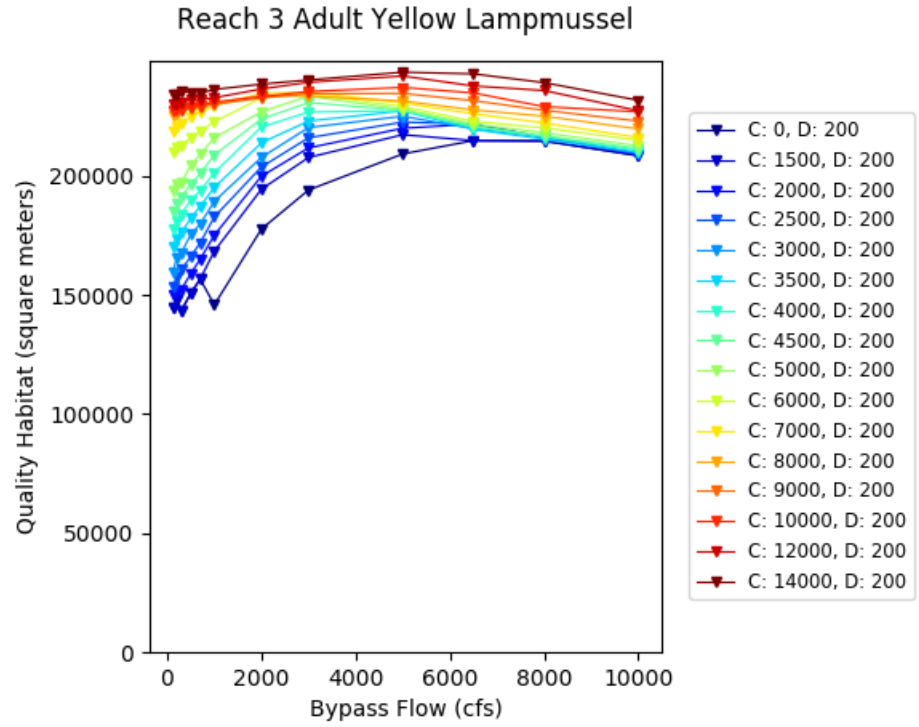

Reach 3 Juvenile Yellow Lampmussel
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
25000
50000
75000
100000
125000
150000
175000
200000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445


Reach 3 Juvenile Yellow Lampmussel
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200


Reach 3 % of Max WUA: Juvenile Yellow Lampmussel
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
70%
80%
90%
80%
70%


Reach 3 Adult Yellow Lampmussel
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200


Reach 3 Adult Yellow Lampmussel
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445


Reach 3 Adult Yellow Lampmussel
Quality Habitat (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

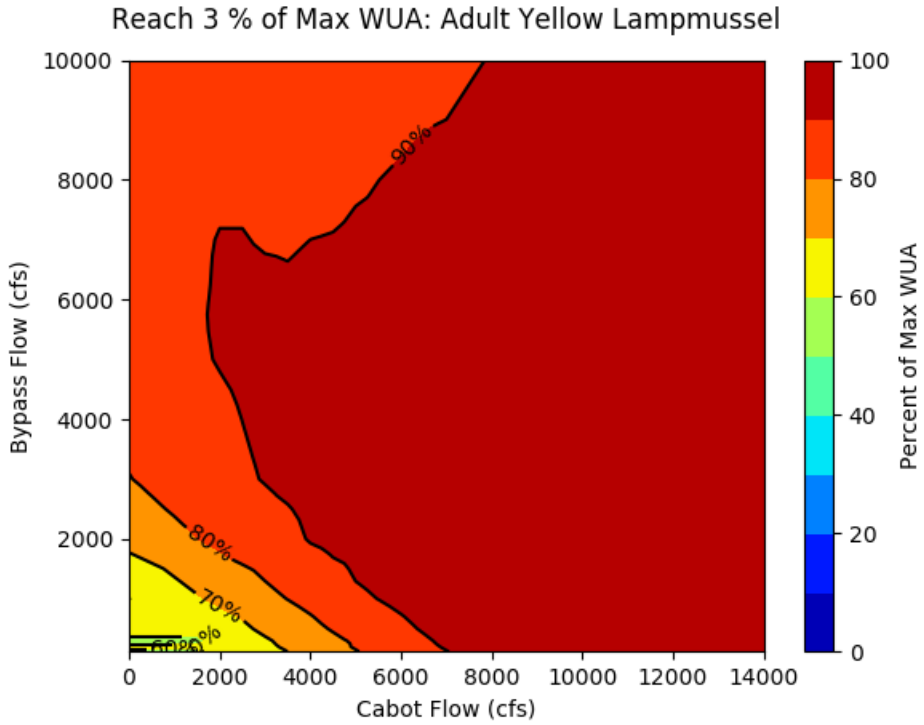
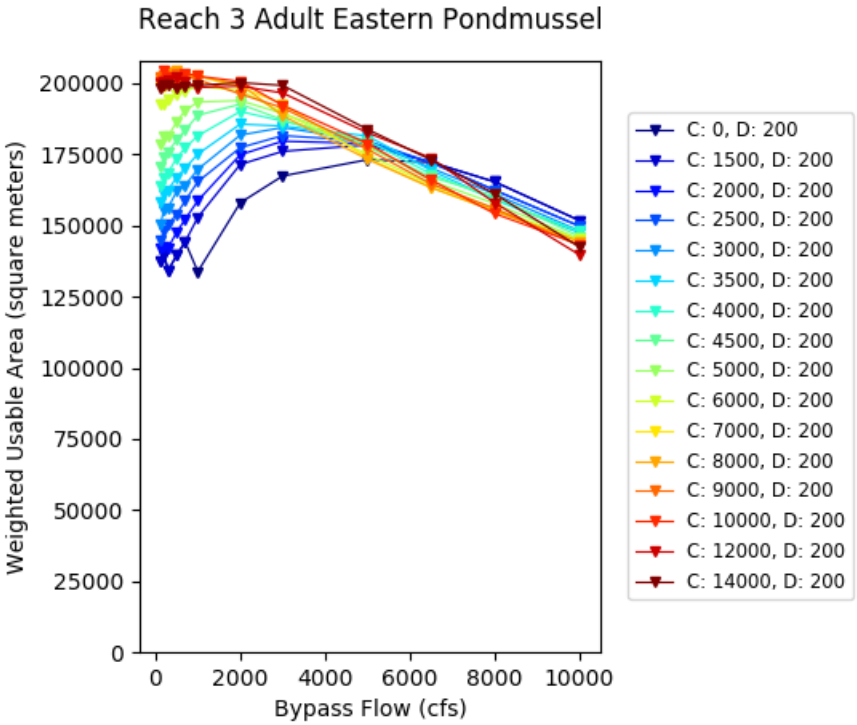
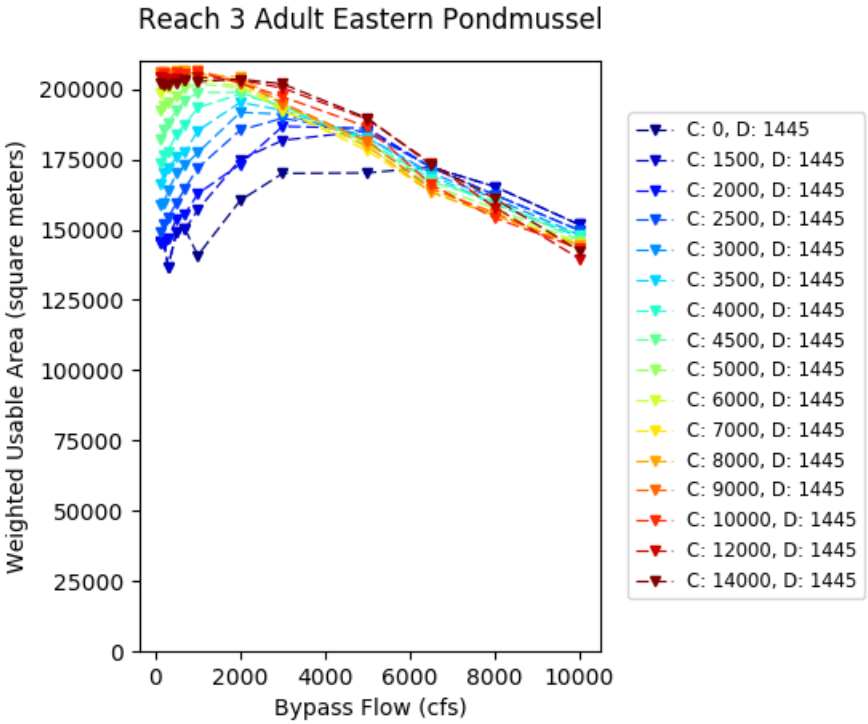
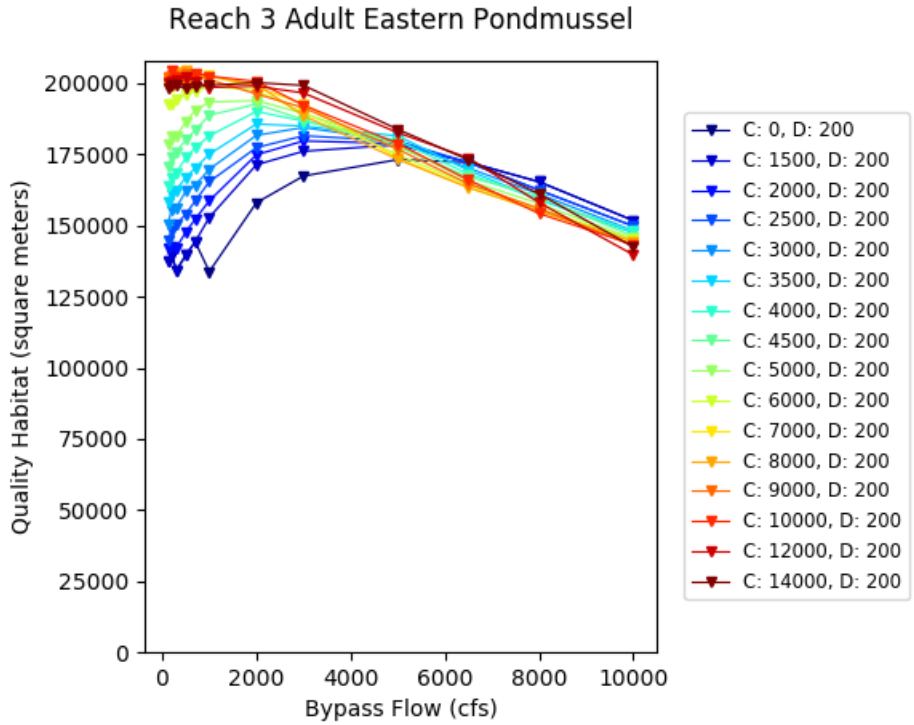
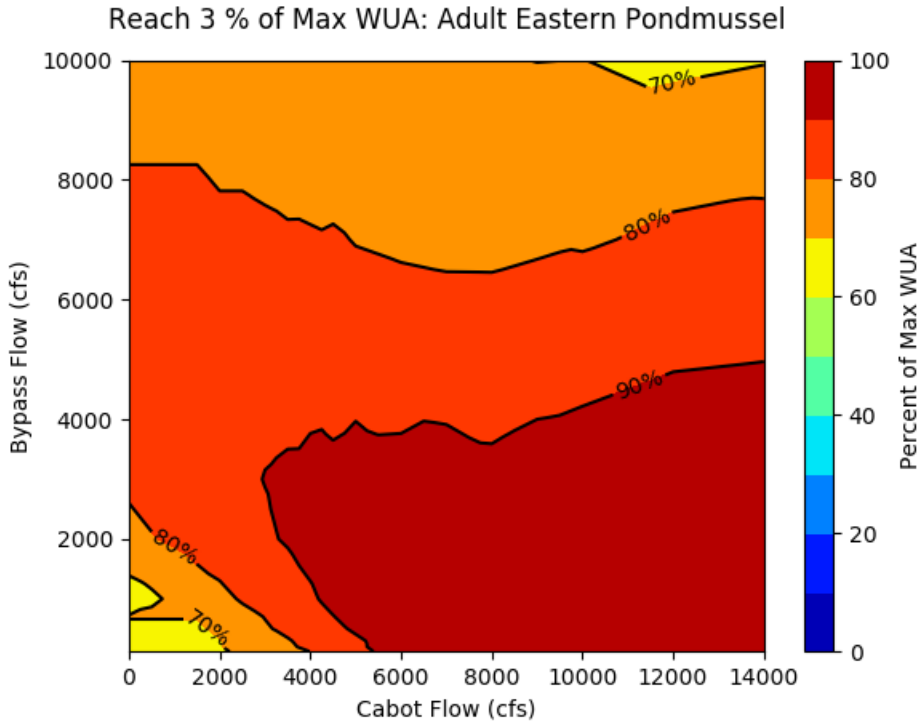

Reach 3 % of Max WUA: Adult Yellow Lampmussel
Bypass Flow (cfs)
2000
4000
6000
8000
10000
90%
80%
70%
0
2000
4000
6000
8000
10000
12000
14000
Cabot Flow (cfs)
Percent of Max WUA
0
20
40
60
80
100

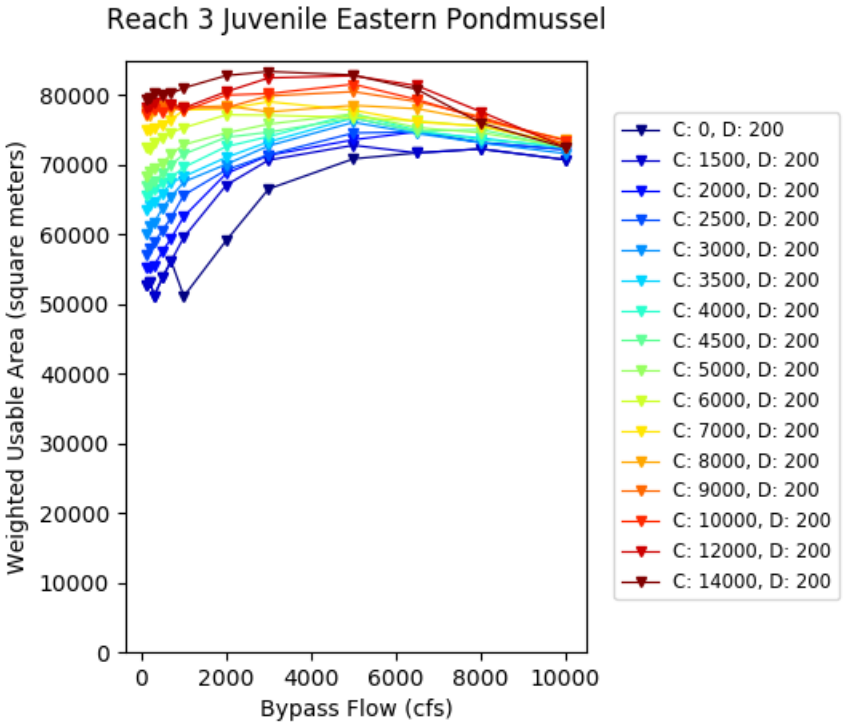
Figure E-X:

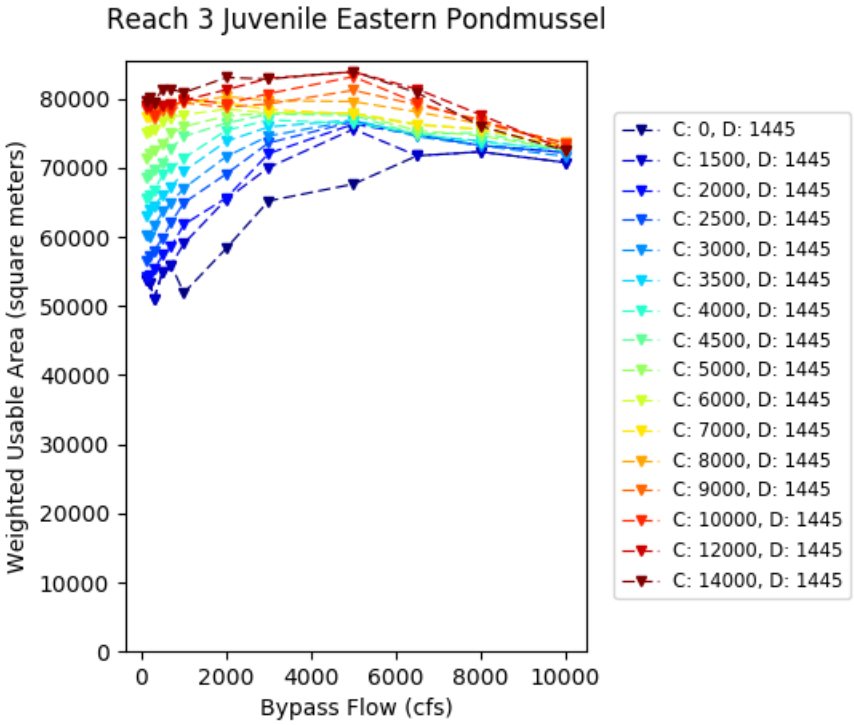

Reach 3 Adult Eastern Pondmussel
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
25000
50000
75000
100000
125000
150000
175000
200000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

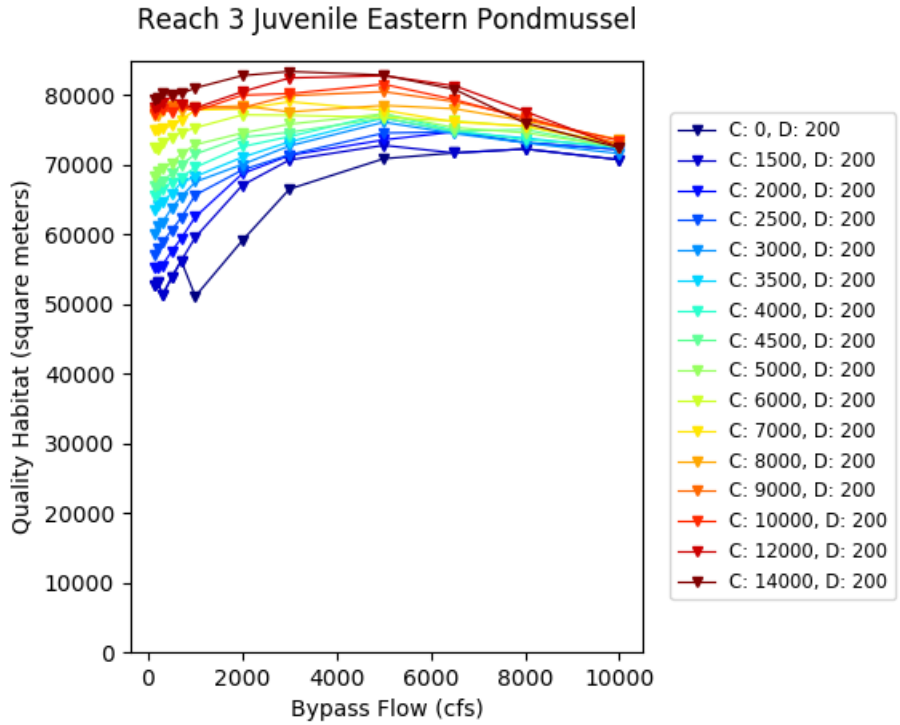

Reach 3 Adult Eastern Pondmussel
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
25000
50000
75000
100000
125000
150000
175000
200000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

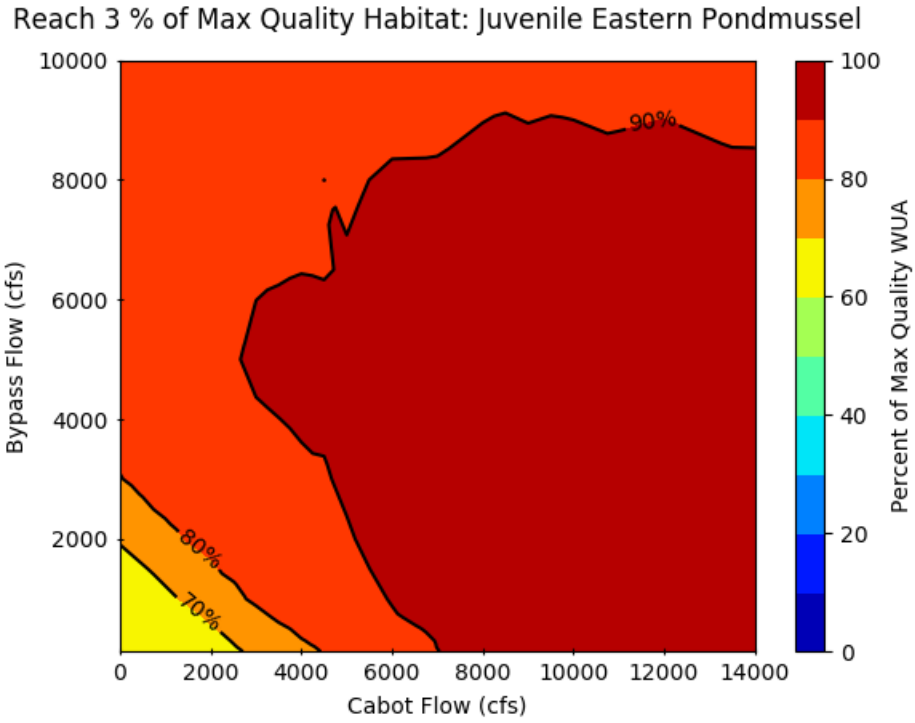

Reach 3 Adult Eastern Pondmussel
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

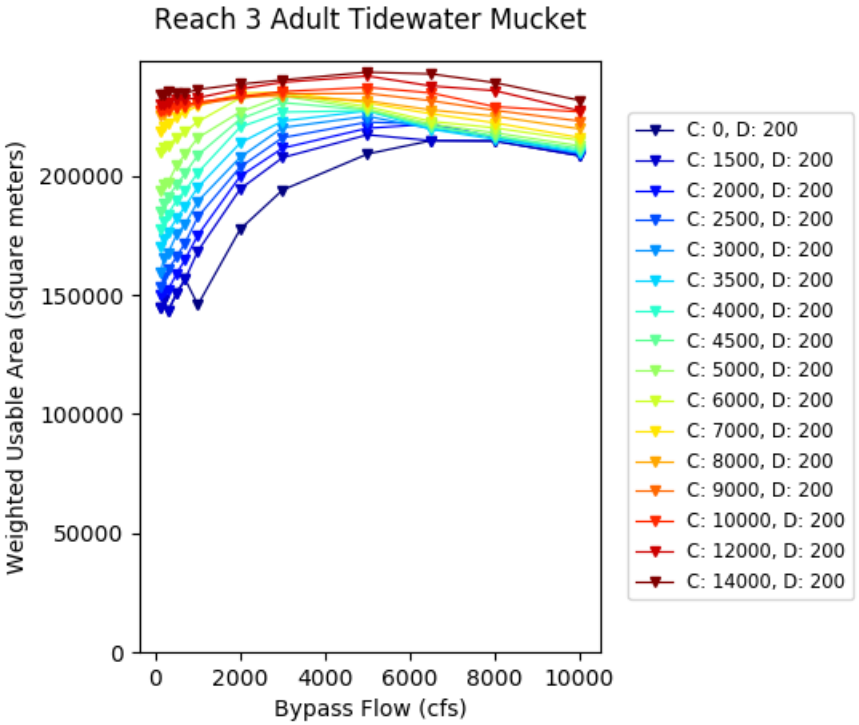

Reach 3 % of Max WUA: Adult Eastern Pondmussel
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max WUA
70%
80%
90%

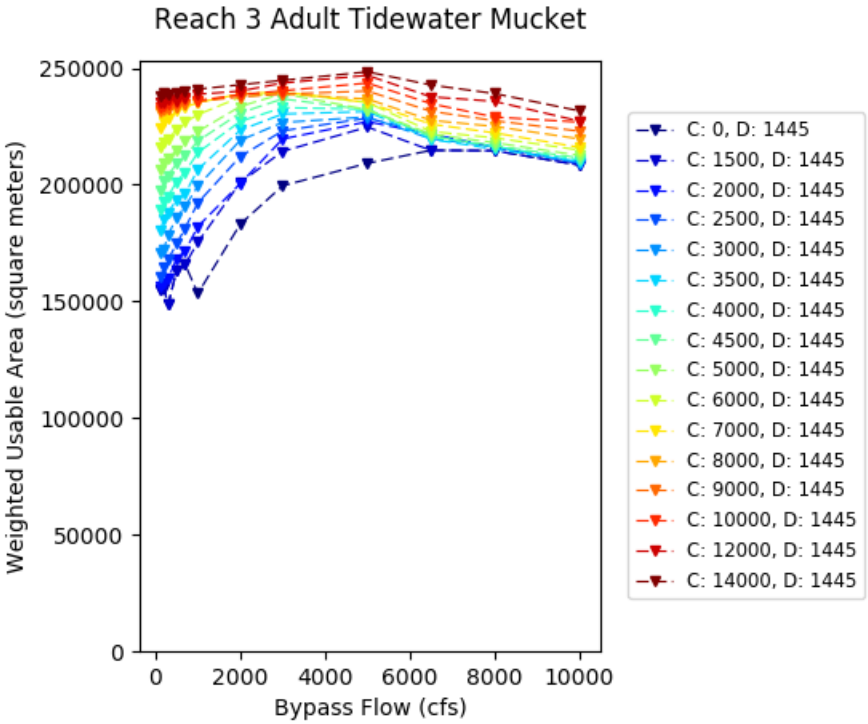

Reach 3 Juvenile Eastern Pondmussel
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
60000
70000
80000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

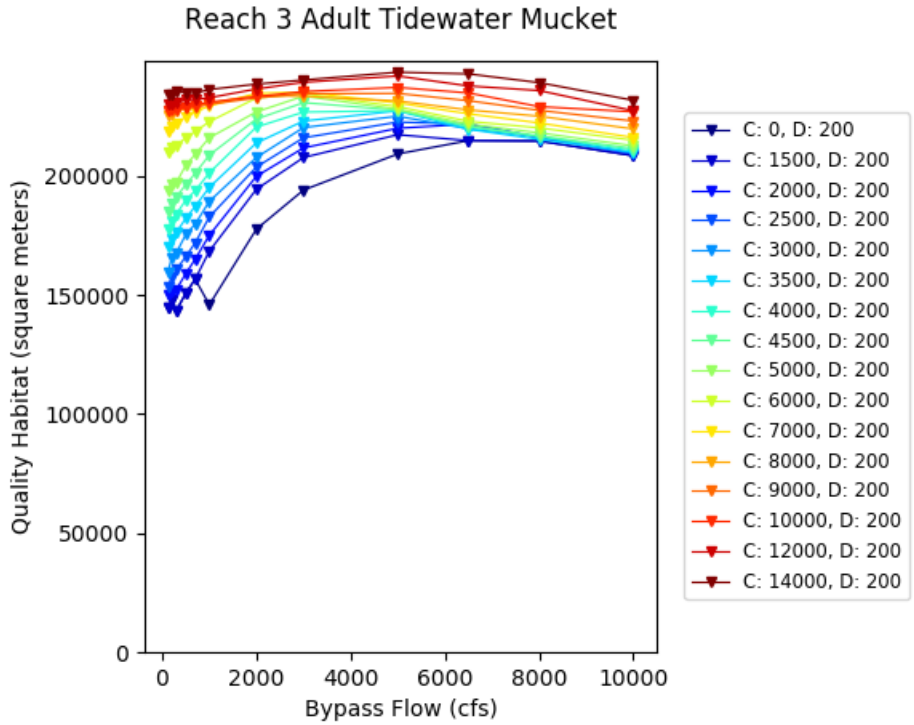

Reach 3 Juvenile Eastern Pondmussel
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
60000
70000
80000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

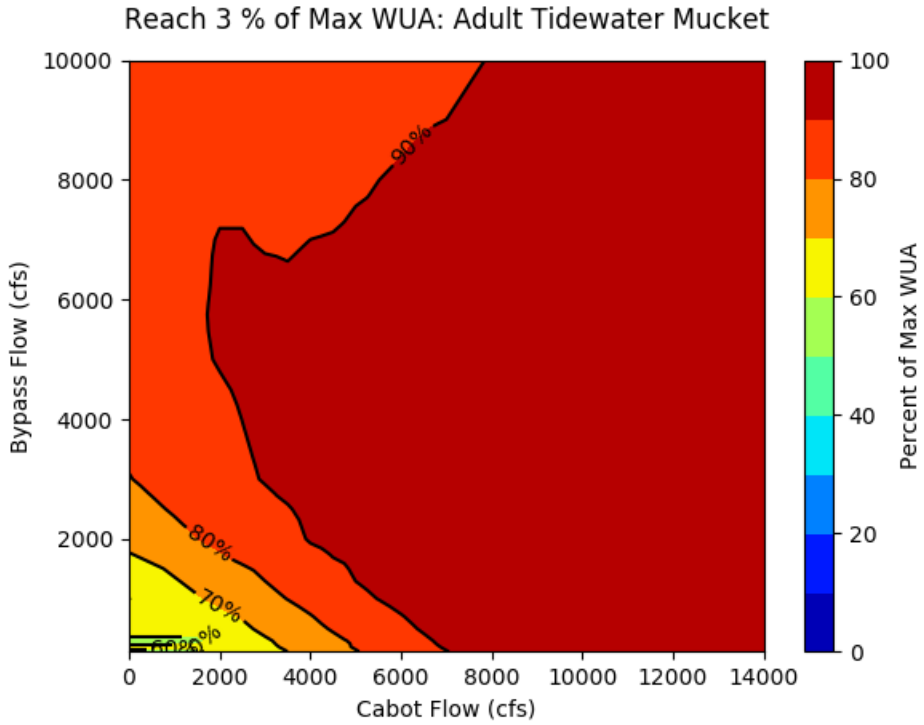

Reach 3 Juvenile Eastern Pondmussel
Quality Habitat (square meters)
Bypass Flow (cfs)
0
10000
20000
30000
40000
50000
60000
70000
80000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

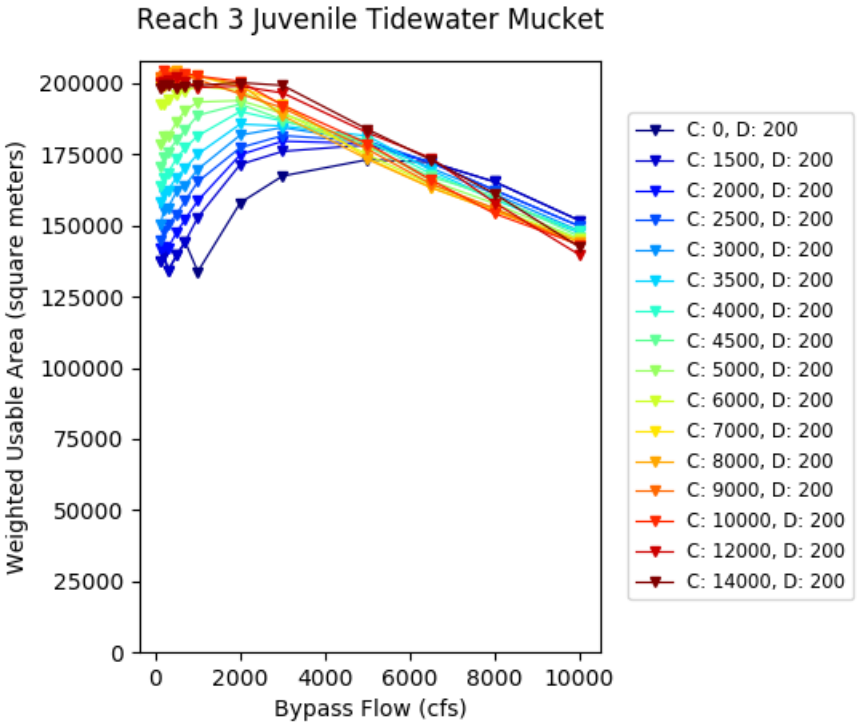

Reach 3 % of Max Quality Habitat: Juvenile Eastern Pondmussel
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max Quality WUA
90%
80%
70%
0
2000
4000
6000
8000
10000
12000
14000
0
20
40
60
80
100

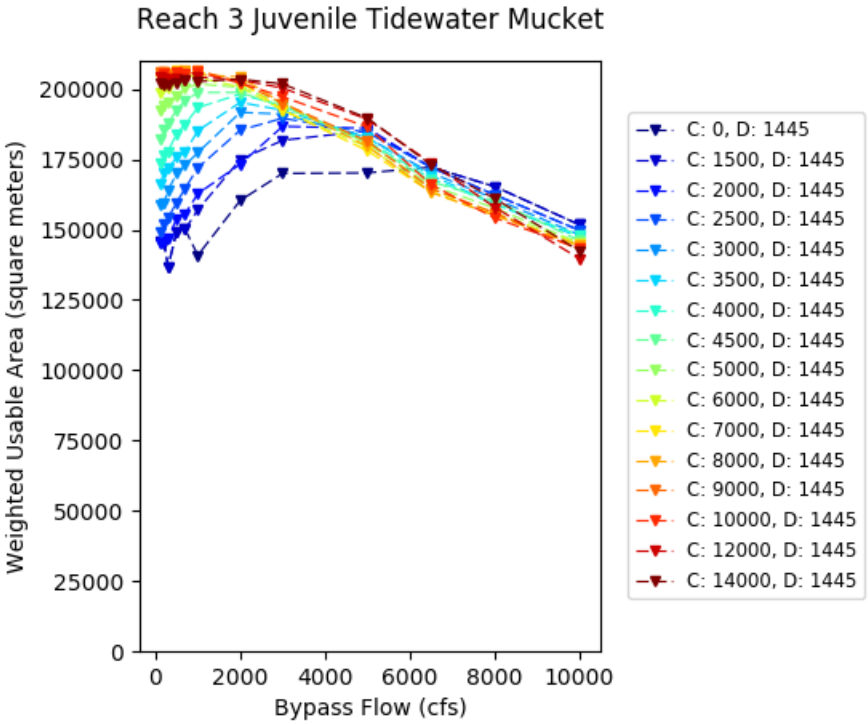

Reach 3 Adult Tidewater Mucket
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200

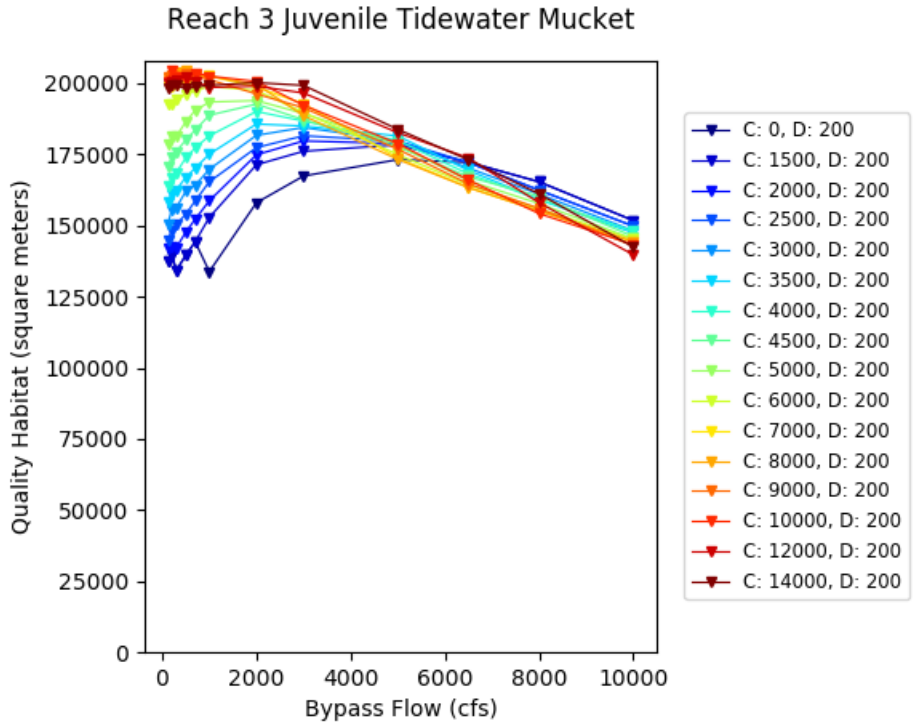

Reach 3 Adult Tidewater Mucket
Weighted Usable Area (square meters)
0
50000
100000
150000
200000
250000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

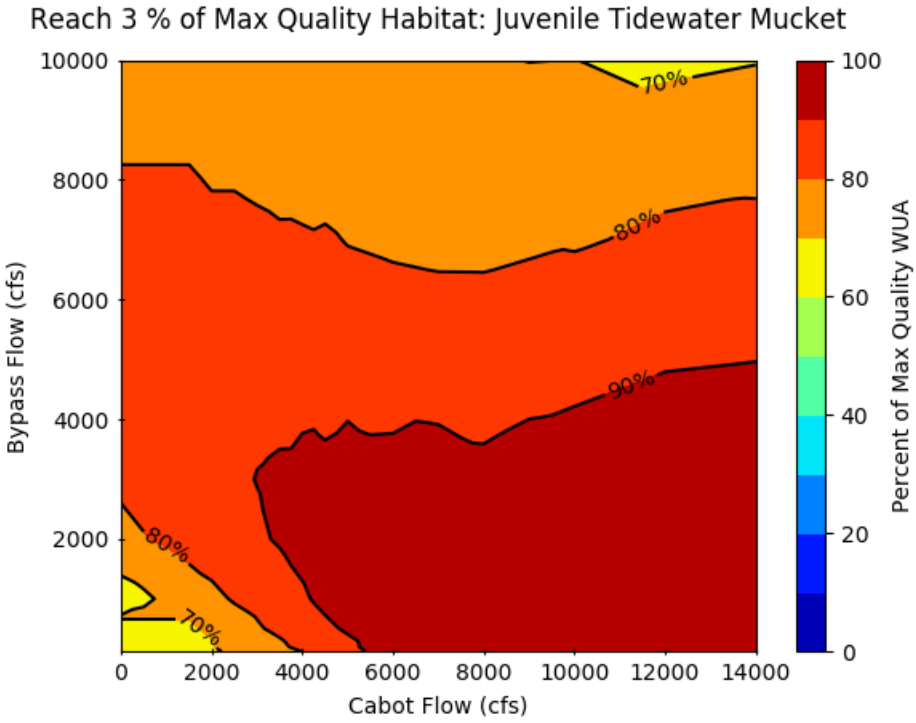

Reach 3 Adult Tidewater Mucket
Quality Habitat (square meters)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200


Reach 3 % of Max WUA: Adult Tidewater Mucket
Bypass Flow (cfs)
2000
4000
6000
8000
10000
0
2000
4000
6000
8000
10000
12000
14000
Cabot Flow (cfs)
90%
80%
70%
Percent of Max WUA
0
20
40
60
80
100

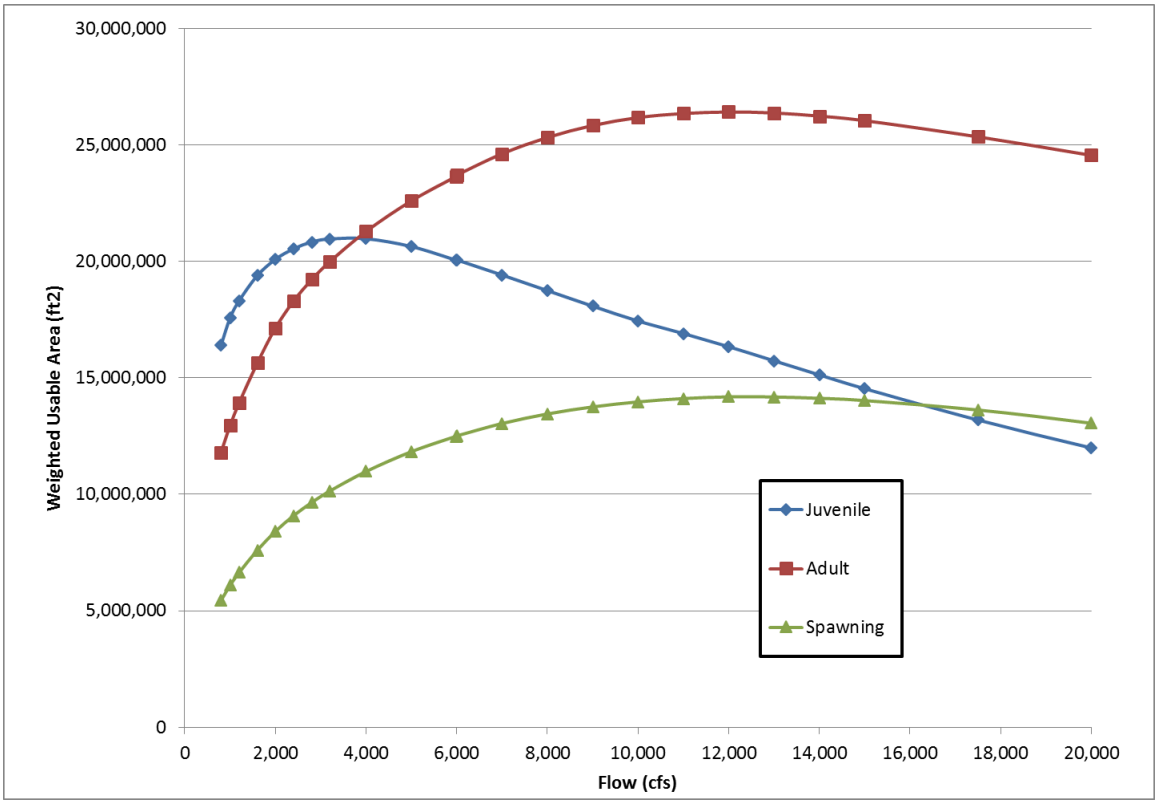

Reach 3 Juvenile Tidewater Mucket
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
25000
50000
75000
100000
125000
150000
175000
200000
0
2000
4000
6000
8000
10000
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200


Reach 3 Juvenile Tidewater Mucket
Weighted Usable Area (square meters)
Bypass Flow (cfs)
0
25000
50000
75000
100000
125000
150000
175000
200000
0
2000
4000
6000
8000
10000
C: 0, D: 1445
C: 1500, D: 1445
C: 2000, D: 1445
C: 2500, D: 1445
C: 3000, D: 1445
C: 3500, D: 1445
C: 4000, D: 1445
C: 4500, D: 1445
C: 5000, D: 1445
C: 6000, D: 1445
C: 7000, D: 1445
C: 8000, D: 1445
C: 9000, D: 1445
C: 10000, D: 1445
C: 12000, D: 1445
C: 14000, D: 1445

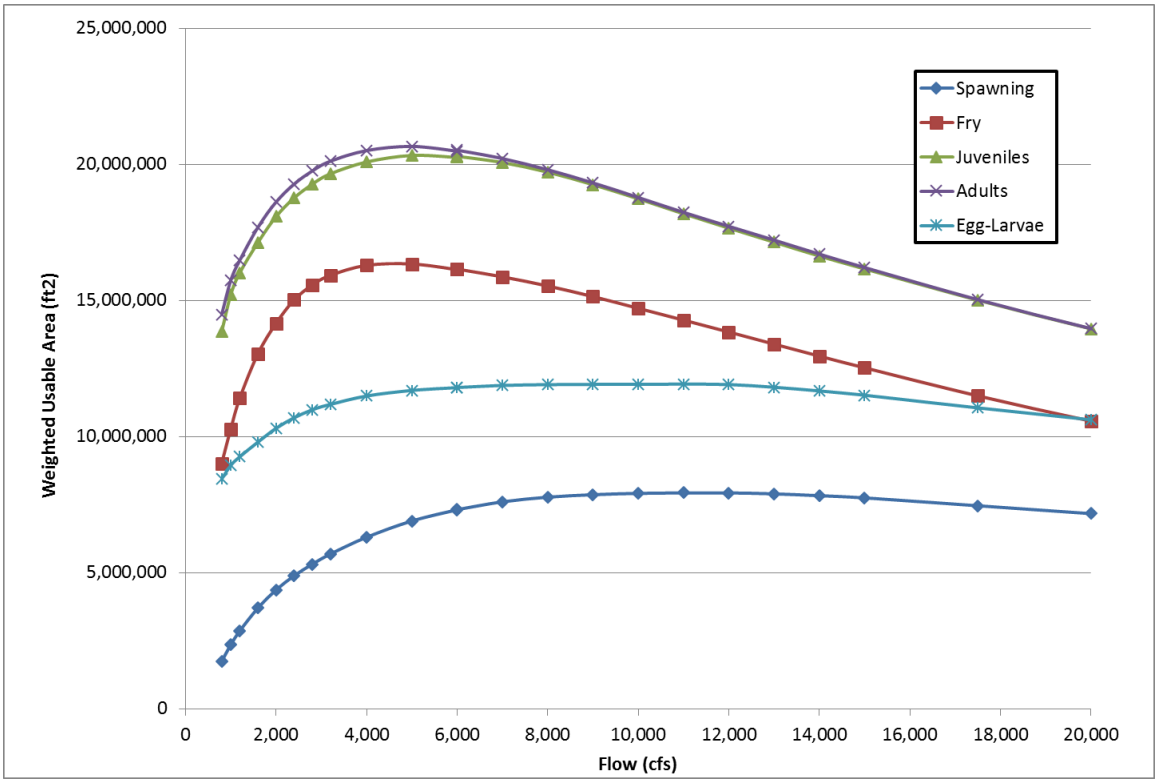

Reach 3 Juvenile Tidewater Mucket
Quality Habitat (square meters)
Bypass Flow (cfs)
C: 0, D: 200
C: 1500, D: 200
C: 2000, D: 200
C: 2500, D: 200
C: 3000, D: 200
C: 3500, D: 200
C: 4000, D: 200
C: 4500, D: 200
C: 5000, D: 200
C: 6000, D: 200
C: 7000, D: 200
C: 8000, D: 200
C: 9000, D: 200
C: 10000, D: 200
C: 12000, D: 200
C: 14000, D: 200


Reach 3 % of Max Quality Habitat: Juvenile Tidewater Mucket
Bypass Flow (cfs)
Cabot Flow (cfs)
Percent of Max Quality WUA
70%
80%
90%
80%
70%

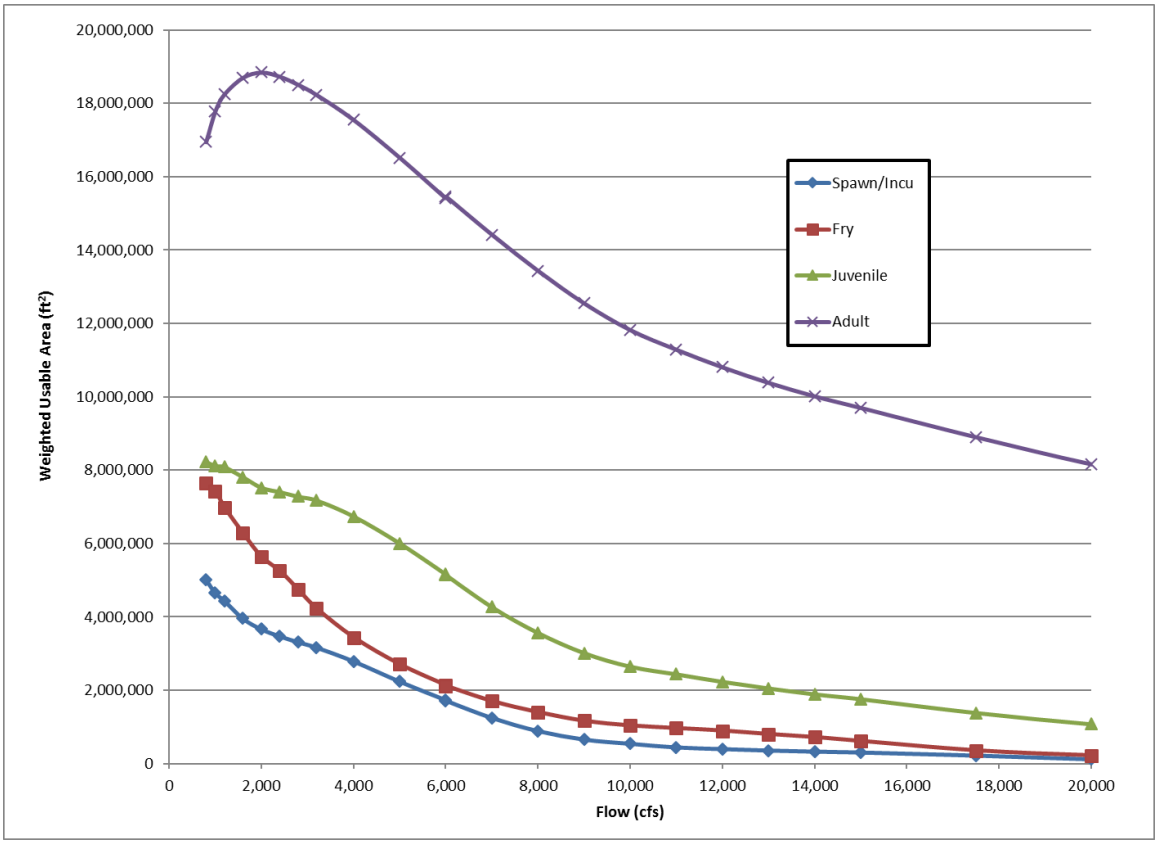
ATTACHMENT C: REVISED APPENDIX F- REACH 4- HABITAT VERSUS DISCHARGE RELATIONSHIPS LIMITED TO MAXIMUM FLOW OF 20,000 CFS



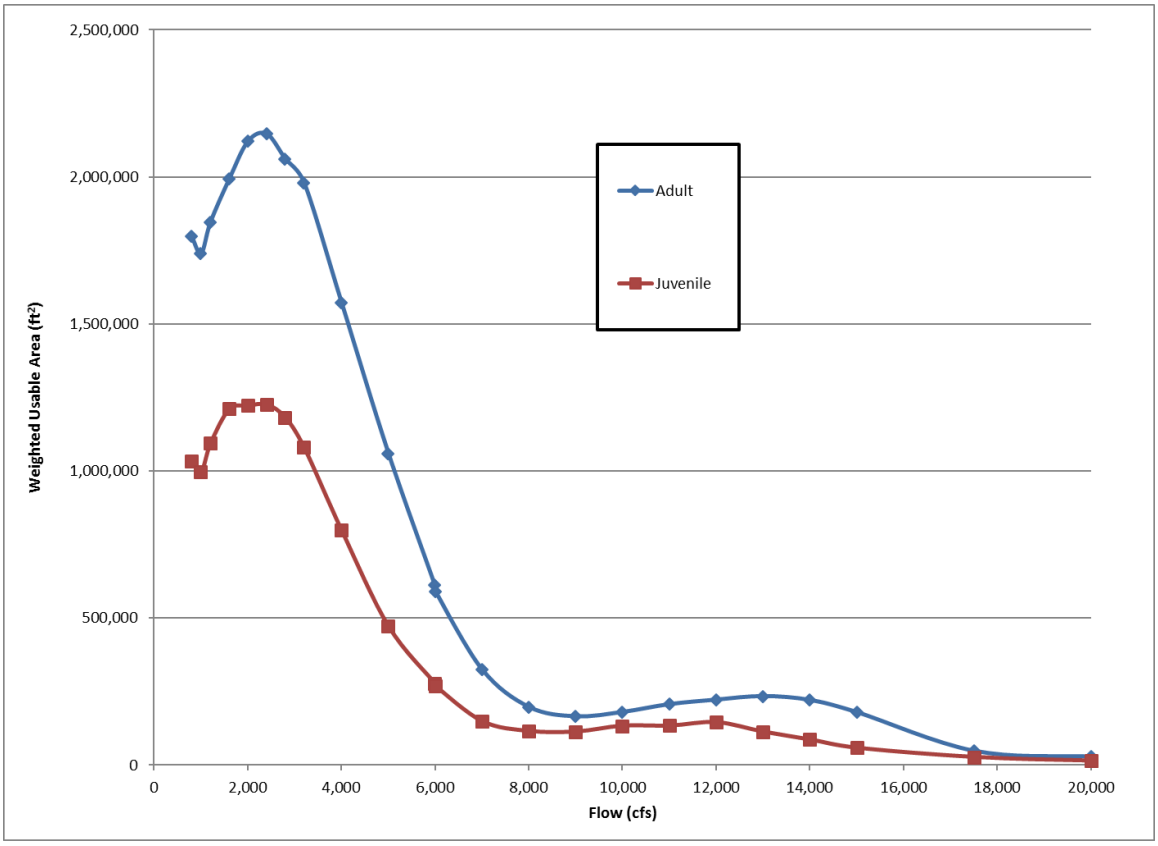
Reach 4 WUA Curves for Spawning, Juvenile and Adult Life Stages of American Shad



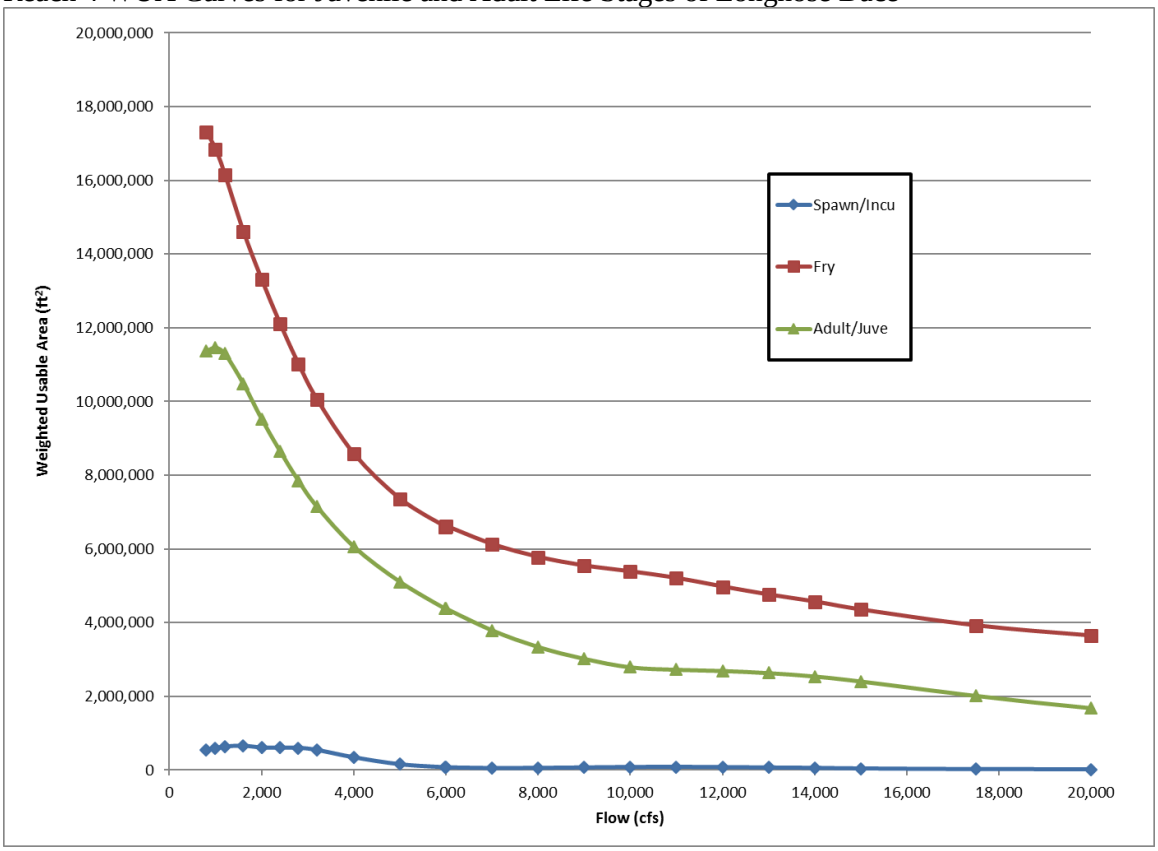
Reach 4 WUA Curves for Egg-Larvae, Spawning, Fry, Juvenile, and Adult Life Stages of Shortnose Sturgeon



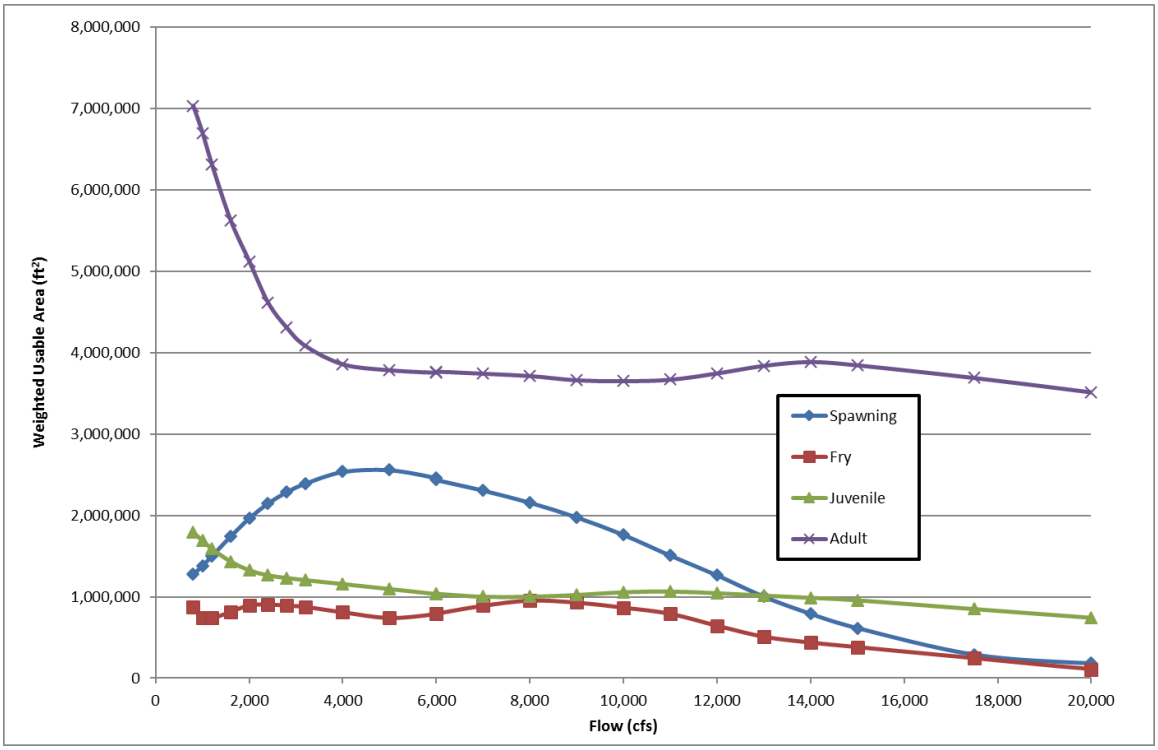
Reach 4 WUA Curves for Spawning/Incubation, Juvenile, Fry, and Adult Life Stages of Fallfish



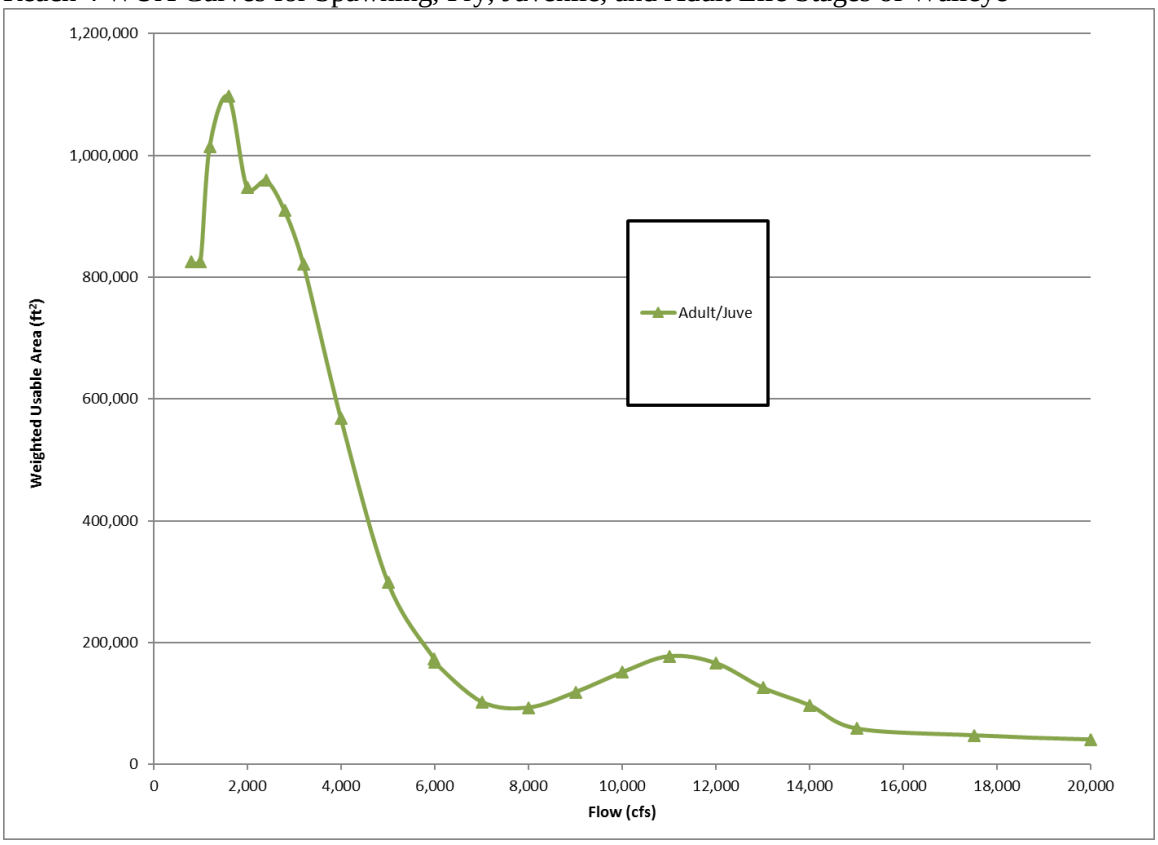
Reach 4 WUA Curves for Juvenile and Adult Life Stages of Longnose Dace



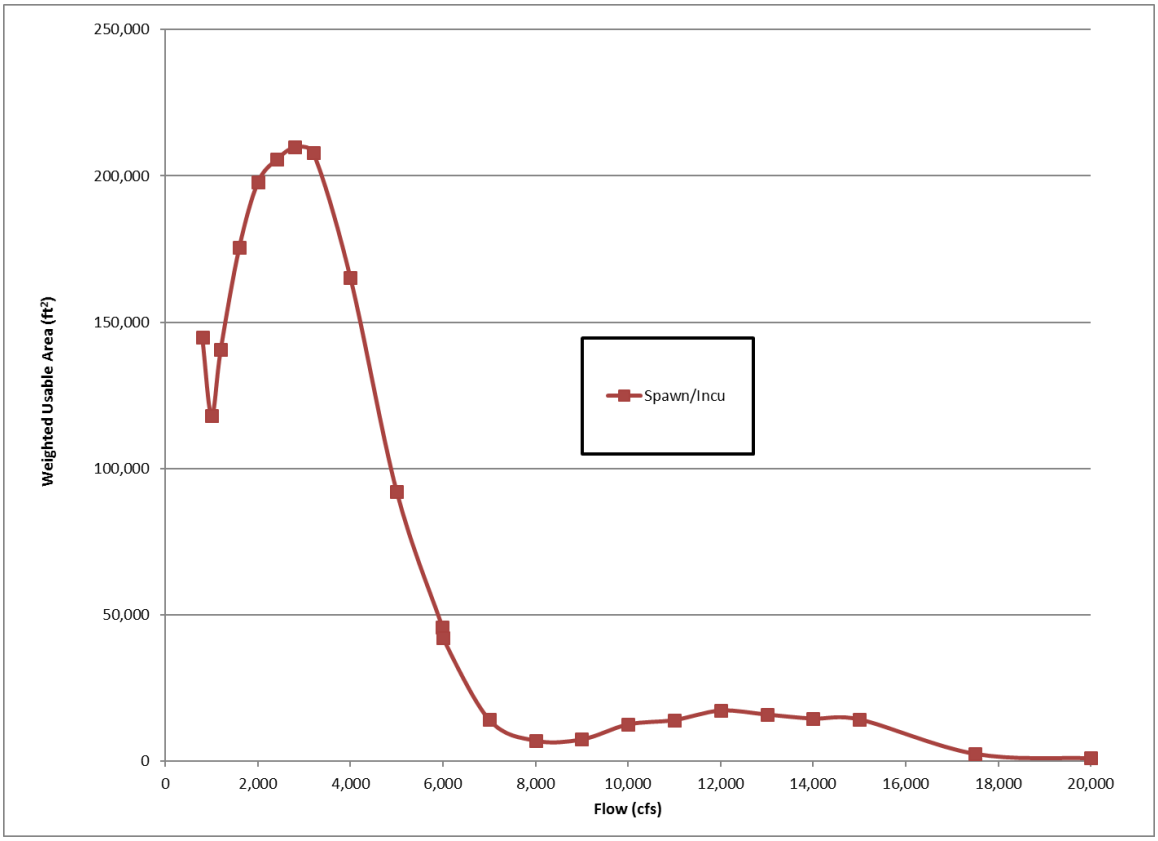
Reach 4 WUA Curves for Spawning/Incubation, Fry, and Adult/Juvenile Life Stages of White Sucker



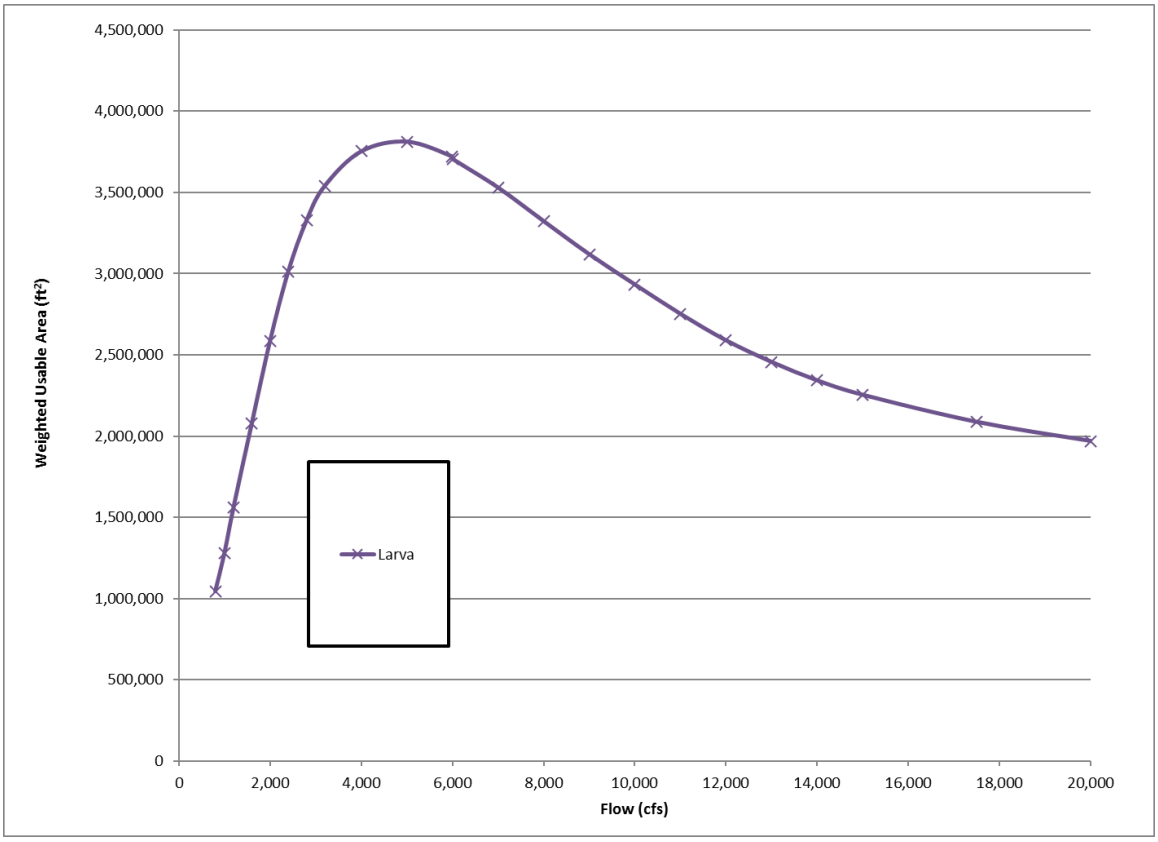
Reach 4 WUA Curves for Spawning, Fry, Juvenile, and Adult Life Stages of Walleye



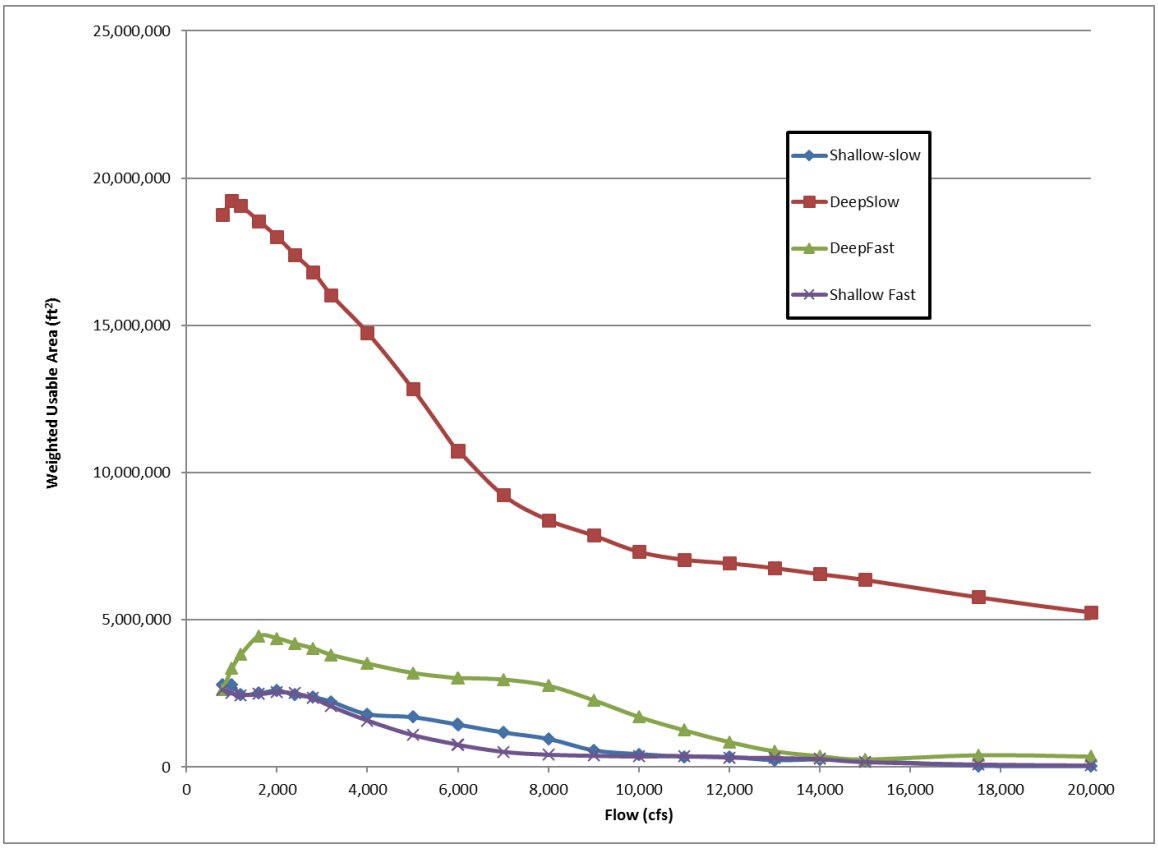
Reach 4 WUA Curves for Adult/Juvenile Life Stages of Tessellated Darter



Reach 4 WUA Curves for Spawning/Incubation Life Stages of Sea Lamprey



Reach 4 WUA Curves for Larva Life Stage of Macroinvertebrates



Reach 4 WUA Curves for Shallow Slow, Deep Slow, Deep Fast, Shallow Fast Habitat Guilds

ATTACHMENT D: NEW COMBINED SUITABILITY INDEX HABITAT MAPS IN REACH 3 TO INCLUDE BYPASS FLOWS OF 6,500, 8,000 AND 10,000 CFS

Attachment D maps are separate PDF files to this report.

See files:

2017_Study_3_3_1_Addendum_Attachment_D1.pdf

2017_Study_3_3_1_Addendum_Attachment_D2.pdf

2017_Study_3_3_1_Addendum_Attachment_D3.pdf

2017_Study_3_3_1_Addendum_Attachment_D4.pdf

2017_Study_3_3_1_Addendum_Attachment_D5.pdf

2017_Study_3_3_1_Addendum_Attachment_D6.pdf

2017_Study_3_3_1_Addendum_Attachment_D7.pdf

ATTACHMENT E: NEW PERSISTENT HABITAT MAPS IN REACH 3 TO INCLUDE BYPASS FLOWS OF 6,500, 8,000 AND 10,000 CFS

Attachment E maps are separate PDF files to this report.

See files:

2017_Study_3_3_1_Addendum_Attachment_E1.pdf

2017_Study_3_3_1_Addendum_Attachment_E2.pdf

ATTACHMENT F: TABLES OF PERCENTAGE OF THE MAXIMUM WEIGHTED USABLE AREA

Percentage of the Maximum Weighted Usable Area (WUA) for Various Bypass Flows within Reach 3 with Cabot Station Operating at 2,500 cfs and a Deerfield flow of 200 cfs

Species	Lifestage	Months Present	Maximum WUA Bypass Flow (cfs)	Maximum WUA (ft^2)	120 (cfs)	200 (cfs)	300 (cfs)	500 (cfs)	700 (cfs)	1,000 (cfs)	2,000 (cfs)	3,000 (cfs)	5,000 (cfs)	6,500 (cfs)	8,000 (cfs)	10,000 (cfs)
					0.02 (cfsm)	0.03 (cfsm)	0.04 (cfsm)	0.07 (cfsm)	0.1 (cfsm)	0.14 (cfsm)	0.28 (cfsm)	0.42 (cfsm)	0.70 (cfsm)	0.91 (cfsm)	1.12 (cfsm)	1.40 (cfsm)
American Shad	Spawning/Incu	May-June	10,000 cfs	2,350,864	33.7%	35.9%	38.1%	41.8%	44.8%	48.9%	61.0%	71.1%	86.0%	92.6%	97.3%	100.0%
American Shad	Juvenile	June-Oct	5,000 cfs	2,282,496	55.4%	60.8%	64.9%	69.5%	72.6%	77.4%	90.5%	97.2%	100.0%	97.4%	93.7%	87.3%
American Shad	Adult	May-June	10,000 cfs	2,871,437	42.4%	43.9%	45.5%	48.1%	50.3%	53.5%	62.8%	71.1%	83.8%	90.3%	96.1%	100.0%
Shortnose Sturgeon	Spawning	April-May	8,000 cfs	1,696,981	25.8%	28.9%	32.9%	39.2%	44.2%	49.9%	64.9%	77.5%	94.5%	98.8%	100.0%	98.0%
Shortnose Sturgeon	Egg-Larvae	May	5,000 cfs	2,551,226	52.3%	56.4%	59.7%	63.8%	67.5%	73.2%	87.3%	95.0%	100.0%	99.1%	96.8%	92.3%
Shortnose Sturgeon	Fry	May	5,000 cfs	1,444,448	48.0%	52.9%	57.9%	63.9%	67.7%	73.0%	84.8%	93.3%	100.0%	99.0%	95.7%	88.4%
Shortnose Sturgeon	Juvenile	June	8,000 cfs	1,908,712	46.9%	51.2%	54.8%	59.3%	61.8%	65.5%	75.7%	83.7%	95.8%	99.5%	100.0%	95.2%
Shortnose Sturgeon	Adult	Year Round	6,500 cfs	1,964,490	48.4%	52.9%	56.7%	61.5%	64.1%	67.9%	78.9%	87.3%	97.7%	100.0%	99.4%	93.9%
Fall Fish	Spawning/Incu	May-June	3,000 cfs	576,656	53.1%	58.1%	61.3%	65.1%	68.9%	73.8%	93.1%	100.0%	91.9%	74.3%	52.6%	32.0%
Fall Fish	Fry	May-June	3,000 cfs	825,054	66.4%	69.9%	71.4%	74.6%	79.3%	85.2%	98.7%	100.0%	77.5%	57.3%	41.1%	29.5%
Fall Fish	Juvenile	Year Round	3,000 cfs	1,182,746	59.7%	65.8%	69.9%	72.9%	74.6%	78.6%	95.2%	100.0%	91.9%	78.6%	62.8%	47.1%
Fall Fish	Adult	Year Round	3,000 cfs	1,780,782	75.5%	81.5%	85.2%	87.9%	88.7%	90.3%	96.5%	100.0%	98.1%	93.7%	87.3%	80.3%
Longnose Dace	Juvenile	Year Round	2,000 cfs	307,054	76.7%	84.7%	85.1%	80.1%	77.5%	80.9%	100.0%	94.8%	69.3%	43.6%	25.9%	17.0%
Longnose Dace	Adult	Year Round	3,000 cfs	547,316	65.2%	74.8%	80.0%	82.6%	82.3%	82.8%	97.4%	100.0%	76.8%	52.9%	32.1%	19.9%
White Sucker	Spawning/Incu	April-May	3,000 cfs	162,255	71.8%	79.9%	83.2%	83.3%	84.2%	86.9%	99.0%	100.0%	82.9%	54.4%	28.9%	16.0%
White Sucker	Fry	May-June	120 cfs	2,032,500	100.0%	97.4%	94.5%	90.6%	89.8%	89.2%	86.4%	78.2%	61.2%	54.4%	49.4%	46.0%
White Sucker	Adult/Juvenile	Year Round	3,000 cfs	839,203	69.6%	76.6%	79.1%	77.3%	74.9%	76.5%	93.6%	100.0%	87.6%	76.7%	66.9%	58.2%
Walleye	Spawning	April-May	8,000 cfs	1,152,541	25.8%	27.0%	29.0%	33.9%	39.7%	47.7%	67.1%	80.2%	96.0%	99.9%	100.0%	91.5%
Walleye	Fry	April-May	10,000 cfs	166,471	96.7%	87.7%	83.0%	76.4%	76.6%	68.4%	72.1%	84.1%	77.8%	81.4%	82.1%	100.0%
Walleye	Juvenile	Year Round	10,000 cfs	145,400	83.4%	78.9%	73.4%	67.4%	66.6%	62.7%	66.1%	71.1%	81.7%	83.8%	85.7%	100.0%
Walleye	Adult	Year Round	120 cfs	495,345	100.0%	95.6%	88.2%	78.8%	72.6%	65.9%	64.1%	62.5%	63.1%	66.4%	68.4%	76.7%
Tessellated Darter	Adult/Juvenile	Year Round	2,000 cfs	203,018	78.6%	81.8%	77.0%	74.7%	75.7%	84.1%	100.0%	88.3%	58.3%	34.0%	21.5%	15.3%
Sea Lamprey	Spawning/Incu	May-June	3,000 cfs	134,295	58.1%	69.9%	82.3%	93.5%	96.1%	94.3%	94.3%	100.0%	98.8%	84.8%	53.5%	27.0%
Macroinvertebrates	Larva	Year Round	6,500 cfs	1,254,252	27.9%	32.6%	38.4%	46.9%	53.1%	59.5%	75.0%	85.6%	99.2%	100.0%	96.0%	86.0%
Habitat Guilds	Shallow Slow	Year Round	120 cfs	961,129	100.0%	96.3%	91.7%	90.5%	92.8%	96.9%	89.4%	77.4%	47.9%	33.7%	24.6%	19.2%
Habitat Guilds	Shallow Fast	Year Round	2,000 cfs	483,874	84.2%	87.4%	83.6%	78.6%	79.3%	86.9%	100.0%	94.5%	66.0%	43.0%	29.8%	23.1%
Habitat Guilds	Deep Slow	Year Round	200 cfs	1,699,409	98.7%	100.0%	99.9%	98.1%	95.4%	92.5%	94.0%	96.0%	85.2%	77.5%	68.7%	63.9%
Habitat Guilds	Deep Fast	Year Round	6,500 cfs	947,458	20.8%	23.5%	27.3%	34.3%	40.4%	47.8%	65.4%	79.1%	96.0%	100.0%	97.2%	77.9%
Tidewater Mucket	Juvenile	Year Round	3,000 (cfs)	181,579	79.7%	81.7%	82.8%	84.8%	87.4%	91.1%	97.7%	100.0%	99.0%	94.8%	89.4%	82.5%
Tidewater Mucket	Adult	Year Round	5,000 (cfs)	222,527	69.0%	70.7%	72.1%	74.6%	77.2%	82.1%	91.5%	97.1%	100.0%	99.6%	97.1%	94.0%
Eastern Pondmussel	Juvenile	Year Round	6,500 (cfs)	74,762	76.4%	77.5%	78.7%	81.1%	83.5%	87.9%	92.7%	95.6%	99.8%	100.0%	97.9%	96.6%
Eastern Pondmussel	Adult	Year Round	3,000 (cfs)	181,579	79.7%	81.7%	82.8%	84.8%	87.4%	91.1%	97.7%	100.0%	99.0%	94.8%	89.4%	82.5%
Yellow Lampmussel	Juvenile	Year Round	3,000 (cfs)	181,579	79.7%	81.7%	82.8%	84.8%	87.4%	91.1%	97.7%	100.0%	99.0%	94.8%	89.4%	82.5%
Yellow Lampmussel	Adult	Year Round	5,000 (cfs)	222,527	69.0%	70.7%	72.1%	74.6%	77.2%	82.1%	91.5%	97.1%	100.0%	99.6%	97.1%	94.0%

Percentage of the Maximum Weighted Usable Area (WUA) for Various Bypass Flows within Reach 3 with Cabot Station Operating at 4,500 cfs and a Deerfield flow of 200 cfs

Species	Lifestage	Months Present	Maximum WUA Bypass Flow (cfs)	Maximum WUA (ft^2)	120 (cfs)	200 (cfs)	300 (cfs)	500 (cfs)	700 (cfs)	1,000 (cfs)	2,000 (cfs)	3,000 (cfs)	5,000 (cfs)	6,500 (cfs)	8,000 (cfs)	10,000 (cfs)
					0.02 (cfsm)	0.03 (cfsm)	0.04 (cfsm)	0.07 (cfsm)	0.1 (cfsm)	0.14 (cfsm)	0.28 (cfsm)	0.42 (cfsm)	0.70 (cfsm)	0.91 (cfsm)	1.12 (cfsm)	1.40 (cfsm)
American Shad	Spawning/Incu	May-June	**10,000 cfs**	2,465,089	37.9%	40.0%	42.3%	45.8%	48.9%	52.9%	64.8%	75.2%	88.5%	94.4%	98.5%	100.0%
American Shad	Juvenile	June-Oct	**3,000 cfs**	2,402,571	58.4%	64.6%	69.0%	74.2%	78.4%	84.4%	95.9%	100.0%	98.7%	94.5%	89.3%	82.6%
American Shad	Adult	May-June	**10,000 cfs**	3,044,623	46.5%	47.9%	49.5%	52.0%	54.3%	57.3%	67.4%	76.7%	88.5%	94.0%	98.4%	100.0%
Shortnose Sturgeon	Spawning	April-May	**8,000 cfs**	1,786,357	26.4%	29.7%	34.1%	40.6%	45.1%	50.7%	66.4%	81.5%	96.3%	99.2%	100.0%	96.4%
Shortnose Sturgeon	Egg-Larvae	May	**5,000 cfs**	2,612,727	55.6%	60.1%	64.0%	68.7%	72.9%	79.1%	90.8%	96.8%	100.0%	98.9%	96.5%	91.8%
Shortnose Sturgeon	Fry	May	**5,000 cfs**	1,495,240	53.6%	59.0%	63.9%	70.2%	74.7%	79.8%	92.3%	98.9%	100.0%	95.8%	91.1%	83.8%
Shortnose Sturgeon	Juvenile	June	**5,000 cfs**	2,014,859	50.0%	54.9%	58.5%	62.8%	66.4%	71.0%	83.2%	91.9%	100.0%	99.8%	96.5%	90.0%
Shortnose Sturgeon	Adult	Year Round	**5,000 cfs**	2,080,690	51.8%	56.9%	60.7%	65.4%	69.4%	74.4%	86.3%	93.9%	100.0%	98.8%	94.8%	88.1%
Fall Fish	Spawning/Incu	May-June	**2,000 cfs**	615,874	63.3%	69.0%	73.5%	80.6%	86.3%	92.6%	100.0%	94.8%	70.4%	48.4%	33.4%	21.4%
Fall Fish	Fry	May-June	**1,000 cfs**	845,174	82.5%	86.4%	87.8%	90.2%	94.9%	100.0%	98.1%	86.1%	56.1%	41.2%	31.4%	24.6%
Fall Fish	Juvenile	Year Round	**2,000 cfs**	1,279,748	63.8%	70.6%	75.5%	81.9%	86.6%	92.3%	100.0%	96.7%	77.2%	61.3%	48.3%	36.8%
Fall Fish	Adult	Year Round	**3,000 cfs**	1,942,460	73.5%	80.1%	84.6%	87.9%	90.3%	93.6%	99.4%	100.0%	92.8%	86.8%	79.8%	72.1%
Longnose Dace	Juvenile	Year Round	**2,000 cfs**	296,208	73.8%	83.6%	88.6%	91.7%	92.1%	98.4%	100.0%	81.2%	45.6%	28.0%	20.2%	15.7%
Longnose Dace	Adult	Year Round	**2,000 cfs**	543,699	60.1%	70.4%	77.7%	84.7%	87.9%	94.6%	100.0%	87.1%	53.1%	33.0%	22.7%	16.9%
White Sucker	Spawning/Incu	April-May	**1,000 cfs**	143,079	77.1%	87.4%	92.0%	95.9%	97.0%	100.0%	99.1%	91.9%	52.9%	27.9%	21.3%	18.1%
White Sucker	Fry	May-June	**120 cfs**	2,333,703	100.0%	98.1%	95.7%	91.0%	88.7%	86.1%	76.7%	64.4%	50.2%	46.4%	42.8%	40.4%
White Sucker	Adult/Juvenile	Year Round	**2,000 cfs**	953,610	73.3%	83.2%	86.5%	83.6%	83.3%	87.3%	100.0%	93.8%	76.3%	65.7%	57.2%	50.4%
Walleye	Spawning	April-May	**6,500 cfs**	1,154,309	33.5%	34.3%	35.6%	38.7%	42.7%	49.1%	69.1%	82.9%	97.0%	100.0%	97.0%	84.8%
Walleye	Fry	April-May	**120 cfs**	203,988	100.0%	90.9%	87.6%	88.1%	86.7%	84.1%	79.5%	68.2%	63.6%	72.3%	81.1%	83.4%
Walleye	Juvenile	Year Round	**10,000 cfs**	164,345	83.4%	78.8%	76.3%	72.5%	71.6%	72.3%	75.0%	78.1%	78.2%	81.9%	90.5%	100.0%
Walleye	Adult	Year Round	**120 cfs**	498,647	100.0%	96.1%	90.7%	81.5%	77.6%	74.8%	73.3%	69.1%	69.7%	73.4%	78.7%	83.4%
Tessellated Darter	Adult/Juvenile	Year Round	**1,000 cfs**	188,754	88.9%	94.3%	94.1%	95.2%	95.6%	100.0%	90.2%	71.2%	37.7%	24.1%	19.8%	15.9%
Sea Lamprey	Spawning/Incu	May-June	**3,000 cfs**	128,019	39.9%	49.2%	59.3%	71.4%	78.4%	83.8%	98.4%	100.0%	77.8%	47.7%	30.5%	20.6%
Macroinvertebrates	Larva	Year Round	**5,000 cfs**	1,251,779	28.3%	31.4%	36.2%	45.3%	52.5%	60.4%	77.6%	91.0%	100.0%	97.2%	90.8%	78.8%
Habitat Guilds	Shallow Slow	Year Round	**120 cfs**	1,098,720	100.0%	99.5%	96.2%	94.5%	91.9%	91.3%	68.7%	52.7%	30.8%	23.5%	18.5%	15.1%
Habitat Guilds	Shallow Fast	Year Round	**1,000 cfs**	523,572	81.1%	87.6%	89.0%	90.4%	93.3%	100.0%	90.8%	73.8%	42.8%	30.3%	23.4%	19.6%
Habitat Guilds	Deep Slow	Year Round	**300 cfs**	1,888,547	96.3%	98.1%	100.0%	98.5%	97.0%	96.3%	95.4%	92.1%	75.1%	68.6%	61.2%	57.3%
Habitat Guilds	Deep Fast	Year Round	**5,000 cfs**	1,045,934	22.2%	25.2%	29.8%	37.6%	42.8%	48.1%	64.1%	86.5%	100.0%	95.6%	79.8%	55.9%
Tidewater Mucket	Juvenile	Year Round	**2,000 (cfs)**	192,646	88.7%	90.3%	91.3%	93.5%	95.3%	98.0%	100.0%	97.1%	92.2%	86.7%	83.2%	75.9%
Tidewater Mucket	Adult	Year Round	**3,000 (cfs)**	230,684	80.1%	81.5%	82.8%	85.1%	87.1%	90.5%	97.0%	100.0%	98.6%	95.7%	94.0%	91.7%
Eastern Pondmussel	Juvenile	Year Round	**5,000 (cfs)**	76,752	87.2%	87.5%	88.1%	89.6%	91.2%	93.2%	96.4%	97.3%	100.0%	97.5%	97.8%	94.4%
Eastern Pondmussel	Adult	Year Round	**2,000 (cfs)**	192,646	88.7%	90.3%	91.3%	93.5%	95.3%	98.0%	100.0%	97.1%	92.2%	86.7%	83.2%	75.9%
Yellow Lampmussel	Juvenile	Year Round	**2,000 (cfs)**	192,646	88.7%	90.3%	91.3%	93.5%	95.3%	98.0%	100.0%	97.1%	92.2%	86.7%	83.2%	75.9%
Yellow Lampmussel	Adult	Year Round	**3,000 (cfs)**	230,684	80.1%	81.5%	82.8%	85.1%	87.1%	90.5%	97.0%	100.0%	98.6%	95.7%	94.0%	91.7%

Percentage of the Maximum Weighted Usable Area (WUA) for Various Bypass Flows within Reach 3 with Cabot Station Operating at 7,000 cfs and a Deerfield flow of 200 cfs

Species	Lifestage	Months Present	Maximum WUA Bypass Flow (cfs)	Maximum WUA (ft^2)	120 (cfs)	200 (cfs)	300 (cfs)	500 (cfs)	700 (cfs)	1,000 (cfs)	2,000 (cfs)	3,000 (cfs)	5,000 (cfs)	6,500 (cfs)	8,000 (cfs)	10,000 (cfs)
					0.02 (cfsm)	0.03 (cfsm)	0.04 (cfsm)	0.07 (cfsm)	0.1 (cfsm)	0.14 (cfsm)	0.28 (cfsm)	0.42 (cfsm)	0.70 (cfsm)	0.91 (cfsm)	1.12 (cfsm)	1.40 (cfsm)
American Shad	Spawning/Incu	May-June	**10,000 cfs**	2,627,680	44.5%	47.0%	48.8%	52.6%	55.7%	59.0%	69.5%	77.6%	89.6%	94.7%	98.0%	100.0%
American Shad	Juvenile	June-Oct	**3,000 cfs**	2,560,399	69.9%	80.0%	84.3%	89.1%	92.6%	95.2%	99.4%	100.0%	94.9%	90.0%	84.2%	78.3%
American Shad	Adult	May-June	**10,000 cfs**	3,275,848	54.5%	56.3%	57.6%	60.4%	62.7%	65.4%	74.4%	82.5%	93.3%	97.4%	99.4%	100.0%
Shortnose Sturgeon	Spawning	April-May	**8,000 cfs**	1,880,946	28.5%	30.7%	34.1%	42.2%	49.3%	55.7%	73.4%	84.8%	97.5%	99.9%	100.0%	98.0%
Shortnose Sturgeon	Egg-Larvae	May	**5,000 cfs**	2,655,661	66.9%	73.9%	77.2%	81.2%	83.8%	86.9%	93.6%	97.0%	100.0%	99.4%	97.6%	94.2%
Shortnose Sturgeon	Fry	May	**3,000 cfs**	1,580,581	62.6%	69.5%	73.8%	81.6%	87.1%	91.1%	98.0%	100.0%	95.6%	90.9%	85.7%	78.9%
Shortnose Sturgeon	Juvenile	June	**3,000 cfs**	2,148,224	62.2%	70.4%	74.2%	79.3%	83.2%	86.8%	95.4%	100.0%	99.2%	95.8%	90.2%	84.7%
Shortnose Sturgeon	Adult	Year Round	**3,000 cfs**	2,217,609	64.4%	72.8%	76.7%	81.8%	85.7%	89.1%	96.5%	100.0%	97.9%	94.0%	88.3%	82.9%
Fall Fish	Spawning/Incu	May-June	**700 cfs**	624,183	87.4%	93.3%	95.5%	98.1%	100.0%	99.7%	91.2%	73.8%	44.6%	30.2%	23.3%	17.0%
Fall Fish	Fry	May-June	**300 cfs**	854,381	96.6%	100.0%	100.0%	98.2%	96.5%	92.7%	75.5%	58.5%	37.8%	30.2%	25.4%	20.2%
Fall Fish	Juvenile	Year Round	**1,000 cfs**	1,386,325	80.3%	89.5%	93.0%	97.1%	99.4%	100.0%	93.7%	80.4%	57.9%	45.1%	37.1%	29.7%
Fall Fish	Adult	Year Round	**1,000 cfs**	2,274,837	82.1%	90.3%	94.3%	97.8%	99.4%	100.0%	96.5%	91.6%	78.8%	71.9%	65.7%	60.6%
Longnose Dace	Juvenile	Year Round	**500 cfs**	259,263	89.0%	98.3%	99.1%	100.0%	96.5%	93.4%	74.3%	53.3%	31.1%	23.5%	21.8%	15.1%
Longnose Dace	Adult	Year Round	**700 cfs**	478,846	76.9%	87.3%	91.9%	98.2%	100.0%	99.0%	82.3%	60.2%	36.1%	25.2%	21.4%	17.3%
White Sucker	Spawning/Incu	April-May	**500 cfs**	135,048	84.9%	94.2%	97.0%	100.0%	97.4%	93.2%	68.7%	44.6%	23.1%	19.6%	23.1%	18.0%
White Sucker	Fry	May-June	**120 cfs**	2,672,528	100.0%	98.0%	96.6%	89.6%	82.7%	76.6%	61.0%	51.7%	41.3%	38.4%	36.3%	34.7%
White Sucker	Adult/Juvenile	Year Round	**500 cfs**	1,301,146	78.1%	92.9%	99.0%	100.0%	96.9%	91.3%	76.8%	66.5%	49.6%	44.2%	39.0%	35.9%
Walleye	Spawning	April-May	**5,000 cfs**	1,080,048	41.5%	42.5%	43.4%	45.8%	48.5%	53.2%	71.1%	86.2%	100.0%	99.8%	92.3%	76.1%
Walleye	Fry	April-May	**120 cfs**	259,690	100.0%	88.4%	80.5%	75.4%	69.9%	68.2%	55.5%	55.3%	64.0%	59.5%	62.2%	60.0%
Walleye	Juvenile	Year Round	**120 cfs**	191,661	100.0%	95.4%	92.5%	87.1%	83.5%	81.9%	77.7%	75.1%	77.5%	79.4%	85.8%	86.9%
Walleye	Adult	Year Round	**120 cfs**	643,593	100.0%	96.8%	92.9%	81.4%	73.6%	69.0%	63.6%	63.3%	64.0%	63.8%	65.7%	68.7%
Tessellated Darter	Adult/Juvenile	Year Round	**200 cfs**	158,731	93.7%	100.0%	96.2%	94.6%	89.4%	86.0%	66.6%	46.5%	28.1%	23.7%	23.1%	16.9%
Sea Lamprey	Spawning/Incu	May-June	**1,000 cfs**	119,562	58.3%	67.5%	75.2%	86.6%	94.4%	100.0%	94.2%	71.2%	38.3%	25.8%	23.6%	22.4%
Macroinvertebrates	Larva	Year Round	**5,000 cfs**	1,207,274	33.0%	35.9%	38.5%	45.5%	53.6%	62.9%	85.5%	96.1%	100.0%	94.1%	86.1%	75.6%
Habitat Guilds	Shallow Slow	Year Round	**120 cfs**	991,787	100.0%	97.1%	93.3%	87.7%	80.6%	74.4%	54.9%	39.9%	26.9%	21.9%	18.4%	13.2%
Habitat Guilds	Shallow Fast	Year Round	**300 cfs**	509,290	89.6%	99.2%	100.0%	98.4%	95.3%	90.8%	67.7%	51.0%	31.8%	25.2%	21.9%	16.3%
Habitat Guilds	Deep Slow	Year Round	**500 cfs**	2,425,550	97.0%	97.9%	99.3%	100.0%	98.0%	93.7%	80.6%	70.7%	55.0%	50.1%	46.4%	44.1%
Habitat Guilds	Deep Fast	Year Round	**3,000 cfs**	1,072,859	23.0%	26.5%	30.3%	40.1%	50.5%	58.9%	83.6%	100.0%	95.6%	80.4%	62.3%	41.0%
Tidewater Mucket	Juvenile	Year Round	**1,000 (cfs)**	202,556	98.1%	98.0%	98.5%	98.8%	99.7%	100.0%	98.1%	95.2%	85.8%	80.7%	76.6%	71.2%
Tidewater Mucket	Adult	Year Round	**3,000 (cfs)**	235,104	93.0%	93.7%	94.4%	95.6%	96.5%	97.5%	99.8%	100.0%	98.1%	96.1%	94.5%	91.9%
Eastern Pondmussel	Juvenile	Year Round	**3,000 (cfs)**	79,081	94.8%	95.0%	95.1%	95.7%	96.7%	98.5%	98.7%	100.0%	98.5%	96.3%	95.6%	92.4%
Eastern Pondmussel	Adult	Year Round	**1,000 (cfs)**	202,556	98.1%	98.0%	98.5%	98.8%	99.7%	100.0%	98.1%	95.2%	85.8%	80.7%	76.6%	71.2%
Yellow Lampmussel	Juvenile	Year Round	**1,000 (cfs)**	202,556	98.1%	98.0%	98.5%	98.8%	99.7%	100.0%	98.1%	95.2%	85.8%	80.7%	76.6%	71.2%
Yellow Lampmussel	Adult	Year Round	**3,000 (cfs)**	235,104	93.0%	93.7%	94.4%	95.6%	96.5%	97.5%	99.8%	100.0%	98.1%	96.1%	94.5%	91.9%

Percentage of the Maximum Weighted Usable Area (WUA) for Various Bypass Flows within Reach 3 with Cabot Station Operating at 14,000 cfs and a Deerfield flow of 200 cfs

Species	Lifestage	Months Present	Maximum WUA Bypass Flow (cfs)	Maximum WUA (ft^2)	120 (cfs)	200 (cfs)	300 (cfs)	500 (cfs)	700 (cfs)	1,000 (cfs)	2,000 (cfs)	3,000 (cfs)	5,000 (cfs)	6,500 (cfs)	8,000 (cfs)	10,000 (cfs)
					0.02 (cfsm)	0.03 (cfsm)	0.04 (cfsm)	0.07 (cfsm)	0.1 (cfsm)	0.14 (cfsm)	0.28 (cfsm)	0.42 (cfsm)	0.70 (cfsm)	0.91 (cfsm)	1.12 (cfsm)	1.40 (cfsm)
American Shad	Spawning/Incu	May-June	**10,000 cfs**	2,834,060	62.1%	62.6%	63.8%	64.9%	66.3%	69.4%	78.2%	83.7%	91.7%	95.4%	98.5%	100.0%
American Shad	Juvenile	June-Oct	**2,000 cfs**	2,717,823	78.4%	83.3%	87.5%	89.0%	87.5%	94.7%	100.0%	99.9%	94.3%	88.9%	85.4%	78.5%
American Shad	Adult	May-June	**8,000 cfs**	3,750,369	76.3%	76.7%	77.5%	78.3%	79.1%	81.6%	87.8%	91.7%	96.9%	98.7%	100.0%	98.9%
Shortnose Sturgeon	Spawning	April-May	**10,000 cfs**	2,022,058	45.9%	45.8%	46.5%	48.7%	51.6%	56.6%	75.8%	86.1%	95.4%	97.7%	100.0%	100.0%
Shortnose Sturgeon	Egg-Larvae	May	**8,000 cfs**	2,688,983	73.0%	77.5%	82.8%	84.3%	83.0%	90.2%	94.8%	96.8%	99.2%	99.2%	100.0%	98.2%
Shortnose Sturgeon	Fry	May	**3,000 cfs**	1,623,318	73.3%	75.6%	76.8%	79.0%	79.9%	85.2%	97.3%	100.0%	98.1%	93.3%	89.4%	81.6%
Shortnose Sturgeon	Juvenile	June	**3,000 cfs**	2,387,668	78.5%	83.0%	86.9%	88.4%	87.2%	93.3%	99.2%	100.0%	95.9%	90.8%	87.1%	80.7%
Shortnose Sturgeon	Adult	Year Round	**3,000 cfs**	2,411,757	78.7%	83.3%	87.3%	88.9%	87.6%	93.7%	99.4%	100.0%	95.7%	90.6%	86.8%	80.3%
Fall Fish	Spawning/Incu	May-June	**1,000 cfs**	252,754	79.1%	91.7%	96.9%	99.8%	99.5%	100.0%	97.2%	80.5%	53.0%	41.5%	35.9%	26.2%
Fall Fish	Fry	May-June	**500 cfs**	355,081	81.8%	93.1%	98.1%	100.0%	97.7%	96.2%	82.6%	69.6%	53.3%	45.8%	41.5%	34.0%
Fall Fish	Juvenile	Year Round	**1,000 cfs**	835,582	82.8%	90.8%	95.9%	97.1%	95.3%	100.0%	98.3%	87.9%	68.0%	55.3%	48.0%	39.1%
Fall Fish	Adult	Year Round	**1,000 cfs**	2,510,276	83.4%	91.3%	97.7%	97.7%	93.9%	100.0%	98.3%	92.1%	76.3%	68.5%	63.0%	56.5%
Longnose Dace	Juvenile	Year Round	**2,000 cfs**	75,967	58.1%	64.8%	71.2%	77.6%	81.4%	88.4%	100.0%	91.9%	74.0%	57.6%	44.1%	31.3%
Longnose Dace	Adult	Year Round	**2,000 cfs**	136,099	59.7%	68.8%	76.3%	82.4%	85.5%	89.9%	100.0%	96.7%	76.7%	63.3%	51.7%	34.8%
White Sucker	Spawning/Incu	April-May	**5,000 cfs**	25,776	36.3%	44.3%	55.9%	66.4%	74.4%	80.3%	92.6%	99.0%	100.0%	97.5%	87.8%	59.9%
White Sucker	Fry	May-June	**300 cfs**	2,435,549	99.5%	99.6%	100.0%	98.2%	95.3%	90.3%	70.7%	57.1%	44.9%	41.4%	37.2%	34.4%
White Sucker	Adult/Juvenile	Year Round	**1,000 cfs**	1,138,260	82.4%	91.9%	98.7%	99.8%	94.2%	100.0%	89.2%	71.6%	50.9%	44.2%	40.7%	37.2%
Walleye	Spawning	April-May	**5,000 cfs**	610,524	84.7%	85.3%	85.4%	85.8%	86.7%	87.4%	91.0%	94.2%	100.0%	93.7%	85.7%	67.8%
Walleye	Fry	April-May	**120 cfs**	240,439	100.0%	96.7%	91.6%	86.8%	84.8%	84.9%	73.9%	65.6%	66.6%	67.2%	56.8%	51.6%
Walleye	Juvenile	Year Round	**700 cfs**	239,228	98.8%	97.7%	99.9%	99.1%	100.0%	97.1%	85.6%	78.0%	73.4%	73.8%	65.8%	65.5%
Walleye	Adult	Year Round	**300 cfs**	938,221	94.0%	95.6%	100.0%	98.5%	96.2%	89.9%	67.3%	61.7%	55.6%	54.7%	50.5%	49.4%
Tessellated Darter	Adult/Juvenile	Year Round	**2,000 cfs**	47,028	53.4%	60.4%	68.2%	78.1%	82.5%	91.5%	100.0%	87.7%	81.4%	63.5%	52.7%	39.8%
Sea Lamprey	Spawning/Incu	May-June	**3,000 cfs**	22,772	38.6%	45.1%	50.2%	54.0%	58.4%	61.1%	77.8%	100.0%	99.7%	89.1%	77.0%	52.9%
Macroinvertebrates	Larva	Year Round	**5,000 cfs**	890,586	58.4%	59.1%	60.0%	62.1%	65.2%	69.6%	84.3%	94.9%	100.0%	96.2%	92.7%	85.5%
Habitat Guilds	Shallow Slow	Year Round	**120 cfs**	386,037	100.0%	99.1%	97.4%	94.6%	90.7%	88.9%	70.5%	58.3%	46.5%	34.4%	29.4%	21.4%
Habitat Guilds	Shallow Fast	Year Round	**1,000 cfs**	192,389	73.6%	83.0%	91.2%	94.2%	94.5%	100.0%	95.5%	79.5%	57.8%	44.4%	36.5%	27.0%
Habitat Guilds	Deep Slow	Year Round	**200 cfs**	2,509,620	99.2%	100.0%	99.9%	99.7%	98.7%	97.7%	87.9%	76.4%	54.6%	49.1%	44.5%	41.0%
Habitat Guilds	Deep Fast	Year Round	**3,000 cfs**	612,566	70.5%	70.6%	70.1%	73.4%	76.8%	83.4%	98.3%	100.0%	78.2%	60.9%	51.3%	40.0%
Tidewater Mucket	Juvenile	Year Round	**2,000 (cfs)**	200,190	99.0%	99.5%	99.5%	98.9%	99.3%	99.5%	100.0%	99.5%	91.8%	86.5%	80.5%	71.2%
Tidewater Mucket	Adult	Year Round	**5,000 (cfs)**	243,458	96.2%	96.2%	96.7%	96.5%	96.4%	97.0%	97.9%	98.7%	100.0%	99.7%	98.2%	95.2%
Eastern Pondmussel	Juvenile	Year Round	**3,000 (cfs)**	83,421	95.3%	95.6%	96.2%	95.9%	96.2%	97.2%	99.3%	100.0%	99.4%	96.9%	91.1%	86.9%
Eastern Pondmussel	Adult	Year Round	**2,000 (cfs)**	200,190	99.0%	99.5%	99.5%	98.9%	99.3%	99.5%	100.0%	99.5%	91.8%	86.5%	80.5%	71.2%
Yellow Lampmussel	Juvenile	Year Round	**2,000 (cfs)**	200,190	99.0%	99.5%	99.5%	98.9%	99.3%	99.5%	100.0%	99.5%	91.8%	86.5%	80.5%	71.2%
Yellow Lampmussel	Adult	Year Round	**5,000 (cfs)**	243,458	96.2%	96.2%	96.7%	96.5%	96.4%	97.0%	97.9%	98.7%	100.0%	99.7%	98.2%	95.2%